SSCA04

Cardiac (Cardiac Imaging in the COVID Pandemic/Artificial Intelligence in Coronary CT Imaging)

Participants
Amar B. Shah, MD, New York, New York (*Moderator*) Nothing to Disclose
Anna Palmisano, MD, Milan, Italy (*Moderator*) Nothing to Disclose

Sub-Events

SSCA04-1 Cardiac MRI In Patients With Prolonged Cardiorespiratory Symptoms After Uncomplicated COVID-19 Infection

Participants
Dmitrij Kravchenko, MD, Bonn, Germany (*Presenter*) Stockholder, Pfizer Inc;Stockholder, Viatris;Stockholder, AbbVie Inc;Stockholder, Johnson and Johnson

PURPOSE

Myocardial injury and inflammation on cardiac MRI in patients suffering from coronavirus disease 19 (COVID-19) have been described in recent publications. Concurrently, more and more cases of chronic COVID-19 syndrome (CCS) after COVID-19 infection have been observed manifesting with symptoms like fatigue and exertional dyspnea. The purpose of this study was to explore the relationship between CCS and myocardial injury and inflammation as an underlying cause of the persistent complaints in previously healthy individuals.*Methods and Materials In this prospective study from January 2021 to April 2021, participants without known cardiac or pulmonary diseases prior to COVID-19 infection with persisting CCS symptoms like fatigue or exertional dyspnea after convalescence and healthy control participants underwent cardiac MRI. Cardiac MRI protocol included parameters such as T1 and T2 relaxation times, extracellular volume (ECV), T2 signal intensity ratio, and late gadolinium enhancement (LGE). Student t test, Mann-Whitney U test, and ?2 test were used for statistical analysis.*Results A total of 41 participants with CCS (39 ± 13 years; 18 men) and 42 control participants (39 ± 16 years; 26 men) were evaluated. Parameters indicating myocardial inflammation and edema were comparable between participants with CCS and control participants: T1 relaxation time (977.8 ± 22.6 ms vs 970.5 ± 25.2 ms; P = .17), T2 relaxation time (52.7 ± 2.1 ms vs 52.4 ± 2.4 ms; P = .47), T2 signal intensity ratio (1.64 ± 0.24 vs 1.55 ± 0.28; P = .10). Visible myocardial edema was present in none of the participants. Only 3 of 41 (7%) participants with CCS demonstrated non-ischemic LGE compared to none in the control group (0 of 42 [0%], P = .07). None of the participants fulfilled the 2018 Lake Louise criteria for the diagnosis of myocarditis.*Conclusions Participants with CCS did not demonstrate signs of active myocardial injury or inflammation with only a fraction of symptomatic participants demonstrating LGE findings (3 of 41, 7%).*Clinical Relevance/Application No signs of active myocardial inflammation were present on cardiac MRI in previously healthy participants with prolonged cardiorespiratory symptoms after COVID-19 infection. There is no indication that cardiac MRI should be used a screening tool for CCS.

RESULTS

A total of 41 participants with CCS (39 ± 13 years; 18 men) and 42 control participants (39 ± 16 years; 26 men) were evaluated. Parameters indicating myocardial inflammation and edema were comparable between participants with CCS and control participants: T1 relaxation time (977.8 ± 22.6 ms vs 970.5 ± 25.2 ms; P = .17), T2 relaxation time (52.7 ± 2.1 ms vs 52.4 ± 2.4 ms; P = .47), T2 signal intensity ratio (1.64 ± 0.24 vs 1.55 ± 0.28; P = .10). Visible myocardial edema was present in none of the participants. Only 3 of 41 (7%) participants with CCS demonstrated non-ischemic LGE compared to none in the control group (0 of 42 [0%], P = .07). None of the participants fulfilled the 2018 Lake Louise criteria for the diagnosis of myocarditis.

CLINICAL RELEVANCE/APPLICATION

No signs of active myocardial inflammation were present on cardiac MRI in previously healthy participants with prolonged cardiorespiratory symptoms after COVID-19 infection. There is no indication that cardiac MRI should be used a screening tool for CCS.

SSCA04-2 Cardiac MRI And Imaging Markers Of Myocarditis In Competitive Athletes With Recent SARS-CoV-2 Infection: Results From The Big Ten COVID-19 Cardiac Registry

Participants
Jean Jeudy JR, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To understand the frequency of myocarditis in student athletes recovering from SARS-Cov-2 infection.*Methods and Materials A central IRB for the Big Ten COVID-19 Cardiac Registry (coordinated by Ohio State University) approved this study. A survey of participating Big Ten University principal investigators reported the total number of athletes screened for SARS-CoV-2, the number with positive PCR, the number completing cardiac screening with and without CMR, and the number with findings that were consistent with myocarditis by the assessment of the local clinical team. CMR findings were classified based on updated 2018 Lake Louise criteria (LLC). The diagnosis of myocarditis by LLC requires presence of both a T2 based criterion (T2 mapping or T2 weighted abnormality) and T1 based criteria, (T1 mapping abnormality or late gadolinium enhancement (LGE)). Isolated right ventricular insertion point fibrosis was not used to diagnose myocarditis.*Results Comprehensive cardiovascular testing was performed in 1597 athletes comprised from 13 institutions. Thirty-seven were diagnosed with COVID-19 myocarditis (overall 2.3%,

range per program 0-7.6%). Nine (24%) had clinical myocarditis and 28 (76%) had subclinical myocarditis. Twenty (54%) had neither cardiac symptoms nor cardiac testing abnormalities, except for CMR. If cardiac testing was based upon cardiac symptoms, only 5 cases would have been detected (detected prevalence 0.31%), and 32 (86%) may have been missed. CMR for all athletes yielded a 7.4-fold increase in detection. Follow up CMR performed in 27 (73%) demonstrated resolution of T2 elevation in all (100%) and late gadolinium enhancement in 11 (40.7%).*Conclusions Among 1597 COVID-19 positive athletes with CMR screening, 37 cases of myocarditis were identified (2.3%). Subclinical myocarditis was more common than clinical myocarditis. The role of CMR as a screening tool in this population needs to be explored.*Clinical Relevance/Application The implications of post-COVID myocardial injury detected by CMR are still unknown. This registry looks to study these questions in both the convalescent window and post-acute sequela of COVID-19.

RESULTS

Comprehensive cardiovascular testing was performed in 1597 athletes comprised from 13 institutions. Thirty-seven were diagnosed with COVID-19 myocarditis (overall 2.3%, range per program 0-7.6%). Nine (24%) had clinical myocarditis and 28 (76%) had subclinical myocarditis. Twenty (54%) had neither cardiac symptoms nor cardiac testing abnormalities, except for CMR. If cardiac testing was based upon cardiac symptoms, only 5 cases would have been detected (detected prevalence 0.31%), and 32 (86%) may have been missed. CMR for all athletes yielded a 7.4-fold increase in detection. Follow up CMR performed in 27 (73%) demonstrated resolution of T2 elevation in all (100%) and late gadolinium enhancement in 11 (40.7%).

CLINICAL RELEVANCE/APPLICATION

The implications of post-COVID myocardial injury detected by CMR are still unknown. This registry looks to study these questions in both the convalescent window and post-acute sequela of COVID-19.

SSCA04-3   Quantifying Incidence And Outcomes In COVID-19 Associated Takotsubo Cardiomyopathy

Participants
Brandon Metra, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Takotsubo cardiomyopathy (TCM) is a potential cardiovascular complication of COVID-19. However, the incidence and clinical outcomes of TCM are not known in the context of the COVID-19 pandemic.*Methods and Materials This retrospective cohort study examined adults diagnosed with COVID-19 and or TCM with TriNetX, a global research network that aggregates real-time electronic health records from over 78 million patients. ICD-10, CPT, and SNOMED codes were used to define variables of interest. The diagnosis of TCM was defined by the diagnosis of TCM within one year of cardiac catheterization or coronary CT angiography, excluding all cases with subsequent coronary angioplasty, stenting, or bypass graft. In one analysis, we analyzed mortality in adults diagnosed with COVID-19 from 01/01/2020 - 01/31/2021 to adults diagnosed with TCM after COVID-19 infection. In another analysis, we compared adults with COVID-19 to adults with influenza to compare the TCM incidence. A third analysis examined mortality in adults with COVID and TCM to patients with TCM before the COVID-19 pandemic (TCM up to 01/01/2020). Balanced cohorts were created using propensity matching for age and gender.*Results Out of 4,171,131 patients with COVID-19, 339 patients had TCM (mean age 65.1 ± 13.6 years, 82.6% female). Compared to a cohort of 4,170,975 patients with COVID-19 alone, patients with COVID-19 and TCM had a higher risk of 1-year mortality (risk ratio 5.488 [95% confidence interval 3.849-7.826], p < 0.0001 before propensity matching; RR 2.800 [1.382-5.673], p=0.0027 in balanced cohorts of n=339 after matching). The incidence of TCM was not significantly different between cohorts of 4,171,131 COVID-19 and 768,997 influenza patients (RR 1.27 [0.968,1.668], p=0.0837 before matching; RR 1.349 [0.975-1.867], p=0.0697 in balanced cohorts of 428,038 after matching). Finally, in comparing the 339 patients with COVID-19 and TCM to a cohort of 4,123 patients with TCM alone before the pandemic, COVID-19 and TCM patients did not have a significantly higher risk of 1-year mortality (RR 1.280 [0.881,1.860]; p=0.1971 with matching not utilized to preserve cohort size).*Conclusions Myocarditis is a recognized potential component of COVID-19 infection; combined with the physical and psychological stresses of COVID-19, this may result in Takotsubo cardiomyopathy. We found increased mortality in patients with COVID-19 and TCM compared to COVID-19 alone. Due to a higher risk of significant morbidity and mortality in TCM, this disorder is an important screening and diagnostic consideration in COVID-19 patients.*Clinical Relevance/Application Clinicians should screen and recognize Takotsubo cardiomyopathy as a potential cardiac complication of COVID-19 infection.

RESULTS

Out of 4,171,131 patients with COVID-19, 339 patients had TCM (mean age 65.1 ± 13.6 years, 82.6% female). Compared to a cohort of 4,170,975 patients with COVID-19 alone, patients with COVID-19 and TCM had a higher risk of 1-year mortality (risk ratio 5.488 [95% confidence interval 3.849-7.826], p < 0.0001 before propensity matching; RR 2.800 [1.382-5.673], p=0.0027 in balanced cohorts of n=339 after matching). The incidence of TCM was not significantly different between cohorts of 4,171,131 COVID-19 and 768,997 influenza patients (RR 1.27 [0.968,1.668], p=0.0837 before matching; RR 1.349 [0.975-1.867], p=0.0697 in balanced cohorts of 428,038 after matching). Finally, in comparing the 339 patients with COVID-19 and TCM to a cohort of 4,123 patients with TCM alone before the pandemic, COVID-19 and TCM patients did not have a significantly higher risk of 1-year mortality (RR 1.280 [0.881,1.860]; p=0.1971 with matching not utilized to preserve cohort size).

CLINICAL RELEVANCE/APPLICATION

Clinicians should screen and recognize Takotsubo cardiomyopathy as a potential cardiac complication of COVID-19 infection.

SSCA04-4   Evaluation For Potential Cardiac Involvement In Athletes Recovering From COVID-19 Infection With Cardiac Magnetic Resonance Imaging- Should Cardiac Magnetic Resonance Imaging Be Used As A Screening Tool?

Participants
Tugce Agirlar Trabzonlu, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Myocarditis is a known cause of sudden cardiac death in athletes. Prior studies demonstrated college athletes who have recovered from COVID-19 infection may have cardiovascular involvement detectable by cardiac magnetic resonance imaging (CMR). However, there is no consensus for the utility of CMR screening prior to the return to athletic participation in otherwise healthy athletes after their recovery from COVID-19. Our aim is to describe the prevalence of CMR findings of cardiac involvement in a population of Division 1 college athletes recovered from COVID-19 infection.*Methods and Materials The study was IRB approved. We retrospectively identified athletes who underwent CMR following documented COVID-19 infection before their return to strenuous

exercise between March 1, 2020 and April 30, 2021. The standardized CMR protocol included cine, T1 and T2 mapping, dark blood T2 imaging, extracellular volume (ECV) fraction, and late gadolinium enhancement (LGE) on a 1.5 T scanner. The MRI findings were reviewed by experienced cardiovascular radiologists in the course of normal clinical work. Diagnosis of acute myocarditis was based on the modified Lake Louise criteria. The presence of pericarditis was determined by reviewing abnormal pericardial enhancement, pericardial fluid and/or thickening.*Results A total number of 112 student athletes (75 male and 37 female athletes; mean age 20 years; range 18-23 years) recovered from COVID-19 were included. Two athletes [1.8%, (95%CI, 0.6 - 4.2%)] had MRI findings compatible with acute myocarditis. Of these, one had focal non-ischemic subepicardial LGE with associated abnormal T2 signal (56-64 msec, normal value range in our institution is 52.18 ± 3.4 ms). The second athlete had globally elevated ECV value of 33%, and abnormal native T2 signal (60-65 msec). Pericardial effusion was present in the second athlete in addition to CMR evidence of myocarditis. One athlete [0.9%; (95%CI, -0.8 - 2.6%)] had findings of pericarditis. 5 athletes [4.5%; (95%CI, 0.6 - 8.3%)] had focal LGE in the inferior right ventricle insertion point without abnormal T2 signal, suggestive of prior myocardial injury and/or athletic remodeling.*Conclusions The prevalences of acute myocarditis (1.8%) and acute pericarditis (0.9%) were low in student athletes recovered from COVID-19 infection.*Clinical Relevance/Application The routine use of cardiac MRI as a screening tool in student athletes recovered from COVID-19 infection is controversial as the prevalence among this population is low.

RESULTS

A total number of 112 student athletes (75 male and 37 female athletes; mean age 20 years; range 18-23 years) recovered from COVID-19 were included. Two athletes [1.8%, (95%CI, 0.6 - 4.2%)] had MRI findings compatible with acute myocarditis. Of these, one had focal non-ischemic subepicardial LGE with associated abnormal T2 signal (56-64 msec, normal value range in our institution is 52.18 ± 3.4 ms). The second athlete had globally elevated ECV value of 33%, and abnormal native T2 signal (60-65 msec). Pericardial effusion was present in the second athlete in addition to CMR evidence of myocarditis. One athlete [0.9%; (95%CI, -0.8 - 2.6%)] had findings of pericarditis. 5 athletes [4.5%; (95%CI, 0.6 - 8.3%)] had focal LGE in the inferior right ventricle insertion point without abnormal T2 signal, suggestive of prior myocardial injury and/or athletic remodeling.

CLINICAL RELEVANCE/APPLICATION

The routine use of cardiac MRI as a screening tool in student athletes recovered from COVID-19 infection is controversial as the prevalence among this population is low.

SSCA04-5 Quantification Of Lumen Diameter Within Coronary Artery Stents Using A High Resolution Photon Counting Detector CT And A Deep Convolutional Neural Network Denoising Algorithm

Participants
Emily Koons, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To quantify the effective lumen diameter within coronary stents using an energy-integrating-detector (EID) CT system and compare to results achieved using an investigational photon-counting-detector (PCD) CT and convolutional neural network (CNN) denoising algorithm.*Methods and Materials Seven different types of coronary stents with inner diameters between 3.12-4.47mm were inflated and deployed in plastic tubes containing 20mg/mL of iodine solution, mimicking stented contrast-enhanced coronary arteries. Tubes were placed in an anthropomorphic phantom (QRM) simulating an average-sized patient and scanned on EID and PCD. EID scans were performed using our standard CTA protocol (120kV, 180 quality reference mAs). PCD scans were performed in high resolution (HR) mode (120x0.2mm collimation) at 120kV with tube current adjusted so CTDIvol was matched to EID scans. EID images were reconstructed per our routine clinical protocol (Br40, 0.6mm thickness). PCD images were reconstructed at a thickness of 0.6mm using a sharp kernel (Br89) that is only possible with the PCD HR mode. To address increased noise introduced by the Br89 kernel, an image-based CNN denoising algorithm was applied to PCD images. Stent inner diameters were segmented based on full width half maximum thresholding and morphological operations. Lumen area and effective diameter were calculated and compared to reference sizes measured with a caliper.*Results Substantial blooming artifacts were observed on EID, resulting in larger stent struts and reduced lumen sizes (effective diameter underestimated by 40%). Overall image quality was substantially improved on PCD, with higher spatial resolution and reduced blooming artifacts, resulting in clearer delineation of stent struts. Effective lumen diameters were very accurate relative to reference (2% underestimation). CNN reduced image noise by 44% on PCD images without impacting lumen quantification (< 0.6% difference).*Conclusions The PCD HR mode improved in-stent lumen quantification for all seven stents as compared to EID images due to decreased blooming artifact. Implementation of CNN denoising algorithms to PCD data substantially improved image quality.*Clinical Relevance/Application Improved lumen visibility in stented coronary arteries will allow more accurate non-invasive assessment of in-stent restenosis, potentially avoiding unnecessary interventions.

RESULTS

Substantial blooming artifacts were observed on EID, resulting in larger stent struts and reduced lumen sizes (effective diameter underestimated by 40%). Overall image quality was substantially improved on PCD, with higher spatial resolution and reduced blooming artifacts, resulting in clearer delineation of stent struts. Effective lumen diameters were very accurate relative to reference (2% underestimation). CNN reduced image noise by 44% on PCD images without impacting lumen quantification (< 0.6% difference).

CLINICAL RELEVANCE/APPLICATION

Improved lumen visibility in stented coronary arteries will allow more accurate non-invasive assessment of in-stent restenosis, potentially avoiding unnecessary interventions.

SSCA04-6 Myocardial T2 Value Is The Imaging Biomarker Of Myocardial Involvement In Active COVID-19

Participants
Livia Marchitelli, MD, Rome, Italy (*Presenter*) Nothing to Disclose

PURPOSE

Subclinical myocardial injury is not uncommon in COVID-19 and recognizes a complex multifactorial pathogenesis. We hypothesized that CMR with myocardial mapping techniques would allow non-invasive detection of myocardial structural damage in patients with active infection.*Methods and Materials In this retrospective observational cohort study, we enrolled 27 patients with active COVID-19. Clinical and laboratory characteristics, including high sensitivity troponin T (hs-cTnT), were collected within 48 hours prior to scan. Cooperative patients underwent a combined cardiothoracic-MRI protocol for the comprehensive assessment of cardiovascular structures, lung parenchyma and pulmonary arterial tree; unstable patients underwent a 25-minutes fast protocol to

rule out myocardial and to assess pulmonary involvement.Relationships between CMR parameters, clinical and laboratory findings were explored.Both uni and multivariate analyses (Chi-squared, t-test, Pearson correlation coefficient and regression model) were performed to evaluate most significant predictors of myocardial injury.*Results CMR T1 and T2 values were increased in 11/27 and 14/27 patients, respectively, ranging from 987 to 1210 ms for T1 values and 47 and 63 ms for T2.Left ventricle ejection fraction was impaired in 10/27 patients, ranging from 41% to 65%.Almost all patients were classified as "mild" according to Chinese CDC clinical scoring for SARS-CoV-2 infection.Pulmonary parenchyma consolidation was detected in 11/27, ground-glass opacity in 23/27, interlobular septal thickening in 9/27 and pleural effusion in 4/27 patients. DWI revealed active lung inflammation in 17/27 patients. No pulmonary embolism was identified at MRA sequence, avoiding the CT angiography.A significant correlation was found between T1 map, T2map and ECVmap alterations and increase HsTn (p<0,05). The regression model analysis also showed a significant relationship between T2 value and CRP, WBC and lymphocytes count and Hs-cTnT.*Conclusions CMR mapping predicts subclinical myocardial damage in COVID-19 active disease and correlates with WBC and lymphocytes count, CRP and HscTnT levels.Myocardial T2 appears to be the prevalent imaging biomarker in active COVID-19 patients and the best predictor of myocardial injury.Underlying pathological substrate likely includes a combination of tissue edema and myocarditis-like fibrosis/necrosis changes.*Clinical Relevance/Application Myocardial damage in active COVID-19 patients consists in heterogeneous patterns of injury ranging from acute myocarditis, to MINOCA, pericarditis, and CMR evidence of isolated edematous changes. The prompt recognition of pattern disease is pivotal to drive therapy and patient's management.

RESULTS

CMR T1 and T2 values were increased in 11/27 and 14/27 patients, respectively, ranging from 987 to 1210 ms for T1 values and 47 and 63 ms for T2.Left ventricle ejection fraction was impaired in 10/27 patients, ranging from 41% to 65%.Almost all patients were classified as "mild" according to Chinese CDC clinical scoring for SARS-CoV-2 infection.Pulmonary parenchyma consolidation was detected in 11/27, ground-glass opacity in 23/27, interlobular septal thickening in 9/27 and pleural effusion in 4/27 patients. DWI revealed active lung inflammation in 17/27 patients. No pulmonary embolism was identified at MRA sequence, avoiding the CT angiography.A significant correlation was found between T1 map, T2map and ECVmap alterations and increase HsTn (p<0,05). The regression model analysis also showed a significant relationship between T2 value and CRP, WBC and lymphocytes count and Hs-cTnT.

CLINICAL RELEVANCE/APPLICATION

Myocardial damage in active COVID-19 patients consists in heterogeneous patterns of injury ranging from acute myocarditis, to MINOCA, pericarditis, and CMR evidence of isolated edematous changes. The prompt recognition of pattern disease is pivotal to drive therapy and patient's management.

Abstract Archives of the RSNA, 2021

Participants
Paras Lakhani, MD, Media, Pennsylvania (*Moderator*) Nothing to Disclose
Jessica Chan, MD, Salt Lake City, Utah (*Moderator*) Nothing to Disclose

Sub-Events

SSIN05-1   Computed Tomography-based Radiomic Feature Analysis In Non-Small Cell Lung Cancer For Patient Prognostic Stratification

Participants
Mitchell Chen, MD, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate a radiomic prognostic vector using a comprehensive feature analysis of computed tomography (CT) scans from patients diagnosed with non-small cell lung cancer (NSCLC) for predicting patient prognosis.*Methods and Materials In this retrospective study, 292 patients (age: 68.6 ± 10.4, M:F = 172:120) with NSCLC diagnosed at our multicentre institution between 2014 - 2017 were included, all of whom had contrast-enhanced chest CTs demonstrating primary cancer at the time of diagnosis. Two radiologists double reviewed the scans, and performed semi-automated segmentation of the tumour, peritumoral penumbra, and a spherical parenchymal patch in the surrounding pulmonary lobe. The imaging data were pre-processed to ensure uniform voxel size and comprehensively analysed for radiomic features using in-house software. Unsupervised hierarchical clustering was performed for each histological subtype on the normalised radiomic profile. The dataset was 2:1 split into training and validation sets, balanced for patient's age, sex, and tumour histology. Least absolute shrinkage and selection operator (LASSO)-Cox regression feature selection was performed for deriving a composite radiomic prognostic vector (RPV), which was tested on the validation set following k-means clustering. A statistical significance level of 5% was used.*Results Unsupervised hierarchical clustering achieved significant difference in survival between the groups for each histology subtype (squamous cell: p = 0.0013, adenocarcinoma: p = 0.0080). RPV-based patient stratification showed significant difference in survival between the risk groups (p < 0.001). Univariate Cox regression showed significant predictive value of RPV for a more favourable survival in the higher risk group (Hazard ratio: 2.10, 95% confidence interval (CI): [1.51-3.04], p < 0.001). Significant Pearson's correlation was found between RPV and tumour T stage (0.29, 95% CI [0.088, 0.46], p = 0.005), pleural attachment (0.40, 95% CI [0.21, 0.55], p < 0.0001] and the presence of effusion (0.26, 95% CI [0.064, 0.44], p = 0.012). All quoted figures are those from the validation set.*Conclusions Radiomic feature analysis can be a useful tool for stratifying patient prognostic risk in NSCLC.*Clinical Relevance/Application Recent advances in image pattern recognition and data science have promoted a growing interest in using quantitative features in oncological imaging for predicting patient prognosis and tumour phenotype, thereby facilitating personalised cancer care. In this work, we present clear evidence supporting the clinical utility of CT-based radiomic analysis in NSCLC.

RESULTS

Unsupervised hierarchical clustering achieved significant difference in survival between the groups for each histology subtype (squamous cell: p = 0.0013, adenocarcinoma: p = 0.0080). RPV-based patient stratification showed significant difference in survival between the risk groups (p < 0.001). Univariate Cox regression showed significant predictive value of RPV for a more favourable survival in the higher risk group (Hazard ratio: 2.10, 95% confidence interval (CI): [1.51-3.04], p < 0.001). Significant Pearson's correlation was found between RPV and tumour T stage (0.29, 95% CI [0.088, 0.46], p = 0.005), pleural attachment (0.40, 95% CI [0.21, 0.55], p < 0.0001] and the presence of effusion (0.26, 95% CI [0.064, 0.44], p = 0.012). All quoted figures are those from the validation set.

CLINICAL RELEVANCE/APPLICATION

Recent advances in image pattern recognition and data science have promoted a growing interest in using quantitative features in oncological imaging for predicting patient prognosis and tumour phenotype, thereby facilitating personalised cancer care. In this work, we present clear evidence supporting the clinical utility of CT-based radiomic analysis in NSCLC.

SSIN05-2   Results Of The COVID-19 Lung CT Lesion Segmentation Challenge 2020

Participants
Marius Linguraru, DPhil, Washington, Dist. of Columbia (*Presenter*) Co-founder, PediaMetrix LLC

PURPOSE

Artificial intelligence (AI) for automatic detection and quantification of COVID-19 lesions in chest CT might play a role in the asymptomatic detection, monitoring, or management of the disease. We organized a public challenge to directly compare different AI algorithms and to establish a state-of-the-art benchmark for the detection task. We provide an overview and present the major outcomes of this challenge.*Methods and Materials The challenge was hosted on grand-challenge.org to control data access. Public images (n=295) from The Cancer Imaging Archive were expert annotated to include all CT lesions. In Phase 1, participants were provided access to the "seen" data source for training (n=199) and validation (n=50). Twenty-three cases from this "seen" data source were used for Phase 2 (testing) together with 23 cases from an "unseen" similar data source. The challenge started on Nov. 2, 2020. Phase 1 data were released and 1,096 teams registered. The 225 teams that completed Phase 1 were given access

to Phase 2 data on Dec. 8, 2020, which 98 teams from 29 countries on 6 continents completed. Teams disclosed the use of external training data or networks pre-trained on other lung pathology. The challengeR toolkit for statistical ranking was used to form a consensus of algorithmic performance on different metrics, i.e., Dice coefficient, normalized surfaced, and normalized absolute volume error.*Results The top performing AI algorithm achieved a mean Dice of 0.74±0.20 on the "seen" test data, and 0.60±0.26 on the "unseen" test data, utilizing external data in a semi-supervised fashion. All top 10 teams used a variation of the 2D/3D UNet. Participants took advantage of the open source packages like nnUNet and MONAI, which were adopted by 5 and 1 out of 10 teams, respectively.*Conclusions The AI teams were able to rapidly train well-performing AI algorithms towards automatic detection and quantification of COVID-19 lung lesions. However, robustness to unseen data decreased in the testing phase. This gap may indicate that larger and more diverse data may be beneficial for training, as well as generalizability, and inherent goal/task for any clinically-relevant AI tool.*Clinical Relevance/Application AI models may be rapidly trained by multiple teams for visualization and measurement of COVID-19 specific lesions, potentially providing data at key clinical time points in the disease process towards timely and patient-specific medical countermeasures, such as isolation of asymptomatic or pre-symptomatic patients undergoing CT, or response to therapy. As more and more AI applications arise in the biomedical space, it is essential to be able to validate and compare the functionality of these applications, of which a Grand-Challenge-like competition can prove useful.

RESULTS

The top performing AI algorithm achieved a mean Dice of 0.74±0.20 on the "seen" test data, and 0.60±0.26 on the "unseen" test data, utilizing external data in a semi-supervised fashion. All top 10 teams used a variation of the 2D/3D UNet. Participants took advantage of the open source packages like nnUNet and MONAI, which were adopted by 5 and 1 out of 10 teams, respectively.

CLINICAL RELEVANCE/APPLICATION

AI models may be rapidly trained by multiple teams for visualization and measurement of COVID-19 specific lesions, potentially providing data at key clinical time points in the disease process towards timely and patient-specific medical countermeasures, such as isolation of asymptomatic or pre-symptomatic patients undergoing CT, or response to therapy. As more and more AI applications arise in the biomedical space, it is essential to be able to validate and compare the functionality of these applications, of which a Grand-Challenge-like competition can prove useful.

SSIN05-3   Automated And Comprehensive Quantification Of Airway Wall Thickness In A Large Patient Collective As CT Imaging Biomarker Of Chronic Obstructive Pulmonary Disease

Participants
Thomas Weikert, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

Airway wall thickening is a consequence of inflammatory disease of the airways that is usually only qualitatively described in radiology reports. The purpose of this study is to automatically quantify airway wall thickness throughout the lungs with the help of Artificial Intelligence and assess its diagnostic potential by the example of Chronic Obstructive Pulmonary Disease (COPD).*Methods and Materials This retrospective, single-center study included a consecutive series of unenhanced, high-resolution chest CTs. Inclusion criteria were the mentioning of an explicit COPD GOLD stage in the written radiology report (time period: March, 2013 - April, 2021). A control group of HRCTs with completely unremarkable lungs (identified using the written radiology report and visually confirmed by a radiology resident; PGY-5). The DICOM images of all cases (slice thickness: 1mm) were processed by a validated AI algorithm pipeline consisting of (1) a 3D UNet for segmentation of the bronchial tree (B) extraction of image patches perpendicular to the centerlines of the bronchi (every 1 mm), and (C) a 2D UNet for segmentation of the bronchial walls. Wall thickness was calculated locally across the full bronchial tree and then aggregated per bronchial generation. For evaluation, the average of generations 4 to 9 was calculated per patient. Differences between control vs. COPD and between GOLD stages were analyzed using two-sample t-tests, hypothesizing higher values in the COPD group.*Results A total of 756 chest CTs were identified and processed. Of those, 708 patients had been diagnosed with COPD (GOLD Stage 4: 185). The control group comprised 48 cases. Mean wall thickness differed statistically significantly between the control group and COPD patients. [1.67 mm (SD: 0.13) vs. 1.83 mm (SD: 0.13); $p < 0.001$]. Of note, the mean wall thickness in GOLD group 4 was statistically significantly higher compared to groups GOLD 1-3 ($p < 0.001$).*Conclusions Whereas increased wall thickness as sign of chronic inflammation in COPD is known, the approach presented in this study allows to provide evidence from a large patient collective due to its automated nature. Bronchial walls were slightly, but statistically significantly thicker in patients with COPD and in higher GOLD stages.*Clinical Relevance/Application Quantitative measurements considering the full bronchial tree instead of qualitative description could enhance radiology reports and allow for precise monitoring of disease progression. Running in the background, the algorithm could also point radiologist to cases with imaging biomarker values suspicious for inflammatory disease.

RESULTS

A total of 756 chest CTs were identified and processed. Of those, 708 patients had been diagnosed with COPD (GOLD Stage 4: 185). The control group comprised 48 cases. Mean wall thickness differed statistically significantly between the control group and COPD patients. [1.67 mm (SD: 0.13) vs. 1.83 mm (SD: 0.13); $p < 0.001$]. Of note, the mean wall thickness in GOLD group 4 was statistically significantly higher compared to groups GOLD 1-3 ($p < 0.001$).

CLINICAL RELEVANCE/APPLICATION

Quantitative measurements considering the full bronchial tree instead of qualitative description could enhance radiology reports and allow for precise monitoring of disease progression. Running in the background, the algorithm could also point radiologist to cases with imaging biomarker values suspicious for inflammatory disease.

SSIN05-4   Racoon: Building A Nationwide Radiological Infrastructure For Collaborative Imaging Research On COVID-19

Participants
Tobias Penzkofer, MD, Berlin, Germany (*Presenter*) Researcher, Aprea Therapeutics AB;Researcher, Astellas Group;Researcher, AstraZeneca PLC;Researcher, Celgene Corporation ;Researcher, Genmab A/S;Researcher, Incyte Corporation;Researcher, Lion Biotechnologies, Inc;Researcher, Takeda Pharmaceutical Company Limited;Researcher, Eisai Co, Ltd;Researcher, Merck & Co, Inc;Researcher, GlaxoSmithKline plc;Researcher, F. Hoffmann-La Roche Ltd;

PURPOSE

To build a nationwide infrastructure as an end-to-end solution for radiological research, AI training and biomarker development during the COVID-19 pandemic.*Methods and Materials A collaborative initiative was created following a public funding initiative by

the Federal Ministry of Education and Research to fight the current COVID-19 pandemic and build pandemic preparedness measures. The imaging platform RACOON (Radiology COOperative Network) was proposed to provide image based diagnosis, management and follow-up research on a nation-wide scale.*Results All 36 university hospitals in Germany participate in this network project. Primary goals were (a) to build a unique hybrid network infrastructure with both, distributed hardware nodes at each university hospital for federated analysis and a cloud based central environment (b) to develop dedicated toolsets for structured reporting and annotation of image datasets and AI training (c) to define a common data-model of CT reporting and aggregated clinical data (d) to enable research use cases from the entire academic radiological community concerning the analysis of COVID-19. A cohort of 14,400 chest imaging datasets are collected and reported according to the RACOON data model. Additionally, segmentations of 2880 of the datasets are performed for AI research. Over 30 individual research topics ranging from screening to prognostic models were defined and are being collaboratively executed within the project.*Conclusions Sparked by the extraordinary challenge of a global pandemic we were able to create a unique collaborative infrastructure which, to our knowledge, has never been available with this functionality or on this scale. RACOON allows oligo- and multicentric imaging research across the entire academic radiological community nationwide while largely reducing the organizational overhead for federated AI training.*Clinical Relevance/Application - A radiological network was built that enables science ready data acquisition on a nation-wide level- Dedicated toolsets ensure data quality and foster image analysis research and AI development

RESULTS

All 36 university hospitals in Germany participate in this network project. Primary goals were (a) to build a unique hybrid network infrastructure with both, distributed hardware nodes at each university hospital for federated analysis and a cloud based central environment (b) to develop dedicated toolsets for structured reporting and annotation of image datasets and AI training (c) to define a common data-model of CT reporting and aggregated clinical data (d) to enable research use cases from the entire academic radiological community concerning the analysis of COVID-19. A cohort of 14,400 chest imaging datasets are collected and reported according to the RACOON data model. Additionally, segmentations of 2880 of the datasets are performed for AI research. Over 30 individual research topics ranging from screening to prognostic models were defined and are being collaboratively executed within the project.

CLINICAL RELEVANCE/APPLICATION

- A radiological network was built that enables science ready data acquisition on a nation-wide level- Dedicated toolsets ensure data quality and foster image analysis research and AI development

SSIN05-6   Predicting Patient Demographic Information From Chest Radiographs With Deep Learning

Participants
Jason Adleberg, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning models are increasingly playing a role in making important medical decisions within radiology in the United States. Some decisions are especially high-stakes, such as whether a patient is experiencing an acute hemorrhagic stroke. However, many deep learning models are trained on medical image datasets that poorly represent the diversity of the American population. In turn, models may not perform well when making medical decisions for underrepresented populations. In this study, we create and evaluate deep learning models to classify the biological sex, age decade, ethnicity, and insurance status of an individual patient from a given chest radiograph. This technology can be used to ensure the creation of equitable medical imaging datasets and deep learning models. Furthermore, it can illuminate certain anatomical regions that may differ in different groups of patients.*Methods and Materials Deep Learning models were trained and tested on subsets from a pool of 63,663 posteroanterior (PA) radiographs in the MIMIC-CXR dataset. When possible, a separate dataset, CheXpert, containing 29,452 PA radiographs was used as a validation dataset. Four classification models were created: biological sex, age decade, ethnicity, and insurance status. EfficientNet-B4 architecture was used, along with extra layers for Gradient-weighted Class Activation Mapping (Grad-CAM) analysis. The EfficientNet-B4 was initialized with ImageNet pretrained weights. Training was done on the Google Colab Pro platform. GPU hardware varied per training session but typically was either an Nvidia K80 or an Nvidia P100.*Results On held-out test data from the MIMIC-CXR dataset, macro-averaged ROC scores were as follows: 0.999 for biological sex (2 labels), 0.917 for age decade (7 labels), 0.907 for ethnicity (4 labels), and 0.709 for insurance status (3 labels). On the CheXpert validation dataset, ROC scores were 0.994 for biological sex and 0.871 for age decade.*Conclusions Deep learning models can predict the biological sex, age, ethnicity, and insurance status of a patient from their chest radiograph. Visualization techniques are useful to ensure models function as intended, and to demonstrate anatomical regions of interest. The Google Colab notebooks used in their creation are open-source and will be made available at the time of publication.*Clinical Relevance/Application Deep learning models can predict the biological sex, age, ethnicity, and insurance status of a patient from their chest radiograph.

RESULTS

On held-out test data from the MIMIC-CXR dataset, macro-averaged ROC scores were as follows: 0.999 for biological sex (2 labels), 0.917 for age decade (7 labels), 0.907 for ethnicity (4 labels), and 0.709 for insurance status (3 labels). On the CheXpert validation dataset, ROC scores were 0.994 for biological sex and 0.871 for age decade.

CLINICAL RELEVANCE/APPLICATION

Deep learning models can predict the biological sex, age, ethnicity, and insurance status of a patient from their chest radiograph.

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Participants

Joseph Stayman, PhD, Baltimore, Maryland (*Moderator*) Research Grant, Fischer Medical;Research Grant, General Electric Company;Research Grant, Canon Medical Systems Corporation;Research collaboration, Koninklijke Philips NV;Research collaboration, Siemens AG;Research collaboration, Varex Imaging Corporation

Xiaochuan Pan, PhD, Chicago, Illinois (*Moderator*) Founder, XP Imaging, LLC;Shareholder, XP Imaging, LLC;Founder, XPIM, LLC;Shareholder, XPIM, LLC;Founder, Clarix Imaging Corp;Shareholder, Clarix Imaging Corp

Sub-Events

SSPH08-1 Noise And Streak Artifacts Reduction In Cone-beam Computed Tomography Using Wavelet Decomposition

Participants
Mohamed Eldib, Aurora, Colorado (*Presenter*) Nothing to Disclose

PURPOSE

We have been developing a 2D anti-scatter grid (2D ASG) to improve the quality of cone-beam computed tomography (CBCT) in image-guided radiation therapy. While 2D ASG significantly improves CT number accuracy, it also introduces fixed-pattern noise in projections and artifacts in CBCT images. In this work, we introduce a method to reduce both stochastic noise and streak artifacts, and artifacts induced by 2D ASG.*Methods and Materials A noise reduction filter was developed using wavelet decomposition, which uses a bank of wavelet filters that sequentially removes high-frequency signal in projections and preserves low-frequency signal containing the object information. Daubechies wavelets dB8 at level 4 were used with Bayes denoising. To preserve spatial resolution after wavelet filtering, wavelet denoised CBCT image was subtracted from the original CBCT image. Subsequently, the difference image was smoothed using a Gaussian filter, and smoothed difference image was added to the wavelet denoised CT image. To test the method, imaging experiments were performed using a clinical linac-mounted CBCT system. CBCT projections of phantoms were acquired using a 2D ASG with a grid ratio of 12 and a grid pitch of 1.2 mm. Images were reconstructed offline, using a modified FDK method.*Results With the proposed method, both stochastic noise and 2D ASG induced artifacts in CBCT images were significantly reduced. More than a factor of two improvements in signal-to-noise ratio and contrast-to-noise ratio were observed, while the spatial resolution was preserved.*Conclusions The proposed method successfully reduced noise and noise-induced streak artifacts without compromising spatial resolution. Since our method is frequency domain-based and does not involve forward/backward projection, it is computationally fast. Finally, our work shows that wavelet-based denoising may be a viable choice to reduce 2D-ASG induced image artifacts.*Clinical Relevance/Application We are developing 2D ASGs to improve the quality of CBCT images used in image-guided radiation therapy. This work proposes a novel noise reduction method when 2D ASGs are used during CBCT scans.

RESULTS

With the proposed method, both stochastic noise and 2D ASG induced artifacts in CBCT images were significantly reduced. More than a factor of two improvements in signal-to-noise ratio and contrast-to-noise ratio were observed, while the spatial resolution was preserved.

CLINICAL RELEVANCE/APPLICATION

We are developing 2D ASGs to improve the quality of CBCT images used in image-guided radiation therapy. This work proposes a novel noise reduction method when 2D ASGs are used during CBCT scans.

SSPH08-2 Improving Intraoperative Visualization Of Arterial Branching Pattern Using A High Spatial Resolution C-arm Photon Counting Detector CT System

Participants
Ke Li, PhD, Madison, Wisconsin (*Presenter*) Research Consultant, Pulmera Inc.

PURPOSE

During transarterial embolization procedures, it is crucial to provide treating physicians a clear visualization of complex arterial branching patterns. The purpose of this work was to investigate the potential application of a C-arm photon counting detector CT (PCD-CT) system for improving the visualization of arterial branching patterns during interventional procedures.*Methods and Materials The developed C-arm PCD-CT system has a switchable add-on CdTe PCD to the conventional flat panel detector (FPD)-based imaging platform. Cone beam CT acquisitions are performed in a binned mode to achieve the required readout frame rate. In comparison, the PCD has a pixel size of 100 um and no binning is required to achieve up to 100 frames/s data acquisitions and thus can potentially image small vessels with improved visualization. To demonstrate this potential, an anthropomorphic phantom containing models of iodinated cerebral arteries, with its smallest branches down to 0.5 mm, was scanned by both the PCD-CT and FPD-CBCT with matched narrow beam collimation (2.5 cm). A low dose protocol (7.1 mGy) with a short data acquisition time (7 s) was used. Reconstruction pixel size (0.47 mm) and slice thickness (0.85 mm) were matched between PCD and FPD scans. MIP images of vascular tree were generated over a range of 10 mm for performance evaluations.*Results 1) Distal vessels completely or partial missed on FPD-CBCT images were clearly visualized on C-arm PCD-CT images. 2) When all distal and smaller artery branches

(0.5 mm) are considered, the CNR was 6.9 [95% CI: 5.8, 8.0] in PCD-CT and 2.9 [95% CI: 2.1, 3.7] in FPD-CBCT. 3) The limiting spatial resolution of PCD-CT was measured to be 21 lp/cm compared with 12 lp/cm for FPD-CBCT.*Conclusions C-arm PCD-CT offers potential advantages in improving the visualization of arterial branching pattern during interventional procedures.*Clinical Relevance/Application Improved visualization of small arterial branching patterns in the interventional suite will significantly facilitate the treatment planning in endovascular interventions.

RESULTS

1) Distal vessels completely or partial missed on FPD-CBCT images were clearly visualized on C-arm PCD-CT images. 2) When all distal and smaller artery branches (0.5 mm) are considered, the CNR was 6.9 [95% CI: 5.8, 8.0] in PCD-CT and 2.9 [95% CI: 2.1, 3.7] in FPD-CBCT. 3) The limiting spatial resolution of PCD-CT was measured to be 21 lp/cm compared with 12 lp/cm for FPD-CBCT.

CLINICAL RELEVANCE/APPLICATION

Improved visualization of small arterial branching patterns in the interventional suite will significantly facilitate the treatment planning in endovascular interventions.

SSPH08-3 Correction Of Spectral Inconsistency-induced Image Artifacts In C-arm Photon Counting CT

Participants
Kevin J. Treb, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

Recently, a photon counting detector CT (PCD-CT) prototype system was developed using a C-arm gantry. Since the PCD used in this system consists of 20 individual CdTe panels, variations in the detector responses across these panels lead to low-frequency concentric artifacts in PCD-CT images. The purpose of this study was to develop a method to correct these artifacts.*Methods and Materials The underlying principle of the method is to decompose the measured data into a combination of two parts: a part that is intrinsic to the image object and the other part that is extrinsic, dependent on factors such as the panel response function and x-ray spectrum. To achieve this objective, materials with known compositions and thicknesses (i.e., acrylic and Al plates) were imaged by the PCD. The measured data were used to fit a target function that aims to perform the aforementioned decomposition. After the decomposition function is determined, the method was then used to correct data by isolating the image object dependent component, and the final image is reconstructed using the corrected data. The method was validated using an anthropomorphic head phantom with iodinated vessels and a Gammex dual-energy CT characterization phantom with both iodine and calcium inserts. The method was compared with a conventional Fourier-based ring artifact correction method in terms of image nonuniformity index (NUI), CNR, and spatial resolution.*Results Compared with the conventional ring correction method, the proposed method successfully removed both beam hardening and concentric artifacts in the individual energy bin images and material basis images. The NUI reduced from 30 to 8 HU (low-energy bin) or from 37 to 3 HU (high-energy bin) following correction. The CNR of the material inserts was improved by at least a factor of 2 by the proposed method without any loss in spatial resolution. The quantification bias of the inserts was reduced by at least 35% to be within 0.7 mg/ml.*Conclusions With the proposed correction method, high-quality and artifact-free C-arm PCD-CT images can be generated to provide improved imaging guidance for interventional procedures.*Clinical Relevance/Application This work provides a new pathway to generate high-quality spectral CT images in the interventional room to help physicians perform immediate post-treatment assessments and monitor for hemorrhages.

RESULTS

Compared with the conventional ring correction method, the proposed method successfully removed both beam hardening and concentric artifacts in the individual energy bin images and material basis images. The NUI reduced from 30 to 8 HU (low-energy bin) or from 37 to 3 HU (high-energy bin) following correction. The CNR of the material inserts was improved by at least a factor of 2 by the proposed method without any loss in spatial resolution. The quantification bias of the inserts was reduced by at least 35% to be within 0.7 mg/ml.

CLINICAL RELEVANCE/APPLICATION

This work provides a new pathway to generate high-quality spectral CT images in the interventional room to help physicians perform immediate post-treatment assessments and monitor for hemorrhages.

SSPH08-4 Performance Evaluation Of An IGZO-Based Flat-Panel Detector In 2D Fluoroscopy And 3D Cone-Beam CT

Participants
Niral Sheth, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Emerging flat-panel detectors (FPDs) based on high electron mobility oxide TFTs offer improvements in electronic noise, frame rate, and fill factor compared to conventional FPDs with readout based on a-Si:H TFTs. We report the imaging performance for both 2D fluoroscopy and 3D cone-beam CT (CBCT) of a new indium gallium zinc oxide (IGZO) TFT detector (3131Z, Varex, Salt Lake City UT).*Methods and Materials The IGZO FPD features oxide TFTs combined with a-Si:H photodiodes and a high-resolution CsI scintillator. The detector was implemented on an x-ray imaging bench in comparison to a conventional a-Si:H FPD (4030CB, Varex, Salt Lake City UT) with system geometry emulating intraoperative CBCT (O-armTM imaging system, Medtronic, Littleton MA). 2D imaging performance was characterized in terms of electronic readout noise, gain, linearity, lag, spatial resolution (MTF), image noise (NPS), and detective quantum efficiency (DQE). CBCT performance for the IGZO system was evaluated for the first time in terms of 3D MTF and NEQ, soft-tissue contrast-to-noise ratio (CNR), and visual image quality in anthropomorphic head and body phantoms across a range of imaging protocols and dose levels.*Results The IGZO detector demonstrated ~2.5x lower electronic noise than the a-Si:H system and ~27% increase in 2D DQE (at 1 mm-1) at matched pixel size and dose (EAK / frame < 1 μGy). Tenth-frame image lag was reduced by ~26%, indicative of improved electron mobility. In CBCT imaging, the IGZO FPD exhibited better uniformity (reduced ring artifacts) attributable to improved electronic noise characteristics and 3D MTF consistent with high-resolution bone imaging applications. The improved 3D NEQ and CNR for the IGZO system (e.g., CNR = 6.1 for a 50 HU contrast brain lesion at 4.7 mGy) benefit soft-tissue CBCT imaging.*Conclusions The FPD based on oxide TFTs demonstrated enhancements in electronic noise, readout rate, and uniformity that improve 2D and 3D imaging performance compared to conventional FPD based on a-Si:H TFTs. This technology appears to maintain the advantages of maturity and cost of a-Si:H sensors while advancing the performance of the underlying active matrix TFT readout.*Clinical Relevance/Application Flat Panel Detectors with oxide TFTs could form a new base technology with higher performance for digital x-ray detectors in fluoroscopy, radiography, and CBCT.

RESULTS

The IGZO detector demonstrated ~2.5x lower electronic noise than the a-Si:H system and ~27% increase in 2D DQE (at 1 mm-1) at matched pixel size and dose (EAK / frame < 1 µGy). Tenth-frame image lag was reduced by ~26%, indicative of improved electron mobility. In CBCT imaging, the IGZO FPD exhibited better uniformity (reduced ring artifacts) attributable to improved electronic noise characteristics and 3D MTF consistent with high-resolution bone imaging applications. The improved 3D NEQ and CNR for the IGZO system (e.g., CNR = 6.1 for a 50 HU contrast brain lesion at 4.7 mGy) benefit soft-tissue CBCT imaging.

CLINICAL RELEVANCE/APPLICATION

Flat Panel Detectors with oxide TFTs could form a new base technology with higher performance for digital x-ray detectors in fluoroscopy, radiography, and CBCT.

SSPH08-5   Feasibility Of Dual Energy Cone Beam Computed Tomography In Human Torso Sized Objects

Participants
Cem Altunbas, PhD, Aurora, Colorado (*Presenter*) Founder, M2 Technologies LLC

PURPOSE

While application of dual energy (DE) imaging principles in CBCT is an active area of research, utility of DE is currently limited to small objects, such as extremities or small test phantoms. In this work, we explored the feasibility of DE material decomposition for human torso sized objects, via implementing robust scatter mitigation methods in CBCT.*Methods and Materials High intensity of scatter is the primary cause of degraded CT number accuracy in CBCT. To achieve sufficient quantitative accuracy for DE processing, a novel 3D-printed antiscatter grid and a novel projection-domain based scatter correction algorithm were implemented in a flat panel detector based CBCT. Iodine vials (concentrations: 2 - 40 mg/ml) were placed in small (head equivalent), and large (pelvis equivalent) phantoms. CBCT and 16-slice multidetector CT (MDCT) scans of phantoms were obtained using sequential scans at 90 and 140 kVp. Small phantom images were used for calibration, whereas large phantom images were used for evaluating iodine mapping accuracy. CBCT and MDCT images were decomposed into iodine and water basis materials using an image-domain based material decomposition method.*Results At 90 and 140 kVp, CT numbers of iodine vials showed a high degree of linear correlation both in CBCT and MDCT images. Qualitatively, DE CBCT material decomposition in small and large phantoms yielded similar results, implying that DE material decomposition is viable in pelvis sized phantoms. Quantitative evaluations supported our observations; when compared to iodine concentration measurements in the small phantom, iodine concentration errors were 0.86±0.39 mg/ml and 0.32±0.31 mg/ml for CBCT and MDCT images, respectively, in the large phantom.*Conclusions We demonstrated that iodine mapping in DE CBCT can be achieved in human torso sized phantoms when robust scatter correction strategies are implemented. In our experiments, MDCT provided slightly better performance than CBCT. We attribute this discrepancy to other sources of image quality degradation in the CBCT system, such as effects of image lag, nonlinear response at low exposure levels, and relatively higher image noise.*Clinical Relevance/Application This work demonstrates the efficacy of iodine mapping in human torso sized phantoms using dual energy CBCT imaging.

RESULTS

At 90 and 140 kVp, CT numbers of iodine vials showed a high degree of linear correlation both in CBCT and MDCT images. Qualitatively, DE CBCT material decomposition in small and large phantoms yielded similar results, implying that DE material decomposition is viable in pelvis sized phantoms. Quantitative evaluations supported our observations; when compared to iodine concentration measurements in the small phantom, iodine concentration errors were 0.86±0.39 mg/ml and 0.32±0.31 mg/ml for CBCT and MDCT images, respectively, in the large phantom.

CLINICAL RELEVANCE/APPLICATION

This work demonstrates the efficacy of iodine mapping in human torso sized phantoms using dual energy CBCT imaging.

SSPH08-6   Performance Characterization Of A Prototype Dual-layer Cone Beam Computed Tomography System

Participants
Fredrik Stahl, MD, Stockholm, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

Conventional cone-beam CT (CBCT) provides limited discrimination between low-contrast tissues. Furthermore it is limited to single-energy acquisitions. A dual-energy CBCT system could be used to separate photon energy with the potential to increase visibility of clinically relevant features and acquire additional information relevant in a multitude of clinical imaging settings. In this work, the performance of a novel dual-layer dual-energy CBCT c-arm system is characterized for the first time.*Methods and Materials A prototype dual-layer detector was fitted into a commercial interventional c-arm CBCT system. The modulation transfer function (MTF) of the prototype CBCT was compared to that of a commercial CBCT. Noise and uniformity characteristics were evaluated using a cylindrical water phantom. Effective atomic numbers and electron densities were estimated in clinically relevant tissue substitutes. Iodine quantification was performed and virtual non-contrast (VNC) images were evaluated. Lastly, contrast-to-noise ratios (CNR) and CT number accuracy were estimated.*Results The prototype and commercial CBCT showed similar spatial resolution, with a mean 10% MTF of 5.98 and 6.28 cycles/cm, respectively. The lowest noise was seen in the 80 keV virtual monoenergetic (VM) images (7.4 HU) and the most uniform images were seen at VM 60 keV (4.7 HU) or VM 80 keV (2.0 HU), depending on the uniformity measure used. The mean accuracy in effective atomic number and electron density were 98.2% and 100.3%, respectively. Iodine quantification images showed a mean difference of -0.1 mg/ml compared to the true iodine concentration. For VNC images, all water-containing iodine substitutes measured a mean CT number of 2.6 HU, blood substitutes containing iodine averaged 43.2 HU, whereas the blood-only substitute measured 44.8 HU. A noise-suppressed dataset showed a CNR peak at VM 40 keV and low at VM 120 keV. In the same dataset without noise suppression applied, a peak in CNR was obtained at VM 70 keV. The estimated CT numbers of clinically relevant objects were very close to the calculated CT number.*Conclusions Spatial resolution and noise were comparable with a commercially available c-arm CBCT system, while offering dual-energy capability. Iodine quantifications, effective atomic numbers and electron densities were in good agreement with expected values, indicating that the system can be used to reliably evaluate the material composition of clinically relevant tissues. The virtual non-contrast and monoenergetic images indicate a consistent ability to separate clinically relevant tissues.*Clinical Relevance/Application The results presented indicate that the system could find utility in diagnostic, interventional and radiotherapy planning settings.

RESULTS

The prototype and commercial CBCT showed similar spatial resolution, with a mean 10% MTF of 5.98 and 6.28 cycles/cm

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CLINICAL RELEVANCE/APPLICATION

The results presented indicate that the system could find utility in diagnostic, interventional and radiotherapy planning settings.

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Participants

Hiroyuki Abe, MD, Chicago, Illinois (*Moderator*) Nothing to Disclose
Deepa Sheth, MD, Chicago, Illinois (*Moderator*) Nothing to Disclose

Sub-Events

SSBR04-1   Sentinel Lymph Node Identification In Breast Cancer Patients Using Lymphosonography

Participants

Priscilla Machado, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the efficacy of contrast-enhanced ultrasound (CEUS) lymphosonography in the identification of sentinel lymph nodes (SLNs) in patients with breast cancer undergoing surgical excision.*Methods and Materials To date 66 women scheduled for breast cancer surgery with SLN excision were enrolled in this ongoing, IRB-approved study. Subjects underwent percutaneous Sonazoid (GE Healthcare, Oslo, Norway) injections around the tumor area at the 12,-3,-6,-and 9 o'clock positions for a total of 1.0 ml. Lymphosonography was done using Cadence Pulse Sequencing on an S3000 HELX scanner (Siemens Healthineers, Mountain View, CA) with a 9L4 linear probe. Subjects received blue dye and radioactive tracer as part of their standard of care. After surgical excision, the ex-vivo SLNs specimen were scanned using color Doppler to confirm the uptake of Sonazoid and sent for pathology. The excised SLNs were classified as positive or negative for presence of blue dye, radioactive tracer and Sonazoid. The results were compared between methods and pathology findings.*Results One-hundred and ninety-five SLNs were surgically excised from 66 subjects, 125 were positive for blue dye, 175 were positive for the radioactive tracer and 166 were positive for Sonazoid. Comparison with the reference standard (blue dye) showed that the radioactive tracer had an accuracy of 67%, while lymphosonography achieved an accuracy of 73% (p=0.56). When the comparison was done with radioactive tracer as the reference standard, the blue dye injections had an accuracy of 66%, while lymphosonography achieved an accuracy of 80% (p<0.001). Of the 195 SLNs excised, 26 were determined to be malignant by pathology; amongst them 13 were positive for blue dye, 19 were positive for radioactive tracer and 26 were positive for Sonazoid, which translated into an accuracy of 50% for blue dye, 73% for radioactive tracer and 100% for lymphosonography (p<0.008).*Conclusions Lymphosonography achieved better accuracy compared with radioactive tracer and blue dye for identifying SLNs in breast cancer patients. All the 26 SLNs positive for malignancy were identified by lymphosonography.*Clinical Relevance/Application Lymphosonography is an ultrasound modality that uses ultrasound contrast agents to identify SLNs, which is an important aspect of predicting outcomes for patients with breast cancer.

RESULTS

One-hundred and ninety-five SLNs were surgically excised from 66 subjects, 125 were positive for blue dye, 175 were positive for the radioactive tracer and 166 were positive for Sonazoid. Comparison with the reference standard (blue dye) showed that the radioactive tracer had an accuracy of 67%, while lymphosonography achieved an accuracy of 73% (p=0.56). When the comparison was done with radioactive tracer as the reference standard, the blue dye injections had an accuracy of 66%, while lymphosonography achieved an accuracy of 80% (p<0.001). Of the 195 SLNs excised, 26 were determined to be malignant by pathology; amongst them 13 were positive for blue dye, 19 were positive for radioactive tracer and 26 were positive for Sonazoid, which translated into an accuracy of 50% for blue dye, 73% for radioactive tracer and 100% for lymphosonography (p<0.008).

CLINICAL RELEVANCE/APPLICATION

Lymphosonography is an ultrasound modality that uses ultrasound contrast agents to identify SLNs, which is an important aspect of predicting outcomes for patients with breast cancer.

SSBR04-2   Percutaneous Sonazoid Enhanced Ultrasonography Combined With In Vitro Verification For Detection And Characterization Of Sentinel Lymph Nodes In Early Breast Cancer

Participants

Yan Sun, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To assess the efficacy of percutaneous Sonazoid-enhanced ultrasound and in vitro verification for identification sentinel lymph nodes (SLNs) and diagnosis of metastatic SLNs in patients with early breast cancer(BC).*Methods and Materials 115 patients with early BC were enrolled finally. After the induction of general anesthesia, 0.4 ml of Sonazoid (SNZ), a new second-generation tissue specific ultrasound contrast agent (UCA), mixed with 0.6ml of methylene blue, was injected intradermally. The lymphatic vessels and connected SLNs were immediately observed and marked. After being resected, these SLNs were soaked in saline water and examined still in the mode of contrast enhanced ultrasound (CEUS) in vitro, This procedure could ensure that all the enhanced nodes had been removed as much as possible. The numbers of SLNs detected by UCA and blue dye were recorded. The enhancement patterns of SLNs were compared with the final pathological results.*Results SLNs detection rate by SNZ-CEUS was 94.78%. CEUS identified a median of 1.5 nodes, while blue dye identified a median of 1.84 nodes per case(P<0.001). When homogeneous high perfusion, complete annular high perfusion and low perfusion were considered negative, the diagnostic sensitivity and specificity of CEUS for SLN were 90.91% and 84.50%, and the negative predictive value was 97.32%. The FNR was 9.09%. The

diagnostic performance of CEUS for SLN is better than that of gray scale ultrasonography.*Conclusions Percutaneous SNZ-enhanced ultrasonography combined with in vitro verification is a feasible and reliable method for SLNs identification intraoperatively. Enhancement patterns can be helpful in determining the status of SLNs.*Clinical Relevance/Application (1)CEUS with percutaneous injection of Sonazoid can successfully and accurately identify and character SLNs in early breast cancer patients. (2) Sonazoid, with high affinity with reticuloendothelial cells, increases the imaging time of SLNs and facilitates biopsy intraoperatively better than Sonovue as a lymphatic tracer.

RESULTS

SLNs detection rate by SNZ-CEUS was 94.78%. CEUS identified a median of 1.5 nodes, while blue dye identified a median of 1.84 nodes per case(P<0.001). When homogeneous high perfusion, complete annular high perfusion and low perfusion were considered negative, the diagnostic sensitivity and specificity of CEUS for SLN were 90.91% and 84.50%, and the negative predictive value was 97.32%. The FNR was 9.09%. The diagnostic performance of CEUS for SLN is better than that of gray scale ultrasonography.

CLINICAL RELEVANCE/APPLICATION

(1)CEUS with percutaneous injection of Sonazoid can successfully and accurately identify and character SLNs in early breast cancer patients. (2) Sonazoid, with high affinity with reticuloendothelial cells, increases the imaging time of SLNs and facilitates biopsy intraoperatively better than Sonovue as a lymphatic tracer.

SSBR04-4   3D Harmonic And Subharmonic US For Characterizing Breast Lesions: A Multi-center Clinical Trial

Participants
Flemming Forsberg, PhD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Canon Medical Systems Corporation;Research support, Canon Medical Systems Corporation;Research support, General Electric Company;Speaker, General Electric Company;Research support, Siemens AG;Research Grant, Butterfly Network, Inc;Research support, Lantheus Medical Imaging, Inc;Research support, Bracco Group

PURPOSE

Breast cancer is the second most common cancer in the world and the most frequent type of cancer among women (30% of all cancers). This multi-center study assessed the ability of contrast-enhanced, nonlinear 3D US imaging to characterize previously indeterminate breast lesions using quantitative parameters and clinical assessments.*Methods and Materials In total 236 women with biopsy-proven breast lesions were enrolled in this prospective, FDA approved study (IND: 112,241). Following conventional US and power Doppler imaging (PDI), an US contrast agent (Definity, Lantheus Medical Imaging, N Billerica, MA) was administrated IV. Contrast-enhanced 3D harmonic imaging (HI; transmitting/receiving at 5.0/10.0 MHz) as well as 3D subharmonic imaging (SHI; transmitting/receiving at 5.8/2.9 MHz) were performed using a modified Logiq 9 scanner (GE Healthcare, Waukesha, WI) with a 4D10L probe. Five radiologists blinded to other results independently scored the 4 randomized US modes using a 7-point BIRADS scale from negative to highly suggestive of malignancy as well as lesion vascularity and diagnostic confidence. Quantitative parametric volumes were constructed from time-intensity curves for vascular heterogeneity, perfusion and area under the curve. Diagnostic accuracy for US and mammography were determined relative to pathology using ROC and reverse, step-wise logistical regression analyses. The ? statistic was calculated for inter-reader agreement.*Results Of the 236 cases, 219 were successfully scanned and biopsies indicated 164 (75%) benign and 55 (25%) malignant lesions. 3D HI showed flow in 8 lesions, whereas 3D SHI visualized flow in 83 lesions. SHI depicted more anastomoses and vascularity than HI (p<0.021), but there were no differences by pathology (p>0.27). US modes achieved accuracies from 79-85%, which was significantly better than mammography (72%; p<0.03). SHI increased diagnostic confidence by 3-6% (p<0.01), but inter-reader agreements were medium to low (?<0.52). The best logistical regression model achieved a 96% accuracy by combining clinical reads and quantitative 3D SHI parameters.*Conclusions 3D SHI is better at detecting contrast flow in vascular breast masses than 3D HI. Characterization of indeterminate breast lesions with quantitative 3D SHI parameters and clinical assessments improves diagnostic accuracy.*Clinical Relevance/Application Combining quantitative 3D SHI parameters and radiologists' assessments increase the accuracy and confidence for characterizing indeterminate breast lesions.

RESULTS

Of the 236 cases, 219 were successfully scanned and biopsies indicated 164 (75%) benign and 55 (25%) malignant lesions. 3D HI showed flow in 8 lesions, whereas 3D SHI visualized flow in 83 lesions. SHI depicted more anastomoses and vascularity than HI (p<0.021), but there were no differences by pathology (p>0.27). US modes achieved accuracies from 79-85%, which was significantly better than mammography (72%; p<0.03). SHI increased diagnostic confidence by 3-6% (p<0.01), but inter-reader agreements were medium to low (?<0.52). The best logistical regression model achieved a 96% accuracy by combining clinical reads and quantitative 3D SHI parameters.

CLINICAL RELEVANCE/APPLICATION

Combining quantitative 3D SHI parameters and radiologists' assessments increase the accuracy and confidence for characterizing indeterminate breast lesions.

SSBR04-5   Artificial Intelligence (AI) System For Automated Triage Of Breast Ultrasound (US) Exams

Participants
Linda Moy, MD, New York, New York (*Presenter*) Grant, Siemens AG ;Advisory Board, Lunit Inc;Advisory Board, iCad, Inc

PURPOSE

To train an AI system to triage breast US exams into an enhanced assessment workflow and a no radiologist workflow (standalone AI interpretation of US exams with very low probability for malignancy), with the goal of reallocating radiologist time towards exams with high suspicion of malignancy.*Methods and Materials Our AI model was based on a neural network inspired by the Globally-Aware Multiple Instance Classifier. To develop and validate this system, we curated a dataset consisting of 288,767 breast US exams with 5,442,907 total images acquired from 143,203 patients examined between 2012 and 2019 at a large academic medical center. 28,914 of these exams were associated with at least one biopsy procedure, 5,593 of which had biopsies yielding malignant findings. Pathology was used as the reference standard. This dataset was split on into training (60%), validation (10%), and test datasets (30%). The AI system was initially trained to automatically detect and classify breast lesions on US imaging with imaging-level data and did not require region of interest input from radiologists. Predictions from this system were then used to channel women to the two new workflows: a no radiologist workflow and an enhanced assessment workflow.*Results On a test set of 44,755 exams, the AI system achieved an AUC of 0.976 for identifying exams with malignant lesions. When triaging 60%, 70%, or 80% of women with the lowest AI scores from the test set into the no radiologist workflow, the false negative rate of the AI

system was 1 out every 11905 exams (0.008%), 4608 exams (0.02%), and 2532 exams (0.04%) respectively. When this triage system was used to evaluate 3553 exams from the test set which were given a BI-RADS 3 assessment at the time of original read, it reclassified 60%, 70%, and 80% of exams with the lowest AI scores as benign without missing any malignant lesions. When the AI system utilized a high specificity threshold to triage exams it considered to be at high risk for malignancy, it placed 978 (2.2% of total) exams into an enhanced assessment workflow, with high positive predictive value (69.6%) that significantly exceeded that of the breast radiologists who initially evaluated the test set exams (15.7%). Despite representing only 2.2% of the test dataset, this enhanced assessment workflow contained 56.5% of all malignant cases in the dataset.*Conclusions Our AI system could potentially eliminate up to 60-80% of breast US exams from the radiologist worklist, with a false-negative rate of 0.008-0.04%.*Clinical Relevance/Application Using a high sensitivity threshold, AI based software may function as a standalone interpreter and eliminate low probability of malignancy cases from the radiologist worklist.

RESULTS

On a test set of 44,755 exams, the AI system achieved an AUC of 0.976 for identifying exams with malignant lesions. When triaging 60%, 70%, or 80% of women with the lowest AI scores from the test set into the no radiologist workflow, the false negative rate of the AI system was 1 out every 11905 exams (0.008%), 4608 exams (0.02%), and 2532 exams (0.04%) respectively. When this triage system was used to evaluate 3553 exams from the test set which were given a BI-RADS 3 assessment at the time of original read, it reclassified 60%, 70%, and 80% of exams with the lowest AI scores as benign without missing any malignant lesions. When the AI system utilized a high specificity threshold to triage exams it considered to be at high risk for malignancy, it placed 978 (2.2% of total) exams into an enhanced assessment workflow, with high positive predictive value (69.6%) that significantly exceeded that of the breast radiologists who initially evaluated the test set exams (15.7%). Despite representing only 2.2% of the test dataset, this enhanced assessment workflow contained 56.5% of all malignant cases in the dataset.

CLINICAL RELEVANCE/APPLICATION

Using a high sensitivity threshold, AI based software may function as a standalone interpreter and eliminate low probability of malignancy cases from the radiologist worklist.

SSBR04-6 Artificial Intelligence (AI) System Reduces False-Positive Findings In The Interpretation Of Breast Ultrasound (US) Exams

Participants
Linda Moy, MD, New York, New York (*Presenter*) Grant, Siemens AG ;Advisory Board, Lunit Inc;Advisory Board, iCad, Inc

PURPOSE

To evaluate an AI system to assist radiologists in interpreting breast US exams.*Methods and Materials We developed and evaluated an AI system using a DCNN inspired by the Globally-Aware Multiple Instance Classifier. The model automatically identified malignant and benign lesions without requiring manual annotations from radiologists. The AI system was trained using our internal dataset of 288,767 US exams with 5,442,907 total images acquired from 143,203 patients between 2012-2019, including screening and diagnostic exams. 28,914 of these exams were associated with at least one biopsy procedure, 5,593 of which had biopsies yielding malignant findings. Pathology was used as the reference standard. This dataset was split on a patient level into training (60%), validation (10%), and test datasets (30%). We validated our AI system with a reader study with 10 board-certified breast radiologists (average 14.5 years of experience). Each reader reviewed 663 exams that were sampled from the test set. A hybrid decision-making model was created for each reader which made predictions by evenly weighting the predictions of the reader and AI system. Diagnostic accuracy of the AI system, readers, and hybrid models were evaluated using ROC curves.*Results On a test set of 44,755 exams, the AI system achieved an AUC of 0.976 for identifying exams with malignancies. Among the 663 reader study exams, the AI system had an AUC of 0.962, which was significantly higher than the average radiologist (0.929 ± 0.018, p < 0.001). At the average radiologist's sensitivity (90.1%), the AI system had a higher specificity (85.6% vs 80.7%, p < 0.001) and recommended fewer biopsies (19.8% vs 24.3%, p < 0.001). On average, the hybrid models improved radiologists' AUC from 0.929 to 0.960. At the radiologists' sensitivity levels, the hybrid models increased their average specificity from 80.7% to 88.4% (p < 0.001), increased their PPV from 27.1% to 39.2% (p < 0.001), and decreased their average biopsy rate from 24.3% to 17.2% (p < 0.001). The reduction in biopsies using the hybrid models represented 29.4% of all recommended biopsies.*Conclusions Our AI system detected and diagnosed cancer on breast US with accuracy that exceeds that of board-certified radiologists. Our hybrid decision-making models may potentially enhance the performance of breast imagers without the added cost of a second human reader.*Clinical Relevance/Application Breast US detects additional cancers when used as a supplemental screening exam, but has high false-positive rates. AI decision support improves diagnostic accuracy by decreasing unnecessary biopsies.

RESULTS

On a test set of 44,755 exams, the AI system achieved an AUC of 0.976 for identifying exams with malignancies. Among the 663 reader study exams, the AI system had an AUC of 0.962, which was significantly higher than the average radiologist (0.929 ± 0.018, p < 0.001). At the average radiologist's sensitivity (90.1%), the AI system had a higher specificity (85.6% vs 80.7%, p < 0.001) and recommended fewer biopsies (19.8% vs 24.3%, p < 0.001). On average, the hybrid models improved radiologists' AUC from 0.929 to 0.960. At the radiologists' sensitivity levels, the hybrid models increased their average specificity from 80.7% to 88.4% (p < 0.001), increased their PPV from 27.1% to 39.2% (p < 0.001), and decreased their average biopsy rate from 24.3% to 17.2% (p < 0.001). The reduction in biopsies using the hybrid models represented 29.4% of all recommended biopsies.

CLINICAL RELEVANCE/APPLICATION

Breast US detects additional cancers when used as a supplemental screening exam, but has high false-positive rates. AI decision support improves diagnostic accuracy by decreasing unnecessary biopsies.

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SSGI16

Gastrointestinal (Dual Energy CT - Techniques/MRI Techniques)

</div>

Participants
Alvin C. Silva, MD, Scottsdale, Arizona (*Moderator*) Scientific Advisory Committee, HealthMyne, Inc;Consultant, Exact Sciences Corporation;Research Grant, Ascelia Pharma AB
Paul Nikolaidis, MD, Chicago, Illinois (*Moderator*) Nothing to Disclose
Bari Dane, MD, New York, New York (*Moderator*) Nothing to Disclose

Sub-Events

SSGI16-1   Deep Learning-enabled Single-kV Deluxe Abdominal CT Imaging With Spectral CT Functionalities

Participants
Meghan G. Lubner, MD, Madison, Wisconsin (*Presenter*) Grant, Koninklijke Philips NV;Grant, Johnson & Johnson

PURPOSE

Dual-energy or spectral CT has been implemented using advanced tube or detector technologies to provide virtual non-contrast (VNC) and quantitative material basis images. Due to higher hardware costs, clinical workflow challenges, and other limitations, the dissemination and employment of spectral CT in clinical abdominal CT practice have been restricted. The purpose of this work was to develop and evaluate a novel deep learning network to harvest the hidden spectral information encoded in routine single-kV contrast-enhanced abdominal CT projection data to generate an additional deluxe series of images with the desired spectral CT functionalities.*Methods and Materials A deep learning architecture including a material basis generator and a VNC generator was developed. The deep learning model was trained using a curated data set of 4,034 pairs of a high kV image and the corresponding material basis images from hardware-based DECT acquisitions (Gemstone Spectral Imaging). The trained network was evaluated using an independent test cohort of 90 subjects acquired at a different institution using different CT platforms and scan protocols: among them, 74 subjects received GSI-based DECT but only the 140 kV-component of the acquired data were processed by the network; the GSI images provide the needed reference standard for quantifying the network-based spectral CT accuracy. The other 16 subjects received single-kV contrast-enhanced CT and true non-contrast CT and/or MRI to establish the gold standard diagnosis.*Results Across the 74 test subjects, Bland-Altman analysis showed that the mean relative difference in spectral CT image signal values between the GSI and the proposed method is 3.8% and the 95% limits of agreement are [-0.6%, 8.2%]. Two One-Sided Test (TOST) for equivalence with an alpha of 0.05 showed that single-kV VNC images and true non-contrast images have equivalent means within a bound of [-5HU, +5HU] (p<0.05) for all tissue types evaluated. As confirmed by MRI and other clinical gold standards, the single-kV VNC images, iodine images, and atomic number maps provide the needed baseline HU and quantitative contrast-uptake information for characterizing adrenal and renal masses and confidently prescribing diagnosis.*Conclusions The deep learning-based method in this work enables conventional CT scanners and single-kV scan protocols to generate spectral abdominal CT images with added quantitative imaging capability to improve diagnostic accuracy and confidence.*Clinical Relevance/Application This method enables an integrated clinical abdominal CT workflow to improve diagnostic accuracy and confidence while reducing radiation dose to patients and overall healthcare costs.

RESULTS

Across the 74 test subjects, Bland-Altman analysis showed that the mean relative difference in spectral CT image signal values between the GSI and the proposed method is 3.8% and the 95% limits of agreement are [-0.6%, 8.2%]. Two One-Sided Test (TOST) for equivalence with an alpha of 0.05 showed that single-kV VNC images and true non-contrast images have equivalent means within a bound of [-5HU, +5HU] (p<0.05) for all tissue types evaluated. As confirmed by MRI and other clinical gold standards, the single-kV VNC images, iodine images, and atomic number maps provide the needed baseline HU and quantitative contrast-uptake information for characterizing adrenal and renal masses and confidently prescribing diagnosis.

CLINICAL RELEVANCE/APPLICATION

This method enables an integrated clinical abdominal CT workflow to improve diagnostic accuracy and confidence while reducing radiation dose to patients and overall healthcare costs.

SSGI16-2   Multireader Assessment Of A Hybrid Dataset Of Real And Simulated Hypoenhancing Liver Lesions In Dual-Energy CT Examinations

Participants
Fides Schwartz, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To assess whether virtual monoenergetic image reconstructions of dual-energy (DE) CT scans at 70 keV can improve detectability of hypoenhancing liver lesions in comparison with the current standard mixed reconstructions, similar to the improvement seen in hyperenhancing liver lesions.*Methods and Materials This retrospective study included DECT scans from 50 patients scanned with second and third generation dual-source CT. A hybrid dataset was built including 11 patients with hypoenhancing liver lesions on portal venous phase, and 39 patients without lesions, including several with hepatic steatosis. In 33 of the datasets without lesions, small low-contrast lesions were artificially inserted into the parenchyma peripherally or near vessels following a previously validated technique adapted to DECT that enables the design of challenging-to-detect lesions with diameters of 10, 15 or 20 mm

and -10, -15 or -20 HU of contrast relative to the liver parenchyma. Six lesion free datasets functioned as negative controls. Two reconstructions were made: standard mixed images, and 70 keV. Three readers (6, 7 and 12 years of experience in diagnostic radiology) evaluated the resulting 100 images in blinded, randomized order, marking low density liver lesions on the images and giving their level of confidence with the lesion identification on a scale of 0 (not confident at all) to 100 (fully confident) as well as an overall image quality score (0=image quality completely non-diagnostic, 100=perfect image quality). Accuracy, sensitivity and specificity of lesion identification was evaluated per reconstruction. Detection confidence and image quality scores were compared using t-tests.*Results Accuracy of lesion detection was 87% and 83% for 70 keV and mixed images respectively. Sensitivity was 89% and 80%, respectively and specificity was 78% and 96%, respectively. Reader confidence in lesion detection was not significantly different between mixed images (82%) and 70 keV images (80%; P=0.26). Image quality was not rated statistically significantly different between mixed images (79%) and 70 keV images (77%; P=0.67).*Conclusions Hypoenhancing liver lesion detection accuracy and sensitivity was higher using 70 keV image reconstruction though specificity was lower than the standard mixed images. Image quality and confidence were rated similar between 70 keV reconstructions and standard reconstructions.*Clinical Relevance/Application Hypoenhancing liver lesions can be detected with higher accuracy and sensitivity on 70 keV reconstructions compared to standard mixed images and could be the new standard for clinical practice.

RESULTS

Accuracy of lesion detection was 87% and 83% for 70 keV and mixed images respectively. Sensitivity was 89% and 80%, respectively and specificity was 78% and 96%, respectively. Reader confidence in lesion detection was not significantly different between mixed images (82%) and 70 keV images (80%; P=0.26). Image quality was not rated statistically significantly different between mixed images (79%) and 70 keV images (77%; P=0.67).

CLINICAL RELEVANCE/APPLICATION

Hypoenhancing liver lesions can be detected with higher accuracy and sensitivity on 70 keV reconstructions compared to standard mixed images and could be the new standard for clinical practice.

SSGI16-3 Contrast-enhanced Abdominal CT With Clinical Photon-counting CT: Assessment Of Image Quality And Comparison With Energy-integrating Detector CT

Participants
Kai Higashigaito, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To determine the image quality of contrast-enhanced abdomen with clinical photon counting CT (PCCT) compared to energy integrating detector CT (EID-CT) at the same radiation dose.*Methods and Materials Twenty-four consecutive patients (mean age 63.7 ± 10.5 years, 4 females, mean body mass index 26.9 ± 6.2 kg/m2) were included in this prospective study. Inclusion criteria were clinically indicated, contrast-enhanced abdominal CT in the portal-venous phase and previously obtained abdominal CT with EID-CT in the same patients and using the same contrast media protocol. PCCT was performed using the QuantumPlus mode (obtaining complete spectral data) at 120kVp. EID-CT was performed using automated tube voltage selection (reference 100 kVp). For PCCT, virtual monoenergetic images (VMI) were reconstructed in 10 keV intervals from 40-90 keV using the same soft tissue reconstruction kernel (Br36) and slice thickness as with EID-CT. Tube current-time product was modified in PCCT for each patient to obtain the same CTDIvol values as with previous EID-CT. Attenuation of parenchymatous organs (liver, pancreas, spleen, kidney) and vascular structures (abdominal aorta, portal vein, inferior caval vein) were measured, noise was quantified using the standard deviation of attenuation in the psoas muscle, and contrast-to-noise ratio (CNR) was calculated. Two independent, blinded radiologists assessed subjective image quality (overall image quality, image noise, image contrast).*Results Median time interval between EID-CT and PCCT was 11 months. Inter-reader agreement for subjective image quality was good (Krippendorff's alpha = 0.774-0.902). CTDIvol (6.08 mGy, p=0.990) and body mass index (p=0.930) were similar between scans. Average CNRorgans and CNRvascular for EID-CT was 3.7 ± 1.4 and 4.9 ± 2.2 respectively, CNRorgans and CNRvascular for 40-90 keV ranged from 6.8 ± 2.2 to 1.9 ± 0.9 and 9.0 ± 2.8 to 2.6 ± 2.5 respectively. CNRorgans and CNRvascular of VMI at 40 and 50 keV were significantly higher compared to EID-CT (all, p<0.05). Compared to EID-CT, overall image quality of VMI was rated higher at 60 keV, image contrast was rated higher at 40, 50 and 60 keV, and subjective image noise higher at 40 keV (all, p<0.05).*Conclusions Our intra-individual analysis indicates that at identical radiation dose, clinical PCCT with reconstruction of VMI at 50 and 60 keV shows significantly better image quality compared to EID-CT.*Clinical Relevance/Application Initial experience of clinical PCCT of contrast-enhanced abdominal CT. Results indicate significant improvements of image quality of the PCCT system compared to conventional EID-CT.

RESULTS

Median time interval between EID-CT and PCCT was 11 months. Inter-reader agreement for subjective image quality was good (Krippendorff's alpha = 0.774-0.902). CTDIvol (6.08 mGy, p=0.990) and body mass index (p=0.930) were similar between scans. Average CNRorgans and CNRvascular for EID-CT was 3.7 ± 1.4 and 4.9 ± 2.2 respectively, CNRorgans and CNRvascular for 40-90 keV ranged from 6.8 ± 2.2 to 1.9 ± 0.9 and 9.0 ± 2.8 to 2.6 ± 2.5 respectively. CNRorgans and CNRvascular of VMI at 40 and 50 keV were significantly higher compared to EID-CT (all, p<0.05). Compared to EID-CT, overall image quality of VMI was rated higher at 60 keV, image contrast was rated higher at 40, 50 and 60 keV, and subjective image noise higher at 40 keV (all, p<0.05).

CLINICAL RELEVANCE/APPLICATION

Initial experience of clinical PCCT of contrast-enhanced abdominal CT. Results indicate significant improvements of image quality of the PCCT system compared to conventional EID-CT.

SSGI16-4 Comparison Of Conventional And Spectral-based Tagged Stool Cleansing Algorithms At CT Colonography

Participants
Sergio Grosu, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To compare the performance of conventional versus spectral-based electronic stool cleansing for iodine-tagged CT colonography (CTC) using a dual-layer (DL) spectral detector scanner.*Methods and Materials We retrospectively evaluated iodine contrast stool-tagged CTC scans of 30 consecutive asymptomatic patients (mean age: 69±8 years) undergoing colorectal cancer screening obtained on a spectral DL detector CT scanner. One reader identified locations of electronic cleansing artifacts (n=229) on conventional and spectral cleansed images. Three additional independent readers then evaluated these locations using a conventional cleansing algorithm (Intellispace Portal, Philips, Best, Netherlands) and two experimental spectral cleansing algorithms

(i.e. fully transparent and translucent tagged stool). For each cleansed image set, readers recorded the severity of over- and under-cleansing artifact on a five-point Likert scale (0=none to 4=severe) and readability compared to uncleansed images. Wilcoxon signed-rank tests were used to assess artifact severity, type and readability (worse, unchanged, better).*Results Compared with conventional electronic stool cleansing (mean score 3.02), the severity of overall cleansing artifacts was lower in translucent spectral cleansing (mean score 2.32, p<0.001). Under-cleansing artifact severity was lower in transparent (mean score 2.28, p<0.001) and translucent (mean score 1.81, p<0.001) spectral cleansing compared with conventional cleansing (mean score 2.66). Over-cleansing artifact severity was worse in transparent (mean score 0.62, p<0.001) and translucent (mean score 0.51, p<0.05) spectral cleansing compared with conventional cleansing (mean score 0.36). Overall readability was significantly improved in transparent (p<0.001) and translucent spectral cleansing (p<0.001) compared with conventional cleansing.*Conclusions Spectral cleansing provides more robust electronic stool cleansing of iodine tagged stool than conventional cleansing. Translucent spectral stool cleansing is preferred over full transparent stool subtraction.*Clinical Relevance/Application Spectral-based electronic cleansing of tagged stool at CTC provides superior images with less perceived anatomic distortion than does conventional cleansing. Further clinical trials are warranted.

RESULTS

Compared with conventional electronic stool cleansing (mean score 3.02), the severity of overall cleansing artifacts was lower in translucent spectral cleansing (mean score 2.32, p<0.001). Under-cleansing artifact severity was lower in transparent (mean score 2.28, p<0.001) and translucent (mean score 1.81, p<0.001) spectral cleansing compared with conventional cleansing (mean score 2.66). Over-cleansing artifact severity was worse in transparent (mean score 0.62, p<0.001) and translucent (mean score 0.51, p<0.05) spectral cleansing compared with conventional cleansing (mean score 0.36). Overall readability was significantly improved in transparent (p<0.001) and translucent spectral cleansing (p<0.001) compared with conventional cleansing.

CLINICAL RELEVANCE/APPLICATION

Spectral-based electronic cleansing of tagged stool at CTC provides superior images with less perceived anatomic distortion than does conventional cleansing. Further clinical trials are warranted.

SSGI16-5 Dynamic Liver MRI During Free Breathing - A Feasibility Study With A Motion Compensated Variable Density Radial Acquisition And A Viewsharing High Pass Filtering Reconstruction

Participants
Christoph Endler, MD, Bonn, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Robust dynamic liver MRI sequences are essential for accurate detection and characterization of focal liver lesions. As optimal dynamic imaging usually requires multiple breath-holds, its inherent susceptibility to motion artifacts frequently results in degraded image quality in incompliant patients. Since free breathing imaging may overcome this drawback, the aim of this study was to evaluate a MRI sequence acquired during free breathing using the VDGA SOS radial sampling scheme, that so far has not been implemented in 4D applications.*Methods and Materials In a prospective pilot study, 27 patients received a routine abdominal MRI protocol including the prototype free-breathing sequence (4DFreeBreathing) for dynamic imaging. This enables more convenient and faster reconstruction through VDGA-SOS without the use of additional reconstruction hardware, and hypothetically higher robustness regarding motion artefacts through soft-gating. A standard breath-hold sequence performed hereafter served as reference standard. Out of the continuous dynamic data sets each dynamic phase was analyzed regarding image quality, motion artifacts and vessel conspicuity using 5-point Likert scales. Furthermore, correct timing of the late arterial phase was compared to the pre-examinations.*Results 4DFreeBreathing delivered motion-free dynamic images with high temporal resolution in each subject. Overall image quality scores were rated good or excellent for 4DFreeBreathing and the gold standard without significant differences (P=0.34). There were significantly less motion artifacts in the 4DFreeBreathing sequence (P<0.0001), while vessel conspicuity in each dynamic phase was comparable for both groups (P=0.45, P>0.99, P=0.22, respectively). Correct timing of the late arterial phase could be achieved in 27/27 (100%) examinations using 4DFreeBreathing vs. 35/53 (66%) pre-examinations using gold standard (P<0.001).*Conclusions 4DFreeBreathing is a valuable technique that should be considered in special patient groups with foreseeable non-compliance or with preceding non-diagnostic dynamic liver MRI as a beneficial alternative to standard breath-hold sequences.*Clinical Relevance/Application 4DFreeBreathing allows for more convenient and faster reconstruction than current free breathing techniques with even higher motion robustness due to the VDGA SOS radial sampling scheme. This is beneficial in incompliant patients groups.

RESULTS

4DFreeBreathing delivered motion-free dynamic images with high temporal resolution in each subject. Overall image quality scores were rated good or excellent for 4DFreeBreathing and the gold standard without significant differences (P=0.34). There were significantly less motion artifacts in the 4DFreeBreathing sequence (P<0.0001), while vessel conspicuity in each dynamic phase was comparable for both groups (P=0.45, P>0.99, P=0.22, respectively). Correct timing of the late arterial phase could be achieved in 27/27 (100%) examinations using 4DFreeBreathing vs. 35/53 (66%) pre-examinations using gold standard (P<0.001).

CLINICAL RELEVANCE/APPLICATION

4DFreeBreathing allows for more convenient and faster reconstruction than current free breathing techniques with even higher motion robustness due to the VDGA SOS radial sampling scheme. This is beneficial in incompliant patients groups.

SSGI16-6 Respiratory Triggered Diffusion-weighted Imaging With A Single Diffusion Sensitising Gradient To Reduce Image Acquisition Time -a Feasibility Study In The Workup Of Hepatocellular Carcinoma.

Participants
Adarsh Ghosh, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

We evaluated respiratory triggered unidirectional single-shot echo-planar imaging (u-SSEPI) as a time-saving measure in diffusion imaging of the upper abdomen. Specifically, we compared the ADC values obtained from unidirectional DWI(u-SSEPI) and routine DWI (4t-SSEPI) and also the diagnostic accuracies of unidirectional and routine DWI sequences in the identification of focal liver lesions in the setting of chronic liver disease (CLD).*Methods and Materials This prospective, IRB approved study, included 48 patients of CLD who underwent-DCE-MRI on a 1.5 T scanner for hepatocellular carcinoma (HCC) workup. In addition to 4t-SSEPI, u-SSEPI was acquired with the diffusion sensitising gradient being applied in only one direction; keeping all other parameters same as 4t-SSEPI. Two blinded radiologists evaluated the DWI studies for image quality and detection of liver lesions. A composite gold

standard was established using DCE-MRI, follow-up imaging and patient clinical details. The apparent diffusion coefficients (ADCs) of the liver, spleen and the lesions were compared between the two sequences. ROC analysis evaluated the diagnostic accuracy of ADC from both the sequences in identifying HCC.*Results Eighty-eight lesions were identified using the composite gold standard. u-SSEPI resulted in 3 times faster image acquisition. No statistically significant differences were demonstrated between the unidirectional and routine DWI sequences for image quality parameters and lesion detection rates. Lesion wise comparison of the ADC values from both the sequences was not statistically different (p = 0.8) with a coefficient of variation = 12-14%. The Bland-Altman plots and the Passing-Bablock regression analysis demonstrated a systematic and proportional bias between the ADC values obtained. The AUC of the ROC curve, however, was 0.63-o1; 0.62-o2 for routine DWI and 0.65; 0.62 for unidirectional DWI when ADC was used to identify HCC (the AUCs were not statistically different (p = 0.6-0.8)).*Conclusions No significant differences were demonstrated in the diagnostic accuracies of unidirectional and routine DWI in the diagnosis of HCC. Unidirectional diffusion may be further evaluated in other organs where diffusion is isotropic, especially in respiratory triggered sequences where the imaging time dividend is significant.*Clinical Relevance/Application Utilising diffusion sensitising gradient in a single direction with respiratory triggering can reduce image acquisition times with no significant differences in image quality or diagnostic accuracies

RESULTS

Eighty-eight lesions were identified using the composite gold standard. u-SSEPI resulted in 3 times faster image acquisition. No statistically significant differences were demonstrated between the unidirectional and routine DWI sequences for image quality parameters and lesion detection rates. Lesion wise comparison of the ADC values from both the sequences was not statistically different (p = 0.8) with a coefficient of variation = 12-14%. The Bland- Altman plots and the Passing-Bablock regression analysis demonstrated a systematic and proportional bias between the ADC values obtained. The AUC of the ROC curve, however, was 0.63-o1; 0.62-o2 for routine DWI and 0.65; 0.62 for unidirectional DWI when ADC was used to identify HCC (the AUCs were not statistically different (p = 0.6-0.8)).

CLINICAL RELEVANCE/APPLICATION

Utilising diffusion sensitising gradient in a single direction with respiratory triggering can reduce image acquisition times with no significant differences in image quality or diagnostic accuracies

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Participants

Jonathan E. McConathy, MD, PhD, Birmingham, Alabama (*Moderator*) Research Consultant, Eli Lilly and Company;Research Grant, Eli Lilly and Company;Research Consultant, Blue Earth Diagnostics Ltd;Research Grant, Blue Earth Diagnostics Ltd;Research Consultant, General Electric Company;Research support, CytoSite Biopharma;Research Consultant, Canon Medical Systems Corporation;Research Consultant, ImaginAb, Inc;Spouse, Research Consultant, Baird Capital;Spouse, Research Grant, Navidea Biopharmaceuticals, Inc;Spouse, Research Grant, AbbVie Inc

Sub-Events

SSNMMI06-1 The Relation Of The Gleason Score, Prostate Health Index, Immunochemistry Staining Specific For PSMA, 68Ga-PSMA-11 Accumulation, Apparent Diffusion Coefficient And Pharmacokinetic Analysis During PET/MRI

Participants
Jiri Ferda, MD, PhD, Pilsen, Czech Republic (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the relationship between the level of the accumulation of the prostate specific membrane antigen (PSMA) ligand 68Ga-PSMA-11 (HBED), apparent diffusion coefficient, the pharmacokinetic parameters of the tissue enhancement, the level of the expression of the PSMA and Gleason score, and the prostate health index (PHI)*Methods and Materials Prospective study evaluated 40 whole mount prostate gross sections of 40 male patients with prostate cancer, they underwent the staging PET/MRI with the application of 68Ga-PSMA-11, the biopsy confirmed the prostate carcinoma within three weeks. The evaluation of the prostate carcinoma accumulation used the measurement of the standardized uptake value of 68Ga-PSMA-11s. The pathological staining was made using immunochemistry targeted the molecule of PSMA. The samples to be stained were removed from whole mount section according to the findings of PET/MRI. Gleason score was set in all patients. The following qualities were compared using Spearman correlation coefficient: Gleason score, four step scale of the immunochemistry confirmation of expression of PSMA, PHI (including proPSA level), than MRI derived values ADC (minimum value), Ktrans, iAUC, Ve , Kep .*Results The correlation of the expression of PSMA assessed using histochemistry with the accumulation of 68Ga-PSMA-11 was found by the Spearmann correlation coefficient (p=0.0011), the better correlation was found in patients where Gleason score pattern was 3 or 4 (p= 0.006). ADC correlated with PSA level (p=0.0074), with Gleason score pattern when it was 4 and 5 or, and with the overall accumulation of 68Ga-PSMA-11 (p=0.0157). Only Kep pharmacokinetic parameter correlates with the 68Ga-PSMA-11 (p=0.0052). ProPSA correlates with size of the tumor and extraprostatic extension (both p<0.0001), PHI correlates with ADC weekly (p=0.0391)*Conclusions The level of the PSMA ligand accumulation correlates with the PSMA expression assesed by the PSMA targeting immunochemistry staining; 68Ga-PSMA-11 accumulation correlates surprisingly weakly to the Gleason score, when the pattern is 5, then accumulation tends to be less expressed. The important finding is that the 68Ga-PSMA-11 accumulation relates to the real expression of PSMA molecule within the prostatic gland cell membrane.*Clinical Relevance/Application The relevances of the presented finding is important to the interpretationof the PET images using 68Ga-PSMA-11, when the accumulation is limited, the real presence of the PSMA protein within prostatic glandular cells is limited

RESULTS

The correlation of the expression of PSMA assessed using histochemistry with the accumulation of 68Ga-PSMA-11 was found by the Spearmann correlation coefficient (p=0.0011), the better correlation was found in patients where Gleason score pattern was 3 or 4 (p= 0.006). ADC correlated with PSA level (p=0.0074), with Gleason score pattern when it was 4 and 5 or, and with the overall accumulation of 68Ga-PSMA-11 (p=0.0157). Only Kep pharmacokinetic parameter correlates with the 68Ga-PSMA-11 (p=0.0052). ProPSA correlates with size of the tumor and extraprostatic extension (both p<0.0001), PHI correlates with ADC weekly (p=0.0391)

CLINICAL RELEVANCE/APPLICATION

The relevances of the presented finding is important to the interpretationof the PET images using 68Ga-PSMA-11, when the accumulation is limited, the real presence of the PSMA protein within prostatic glandular cells is limited

SSNMMI06-2 Comparative Efficacy Of PSMA-targeted 18F-DCFPyL PET-CT Scan And Multi-parametric MRI For Detection And Staging Of Prostate Cancer: A Prospective Study

Participants
Soheil Kooraki, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

To compare the efficacy of 18F-DCFPyL PET/CT scan for detection of intra-prostatic and extra-prostatic lesions in individuals with prostate cancer (PCa), compared to multiparametric MRI (mpMRI) of prostate.*Methods and Materials This IRB-approved, HIPAA-compliant, open label, single-center, prospective study was nested in a clinical trial study which assesses clinical applications of 18F-DCFPyL PET/CT in individuals with PCa. Data of 110 patients who had undergone 18F-DCFPyL PET/CT were reviewed and 34 patients (mean age 70, ranged 59-92 years, mean PSA 20.7 ng/mL at the time of performing scan) who had completed a diagnostic mpMRI no more than three months before acquisition of 18F-DCFPyL PET/CT were included. Whole body PET/CT scan was acquired

either for initial staging or restaging of PCa, approximately 60 minutes after injection of 9 ± 1 mCi 18F-DCFPyL. PET/CT scans were interpreted by an experienced nuclear medicine specialist, blinded to the results of mpMRI. Findings were later compared to those of mpMRI. The pre- and post- scan questionnaires were completed by the referring physician within two weeks before and four weeks after 18F-DCFPyL PET/CT study, respectively.*Results 18F-DCFPyL PET/CT scan and mpMRI were concordant for detection of intraprostatic lesions in 73.5% (25/34) of the study cohort. The intraprostatic findings were discordant in 9 patients, of whom two had negative, and one had non-diagnostic mpMRI. Also, mpMRI found extra-capsular extension in 32.3% (11/34) of patients, for which PET/CT study was limited. Positive regional and non-regional lymph nodes were found in 32.3% (11/34) and 5.9% (2/34) of individuals by 18F-DCFPyL PET/CT, respectively, vs. regional lymph nodes in 2.9% (1/34) on mpMRI. Skeletal metastasis was detected in 17.6% (6/34) by 18F-DCFPyL PET/CT compared to 2.9% (1/34) by mpMRI. Overall, based on the results of 18F-DCFPyL PET/CT scan, staging was altered in 44.1% (15/34) of patients.*Conclusions 18F-DCFPyL PET/CT scan and mpMRI were concordant for detection of intraprostatic lesions in 73.5% of the study cohort. 18F-DCFPyL PET/CT is more sensitive to detect regional and non-regional lymph nodes and skeletal metastasis.*Clinical Relevance/Application In addition to localization of intraprostatic lesions, 18F-DCFPyL PET/CT has the advantage of depicting nodal and skeletal metastasis; therefore, acquiring 18F-DCFPyL PET/CT and mpMRI together can be beneficial for patient care in the diagnostic path of PCa.

RESULTS

18F-DCFPyL PET/CT scan and mpMRI were concordant for detection of intraprostatic lesions in 73.5% (25/34) of the study cohort. The intraprostatic findings were discordant in 9 patients, of whom two had negative, and one had non-diagnostic mpMRI. Also, mpMRI found extra-capsular extension in 32.3% (11/34) of patients, for which PET/CT study was limited. Positive regional and non-regional lymph nodes were found in 32.3% (11/34) and 5.9% (2/34) of individuals by 18F-DCFPyL PET/CT, respectively, vs. regional lymph nodes in 2.9% (1/34) on mpMRI. Skeletal metastasis was detected in 17.6% (6/34) by 18F-DCFPyL PET/CT compared to 2.9% (1/34) by mpMRI. Overall, based on the results of 18F-DCFPyL PET/CT scan, staging was altered in 44.1% (15/34) of patients.

CLINICAL RELEVANCE/APPLICATION

In addition to localization of intraprostatic lesions, 18F-DCFPyL PET/CT has the advantage of depicting nodal and skeletal metastasis; therefore, acquiring 18F-DCFPyL PET/CT and mpMRI together can be beneficial for patient care in the diagnostic path of PCa.

SSNMMI06-3   Whole Prostate SUVmax On 18f-fluciclovine PET Correlates With Gleason Grade (Grade Group) Change After Radical Prostatectomy In High Risk Patients With Primary Prostate Cancer

Participants
Olayinka Abiodun-Ojo, MD,MPH, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

Preoperative Gleason score (GS)/Grade group (GG) are important parameters for prostate cancer (PCa) staging and treatment planning. The role of 18F-fluciclovine in primary PCa staging is currently being explored. The aim of this study was to determine whether fluciclovine uptake in the prostate gland correlates with GS/GG change after radical prostatectomy (RP).*Methods and Materials Fifty-six patients (mean age 61.8 [±7.1] years) with unfavorable intermediate to high risk PCa considered eligible for surgery underwent 18F-fluciclovine PET/CT prior to robotic RP with extended pelvic lymph node dissection. Patients were diagnosed with PCa and risk category was determined based on 12-core trans-rectal prostate biopsy findings and prostate-specific antigen (PSA). On PET, regions of interest were highlighted around the prostate gland to determine the maximum standardized uptake values (SUVmax). Following surgery, histopathologic assessment was performed and GS/GG were reported. GS/GG at prostate biopsy and RP were compared and grade changes documented. Grade change was defined as any upward or downward change in GG. PET prostate findings were correlated with GS/GG and grade change.*Results Median preoperative PSA was 15.50 ng/mL (2.49-147.03 ng/mL). All patients had abnormal fluciclovine uptake in the prostate. There was no significant difference in whole prostate SUVmax across GG at biopsy (p = 0.188) and RP (p = 0.708). Of the 56 prostate specimens analyzed, significant GG change was found in 9/56 (16.1%) patients. GG downgrade and upgrade rates were 7/56 (12.5%) and 2/56 (3.6%), respectively. Patients that were downgraded at RP had significantly lower whole prostate SUVmax than patients with no grade change (8.5 ± 2.6 vs 6.4 ± 0.6; p<0.01).Additionally, fluciclovine uptake (SUVmax) was significantly higher in upgraded than downgraded cases (8.9 ± 2.2 vs. 6.8 ± 1.7; p <0.01). ROC analysis showed SUVmax (area under curve = 0.78; 95% CI: 0.59-0.97) with cutoff of 7.3 yielded a sensitivity of 80% and specificity of 79% for fluciclovine PET to predict upgrade. SUVmax was significantly associated with upgrading only when downgraded cases were used as the reference group (p = 0.02). After adjusting for PSA, there was a non-significant association between SUVmax and upgrading (p = 0.062).*Conclusions Fluciclovine PET uptake parameters may indicate upgrading of patients with primary prostate cancer postoperatively, which is critical for accurate staging, treatment planning, and outcome.*Clinical Relevance/Application Fluciclovine PET appears to be a valuable tool for pre-treatment staging and treatment planning of primary prostate cancer patients.

RESULTS

Median preoperative PSA was 15.50 ng/mL (2.49-147.03 ng/mL). All patients had abnormal fluciclovine uptake in the prostate. There was no significant difference in whole prostate SUVmax across GG at biopsy (p = 0.188) and RP (p = 0.708). Of the 56 prostate specimens analyzed, significant GG change was found in 9/56 (16.1%) patients. GG downgrade and upgrade rates were 7/56 (12.5%) and 2/56 (3.6%), respectively. Patients that were downgraded at RP had significantly lower whole prostate SUVmax than patients with no grade change (8.5 ± 2.6 vs 6.4 ± 0.6; p<0.01).Additionally, fluciclovine uptake (SUVmax) was significantly higher in upgraded than downgraded cases (8.9 ± 2.2 vs. 6.8 ± 1.7; p <0.01). ROC analysis showed SUVmax (area under curve = 0.78; 95% CI: 0.59-0.97) with cutoff of 7.3 yielded a sensitivity of 80% and specificity of 79% for fluciclovine PET to predict upgrade. SUVmax was significantly associated with upgrading only when downgraded cases were used as the reference group (p = 0.02). After adjusting for PSA, there was a non-significant association between SUVmax and upgrading (p = 0.062).

CLINICAL RELEVANCE/APPLICATION

Fluciclovine PET appears to be a valuable tool for pre-treatment staging and treatment planning of primary prostate cancer patients.

SSNMMI06-4   18F-fluciclovine PET/CT And 68GA-PSMA PET/CT Guidance Of Salvage Radiotherapy In Patients With Biochemical Recurrence Postprostatectomy: Interim Analysis Of A Secondary Endpoint From A Randomized Trial

Participants

Olayinka Abiodun-Ojo, MD,MPH, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

We examined the potential influence of 18F-fluciclovine and 68Ga-PSMA PET/CT on salvage radiotherapy (RT) management decisions (planned secondary endpoint) in patients with biochemical recurrence postprostatectomy.*Methods and Materials 68 patients (accrual goal: 140) with detectable prostate-specific antigen (PSA) postprostatectomy were randomized to treatment planning guided by fluciclovine (mean dose: 9.96 ± 0.80 mCi) [arm A] or Ga-PSMA (mean dose: 5.07 ± 0.21 mCi) with 20 mg Lasix given unless contraindicated [arm B] in an ongoing prospective intention-to-treat clinical trial. Pre-PET RT plans were based on clinical history, histopathology findings at prostatectomy, PSA trajectory and conventional imaging findings. Post-PET RT plans were based on PET findings: no uptake or prostate bed (PB) only uptake - RT to PB only; pelvic nodal uptake - RT to PB+pelvis; extrapelvic nodal uptake - no RT. For each arm, pre- and post-PET management decisions were compared and significance of decision changes were determined using the Clopper-Pearson (exact) binomial method.*Results 3/68 patients dropped out before PET scanning. Of the remaining 65 patients analyzed, 32 (median PSA 0.29 ng/mL) underwent fluciclovine PET and 33 (median PSA 0.31 ng/mL) Ga-PSMA PET. No significant difference in PSA at PET (p = 0.48), Gleason score (p = 0.73) and surgery-PET interval (p = 0.94) between arms. On whole body analysis, positivity rate of fluciclovine was significantly higher than Ga-PSMA (96.9% vs 60.6%; p < 0.01). Overall RT decision change was 9/32 (28.1%) in arm A; in 4/32 (12.5%) patients, RT decision was withdrawn because of systemic disease detected on PET. 5/28 (17.9%) patients with sustained plans to undergo RT had treatment fields changed from RT to PB and pelvis to PB only. RT decision change was 12/33 (36.4%) in arm B; 5/33 (15.2%) patients had RT decision withdrawn because of extrapelvic uptake on PET. 7/28 (25.0%) patients with final decision to undergo RT had fields changed; 6/28 (21.4%) had fields reduced from RT to PB and pelvis to PB only, while 1/28 (3.6%) had fields increased from RT to PB only to PB and pelvis. Changes in overall RT decisions and fields were statistically significant (P < 0.01) for both arms.*Conclusions In this interim analysis, whole body positivity rate for fluciclovine was significantly higher than Ga-PSMA. Both fluciclovine and Ga-PSMA had a significant influence on salvage RT management decisions.*Clinical Relevance/Application For PCa patients with biochemical recurrence fluciclovine PET had higher positivity rate primarily due to superior ability to detect local recurrence compared with Ga-PSMA. Both fluciclovine and Ga-PSMA had a significant influence on salvage radiotherapy management decisions.

RESULTS

3/68 patients dropped out before PET scanning. Of the remaining 65 patients analyzed, 32 (median PSA 0.29 ng/mL) underwent fluciclovine PET and 33 (median PSA 0.31 ng/mL) Ga-PSMA PET. No significant difference in PSA at PET (p = 0.48), Gleason score (p = 0.73) and surgery-PET interval (p = 0.94) between arms. On whole body analysis, positivity rate of fluciclovine was significantly higher than Ga-PSMA (96.9% vs 60.6%; p < 0.01). Overall RT decision change was 9/32 (28.1%) in arm A; in 4/32 (12.5%) patients, RT decision was withdrawn because of systemic disease detected on PET. 5/28 (17.9%) patients with sustained plans to undergo RT had treatment fields changed from RT to PB and pelvis to PB only. RT decision change was 12/33 (36.4%) in arm B; 5/33 (15.2%) patients had RT decision withdrawn because of extrapelvic uptake on PET. 7/28 (25.0%) patients with final decision to undergo RT had fields changed; 6/28 (21.4%) had fields reduced from RT to PB and pelvis to PB only, while 1/28 (3.6%) had fields increased from RT to PB only to PB and pelvis. Changes in overall RT decisions and fields were statistically significant (P < 0.01) for both arms.

CLINICAL RELEVANCE/APPLICATION

For PCa patients with biochemical recurrence fluciclovine PET had higher positivity rate primarily due to superior ability to detect local recurrence compared with Ga-PSMA. Both fluciclovine and Ga-PSMA had a significant influence on salvage radiotherapy management decisions.

SSNMMI06-5 The Impact Of 18F-DCFPyL (PSMA)PET On The Primary Staging And Management Of Men With Unfavorable Intermediate Or High-risk Prostate Cancer

Participants
Adriano Basso Dias, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether 18F-DCFPyL (PSMA) PET (PET/CT or PET/MRI) performed at initial staging of men with unfavorable intermediate or high-risk prostate cancer detects pelvic nodal and distant metastases more frequently than conventional imaging (=CI; bone scan and CT± MR) and to assess the impact of PSMA PET on patient management.*Methods and Materials There were 108 men with biopsy-proven unfavorable intermediate or high-risk prostate cancer with no metastases (n=84), oligometastatic disease (=4 metastases) (n=22) or equivocal for extensive disease (>4 metastases) on CI (n=2) referred for primary staging with PSMA PET. The diagnostic performance of PET for detection of pelvic nodal and distant metastatic disease was compared to staging with CI. Metastatic sites and disease stage were recorded for each modality and compared with a composite reference standard including histopathologic examination (when available), correlative imaging and clinical/biochemical follow-up. Pre-PET intended treatment was recorded and compared to treatment after PET.*Results The performance (95% CI) of CI and PSMA PET for the detection of pelvic nodal metastases was 0.79 (0.49, 0.95) vs 0.97 (0.84, 1.00) for sensitivity and 0.74 (0.63, 0.83) vs. 0.97 (0.90, 1.00) for specificity, respectively; and for distant metastases was 0.75 (0.43, 0.95) vs 1.00 (0.86, 1.00) for sensitivity and 0.82 (0.72, 0.89) vs. 0.98 (0.91, 1.00) for specificity, respectively. PSMA PET altered stage in 42/108 (39%) and management in 24/108 (23%) men. The most frequent change in management was from systemic to locoregional therapy in 10/108 (9.3%) and from locoregional to systemic therapy in 9/108 (8.3%). Equivocal findings were encountered less frequently with PET (1/108, 0.9%) than conventional imaging (27/108, 25%).*Conclusions In patients with unfavorable intermediate or high-risk biopsy prostate cancer, initial staging with PSMA PET detects more nodal and distant metastases than CI and results in a change in management in >20% of men. Long term follow-up is needed to determine whether this translates to better clinical outcomes.*Clinical Relevance/Application PSMA PET is more sensitive in identifying nodal and distant metastases at initial staging of men with unfavorable intermediate or high-risk prostate cancer, resulting in a frequent change in management.

RESULTS

The performance (95% CI) of CI and PSMA PET for the detection of pelvic nodal metastases was 0.79 (0.49, 0.95) vs 0.97 (0.84, 1.00) for sensitivity and 0.74 (0.63, 0.83) vs. 0.97 (0.90, 1.00) for specificity, respectively; and for distant metastases was 0.75 (0.43, 0.95) vs 1.00 (0.86, 1.00) for sensitivity and 0.82 (0.72, 0.89) vs. 0.98 (0.91, 1.00) for specificity, respectively. PSMA PET altered stage in 42/108 (39%) and management in 24/108 (23%) men. The most frequent change in management was from systemic to locoregional therapy in 10/108 (9.3%) and from locoregional to systemic therapy in 9/108 (8.3%). Equivocal findings were encountered less frequently with PET (1/108, 0.9%) than conventional imaging (27/108, 25%).

CLINICAL RELEVANCE/APPLICATION

PSMA PET is more sensitive in identifying nodal and distant metastases at initial staging of men with unfavorable intermediate or high-risk prostate cancer, resulting in a frequent change in management.

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SSNR14

Neuroradiology (Techniques and Methods: AI for Image Acquisition)

Participants
Daniel S. Chow, MD, Irvine, California (*Moderator*) Shareholder, Avicenna.aiConsultant, Canon Medical Systems CorporationGrant, Canon Medical Systems CorporationConsultant, Cullen & GrandyGrant, NovoCure Ltd

Sub-Events

SSNR14-1 Clinical Evaluation Of An AI-accelerated Two-minute Multi-shot EPI Protocol For Comprehensive High-quality Brain MRI In An Emergency And Inpatient Setting

Participants
Augusto Goncalves Filho, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Rapid, multi-contrast MRI of the brain can improve the evaluation of acutely ill patients who may not be able to tolerate prolonged exams. In this work, we performed an initial clinical evaluation of an artificial-intelligence-accelerated multi-shot echo-planar imaging (msEPI)-based method that provides multi-contrast images with high signal-to-noise ratio, high tissue contrast, and minimal distortions within two minutes.*Methods and Materials With IRB approval, 26 patients from emergency and inpatient care settings were prospectively scanned on two 3T systems (MAGNETOM Prisma and Skyra, Siemens) with prototype 2-min fast msEPI-based sequences including the following contrasts: T2, T2*, inversion recovery-based T1, T2-FLAIR, and diffusion-weighted imaging (Fig. 1). Corresponding clinical reference scans lasting 10-min using turbo spin echo (TSE) scans were also acquired for comparison. Two neuroradiologists blinded to sequence type independently reviewed the imaging data sets for the presence of 6 major imaging findings (intracranial masses, hemorrhage, WM hyperintensities, subarachnoid FLAIR, diffusion restriction, and hydrocephalus). The raters used a 3-point score to evaluate image degradation by noise and artifacts.*Results Data from 19 study participants were included (7 subjects excluded due to incomplete datasets). ICCs showed almost perfect interobserver agreement for the evaluation of intracranial masses (ICC = 1), WM hyperintensities (ICC = 0.83), diffusion restriction (ICC = 0.83), and hydrocephalus (ICC = 1); and substantial agreement for intracranial hemorrhage (ICC = 0.76) and subarachnoid FLAIR hyperintensities (ICC = 0.65). Comparisons of image quality (Fig. 2) showed increased noise on the msEPI exams for the T1, FLAIR and DWI (p<0.05) and increased artifacts on T2, T2* and FLAIR (p<0.05), without compromising detection of the imaging findings.*Conclusions The AI-accelerated 2-minute multi-shot EPI protocol provides rapid, comprehensive brain MRI evaluation of emergency and hospitalized patients with a high degree of interobserver agreement for major brain imaging findings, similar to that of a 10-minute conventional TSE-based protocol.*Clinical Relevance/Application A 2-min AI-accelerated multi-contrast brain MRI exam was evaluated in acutely ill patients and shown to detect most imaging findings, in agreement with those on a conventional 10-min brain MRI exam.

RESULTS

Data from 19 study participants were included (7 subjects excluded due to incomplete datasets). ICCs showed almost perfect interobserver agreement for the evaluation of intracranial masses (ICC = 1), WM hyperintensities (ICC = 0.83), diffusion restriction (ICC = 0.83), and hydrocephalus (ICC = 1); and substantial agreement for intracranial hemorrhage (ICC = 0.76) and subarachnoid FLAIR hyperintensities (ICC = 0.65). Comparisons of image quality (Fig. 2) showed increased noise on the msEPI exams for the T1, FLAIR and DWI (p<0.05) and increased artifacts on T2, T2* and FLAIR (p<0.05), without compromising detection of the imaging findings.

CLINICAL RELEVANCE/APPLICATION

A 2-min AI-accelerated multi-contrast brain MRI exam was evaluated in acutely ill patients and shown to detect most imaging findings, in agreement with those on a conventional 10-min brain MRI exam.

SSNR14-2 Multi-center Multi-reader Clinical Evaluation Of Deep Learning Model For 10x Dose Reduction In Contrast-enhanced Brain MRI With A Focus On Tumor Categorization

Participants
Srivathsa Venkata, MSc, Menlo Park, California (*Presenter*) Employee, Subtle Medical, Inc;Stockholder, Subtle Medical, Inc

PURPOSE

To evaluate the diagnostic performance of a deep learning (DL) algorithm for reduced gadolinium dosage through qualitative assessment and quantitative study.*Methods and Materials 3D T1-weighted scans for pre-contrast injection, low dose (10%), and full dose (100%) were acquired from 119 patients (59 females, 60 males;54+/-16 years) from 3 institutions and 3 scanners using different protocols. The dataset (56 train/13 validation/50 test) was used to train a DL model using the zero-dose and low-dose images to predict the full-dose image thus reducing the dosage by 90%. 50 test cases were randomized and presented to 3 board-certified neuroradiologists(10,15 & 23 years experience) who performed blinded evaluation of 100 image volumes (50 full-dose & 50 DL-synthesized). The evaluation criteria were tumor category (no tumor, enhancing, and non-enhancing tumors), overall image quality (IQ) and image artifacts(IA). IQ & IA were scored using a 5 point Likert scale. Confusion matrices for the individual readers were plotted for the 3 scoring criteria. Cohen's kappa scores were computed for pairwise agreement between readers on the tumor category for the DL-synthesized images. Enhancing tumor cases as identified by the readers were used to generate tumor masks using a DL-based tumor segmentation algorithm. Dice scores were computed between the masks of ground truth and DL

synthesized images.*Results Using a majority voting scheme among readers to determine outcome, 98% (49/50) agreement was observed for the tumor category. The 3 readers had substantial pairwise agreement of tumor category on the DL synthesized images (Cohen's kappa=0.61, 0.67 & 0.66 respectively). High values in the confusion matrix diagonals demonstrate good agreement in the tumor category. High values in the right bottom elements in the confusion matrices of IQ and IA show that the DL synthesized images are similar or better than the ground truth in terms of image quality and artifacts. Average Dice score was 0.88+/-0.06 (median = 0.91) for 17 enhancing tumor cases.*Conclusions DL algorithm reduced the gadolinium dosage by 90% with diagnostic equivalence and non-inferior image quality.*Clinical Relevance/Application Given the growing concerns over the use of gadolinium-based contrast agents, DL can reduce contrast dosage in diverse clinical settings.

RESULTS

Using a majority voting scheme among readers to determine outcome, 98% (49/50) agreement was observed for the tumor category. The 3 readers had substantial pairwise agreement of tumor category on the DL synthesized images (Cohen's kappa=0.61, 0.67 & 0.66 respectively). High values in the confusion matrix diagonals demonstrate good agreement in the tumor category. High values in the right bottom elements in the confusion matrices of IQ and IA show that the DL synthesized images are similar or better than the ground truth in terms of image quality and artifacts. Average Dice score was 0.88+/-0.06 (median = 0.91) for 17 enhancing tumor cases.

CLINICAL RELEVANCE/APPLICATION

Given the growing concerns over the use of gadolinium-based contrast agents, DL can reduce contrast dosage in diverse clinical settings.

SSNR14-3 It'S Not Magic - Image Quality Improvement Of High Resolution 3d Brain Images Using Deep Learning

Participants
Woojin Jung, Seoul, Korea, Republic Of (*Presenter*) Employee, AIRS Medical Inc

PURPOSE

Thanks to recent advances, modern clinical 3T MR system enables sub-millimeter resolution brain images. To achieve this, long scan time for sufficient signal-to-noise ratio (SNR) is required. However, it is not always possible, depending on clinical situation. Also, it might aggravate motion artifacts. While acquisition of high-resolution image with sufficient SNR in reasonable scan time is desirable, it is a challenging goal. In this study, we developed and applied a deep-learning-based approach to enhance image quality of high-resolution 3D T1-weighted images of the brain without an increase in scan time, and explore their clinical values.*Methods and Materials From 80 sets of 3D MPRAGE data (60 for training, 6 for validation, and 14 for test) with 0.7 x 0.7 x 0.7 mm3 resolution (TR/TE/TI = 2300/3.2/1040 ms, GRAPPA factor 2, scan time 320 s) at 3T clinical scanner, we trained and tested a deep-learning model adopted Noise2Noise framework as a fundamental architecture. For the assessment of image quality, visual appropriateness and identification of several clinically relevant anatomical structures were assessed by two experienced neuroradiologists. PSNR was calculated for quantitative image quality evaluation, using retrospective noise simulation from the two full-sampled data.*Results In all test set data, denoising was successfully applied in under-sampled data. In visual assessment, there was definite image quality improvement as compared to conventional reconstruction results, and to fully sampled data (n=2). Proposed images enabled clear depiction of putamina tail, cerebellar folia and hippocampus, as compared to conventional reconstruction images. Fine structures such as mammillothalamic tract, claustrum, periaqueductal gray, and substantia nigra were consistently and clearly identified. Some of them were not clearly seen in conventional reconstruction images, or even in fully sampled data. There was significant improvement of PSNR, demonstrating the performance of the proposed method for the image quality improvement.*Conclusions Our approach enables effective suppression of noise from undersampled MR images. As a result, we obtained 7T-like high resolution 3D T1 weighted images in about 5 minutes at 3T scanner. It would be helpful to detect abnormalities in fine structures and for deep brain stimulation targeting.*Clinical Relevance/Application From this approach, high-quality 3D T1-weigted images can be obtained in reasonable scan time at clinical 3T MR. It would be helpful to detect abnormalities in fine structures, such as hippocampus, and for deep brain stimulation targeting.

RESULTS

In all test set data, denoising was successfully applied in under-sampled data. In visual assessment, there was definite image quality improvement as compared to conventional reconstruction results, and to fully sampled data (n=2). Proposed images enabled clear depiction of putamina tail, cerebellar folia and hippocampus, as compared to conventional reconstruction images. Fine structures such as mammillothalamic tract, claustrum, periaqueductal gray, and substantia nigra were consistently and clearly identified. Some of them were not clearly seen in conventional reconstruction images, or even in fully sampled data. There was significant improvement of PSNR, demonstrating the performance of the proposed method for the image quality improvement.

CLINICAL RELEVANCE/APPLICATION

From this approach, high-quality 3D T1-weigted images can be obtained in reasonable scan time at clinical 3T MR. It would be helpful to detect abnormalities in fine structures, such as hippocampus, and for deep brain stimulation targeting.

SSNR14-5 K-space Based Deep Learning Reconstruction Empowers 60-70% Acceleration Of MR Imaging Of The Spine

Participants
Lawrence N. Tanenbaum, MD, Riverside, Connecticut (*Presenter*) Speaker, General Electric Company;Speaker, Siemens AG;Speaker, Guerbet SA;Speaker, Koninklijke Philips NV;Consultant, Enlitic, Inc;Consultant, icoMetrix NV;Consultant, Subtle Medical, Inc;Consultant, Columbo;Consultant, Canon Medical Systems Corporation;Consultant, FUJIFILM Holdings Corporation

PURPOSE

This prospective, multireader study evaluates the impact on perceived image quality of highly scan-time reduced cervical (72%) and lumbar (64%) spine MRI reconstructed with deep learning (DL).*Methods and Materials With IRB approval and patient consent, 26 consecutive patients underwent standard-of-care (SOC) and accelerated (FAST) spine MRI exams acquired on a GE 3T Architect scanner. DL processing of the FAST scan data set (FAST-DL) was performed using an FDA-cleared CNN based, DL image enhancement product - Air Recon DLTM. The k-space based tool offers powerful denoising, sharpness enhancement and elimination of some artifacts such as truncation ringing. Two neuroradiologists were presented with the image sets in a paired side-by-side fashion. Datasets were blinded and randomized in sequence and left-right display order. Image features were preference rated on a 5-point Likert scale for overall quality, structural conspicuity, cord/CSF contrast, sharpness, SNR and artifacts. Readers were

advised to search for image aberrations that could be attributable to DL processing.*Results FAST-DL was qualitatively better than SOC and FAST for perceived signal-to-noise ratio (SNR) sharpness and artifacts. No image aberrations were noted.*Conclusions DL enables 64-72% spine MRI scan time reduction as well as what radiologists perceive as enhanced image quality with benefits in SNR, image sharpness and artifact reduction over SOC and FAST images without DL processing, providing gains in efficiency and portending practice utility for routine use.*Clinical Relevance/Application Deep learning based MR image reconstruction techniques can reduce scan times and improve quality and are now commercially available from multiple vendors suggesting the potential for widespread use in practice.

RESULTS

FAST-DL was qualitatively better than SOC and FAST for perceived signal-to-noise ratio (SNR) sharpness and artifacts. No image aberrations were noted.

CLINICAL RELEVANCE/APPLICATION

Deep learning based MR image reconstruction techniques can reduce scan times and improve quality and are now commercially available from multiple vendors suggesting the potential for widespread use in practice.

SSNR14-6   Pilot Study To Evaluate The Feasibility Of Replacing Conventional Head CT Images With A Single Series Of Thin-slice, Low-noise Images Created Using A Multi-kernel Synthesis Method

Participants
Akitoshi Inoue, MD,PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Multi-kernel synthesis (MKS) is a CNN method to create CT images with high spatial resolution in bone regions (as with bone reconstruction kernels) and low noise in brain regions (as with head reconstruction kernels). MKS creates a single, thin-slice image series that can display bone and brain pathology. Our purpose was to determine if MKS images are non-inferior to routine clinical images in diagnosing acute bone and brain lesions in head CT.*Methods and Materials 50 patients underwent head CT due to trauma or acute-onset symptoms. Axial MKS (0.75mm) and routine (bone [0.75mm] and brain [5mm and 0.75mm]) images were reconstructed. A non-reader neuroradiologist defined the reference standard for brain and bone pathology using routine CT, prior and follow-up CT/MRI, and medical records. Three neuroradiologists, blinded to clinical information, reviewed either MKS or routine images in two sessions, marking brain and bone pathologies and rating image quality. Subsequently, a side-by-side comparison was performed (-4=MKS is worse, 0=MKS is equal to routine, +4=MKS is better).*Results The reference standard included 20 fractures in 11 patients and 71 intracranial pathologies in 31 patients. Overall patient-level sensitivity and specificity were 0.89 (93/105; 95% CI: 0.70—0.95) and 0.84 (38/45; 95% CI: 0.68—1.00) for routine CT and 0.87 (91/105; 95% CI: 0.63—0.92) and 0.89 (40/45; 95% CI: 0.68—1.00) for MKS. For intracranial pathologies, sensitivity and specificity were 0.69 (95% CI: 0.62—0.75) and 0.81 (95% CI: 0.75—0.87) for routine CT and 0.69 (95% CI: 0.62—0.75) and 0.76 (95% CI: 0.69—0.82) for MKS. For fractures, lesion-level sensitivity and positive predictive value were 0.48 (95% CI: 0.35—0.62) and 0.81 (95% CI: 0.64—0.92) for routine CT and 0.40 (95% CI: 0.28—0.53) and 0.73 (95% CI: 0.54—0.87) for MKS. The comparison scores of brain and bone images were -0.17±1.30 (range: -2—3) and -0.31±0.57 (range: -2—1), respectively, indicating only subtle differences.*Conclusions Reader performance for identification of fractures and intracranial pathology in head CT was similar using a single series of thin-slice MKS images compared to routine clinical CT with different slice thicknesses and kernels.*Clinical Relevance/Application MKS creates a single series of low-noise, thin-slice images that can potentially replace multiple image series for head CT in the emergency setting.

RESULTS

The reference standard included 20 fractures in 11 patients and 71 intracranial pathologies in 31 patients. Overall patient-level sensitivity and specificity were 0.89 (93/105; 95% CI: 0.70—0.95) and 0.84 (38/45; 95% CI: 0.68—1.00) for routine CT and 0.87 (91/105; 95% CI: 0.63—0.92) and 0.89 (40/45; 95% CI: 0.68—1.00) for MKS. For intracranial pathologies, sensitivity and specificity were 0.69 (95% CI: 0.62—0.75) and 0.81 (95% CI: 0.75—0.87) for routine CT and 0.69 (95% CI: 0.62—0.75) and 0.76 (95% CI: 0.69—0.82) for MKS. For fractures, lesion-level sensitivity and positive predictive value were 0.48 (95% CI: 0.35—0.62) and 0.81 (95% CI: 0.64—0.92) for routine CT and 0.40 (95% CI: 0.28—0.53) and 0.73 (95% CI: 0.54—0.87) for MKS. The comparison scores of brain and bone images were -0.17±1.30 (range: -2—3) and -0.31±0.57 (range: -2—1), respectively, indicating only subtle differences.

CLINICAL RELEVANCE/APPLICATION

MKS creates a single series of low-noise, thin-slice images that can potentially replace multiple image series for head CT in the emergency setting.

Abstract Archives of the RSNA, 2021

SSNR09

Neuroradiology (Brain: Vascular (Excluding Acute Stroke)/Stroke (Diagnosis and Treatment))

Participants
Ajay Malhotra, MD, New Canaan, Connecticut (*Moderator*) Nothing to Disclose

Sub-Events

SSNR09-1 Admission NIHSS As A Clinical Marker Of Penumbra Underestimates The Size Of Tissue-at-Risk In Right Versus Left-Sided Large Vessel Occlusion Stroke

Participants
Adrian Mak, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Admission NIHSS is used as clinical surrogate for penumbra when determining eligibility for endovascular therapy (ET) in the 6-24 hours extended time window after acute large vessel occlusion (LVO) stroke. However, it is known that the admission NIHSS for an infarct of a given volume is higher in left compared to right hemispheric stroke. We aimed to determine the effects of LVO side on final infarct volume and clinical outcome after ET with regards to admission NIHSS score.*Methods and Materials We analyzed the post-thrombectomy infarct volume and distribution as well as discharge outcome in patients with anterior LVO that received ET and follow-up MRI. We applied a multivariate voxel-wise general linear model to assess infarct distribution in relation to admission NIHSS, post-thrombectomy reperfusion (mTICI), and discharge modified Rankin Scale (mRS) score. We performed multivariate regression analyses to identify independent predictors of clinical and tissue outcomes, and ANOVA to investigate their interactions.*Results A total of 469 patients were included (254 left; 215 right). Admission NIHSS was higher among those with left (median 16: IQR 10-22) versus right-sided LVO (11: 8-16, p>0.001). In voxel-wise analysis, worse reperfusion (lower mTICI), lower admission NIHSS, and poor discharge outcome (mRS >2) were associated with right-hemispheric infarct lesions. In multivariate analysis, right-sided LVO was an independent predictor of larger final infarct volume (ß=18.3, p=0.003). There was a significant three-way interaction between admission stroke severity (based on NIHSS), LVO side, and mTICI regarding infarct volume (F(7,440)=2.11, p=0.041). Specifically, in patients with moderate stroke (NIHSS 6-15), incomplete reperfusion (mTICI 0-2b) was associated with larger infarct volume (55.5±76.6ml vs. 30.0±47.2ml, p<0.001) and worse discharge mRS (4: 2-4 vs. 3: 1-4, p=0.022) in right compared to left-sided LVO. More tissue is saved for each degree of mTICI in patients with moderate stroke and right-sided LVO (F(4,440)=3.19, p=0.013).*Conclusions Incomplete reperfusion leads to larger infarction of eloquent brain tissue and worse clinical outcome in patients with right-sided LVO compared to left-sided LVO. These results likely represent larger tissue-at-risk in patients with right-sided LVO for a given admission NIHSS score.*Clinical Relevance/Application Using admission NIHSS as "clinical penumbra" for ET eligibility may lead to underestimation of tissue-at-risk and consequently to undertreatment among patients with right-sided LVO, highlighting the advantage of objective imaging biomarkers for penumbra.

RESULTS

A total of 469 patients were included (254 left; 215 right). Admission NIHSS was higher among those with left (median 16: IQR 10-22) versus right-sided LVO (11: 8-16, p>0.001). In voxel-wise analysis, worse reperfusion (lower mTICI), lower admission NIHSS, and poor discharge outcome (mRS >2) were associated with right-hemispheric infarct lesions. In multivariate analysis, right-sided LVO was an independent predictor of larger final infarct volume (ß=18.3, p=0.003). There was a significant three-way interaction between admission stroke severity (based on NIHSS), LVO side, and mTICI regarding infarct volume (F(7,440)=2.11, p=0.041). Specifically, in patients with moderate stroke (NIHSS 6-15), incomplete reperfusion (mTICI 0-2b) was associated with larger infarct volume (55.5±76.6ml vs. 30.0±47.2ml, p<0.001) and worse discharge mRS (4: 2-4 vs. 3: 1-4, p=0.022) in right compared to left-sided LVO. More tissue is saved for each degree of mTICI in patients with moderate stroke and right-sided LVO (F(4,440)=3.19, p=0.013).

CLINICAL RELEVANCE/APPLICATION

Using admission NIHSS as "clinical penumbra" for ET eligibility may lead to underestimation of tissue-at-risk and consequently to undertreatment among patients with right-sided LVO, highlighting the advantage of objective imaging biomarkers for penumbra.

SSNR09-3 High-Speed Angiography At 1000 Fps Used To Assess Blood Flow Changes Induced By A Flow Diverting Stent In-Vitro

Participants
Allison Shields, Buffalo, New York (*Presenter*) Research Grant, Canon Medical Systems Corporation

PURPOSE

Flow diversion is a well-established endovascular treatment option for intracranial aneurysms (IA's). Current evaluation of treatment success is generally restricted to qualitative evaluation of low-frame rate angiographic sequences. High-speed angiography (HSA) was utilized to perform a quantitative assessment of hemodynamic changes induced by a flow diverting (FD) stent.*Methods and Materials Blood flow changes were evaluated in a 3D-printed, patient-specific middle cerebral artery (MCA) saccular aneurysm model. Baseline images of the flow into the aneurysm were acquired using 1000 fps HSA, enabled by a 5x7.5 cm FOV photon-counting detector. Iodinated contrast injections were performed with an automated syringe injector, operated at a constant rate and volume for all acquisitions. Flow was evaluated before treatment and after partial and full deployment of a Flow-Redirecting

Endoluminal Device (FRED) stent. Individual 1-ms images were evaluated sequentially to determine the flow velocity in the aneurysm sac using an optical flow method.*Results Flow patterns in the high-speed sequences showed reduction of vortex flow in the aneurysm after full FRED deployment. This phenomenon was further illustrated through the change in streamlines between each deployment stage, which were calculated from the 1-ms velocity distributions obtained via optical flow. Partial FD deployment, which is comparable to suboptimal device deployment or sizing, in this case resulted in more contrast entering the aneurysm and thus had little flow diversion effect. Post-FD analysis showed a drastic improvement in both the magnitude and spatial distribution of velocities in the aneurysm sac, at a resolution of one vector per 100 μm.*Conclusions This study illustrated the ability of HSA to provide high-temporal resolution, quantitative hemodynamic information before and after deployment of a FD stent. These results demonstrate the feasibility of using such a method in an interventional setting to evaluate detailed velocity distribution changes following IA treatment, which could be used as an additional predictive measure of treatment outcome at the time of the procedure.*Clinical Relevance/Application High-temporal resolution, quantitative-flow data obtained during the endovascular intervention may provide additional key information to assess the efficacy of the intervention.

RESULTS

Flow patterns in the high-speed sequences showed reduction of vortex flow in the aneurysm after full FRED deployment. This phenomenon was further illustrated through the change in streamlines between each deployment stage, which were calculated from the 1-ms velocity distributions obtained via optical flow. Partial FD deployment, which is comparable to suboptimal device deployment or sizing, in this case resulted in more contrast entering the aneurysm and thus had little flow diversion effect. Post-FD analysis showed a drastic improvement in both the magnitude and spatial distribution of velocities in the aneurysm sac, at a resolution of one vector per 100 μm.

CLINICAL RELEVANCE/APPLICATION

High-temporal resolution, quantitative-flow data obtained during the endovascular intervention may provide additional key information to assess the efficacy of the intervention.

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SSGI12

Gastrointestinal (Focal Liver Lesions - Non HCC/Dual Energy CT-Applications)

Participants

Frank H. Miller, MD, Chicago, Illinois (*Moderator*) Advisory Board, Bayer AGAdvisory Board, Guerbet
Mustafa Bashir, MD, Cary, North Carolina (*Moderator*) Research Grant, Siemens AGResearch Grant, NGM Biopharmaceuticals, IncResearch Grant, Madrigal Pharmaceuticals, IncResearch Grant, Metacrine, IncResearch Grant, ProSciento, IncResearch Grant, Medscape, LLCResearch Grant, Carmot Therapeutics Inc
Hailey Choi, MD, San Francisco, California (*Moderator*) Nothing to Disclose

Sub-Events

SSGI12-1   Iodine Quantification In Patients With Clinical Scans On Different Dual-energy CT Scanners: Impact Of Normalization On Inter-scanner Variability

Participants
Simon Lennartz, MD, Boston, Massachusetts (*Presenter*) Institutional research support, Koninklijke Philips NV

PURPOSE

To compare intra-patient iodine quantification between different dual-energy CT (DECT) scanner types and investigate normalization to mitigate clinical inter-scanner variability.*Methods and Materials 44 patients who underwent regular abdominal CT for cancer follow-up on a dual-source (dsDECT), a rapid kVp switching (rsDECT) and a dual-layer detector scanner (dlDECT) between 01/2016 and 09/2020 were included. Iodine concentrations were obtained ROI-based in the liver, pancreas, kidney, aorta, portal vein, muscle, gallbladder and retroperitoneal fat. Absolute (IC) and three different normalized iodine concentrations (NICAA: normalized to aorta; NICPV: normalized to portal vein; NICALL: normalized to overall iodine load of the liver, kidneys, pancreas, aorta, portal vein) were compared between scanner types and median inter-scanner variability was calculated.*Results The time between CT exams on different scanners as well as the amount of iodinated contrast media that was applied were comparable for all inter-scanner comparisons (p-range: 0.9-0.99). IC was significantly different between DECT scanner types for all tissues included except for the kidney and the aorta; largest differences in IC between scanner types were found in the liver and in the retroperitoneal fat. The median inter-scanner variability of IC was highest in the liver for all inter-scanner comparisons (dsDECT vs dlDECT: 24.97% (13.73-47.55%); dsDECT vs rsDECT: 27.51% (14.61-57.85%); rsDECT vs dlDECT: 22.59% (8.24-35.02%)), lowest for the kidneys (dsDECT vs dlDECT: 14.89% (7.41-26.12%); dsDECT vs rsDECT: 14.79%(8.86-23.91%); rsDECT vs dlDECT: 11.19% (4.16-23.02%)) and intermediate for the pancreas (dsDECT vs dlDECT 21.23% (6.96-37.37%); dsDECT vs rsDECT 19.86 % (10.9-27.14%); rsDECT vs dlDECT: 12.81% (7.63-27.16%)). NICALL was the only normalization approach that decreased inter-scanner variability of the pancreas and kidneys for all inter-scanner comparisons, whereas for the liver, it only reduced variability between rsDECT and dlDECT (NICALL: 18.21% (8.52-27.94) vs IC: 22.59% (8.24-35.02)).*Conclusions Inter-scanner variability of iodine quantification in DECT can in part be mitigated by normalization, yet variability in the liver remains on a high level. *Clinical Relevance/Application Inter-scanner variability of iodine quantification in DECT should be acknowledged if the latter is used longitudinally in patients examined on different DECT scanner types.

RESULTS

The time between CT exams on different scanners as well as the amount of iodinated contrast media that was applied were comparable for all inter-scanner comparisons (p-range: 0.9-0.99). IC was significantly different between DECT scanner types for all tissues included except for the kidney and the aorta; largest differences in IC between scanner types were found in the liver and in the retroperitoneal fat. The median inter-scanner variability of IC was highest in the liver for all inter-scanner comparisons (dsDECT vs dlDECT: 24.97% (13.73-47.55%); dsDECT vs rsDECT: 27.51% (14.61-57.85%); rsDECT vs dlDECT: 22.59% (8.24-35.02%)), lowest for the kidneys (dsDECT vs dlDECT: 14.89% (7.41-26.12%); dsDECT vs rsDECT: 14.79%(8.86-23.91%); rsDECT vs dlDECT: 11.19%(4.16-23.02%)) and intermediate for the pancreas (dsDECT vs dlDECT 21.23% (6.96-37.37%); dsDECT vs rsDECT 19.86 % (10.9-27.14%); rsDECT vs dlDECT: 12.81% (7.63-27.16%)). NICALL was the only normalization approach that decreased inter-scanner variability of the pancreas and kidneys for all inter-scanner comparisons, whereas for the liver, it only reduced variability between rsDECT and dlDECT (NICALL: 18.21% (8.52-27.94) vs IC: 22.59% (8.24-35.02)).

CLINICAL RELEVANCE/APPLICATION

Inter-scanner variability of iodine quantification in DECT should be acknowledged if the latter is used longitudinally in patients examined on different DECT scanner types.

SSGI12-2   Orally Administered Mangoral (Manganese Chloride Tetrahydrate) And Intravenously Administered Gadobenate Dimeglumine For MRI Of Colorectal Liver Metastases - An Intraindividual Comparison

Participants
Kohkan Shamsi, MD, PhD, Conshohocken, Pennsylvania (*Presenter*) Consultant, Ascelia Pharma

PURPOSE

The purpose of the study was to compare the diagnostic efficacy of orally administered mangoral-enhanced MRI (MMRI) with intravenously administered gadobenate-enhanced MRI (GMRI).*Methods and Materials This is an independent re-read of a previously reported phase II, single center study in which 20 patients with colorectal liver metastases underwent both MMRI and

GMRI within 1 week interval. Three independent radiologists (R1, R2, R3) evaluated unenhanced and enhanced T1 and T2-weighted images describing number and size of the detected lesions and also assessed lesion border delineation and lesion contrast compared to liver using a 4-point scale. A fourth radiologist tracked and matched the lesions identified by each of the three readers and performed additional quantitative assessments on T1-weighted images. Descriptive statistics and CI were used to assess the differences.*Results A higher number of liver lesions were detected by MMRI compared to GMRI by all 3 readers with overlapping 95%-confidence intervals (CI) (mean lesion number: R1: 2.15 vs 1.60; R2: 2.40 vs 2.15; 3.00 vs 2.65 for MMRI and GMRI respectively). For border delineation, the scores for MMRI ranged from 6.40-9.37 compared to 4.41-7.79 for GMRI. Two out of 3 readers showed higher scores for lesion delineation for MMRI compared to GMRI with overlapping CIs. Two out of 3 readers had higher scores for MMRI for lesion contrast compared to the liver with overlapping CIs (MMRI score: 6.80-10.84; GMRI score: 5.18-8.74). Signal-to-noise ratio was 95 for MMRI and 96 for GMRI, lesion-to-liver contrast was 1.97 for MMRI and 1.65 for GMRI. The liver enhancement ratio was 1.60 for MMRI and 1.31 for GMRI with overlapping CIs. Compared to unenhanced MRI, both MMRI and GMRI enabled detection of smaller lesions.*Conclusions Orally administered manganese enhanced MRI showed similar efficacy in terms of lesion detection, lesion visualization, lesion to liver contrast and lesion delineation of liver metastases as compared to intravenous gadolinium enhanced MRI.*Clinical Relevance/Application Orally administered Mangoral, a manganese based liver specific contrast agent, could be a valuable alternative for MRI of the liver in patients in whom use of gadolinium agents is restricted or contra-indicated.

RESULTS

A higher number of liver lesions were detected by MMRI compared to GMRI by all 3 readers with overlapping 95%-confidence intervals (CI) (mean lesion number: R1: 2.15 vs 1.60; R2: 2.40 vs 2.15; 3.00 vs 2.65 for MMRI and GMRI respectively). For border delineation, the scores for MMRI ranged from 6.40-9.37 compared to 4.41-7.79 for GMRI. Two out of 3 readers showed higher scores for lesion delineation for MMRI compared to GMRI with overlapping CIs. Two out of 3 readers had higher scores for MMRI for lesion contrast compared to the liver with overlapping CIs (MMRI score: 6.80-10.84; GMRI score: 5.18-8.74). Signal-to-noise ratio was 95 for MMRI and 96 for GMRI, lesion-to-liver contrast was 1.97 for MMRI and 1.65 for GMRI. The liver enhancement ratio was 1.60 for MMRI and 1.31 for GMRI with overlapping CIs. Compared to unenhanced MRI, both MMRI and GMRI enabled detection of smaller lesions.

CLINICAL RELEVANCE/APPLICATION

Orally administered Mangoral, a manganese based liver specific contrast agent, could be a valuable alternative for MRI of the liver in patients in whom use of gadolinium agents is restricted or contra-indicated.

SSGI12-3   Gallstones Detection On Dual Energy Computerized Tomography (DECT)- Is It Ready For Real-world Use? A Retrospective Observational Study

Participants
Shambo Guha Roy, MBBS, Darby, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Historically, CT was not seen as a reliable imaging modality for detection of gallstones (GS), as most of them are non-calcified. However, with growing use of DECT it is time to reevaluate this notion. The advanced reconstruction algorithm of DECT in the form of virtual non contrast (VNC) and virtual monochromatic (VMC) images improve the ability to detect non-calcified GS which was shown in a few preliminary studies. However, none of them included a control group, thus the real-world sensitivity and specificity of DECT for GS detection is yet to be addressed.*Methods and Materials This IRB approved retrospective study included all the patients between January 2018 through December 2020 who underwent both DECT of the abdomen and right upper quadrant ultrasound (US) within 6 months of each other. The presence or absence of GS on US was used as standard. All the DECT were acquired in the portal phase and all of them includes polychromatic, VNC, VMC at 50Kev and Iodine map images in axial plane. The CTs were reviewed by 4 attending radiologists, who were blinded to the US results. The CT results were taken as either positive or negative for GS when at least 3 readers were in agreement. In case of a 2:2 results, a 5th reader was used.*Results A total of 209 DECT were reviewed. Among them 106 (48 males) had GS on US and 103 (43 males) were negative for GS. Patients with GS were significantly older with mean age 61.5+16.3 years compared patients without GS (mean age 53.3+15.7 years). In 197 of 209 DECTs there was 3:1 agreement between the readers. The rest of the 12 DECTs were reviewed by a 5th radiologist. The agreement between 4 readers was assessed using Fleiss' Kappa which was 0.76 suggesting a substantial agreement. The DECT was reported as positive in 95 out of 106 patients with US proven GS. Furthermore, 98 out of 103 patient without gallstone on US were reported as negative on DECT. The overall sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 89.6%, 95.1%, 95%, 89.9% and 92.3%. Of note, in the actual DECT report only 74 out of 106 patients were reported as positive for GS, corresponding to a sensitivity of only 69.8%, suggesting an education opportunity.*Conclusions DECT has excellent sensitivity and specificity for detection of GS. VNC and low energy VMC images increase the detectability of GS over the standard polychromatic images. Further research is needed to evaluate results of training and establishment of formal diagnostic criteria on improving interobserver agreement.*Clinical Relevance/Application To our knowledge this is the first paper to address the real-world accuracy of DECT for detection of GS and demonstrating strong clinical value of VNC and VMC images for increasing GS detection rate when DECT is utilized for abdominal imaging.

RESULTS

A total of 209 DECT were reviewed. Among them 106 (48 males) had GS on US and 103 (43 males) were negative for GS. Patients with GS were significantly older with mean age 61.5+16.3 years compared patients without GS (mean age 53.3+15.7 years). In 197 of 209 DECTs there was 3:1 agreement between the readers. The rest of the 12 DECTs were reviewed by a 5th radiologist. The agreement between 4 readers was assessed using Fleiss' Kappa which was 0.76 suggesting a substantial agreement. The DECT was reported as positive in 95 out of 106 patients with US proven GS. Furthermore, 98 out of 103 patient without gallstone on US were reported as negative on DECT. The overall sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 89.6%, 95.1%, 95%, 89.9% and 92.3%. Of note, in the actual DECT report only 74 out of 106 patients were reported as positive for GS, corresponding to a sensitivity of only 69.8%, suggesting an education opportunity.

CLINICAL RELEVANCE/APPLICATION

To our knowledge this is the first paper to address the real-world accuracy of DECT for detection of GS and demonstrating strong clinical value of VNC and VMC images for increasing GS detection rate when DECT is utilized for abdominal imaging.

SSGI12-5   Computer-aided Liver Metastases Follow-up Changes Analysis In Cect By Volumetric Deep Learning: A Comparative Study To Linear Recist 1.1

Participants
Leo Joskowicz, Jerusalem, Israel (*Presenter*) Officer, HighRAD Ltd

PURPOSE

To compare disease status classification of abdominal contrast enhanced CT (CECT) of liver metastases by radiologists to computer-aided reading with a novel deep learning classification method that simultaneously analyzes liver metastasis changes between the current and the prior CECT scans.*Methods and Materials Forty-three pairs of current and prior CECT scan studies of patients with metastatic liver disease were retrospectively analyzed. The pairs of scans were acquired 4.9 (std=4.3, range=1.4-21.0) months apart. The total number of liver metastases in all scans was 1,041 (mean=12.1, std=11.9, range=1-21). Two radiologists performed a total of 172 readings to assess disease status classification using linear measurements with RECIST 1.1 (43 pairs each) and after two weeks with computer-aided evaluation (43 pairs each). The primary outcome measure was the disease status and the tumor burden difference (TBD). The reference standard was defined by a third radiologist who manually delineated all lesions and graded the disease status.Computer aided evaluation was performed with our novel method. It inputs the prior and current CECT scans and automatically detects and segments the liver metastases in each scan with a simultaneous 3D U-Net classifier. It identifies the changes in the number of metastases and computes the total metastases' volume and the metastases' burden changes. The 3D U-Net was trained on 68 additional pairs of CECT scans of patients with metastatic disease with a total of 2,042 liver metastases.*Results There was agreement between the conventional and computer-aided readings by the two radiologists in 62 (72%) readings of cases (PR=12, SD=26,PD=24) and discrepancy between them in 24 (28%) of cases (PR vs. SD =1, PR vs. PD = 1, SD vs. PR = 11, SD vs. PD = 8, PD vs. SD = 3). Of the 24 reading discrepancies, 19 (73%) were between SD vs. PR or SD vs. PD. The difference between the RECIST 1.1 and the computer aided readings was statistically significant (p=0.02). The main reason for the difference between the conventional and the computer-aided readings was the TBD (p=0.01). In comparison to the third reader reference standard, both readers using the computerized tools had no statistically significant categorization differences (p= 0.07-0.57).*Conclusions Automatic liver metastases change analysis by deep learning can accurately and reliably compute the changes in the number of metastases, the total metastases volume, and the metastases burden between prior and current CECT scans.*Clinical Relevance/Application AI-based computer-aided automatic liver metastases detection and volume change may improve the estimation of changes of neoplastic involvement of the liver and the accuracy of disease status evaluation.

RESULTS

There was agreement between the conventional and computer-aided readings by the two radiologists in 62 (72%) readings of cases (PR=12, SD=26,PD=24) and discrepancy between them in 24 (28%) of cases (PR vs. SD =1, PR vs. PD = 1, SD vs. PR = 11, SD vs. PD = 8, PD vs. SD = 3). Of the 24 reading discrepancies, 19 (73%) were between SD vs. PR or SD vs. PD. The difference between the RECIST 1.1 and the computer aided readings was statistically significant (p=0.02). The main reason for the difference between the conventional and the computer-aided readings was the TBD (p=0.01). In comparison to the third reader reference standard, both readers using the computerized tools had no statistically significant categorization differences (p= 0.07-0.57).

CLINICAL RELEVANCE/APPLICATION

AI-based computer-aided automatic liver metastases detection and volume change may improve the estimation of changes of neoplastic involvement of the liver and the accuracy of disease status evaluation.

SSGI12-6   Clinical And Gd-EOB-DTPA-enhanced MR Imaging Features Associated With High Risk Hepatic Adenomas

Participants
Justin Tse, MD, Cerritos, California (*Presenter*) Research Grant, General Electric Company ;Research Grant, Bayer AG

PURPOSE

To identify clinical and quantitative Gd-EOB-DTPA-enhanced MR imaging features associated with high-risk hepatic adenomas (defined as beta-catenin-activated exon 3 genotype (BCAex3) or hemorrhage on surgical pathology).*Methods and Materials In this retrospective, IRB-approved, and HIPAA compliant study, 64 hepatic adenomas (HCAs) from 53 adult patients (46 female, 7 male) from 2009-2020 with Gd-EOB-DTPA-enhanced MRI and tissue pathology were reviewed. HCAs were classified as inflammatory (I-HCA), hepatocyte nuclear factor-1 alpha mutated (H-HCA), beta-catenin-activated exon 3 (B-HCA), mixed beta-catenin-activated exon 3 inflammatory (BI-HCA), or unclassified (U-HCA) with immunohistochemistry. Signal intensity ratios (SIR) were calculated by comparing regions of interests of HCA to adjacent liver.*Results 64 HCAs were classified into 31 I-HCA, 16 H-HCA, 6 B-HCA, 4 BI-HCA, and 7 U-HCA. BCAex3 genotype was associated with male sex (p=0.004; logistic regression) but not symptoms, AFP, age, BMI, or number of HCAs. Increased HCA size was associated with both hemorrhage (p=0.004) and BCAex3 genotype (p=0.001). On Gd-EOB-DTPA-enhanced MRI, only the hepatobiliary phase could distinguish among subtypes. Hepatobiliary phase SIR ± standard deviation were: I-HCA=0.70±0.08; H-HCA =0.46±0.12; B-HCA or BI-HCA=1.04±0.21; U-HCA=0.75±0.12; p=0.004, one-way ANOVA). Post hoc Tukey test for multiple comparisons showed that SI ratios for I-HCA, H-HCA, and B-HCA or BI-HCA were statistically different from each other (p<0.0001). Sensitivity and specificity of hepatobiliary phase SIR>0.8 for identifying BCAex3 genotype was 90% and 93%, respectively.*Conclusions BCAex3 genotype was associated with higher hepatobiliary phase SIR, larger HCA size, and male sex. Histopathologic hemorrhage was associated with larger size.*Clinical Relevance/Application Current guidelines (European Association for the Study of the Liver) recommend HCA management based on patient sex and lesion size, but not subtype. Noninvasive identification of BCAex3 genotype (most likely to undergo malignant transformation) or those more likely to bleed may improve risk stratification.

RESULTS

64 HCAs were classified into 31 I-HCA, 16 H-HCA, 6 B-HCA, 4 BI-HCA, and 7 U-HCA. BCAex3 genotype was associated with male sex (p=0.004; logistic regression) but not symptoms, AFP, age, BMI, or number of HCAs. Increased HCA size was associated with both hemorrhage (p=0.004) and BCAex3 genotype (p=0.001). On Gd-EOB-DTPA-enhanced MRI, only the hepatobiliary phase could distinguish among subtypes. Hepatobiliary phase SIR ± standard deviation were: I-HCA=0.70±0.08; H-HCA =0.46±0.12; B-HCA or BI-HCA=1.04±0.21; U-HCA=0.75±0.12; p=0.004, one-way ANOVA). Post hoc Tukey test for multiple comparisons showed that SI ratios for I-HCA, H-HCA, and B-HCA or BI-HCA were statistically different from each other (p<0.0001). Sensitivity and specificity of hepatobiliary phase SIR>0.8 for identifying BCAex3 genotype was 90% and 93%, respectively.

CLINICAL RELEVANCE/APPLICATION

Current guidelines (European Association for the Study of the Liver) recommend HCA management based on patient sex and lesion size, but not subtype. Noninvasive identification of BCAex3 genotype (most likely to undergo malignant transformation) or those more likely to bleed may improve risk stratification.

Abstract Archives of the RSNA, 2021

SSMK05

Musculoskeletal (Pelvis and Hip)

Participants

Francesca D. Beaman, MD, Lexington, Kentucky (*Moderator*) Nothing to Disclose

Sub-Events

SSMK05-2   Deep Learning Based Fully Automated 3D Models Of Hip Labrum Based On MR Arthrography Are Feasible And Allow Detection Of Differences In Labrum Volume Among Different Hip Deformities: A Pilot Study

Participants

Malin Meier, MD, Bern, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

Evaluation of hip labrum is mainly based on morphologic 2D MRI. 3D reconstruction is possible via manual segmentation, but is time consuming and therefore not part of clinical practice. We aimed to (1) develop and validate a deep learning approach for fully automatic labrum segmentation based on MR hip arthrography against manual segmentation; (2) compare labrum volume among different hip deformities.*Methods and Materials IRB-approved retrospective study of 48 patients (mean age 31 ± 9 years, 52% women) with femoroacetabular impingement and hip dysplasia (DDH) undergoing 3T MR arthrography including a 3D T1 MP2RAGE sequence (0.5 x 0.5 x 1 mm voxel size). Patients were assigned to three subgroups based on acetabular coverage assessed on AP pelvic radiographs: DDH with a lateral center edge angle (LCE<23°; n=20), normal acetabular coverage (LCE 23-38°; n=13), and deep/ retroverted hips (LCE>38°; n=15). Manual segmentations of labrum served as training data for the neural network (3D U-Net) to obtain an automated 3D labrum model. A 5-fold cross validation was performed and dice-, spearman correlation coefficient and mean bias were calculated to assess the accuracy between manual and automatic segmented labrum models. Kruskal-Wallis test was performed to compare labrum volume among different hip pathologies followed by pairwise comparisons using Mann-Whitney test.*Results Spatial overlap (dice coefficient) of 3D manual and automatic labrum models was 76 ± 5 % corresponding to a mean bias of 90 mm3 (95%CI: -24.4 to 203.5, p = 0.12) and almost perfect correlation (rs = 0.90, p <0.0001). Mean labrum volume differed (p = 0.025) among the hip deformities with 2840 ±1332 mm3 for DDH, 1825 ± 488 mm3 for normal coverage and 2341 ± 670 mm3 for deep / retroverted hips: Pairwise comparison showed significant differences in labrum volume between normal coverage and DDH (p = 0.010) and between normal coverage and deep / retroverted hips (p = 0.0367). Labrum volume between DDH and deep / retroverted hips did not differ significantly (p = 0.587).*Conclusions This pilot study shows the feasibility of automatic segmentation of 3D labrum models using deep learning methods, allowing detection of differences in labrum volume across different hip deformities.*Clinical Relevance/Application This validation highlights the potential for 3D assessment of labrum in large data sets and paves way to routine use of these 3D MRI labrum models to potentially improve surgical decision making.

RESULTS

Spatial overlap (dice coefficient) of 3D manual and automatic labrum models was 76 ± 5 % corresponding to a mean bias of 90 mm3 (95%CI: -24.4 to 203.5, p = 0.12) and almost perfect correlation (rs = 0.90, p <0.0001). Mean labrum volume differed (p = 0.025) among the hip deformities with 2840 ±1332 mm3 for DDH, 1825 ± 488 mm3 for normal coverage and 2341 ± 670 mm3 for deep / retroverted hips: Pairwise comparison showed significant differences in labrum volume between normal coverage and DDH (p = 0.010) and between normal coverage and deep / retroverted hips (p = 0.0367). Labrum volume between DDH and deep / retroverted hips did not differ significantly (p = 0.587).

CLINICAL RELEVANCE/APPLICATION

This validation highlights the potential for 3D assessment of labrum in large data sets and paves way to routine use of these 3D MRI labrum models to potentially improve surgical decision making.

SSMK05-3   Deep Learning Tool For Accurate And Precise Automatic Measurement Of Femoral Component Subsidence Following Total Hip Arthroplasty From Plain Radiographs

Participants

Pouria Rouzrokh, MD,MPH, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Femoral component subsidence is a worrisome radiographic finding following total hip arthroplasty (THA) that may be a sign of loosening and prosthesis failure. Subsidence is usually assessed on two consecutive anteroposterior (AP) hip radiographs, a manual process that is tedious and prone to measurement errors. This study introduces a deep learning tool to automatically measure the femoral component subsidence between two serial AP radiographs.*Methods and Materials We first trained a dynamic UNet to automatically segment femur, implant, and magnification markers on a dataset of 700 (500 training, 100 validation, and 100 test) AP hip radiographs. Input images were zero-padded, resized to 2048×2048-pixel resolution, normalized, and finally augmented using a variation of random rotation (range: -20 to +20°), random zooming (max: 10%), and the addition of Gaussian noise. The UNet had an an ImageNet-pretrained EfficientNetB0 architecture as its encoder and used Squeeze and Excitation attention layers in its decoder. We trained the model with an Adam optimizer, while changing the learning rate following a one-cycle learning rate policy. After training the UNet model, an image processing algorithm was developed to calculate subsidence by: (1) measuring the femur-

stem distance on segmented masks for two AP radiographs, (2) correcting the measured distances based on radiographs' magnification, and (3) subtracting the two standardized femur-stem distances. We finally compared the algorithm's performance with manual subsidence measurements by two independent orthopedic surgeon reviewers on 135 unseen patients.*Results The deep learning algorithm achieved the Dice Similarity Coefficients of 0.97, 0.98, and 0.94 for segmenting the femur, implant, and the magnification markers respectively. Among the 135 test cases, 96 had documented subsidence of > 0.04 mm (range: 0.04-14.01). The mean, median, and the standard deviation of measurement discrepancy between the automatic and manual measurements were 0.57, 0.35, and 0.74 mm, respectively. Our tool quantified subsidence as small as 0.1 mm. An app version of the tool was also developed to showcase its automatic usability (Figure).*Conclusions We developed a fully automatic deep learning tool to measure subtle femoral component subsidence without human annotation. Performance metrics indicate highly accurate and precise measurements compared to human annotation, with very infrequent clinically relevant discrepancies.*Clinical Relevance/Application The automatic deep learning tool may improve THA surveillance and earlier detection of impending component failure. Also, the automatic nature of our tool can help for quick and easy annotation of big imaging datasets for research purposes.

RESULTS

The deep learning algorithm achieved the Dice Similarity Coefficients of 0.97, 0.98, and 0.94 for segmenting the femur, implant, and the magnification markers respectively. Among the 135 test cases, 96 had documented subsidence of > 0.04 mm (range: 0.04-14.01). The mean, median, and the standard deviation of measurement discrepancy between the automatic and manual measurements were 0.57, 0.35, and 0.74 mm, respectively. Our tool quantified subsidence as small as 0.1 mm. An app version of the tool was also developed to showcase its automatic usability (Figure).

CLINICAL RELEVANCE/APPLICATION

The automatic deep learning tool may improve THA surveillance and earlier detection of impending component failure. Also, the automatic nature of our tool can help for quick and easy annotation of big imaging datasets for research purposes.

SSMK05-4   Random Forest-based Radiomics Models For Preoperative Prediction Of Multiple Classifications Of Pelvic And Sacral Tumors

Participants
Ping Yin, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Pelvic and sacral tumors vary in type, but they are treated differently. Accurate preoperative identification of these tumors is essential for the development of individualized treatment. This study aimed to assess the performance of random forest (RF)-based radiomics approaches based on 3D computed tomography (CT) and clinical features to predict the types of pelvic and sacral tumors.*Methods and Materials A total of 795 patients with pathologically confirmed pelvic and sacral tumors were analyzed, including metastatic tumors (n = 181), chordomas (n = 85), giant cell tumors (n =120), chondrosarcoma (n = 127), osteosarcoma (n = 106), neurogenic tumors (n = 95), and Ewing's sarcoma (n = 81). After semi-automatic segmentation, 1316 hand-crafted radiomics features of each patient were extracted. First, we divided the patients into the benign tumors group and malignant tumors group, and built the first radiomics model (RM1) by using RF. RM2, a two-class RF-based radiomics model, was built to identify GCTs and neurogenic tumors. After that, we constructed two triple-classification models, namely, RM3 and RM4. RM3 was used to identify metastatic tumors, chordomas, and sarcomas. RM4 was used to identify osteosarcomas, chondrosarcomas, and Ewing's sarcomas. In addition, we also constructed a seven-classification model, namely, clinica-RM5, to identify these seven types of tumors. The area under the receiver operating characteristic curve (AUC) and accuracy (ACC) were used to evaluate different models.*Results In total, 795 patients (432 males, 363 females; mean age of 42.1 ± 17.8 years) were consisted of 215 benign tumors and 580 malignant tumors. The sex, age, history of malignancy and tumor location had significant differences between benign and malignant tumors (P < 0.05). For the two-class models, clinical-RM2 (AUC = 0.928, ACC = 0.877) performed better than clinical-RM1 (AUC = 0.899, ACC = 0.854). For the three-class models, the proposed clinical-RM3 achieved AUCs between 0.923 (for chordoma) and 0.964 (for sarcoma), while the AUCs of the clinical-RM4 ranged from 0.799 (for osteosarcoma) to 0.869 (for chondrosarcoma) in the validation set. In addition, the AUC and ACC of clinical-RM5 in the training set were 0.771 and 0.580, and those in the validation set were 0.722 and 0.533, respectively.*Conclusions The RF-based clinical-radiomics models provided high discriminatory performance in predicting pelvic and sacral tumor types, which could be used for clinical decision-making.*Clinical Relevance/Application Our models can provide a simple, non-invasive and accurate auxiliary diagnostic tool for the differentiation of pelvic and sacral tumors, improving the diagnostic efficiency of clinicians.

RESULTS

In total, 795 patients (432 males, 363 females; mean age of 42.1 ± 17.8 years) were consisted of 215 benign tumors and 580 malignant tumors. The sex, age, history of malignancy and tumor location had significant differences between benign and malignant tumors (P < 0.05). For the two-class models, clinical-RM2 (AUC = 0.928, ACC = 0.877) performed better than clinical-RM1 (AUC = 0.899, ACC = 0.854). For the three-class models, the proposed clinical-RM3 achieved AUCs between 0.923 (for chordoma) and 0.964 (for sarcoma), while the AUCs of the clinical-RM4 ranged from 0.799 (for osteosarcoma) to 0.869 (for chondrosarcoma) in the validation set. In addition, the AUC and ACC of clinical-RM5 in the training set were 0.771 and 0.580, and those in the validation set were 0.722 and 0.533, respectively.

CLINICAL RELEVANCE/APPLICATION

Our models can provide a simple, non-invasive and accurate auxiliary diagnostic tool for the differentiation of pelvic and sacral tumors, improving the diagnostic efficiency of clinicians.

SSMK05-5   MRI Findings In The Hip Pointer

Participants
Alessandra Sax, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

A "hip pointer" is term used in the sports medicine community to describe an injury to the iliac crest, involving the oblique musculature. It is common in high performance athletes. Based on its relative paucity in the literature, we aimed to describe the imaging findings commonly seen in hip pointer injuries, with the hope of guiding treatment, and potentially predict return to play.*Methods and Materials We retrospectively mined our PACS database for the words "internal oblique" and "external oblique". We then documented which muscle(s) were involved, the strain grade, and the tendon gap for high grade tears. We documented patients' age, gender, and athletic preferences. We then conducted a chart review and determined treatment regimens, as well as

the return to play time for the professional athletes.*Results 44 MRI exams were reviewed (average age 30.6 years, 9 female, 35 male). 48% were grade 1 strains, 39% were grade 2, and 14% were grade 3. 36% had measurable tendon gaps, with an average gap of 19mm. Treatment regimens were available for 26 patients. Of the grade 1 strains, 57% had concurrent injuries to the rectus abdominis-adductor aponeurosis requiring repair, and 22% had surgery to repair the oblique and/or iliac crest. 33% of the surgically managed patients sustained season or career ending injuries. Isolated grade 1 strains managed conservatively missed no significant game time. Of the grade 2 strains, 22% had concurrent injuries to the rectus abdominis-adductor aponeurosis requiring repair which ended the patients' season or professional career, and 22% had surgery to repair the oblique and/or iliac crest. Of the grade 3 strains, 100% were treated with repair of the oblique tear, but only 25% recovered. The remainder had career or season ending injuries. An additional 10 patients had obliques tears at their origin from the inferior ribs, 7 had apophysitis, and 9 patients had other injuries such as heterotopic ossification, hernia, or denervation.*Conclusions "Hip pointers" are injuries to the oblique musculature at their attachment on the iliac crest. We were able to document/categorize imaging findings, as well as common mimickers. We documented treatment regimens, showing that lower grade injuries are commonly associated with tears at the rectus abdominis-adductor aponeurosis, while higher grade tears were more likely isolated and required direct tendon repair. Associated rectus abdominis-adductor aponeurosis injuries portended a worse prognosis, even after surgical repair.*Clinical Relevance/Application By documenting and categorizing the MR findings in a "hip pointer", as well as treatment regimens and return to play, we hope to provide clarity in a relatively sparse realm of musculoskeletal imaging.

RESULTS

44 MRI exams were reviewed (average age 30.6 years, 9 female, 35 male). 48% were grade 1 strains, 39% were grade 2, and 14% were grade 3. 36% had measurable tendon gaps, with an average gap of 19mm. Treatment regimens were available for 26 patients. Of the grade 1 strains, 57% had concurrent injuries to the rectus abdominis-adductor aponeurosis requiring repair, and 22% had surgery to repair the oblique and/or iliac crest. 33% of the surgically managed patients sustained season or career ending injuries. Isolated grade 1 strains managed conservatively missed no significant game time. Of the grade 2 strains, 22% had concurrent injuries to the rectus abdominis-adductor aponeurosis requiring repair which ended the patients' season or professional career, and 22% had surgery to repair the oblique and/or iliac crest. Of the grade 3 strains, 100% were treated with repair of the oblique tear, but only 25% recovered. The remainder had career or season ending injuries. An additional 10 patients had obliques tears at their origin from the inferior ribs, 7 had apophysitis, and 9 patients had other injuries such as heterotopic ossification, hernia, or denervation.

CLINICAL RELEVANCE/APPLICATION

By documenting and categorizing the MR findings in a "hip pointer", as well as treatment regimens and return to play, we hope to provide clarity in a relatively sparse realm of musculoskeletal imaging.

SSMK05-6 Identification Of Acetabular Labral Tears: Diagnostic Accuracy Of Dual Energy CT Versus MR Arthrography Of The Hip

Participants
Giovanni Foti, MD, Negrar, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic accuracy of dual-energy Computed Tomography arthrography (DECTA) and MR arthrography (MRA) of the hip in depicting acetabular labral tears (ALT) and chondral defects (CD).*Methods and Materials This prospective IRB study included 24 consecutive patients (13 males and 11 females; mean age 38.3, range 18-62 years) studied between January 2018 and January 2021. Articular cavity was distended by using a mixture of saline and iodinate contrast material before DECTA (80 kV and tin filter 150 kV) and MRA. DECTA data were postprocessed (SyngoVia®); mono-energetic application was employed to choose the best kV values in order to enhance contrast material and to reduce artifacts. Two radiologists (26 and 16 years of experience), blinded to clinical data, evaluated the presence of ALT and CD on DECTA and MRA. Surgical findings served as standard of reference. Sensitivity and specificity values were calculated. Inter-observer and intra-observer agreement were calculated with k-statistics.*Results At surgery, ALT and CD were depicted respectively in 18/24 (75.0%) and 16/24 (66.6%) patients. Reader 1 achieved 83.3% sensitivity (20/24) and 100% specificity (6/6) for ALT and 93.7% sensitivity (15/16) and 87.5% specificity (7/8) for CD by reading DECTA, and 91.7% sensitivity (22/24) and 83.3% specificity (5/6) for ALT and 87.5% sensitivity (14/16) and 87.5% specificity (7/8) for CD by reading MRA. Reader 2 achieved 79.2% sensitivity (19/24) and 100% specificity (6/6) for ALT and 87.5% sensitivity (14/16) and 100% specificity (8/8) for CD by reading DECTA, and 87.5% sensitivity (21/24) and 83.3% specificity (5/6) for ALT and 81.3% sensitivity (13/16) and 87.5% specificity (7/8) for CD by reading MRA. By using McNemar test, the difference of accuracy between DECTA and MRA was not significant (p=0.21). The inter-observer (k=0.86) and intra-obsever agreement (k=0.88) were near perfect.*Conclusions DECTA can identify ALT and CD with similar performance with respect to MRA.*Clinical Relevance/Application DECTA is a reliable imaging tool for demonstration of ALT and CD in the hip arthrography and could be used as an alternative imaging tool to MRA.

RESULTS

At surgery, ALT and CD were depicted respectively in 18/24 (75.0%) and 16/24 (66.6%) patients. Reader 1 achieved 83.3% sensitivity (20/24) and 100% specificity (6/6) for ALT and 93.7% sensitivity (15/16) and 87.5% specificity (7/8) for CD by reading DECTA, and 91.7% sensitivity (22/24) and 83.3% specificity (5/6) for ALT and 87.5% sensitivity (14/16) and 87.5% specificity (7/8) for CD by reading MRA. Reader 2 achieved 79.2% sensitivity (19/24) and 100% specificity (6/6) for ALT and 87.5% sensitivity (14/16) and 100% specificity (8/8) for CD by reading DECTA, and 87.5% sensitivity (21/24) and 83.3% specificity (5/6) for ALT and 81.3% sensitivity (13/16) and 87.5% specificity (7/8) for CD by reading MRA. By using McNemar test, the difference of accuracy between DECTA and MRA was not significant (p=0.21). The inter-observer (k=0.86) and intra-observer agreement (k=0.88) were near perfect.

CLINICAL RELEVANCE/APPLICATION

DECTA is a reliable imaging tool for demonstration of ALT and CD in the hip arthrography and could be used as an alternative imaging tool to MRA.

Abstract Archives of the RSNA, 2021

Participants

Donna J. Cross, PhD, Salt Lake City, Utah (*Moderator*) Scientific Advisory Board, Ceremark, Inc

Sub-Events

SSNMMI04   Keynote Speaker

Participants

Donna J. Cross, PhD, Salt Lake City, Utah (*Presenter*) Scientific Advisory Board, Ceremark, Inc

SSNMMI04-2   Concordance Of PET Tau Visual Reads With PET Tau Quantification And CSF PTau

Participants

Charles Chen, St. Louis, Missouri (*Presenter*) Nothing to Disclose

PURPOSE

Tau status is central to Amyloid(Aß)/Tau/Neurodegeneration (ATN) diagnoses of Alzheimer disease (AD), evaluated using positron emission tomography (PET) or cerebrospinal fluid (CSF). ATN has limited clinical validation, and tau status from PET or CSF may impact clinical interpretation differently. This study assessed the concordance of PET tau visual reads with PET tau quantification and CSF phosphorylated tau (pTau).*Methods and Materials Two radiologists followed manufacturer's guidelines for visual interpretation of Tauvid (18F-flortaucipir) PET images to classify 199 cases (baseline=161, three-year follow-up=38) as positive or negative. A mixture model quantified the same cases by defining a global PET tau standardized uptake value ratio (SUVR) as the mean of bilateral fusiform, middle temporal, inferior parietal, and isthmus cingulate SUVRs, with a positivity cutoff at 1.57. A majority of participants underwent lumbar puncture (n=119, follow-up=29). Mixture models were used to define a pTau181/Aß40 cutoff at 0.00419, and a Aß42/Aß40 cutoff at 0.0760.*Results At baseline, the agreement between visual readers was high (100%, ?=1) and moderate with SUVRs (95%, ?=0.761). Using visual reads as a standard, false negatives from SUVR analysis had asymmetric parietal or occipital uptake without temporal uptake as a defining characteristic, while false positives had anterolateral temporal, diffusely nonconfluent, or striatal/brainstem uptake. Agreement with pTau181/Aß40 was fair (79%, ?=0.419) and superior to unnormalized pTau181 (71%, ?=0.315). The 25 discordant cases were largely PET-/CSF+ (92%) and Aß42/Aß40 positive (76%); in contrast, PET-/CSF- cases were largely Aß42/Aß40 negative (81.25%). Cases did not change tau status at follow up, with two exceptions: a PET-/CSF- case converted to PET-/CSF+, remaining cognitively normal; a PET+ case changed to PET-, developing memory impairment.*Conclusions SUVR agreement with visual reads was moderate, and may improve by compensating for asymmetric uptake using finer-grained, unilateral parcellations. CSF agreement with visual reads was fair, with discordances from CSF pTau elevating before PET tau in preclinical AD, suggesting caution in ATN diagnoses.*Clinical Relevance/Application This study used manufacturer's guidelines for visual interpretation of Tauvid PET, finding agreement high between readers, moderate with PET tau quantification, and fair with CSF pTau.

RESULTS

At baseline, the agreement between visual readers was high (100%, ?=1) and moderate with SUVRs (95%, ?=0.761). Using visual reads as a standard, false negatives from SUVR analysis had asymmetric parietal or occipital uptake without temporal uptake as a defining characteristic, while false positives had anterolateral temporal, diffusely nonconfluent, or striatal/brainstem uptake. Agreement with pTau181/Aß40 was fair (79%, ?=0.419) and superior to unnormalized pTau181 (71%, ?=0.315). The 25 discordant cases were largely PET-/CSF+ (92%) and Aß42/Aß40 positive (76%); in contrast, PET-/CSF- cases were largely Aß42/Aß40 negative (81.25%). Cases did not change tau status at follow up, with two exceptions: a PET-/CSF- case converted to PET-/CSF+, remaining cognitively normal; a PET+ case changed to PET-, developing memory impairment.

CLINICAL RELEVANCE/APPLICATION

This study used manufacturer's guidelines for visual interpretation of Tauvid PET, finding agreement high between readers, moderate with PET tau quantification, and fair with CSF pTau.

SSNMMI04-4   Comprehensive Functional Evaluation Of The Spectrum Of Progressive Nuclear Palsy With 18F-FDG PET/CT And 99mTc TRODAT-1 SPECT

Participants

Harsh Mahajan, MD,MBBS, New Delhi, India (*Presenter*) Director, Mahajan Imaging Pvt Ltd;Research collaboration, General Electric Company;Research collaboration, Koninklijke Philips NV;Research collaboration, Qure.ai;Research collaboration, Predible Health

PURPOSE

To elucidate the patterns of characteristic hypometabolism on 18F-FDG PET/CT in various subtypes of PSP and correlation with the core clinical features.*Methods and Materials A retrospective analysis of 124 patients of clinically suspected PSP was done. All the subjects were clinically analyzed and rated using the Progressive supra nuclear palsy rating scale proposed by the Movement Disorder Society by the Neurologist and were further clinically segregated into five sub types- PSP with Richardson's syndrome, PSP with predominant parkinsonism, PSP with speech/language presentation, PSP with frontal presentation and PSP with predominant

ocular presentation. All the subjects underwent 99mTc TRODAT-1 SPECT study and 18F-FDG PET/CT scan on two separate days. The scans were analyzed qualitatively (visually) and semi-quantitatively and the FDG uptake patterns were recorded and areas of hypometabolism that were two standard deviations from the mean were considered as abnormal.*Results 99mTc TRODAT-1 scan was abnormal in all the subjects, establishing degenerative Parkinsonism. The subjects of PSP with Richardson's syndrome showed diffuse hypometabolism involving anterior cingulate and orbital frontal cortices with diffuse hypometabolism involving basal ganglia, thalami, mid brain and sensori-motor cortices. In subjects with PSP with speech/language and frontal presentation variable additional involvement of the anterior and medial frontal association, insular and anterior temporal cortices was seen.*Conclusions Dopamine transporter imaging agent 99mTc TRODAT-1 SPECT helps in confirmation of degenerative Parkinsonian disorders. Characteristic patterns of hypometabolism may help in differentiation of the subtypes of PSP in the presence of clinically overlapping symptoms.*Clinical Relevance/Application Characteristic hypometabolism is seen on 18F-FDG PET/CT in various subtypes of PSP

RESULTS

99mTc TRODAT-1 scan was abnormal in all the subjects, establishing degenerative Parkinsonism. The subjects of PSP with Richardson's syndrome showed diffuse hypometabolism involving anterior cingulate and orbital frontal cortices with diffuse hypometabolism involving basal ganglia, thalami, mid brain and sensori-motor cortices. In subjects with PSP with speech/language and frontal presentation variable additional involvement of the anterior and medial frontal association, insular and anterior temporal cortices was seen.

CLINICAL RELEVANCE/APPLICATION

Characteristic hypometabolism is seen on 18F-FDG PET/CT in various subtypes of PSP

SSNMMI04-5   Contrast-enhanced In Vivo MRI Molecular Imaging Of A-Synuclein In A Mouse Model Of Parkinson's Disease

Participants
Eric Tanifum, PhD, Houston, Texas (*Presenter*) Consultant, Alzeca Biosciences, LLC;Stockholder, Alzeca Biosciences, LLC;

PURPOSE

Parkinson's disease (PD) is characterized by progressive deposition of misfolded a-synuclein (a-syn) aggregates in the form of Lewy bodies and Lewy neurites in the brain. The pathology has been shown to originate from the olfactory bulb and brainstem, and progressively spread to other parts of the brain. Noninvasive imaging technologies are considered vital tools for early diagnosis, monitoring disease progression, and evaluation of therapeutic efficacy of PD drugs. We present the preparation and in vivo evaluation of a novel a-syn targeted MRI molecular imaging agent in the A53T a-synuclein transgenic line M83 mouse model.*Methods and Materials T-1 relaxive macrocyclic Gd(III) a-syn targeted liposomes (with a proprietary Lipid-PEG-a-syn-Ligand conjugate as the targeting component) and a non-targeted control formulation were prepared using standard hydration/extrusion protocols. MRI was performed on a 1T permanent magnet scanner. Images were acquired using a T1-weighted spin echo (T1w-SE) sequence with the following parameters: SE parameters: TR = 600 ms, TE = 11.5 ms, slice thickness = 1.2 mm, matrix = 192 × 192, FOV = 30 mm, slices = 16, NEX = 4. A53T a-synuclein transgenic line M83 mice (16-18 months old, n=6) were pre-scanned, followed by intravenous administration of the targeted agent (TgT) at a dose of 0.20 mmol Gd/kg of body weight. Delayed scans were performed 4 days post-contrast, after which animals were euthanized and brains harvested for histology analysis. Controls included age-matched wildtype mice (n=6) injected with the targeted agent (WtT) and transgenic mice (n=6) injected with the non-targeted formulation (TgNT). Brain tissues were histologically assessed with a-syn 4D6 antibody to confirm a-syn pathology.*Results Post-contrast in vivo MR images showed significant signal enhancement in the transgenic mice treated with the targeted agent compared to controls. This was attributed to an association between the targeted nanoparticle and a-synuclein pathology. Signal quantification demonstrated statistically significant differences between test animals versus controls, and histological analysis, suggested that the observed differences were consistent with the regional distribution and density of the pathology in this mouse model.*Conclusions Intravenous administration of a-syn targeted liposomes bearing an MRI contrast payload, results in increase in signal intensity consistent with regional distribution of a-syn pathology in the brains of A53T a-synuclein transgenic line M83 mice.*Clinical Relevance/Application A potential widely accessible tool for early detection of synucleinopathies, including Parkinson's disease, dementia with Lewy bodies, and multiple system atrophy.

RESULTS

Post-contrast in vivo MR images showed significant signal enhancement in the transgenic mice treated with the targeted agent compared to controls. This was attributed to an association between the targeted nanoparticle and a-synuclein pathology. Signal quantification demonstrated statistically significant differences between test animals versus controls, and histological analysis, suggested that the observed differences were consistent with the regional distribution and density of the pathology in this mouse model.

CLINICAL RELEVANCE/APPLICATION

A potential widely accessible tool for early detection of synucleinopathies, including Parkinson's disease, dementia with Lewy bodies, and multiple system atrophy.

Abstract Archives of the RSNA, 2021

SSMK11

Musculoskeletal (Tumors of Bone and Soft Tissues/Trauma, Arthritis and Cartilage)

Participants

Mark D. Murphey, MD, Silver Spring, Maryland (*Moderator*) Nothing to Disclose
Ty K. Subhawong, MD, Miami, Florida (*Moderator*) Research Consultant, Arog Pharmaceuticals, Inc;Stockholder, AbbVie Inc;Stockholder, AstraZeneca PLC;Stockholder, Johnson & Johnson;Stockholder, Pfizer Inc ;Stockholder, F. Hoffmann-La Roche Ltd;Stockholder, Teva Pharmaceutical Industries Ltd

Sub-Events

SSMK11-1 Temporal Evolution Of Clinical Confidence With Dual Energy CT In The Diagnosis And Treatment Of Gout.

Participants
Gregory Aird, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the differences in clinical utilization of dual energy CT (DECT) for the evaluation and management of gout from 2013 and 2020.*Methods and Materials We performed a retrospective review using an institutional database to identify patients with a high clinical suspicion for gout from two time periods. There were 100 patients with a total of 100 DECT from 2013 and 102 patients with a total of 131 DECT from 2020. Three radiologists interpreted the imaging and reviewed the clinical charts and diagnostic radiology reports for each patient cohort. All statistical analyses were performed using R version 3.6.2.*Results The differences between the number of positive, negative, and equivocal cases in each cohort is statistically significant (p<0.001). In the 2013 cohort, 43 cases (43%) were classified as positive for monosodium urate (MSU) crystal deposits, 22 (22%) were negative, and 35 (35%) were equivocal. In the 2020 cohort, 48 cases (37%) were positive, 62 (47%) were negative, and 21 (16%) were equivocal. While there was a significant association between a history of gout and DECT results in the 2020 cohort (p<0.001), no such association was identified with the 2013 cohort (p=0.123). Fewer number of patients in the 2020 cohort underwent a joint aspiration to evaluate for the presence of MSU crystal depositions compared to the 2013 cohort (16/131 patients (12%) and 34/100 patients (34%), respectively (p<0.001). Following a DECT positive for MSU crystals, 43/48 (90%) patients in the 2020 cohort had a clinical diagnosis of gout, with 36/48 (75%) patients undergoing a treatment change (p<0.001). Similar findings were observed in the 2013 cohort with 43/43 (100%) were diagnosed with gout and 35/43 (81%) of these patients having a change in treatment (p<0.001).*Conclusions DECT remains a reliable non-invasive technique to diagnose and manage the treatment of gout. There were fewer equivocal DECT results and joint aspirations performed in the 2020 cohort, which is consistent with an apparent increase in the diagnostic confidence in DECT results.*Clinical Relevance/Application Following advances in technology and improved acquisition times, DECT has seen increased utilization in the clinical setting. Of the many clinical applications of DECT, one of the well-studied and widespread uses of the modality is in the diagnosis and management of gout. While various studies have demonstrated the increasing reliability and accuracy of of DECT in detecting the presence of MSU crystals, none have explored or measured its impact on the clinical management of the condition. The present study provides quantitative data on how clinician confidence in the diagnostic results of DECT results has evolved over time.

RESULTS

The differences between the number of positive, negative, and equivocal cases in each cohort is statistically significant (p<0.001). In the 2013 cohort, 43 cases (43%) were classified as positive for monosodium urate (MSU) crystal deposits, 22 (22%) were negative, and 35 (35%) were equivocal. In the 2020 cohort, 48 cases (37%) were positive, 62 (47%) were negative, and 21 (16%) were equivocal. While there was a significant association between a history of gout and DECT results in the 2020 cohort (p<0.001), no such association was identified with the 2013 cohort (p=0.123). Fewer number of patients in the 2020 cohort underwent a joint aspiration to evaluate for the presence of MSU crystal depositions compared to the 2013 cohort (16/131 patients (12%) and 34/100 patients (34%), respectively (p<0.001). Following a DECT positive for MSU crystals, 43/48 (90%) patients in the 2020 cohort had a clinical diagnosis of gout, with 36/48 (75%) patients undergoing a treatment change (p<0.001). Similar findings were observed in the 2013 cohort with 43/43 (100%) were diagnosed with gout and 35/43 (81%) of these patients having a change in treatment (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Following advances in technology and improved acquisition times, DECT has seen increased utilization in the clinical setting. Of the many clinical applications of DECT, one of the well-studied and widespread uses of the modality is in the diagnosis and management of gout. While various studies have demonstrated the increasing reliability and accuracy of of DECT in detecting the presence of MSU crystals, none have explored or measured its impact on the clinical management of the condition. The present study provides quantitative data on how clinician confidence in the diagnostic results of DECT results has evolved over time.

SSMK11-2 Diffusion Weighted Imaging (DWI) In Diagnosis, Staging, And Treatment Response Assessment Of Multiple Myeloma: A Systematic Review And Meta-analysis

Participants
Pooya Torkian, MD, Minneapolis, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the role of Diffusion-Weighted Imaging (DWI) in the initial diagnosis, staging, and assessment of treatment response in patients with multiple myeloma (MM).*Methods and Materials A systematic literature review was conducted in PubMed, the Cochrane Library, EMBASE, Scopus, and Web of Science databases to identify studies related to the role of DWI in lesion detection, staging, and treatment response assessment in patients with MM. The Primary outcomes were defined as the diagnostic performance of DWI for disease detection, staging of MM, and assessing response to treatment in these patients.*Results Of 5881 initially reviewed publications, 33 articles were selected for in-depth review and eventually were included in the final qualitative and quantitative meta-analysis. The diagnostic performance of DWI in detection of patients with MM revealed pooled sensitivity and specificity of 86% (95% CI: 84-89) and 63% (95% CI: 56-70), respectively with the diagnostic Odds Ratio (OR) of 14.98 (95% CI: 4.24-52.91). The pooled risk difference of 0.19 (95% CI: 0.06-0.39) was reported in favor of upstaging with DWI compared to conventional MRI (P value=0.1). Treatment response evaluation and ADCmean values changes across different studies showed sensitivity and specificity of about 78% (95% CI: 72-83) and 73% (95% CI: 61-83), respectively with the diagnostic OR of 7.21 in distinguishing responders from non-responders. Pooled value of 25.97% (95% CI: 6.50-45.44) was achieved for percent of changes in ADCmean after therapy in responders in comparison with non-responders (P value=0.009).*Conclusions DWI is not only a promising tool for the diagnosis of MM, but also it is useful in initial staging and re-staging of the disease and treatment response assessment. This can help clinicians with earlier initiation or change in treatment strategy, which could have prognostic significance for patients.*Clinical Relevance/Application DWI has revolutionized imaging evaluation for MM from traditional anatomic imaging to functional quantitative imaging. DWI improves diagnosis, staging, and treatment response assessment in patients with MM.

RESULTS

Of 5881 initially reviewed publications, 33 articles were selected for in-depth review and eventually were included in the final qualitative and quantitative meta-analysis. The diagnostic performance of DWI in detection of patients with MM revealed pooled sensitivity and specificity of 86% (95% CI: 84-89) and 63% (95% CI: 56-70), respectively with the diagnostic Odds Ratio (OR) of 14.98 (95% CI: 4.24-52.91). The pooled risk difference of 0.19 (95% CI: 0.06-0.39) was reported in favor of upstaging with DWI compared to conventional MRI (P value=0.1). Treatment response evaluation and ADCmean values changes across different studies showed sensitivity and specificity of about 78% (95% CI: 72-83) and 73% (95% CI: 61-83), respectively with the diagnostic OR of 7.21 in distinguishing responders from non-responders. Pooled value of 25.97% (95% CI: 6.50-45.44) was achieved for percent of changes in ADCmean after therapy in responders in comparison with non-responders (P value=0.009).

CLINICAL RELEVANCE/APPLICATION

DWI has revolutionized imaging evaluation for MM from traditional anatomic imaging to functional quantitative imaging. DWI improves diagnosis, staging, and treatment response assessment in patients with MM.

SSMK11-4   MRI Long-term Follow-up Of Incidentally Detected Enchondromas Of The Long Bones

Participants
Moritz Dreier, BSC, Kempten, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The incidental finding of an enchondroma (EC) within a long bone is a common reason for referral to a bone tumor unit, and the population prevalence of incidental cartilage tumors on MRI scans is increasing due to the higher number of MRI scans performed. The reported risk of malignant transformation varies between 0 and 6% and there is no valid data on the long-term growth behavior of EC. There is no consensus or recommendation on follow-up for EC. The aim of this study was to analyze the long-term changes of incidentally detected EC of the long tubular bones on MRI.*Methods and Materials This retrospective study included 110 patients with EC of the long bones suggestive of an EC diagnosed between 2006 and 2009. A follow-up period of at least 10 years after the initial diagnosis was the main inclusion criterion. To investigate the growth behavior, the change in size was analyzed. Malignant transformation was assessed using radiological criteria including cortical breach, endosteal scalloping, peritumoral edema, and soft tissue component. In addition, the rate of secondary surgeries was analyzed during the observation period.*Results 77/110 (70%) patients were reached by phone and 24/77 (31%) agreed to a follow-up MRI examination. The mean follow-up time for the MRI group (n=24) was 140 months (range 120-172 months). The localization of EC was: 17 femur (71%), 3 tibia (13%), 2 humerus (8%), 1 fibula (4%), 1 ulna (4%). The mean age of the patients at initial diagnosis was 49 years (range, 27-67). 11 EC (46%) increased in size, 10 EC (42%) remained stable, and 3 EC decreased in size. The mean increase in EC size was 3 mm (range -2 mm - +18 mm) between the initial and subsequent MRI. Two patients developed endosteal scalloping, one patient showed new peritumoral edema, in one patient cortical breach with periosteal reaction was found. Overall, 6/77 (8%) patients underwent secondary surgery, all lesions were histologically confirmed as EC.*Conclusions This study has shown that imaging follow-up is justified for all EC, irrespective of initial lesion size, as EC has shown unpredictable growth patterns. As progression is slow, it seems reasonable to extend follow-up intervals to several years. The presence of solitary features of biological aggressiveness, such as endosteal scalloping, without clinical symptoms, does not require surgery but follow-up.*Clinical Relevance/Application This study has shown that long-term imaging follow-up is justified for all EC, irrespective of initial lesion size, as suggested in the past.It seems reasonable to extend follow-up intervals of EC to several years instead of annual or biannual follow-up.

RESULTS

77/110 (70%) patients were reached by phone and 24/77 (31%) agreed to a follow-up MRI examination. The mean follow-up time for the MRI group (n=24) was 140 months (range 120-172 months). The localization of EC was: 17 femur (71%), 3 tibia (13%), 2 humerus (8%), 1 fibula (4%), 1 ulna (4%). The mean age of the patients at initial diagnosis was 49 years (range, 27-67). 11 EC (46%) increased in size, 10 EC (42%) remained stable, and 3 EC decreased in size. The mean increase in EC size was 3 mm (range -2 mm - +18 mm) between the initial and subsequent MRI. Two patients developed endosteal scalloping, one patient showed new peritumoral edema, in one patient cortical breach with periosteal reaction was found. Overall, 6/77 (8%) patients underwent secondary surgery, all lesions were histologically confirmed as EC.

CLINICAL RELEVANCE/APPLICATION

This study has shown that long-term imaging follow-up is justified for all EC, irrespective of initial lesion size, as suggested in the past.It seems reasonable to extend follow-up intervals of EC to several years instead of annual or biannual follow-up.

SSMK11-5   MRI Radiomics-based Machine Learning Classification Of Atypical Cartilaginous Tumor And G2 Chondrosarcoma Of Long Bones

Participants
Salvatore Gitto, MD, Milano, Italy (*Presenter*) Nothing to Disclose

PURPOSE

Atypical cartilaginous tumors (ACT) and G2 chondrosarcomas (CS2) of long bones are respectively managed with curettage/watchful waiting and wide resection. Preoperatively, imaging diagnosis can be challenging due to interobserver variability and biopsy suffers from sampling errors. Our aim was to determine diagnostic performance of MRI radiomics-based machine learning for classification of ACT and CS2 of long bones.*Methods and Materials 158 patients (98 women; median age: 57 years) with surgically treated and histology-proven cartilaginous bone tumors were retrospectively included at two tertiary bone tumor centers. The training cohort consisted of 93 MRI scans from center 1 (74 ACT; 19 CS2). The external test cohort consisted of 65 MRI scans from center 2 (45 ACT; 20 CS2). Bidimensional segmentation was manually performed on preoperative T1-weighted MRI sequences. First-order, shape-based and texture features were extracted. Dimensionality reduction consisting of stability, variance and inter-correlation analyses and recursive feature elimination, after class balancing in center 1 (CS2 oversampled to n=74), was performed. Thus, a machine-learning classifier (Extra Trees Classifier) was automatically tuned on the training cohort using 10-fold cross-validation and tested on the external test cohort.*Results 919 radiomic features were extracted and then reduced to 17 through dimensionality reduction. After tuning on the training cohort (AUC=0.87), the machine-learning classifier had 91% accuracy (59/65, AUC=0.94) in identifying the lesions in the external test cohort. Specifically, its accuracy in classifying ACT and CS2 was 96% (43/45) and 80% (16/20), respectively.*Conclusions Machine learning showed high accuracy in classifying ACT and CS2 of long bones based on preoperative MRI radiomic features.*Clinical Relevance/Application Radiomics-based machine learning is an objective MRI method, using T1-weighted images only, that may be used in clinical decision making by accurately differentiating between ACT and CS2.

RESULTS

919 radiomic features were extracted and then reduced to 17 through dimensionality reduction. After tuning on the training cohort (AUC=0.87), the machine-learning classifier had 91% accuracy (59/65, AUC=0.94) in identifying the lesions in the external test cohort. Specifically, its accuracy in classifying ACT and CS2 was 96% (43/45) and 80% (16/20), respectively.

CLINICAL RELEVANCE/APPLICATION

Radiomics-based machine learning is an objective MRI method, using T1-weighted images only, that may be used in clinical decision making by accurately differentiating between ACT and CS2.

SSMK11-6 Deep Learning Radiomic Nomogram To Predict Recurrence In Soft Tissue Sarcoma: A Multi-institutional Study

Participants
Wang Hexiang, MD, Qing Dao, China (*Presenter*) Nothing to Disclose

PURPOSE

Resection of soft tissue sarcoma (STS) still has a high relapse rate, and the routinely applied prognostic method is not sufficiently accurate.*Methods and Materials In total, 282 patients who underwent MRI and resection for STS at three independent centers were retrospectively enrolled. We separated the participants into a development cohort and an external test cohort. Two MRI-based DLRNs for prediction of tumor relapse after resection of STS were established. We universally tested the DLRNs and compared them with competitive models that do not employ radiomics, but instead use widespread adopted predictors (i.e., staging systems and Ki67).*Results The DLRN1 model incorporated 282 plain MRI-based radiomics signatures into the clinical data, and the DLRN2 model integrated 113 plain and enhanced MRI-based radiomics signatures with the clinical predictors. Across both study sets, the two MRI-based DLRNs had relatively better prognostic capability (C index =0.721 and median AUC = 0.746; $p < 0.05$ compared with most other models and predictors) and less opportunity for prediction error (integrated Brier score = 0.159). The decision curve analysis indicates that the DLRNs have greater benefits than staging systems, Ki67, and other models. We selected appropriate cutoff values for the DLRNs to divide STS recurrence into three risk strata (low,medium, and high) and calculated those groups' cumulative risk rates.*Conclusions The DLRNs helped to predict STS relapse after resection.*Clinical Relevance/Application It is necessary to establish a model to predict the recurrence risk of STS before operation and stratify patients' risk levels so that patients can receive more effective and targeted treatment.

RESULTS

The DLRN1 model incorporated 282 plain MRI-based radiomics signatures into the clinical data, and the DLRN2 model integrated 113 plain and enhanced MRI-based radiomics signatures with the clinical predictors. Across both study sets, the two MRI-based DLRNs had relatively better prognostic capability (C index =0.721 and median AUC = 0.746; $p < 0.05$ compared with most other models and predictors) and less opportunity for prediction error (integrated Brier score = 0.159). The decision curve analysis indicates that the DLRNs have greater benefits than staging systems, Ki67, and other models. We selected appropriate cutoff values for the DLRNs to divide STS recurrence into three risk strata (low,medium, and high) and calculated those groups' cumulative risk rates.

CLINICAL RELEVANCE/APPLICATION

It is necessary to establish a model to predict the recurrence risk of STS before operation and stratify patients' risk levels so that patients can receive more effective and targeted treatment.

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Sub-Events

SPR-BR-1   Race And Ethnicity Based Variability In Breast Cancer Risk Assessment By Traditional Models

Participants
Leslie Lamb, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Decisions for and insurance payment of genetic testing, chemoprevention, and supplemental screening are driven by an individual's breast cancer risk score. There are limited data on model performance outside of White/Non-Hispanic (W/NH) populations on which these models were developed. Our purpose was to compare variability of traditional breast cancer risk assessment models across diverse races.*Methods and Materials This retrospective, multisite study included consecutive patients undergoing screening mammography from September 17, 2017 to April 1, 2021. NCI Breast Cancer Risk Assessment Tool (BRCAT) and Tyrer-Cuzick version 8 (TC8)/IBIS 5-year and lifetime models were used to assess risk based on patients' survey responses. Cancer outcomes were obtained through linkage to a regional tumor registry. Increased 5-year risk was defined as >1.67% and high lifetime risk as >20%. We compared the proportion of high-risk patients across models and racial groups using Pearson's Chi-squared test.*Results Of 155,218 patients who underwent bilateral screening mammography during the study period, 117,899 met inclusion criteria. Median patient age was 58.0 years (IQR: 50.0 to 67.0 years). 81.8% (96,460) were W/NH and 18.2% (21,439) were persons of color (POC) or Hispanic (H) [5.4% (6,341) Black, 6.1% (7,190) Asian, 1.6% (1,877) Hispanic, and 5.1% (6,031) Other]. Significantly more W/NH patients were classified as high-risk by all models, compared to POC/H patients (p<0.001). For 5-year risk, 67.0% of W/NH patients were classified as increased risk by either NCI or TC8, 53.1% by NCI, and 50.2% by TC8, compared to 37.2%, 27.9%, and 24.4% in POC/H patients (p<0.001). For lifetime risk, 13.8% of W/NH patients were classified as high-risk by either NCI or TC8, 12.1% by TC8, and 4.4% by NCI, compared to 7.8%, 6.6%, and 2.4% in POC/H patients (p<0.001).*Conclusions Commonly used risk models produce substantial race and ethnicity-based variability in categorizing patients as high-risk for developing breast cancer. Significantly more W/NH patients are classified as high-risk compared to POC/H patients across all methods, directly impacting access to additional services.*Clinical Relevance/Application Compared to W/NH patients, significantly fewer POC/H patients are assessed as high risk by common risk models, potentially contributing to inequitable access to supplemental services.

RESULTS

Of 155,218 patients who underwent bilateral screening mammography during the study period, 117,899 met inclusion criteria. Median patient age was 58.0 years (IQR: 50.0 to 67.0 years). 81.8% (96,460) were W/NH and 18.2% (21,439) were persons of color (POC) or Hispanic (H) [5.4% (6,341) Black, 6.1% (7,190) Asian, 1.6% (1,877) Hispanic, and 5.1% (6,031) Other]. Significantly more W/NH patients were classified as high-risk by all models, compared to POC/H patients (p<0.001). For 5-year risk, 67.0% of W/NH patients were classified as increased risk by either NCI or TC8, 53.1% by NCI, and 50.2% by TC8, compared to 37.2%, 27.9%, and 24.4% in POC/H patients (p<0.001). For lifetime risk, 13.8% of W/NH patients were classified as high-risk by either NCI or TC8, 12.1% by TC8, and 4.4% by NCI, compared to 7.8%, 6.6%, and 2.4% in POC/H patients (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Compared to W/NH patients, significantly fewer POC/H patients are assessed as high risk by common risk models, potentially contributing to inequitable access to supplemental services.

SPR-BR-11   The Prognostic Value Of Enhancing Lesion Volume In Patients With Breast Cancer That Were Evaluated As Stable Disease By Recist1.1 Criterion After Early Neoadjuvant Chemotherapy

Participants
Jie Ding, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the prognostic value of enhancing lesion volume (ELV) in patients with breast cancer that were evaluated as stable disease (SD) by RECIST1.1 criterion after early neoadjuvant chemotherapy (NAC).*Methods and Materials Seventy-three patients with 73 unilateral lesions which were evaluated as SD by RECIST1.1 criterion after early NAC were included in this study. The lesions with decreased maximum diameter were regarded as responders, otherwise were non-responders according RECIST1.1. All the lesions were then assessed by ELV method, and the lesions with complete or partial response, or SD but decreased ELV were considered as responders, others were classified as non-responders. According to the Miller-Payne (MP) grading system, the lesions with Grade1-2 were defined as non-responders, and Grade3-5 were responders. The diagnostic performance of the two methods were compared with pathological results. The change rate of maximum diameter based on RECIST1.1 and enhancing lesion volume based on ELV method before and after NAC were analyzed and compared for pathological predictive performances via receiver operating characteristic (ROC) curve.*Results Fifty-five lesions were diagnosed as responders and other 23 lesions were non-responders according to pathological MP grading results, and RECIST1.1 and TLV criteria identified 59 and 66 responders, 14 and 7 non-responders, respectively. The values of sensitivity (SE) specificity (SP), positive predictive value (PPV), negative predictive value (NPV), and accuracy based on ELV and RECIST1.1 criteria for predicting pathologic response were 94% vs. 87.3% (P>0.05), 22.2% vs. 38.9% (P>0.05), 78.8 vs. 81.4%, 57.1 vs. 50%, and 76.7% vs. 75.3%, respectively. For the quantitative diagnostic performance of change rate, the areas under the ROC curves (AUC) according to ELV and RECIST1.1 were 0.79 (95%CI: 0.68 to

0.88) and 0.64 (95%CI: 0.52 to 0.75), respectively (P<0.05). The SE and SP were 61.82% and 94.44% (Youden index: 0.563, cut-off: -37.87%), 87.27% and 44.44% (Youden index: 0.317, cut-off: -2.47%), respectively.*Conclusions Both ELV and RECIST1.1 have prognostic value for predicting pathological response in patients with breast cancer after early NAC, and ELV may be a more effective method with statistically higher AUC value.*Clinical Relevance/Application Considering the overall tumor burden, ELV has a high specificity in predicting the prognosis of patients with stable disease in the early evaluation of neoadjuvant chemotherapy for breast cancer, and has a good reference value for guiding clinical medication.

RESULTS

Fifty-five lesions were diagnosed as responders and other 23 lesions were non-responders according to pathological MP grading results, and RECIST1.1 and TLV criteria identified 59 and 66 responders, 14 and 7 non-responders, respectively. The values of sensitivity (SE) specificity (SP), positive predictive value (PPV), negative predictive value (NPV), and accuracy based on ELV and RECIST1.1 criteria for predicting pathologic response were 94% vs. 87.3% (P>0.05), 22.2% vs. 38.9% (P>0.05), 78.8 vs. 81.4%, 57.1 vs. 50%, and 76.7% vs. 75.3%, respectively. For the quantitative diagnostic performance of change rate, the areas under the ROC curves (AUC) according to ELV and RECIST1.1 were 0.79 (95%CI: 0.68 to 0.88) and 0.64 (95%CI: 0.52 to 0.75), respectively (P<0.05). The SE and SP were 61.82% and 94.44% (Youden index: 0.563, cut-off: -37.87%), 87.27% and 44.44% (Youden index: 0.317, cut-off: -2.47%), respectively.

CLINICAL RELEVANCE/APPLICATION

Considering the overall tumor burden, ELV has a high specificity in predicting the prognosis of patients with stable disease in the early evaluation of neoadjuvant chemotherapy for breast cancer, and has a good reference value for guiding clinical medication.

SPR-BR-12 Development And Validation Of Nomograms Integrating Ultrasound Features To Predict Disease-free Survival Of Patients With Triple-negative Breast Cancer

Participants
Liu Lixian, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the relationship between ultrasonographic characteristics and disease-free survival (DFS) of patients with triple-negative breast cancer (TNBC), and to establish a nomogram integrating ultrasound features to predict the prognosis of patients with TNBC.*Methods and Materials Patients with TNBC who underwent surgical treatment from 2013 to 2018 were retrospectively selected. All the data were randomly divided into training and validation groups in a 7:3 ratio. Univariate and multivariate analyses were carried out on the clinical, pathological and ultrasonic characteristics of the training group, and independent prognostic factors were chosen to build a Clinic model, an Image model, a Combined model (including the clinical and ultrasonic factors) and a TNM model, respectively. The concordance index (C-index) of the four models were calculated. The model with the highest prediction efficiency is visualized by a nomogram. The calibration curves were used to evaluate the predictive power of the nomogram.*Results A total of 515 patients were included for analysis. There is no significant difference between the training and validation groups. Three independent ultrasonic factors, including echo pattern, posterior features and status of the deep layer of superficial fascia, and four independent clinicopathological factors, including menopausal status, T, N stage and albumin level were identified. The C-index of the combined model was significantly higher than that of the other models both in the training and validation group. The C-index of the Combined, Image, Clinic and TNM models in the training group were 0.758, 0.725, 0.695 and 0.674, respectively and 0.680, 0.621, 0.625 and 0.673 in the validation group. In addition, the nomogram was built based on the combined model. The calibration curves of the presented nomogram for the probability of DFS at 3 or 5 years show an optimal agreement both in the training and validation group.*Conclusions Ultrasound features combined with clinicopathological factors are predictive for DFS in TNBC. We established and validated a novel nomogram that can provide individual prediction of DFS for TNBC.*Clinical Relevance/Application To our knowledge, this study was firstly estabalished and validated a novel nomogram intergrating ultrasonic features to predict disease-free survival in patients with triple-negative breast cancer (TNBC), which emphasizing the importance of ultrasound in daily clinic work. In addition, preoperative ultrasonic features may be predictive for the prognosis of TNBC, which may help for decision making in clinic work.

RESULTS

A total of 515 patients were included for analysis. There is no significant difference between the training and validation groups. Three independent ultrasonic factors, including echo pattern, posterior features and status of the deep layer of superficial fascia, and four independent clinicopathological factors, including menopausal status, T, N stage and albumin level were identified. The C-index of the combined model was significantly higher than that of the other models both in the training and validation group. The C-index of the Combined, Image, Clinic and TNM models in the training group were 0.758, 0.725, 0.695 and 0.674, respectively and 0.680, 0.621, 0.625 and 0.673 in the validation group. In addition, the nomogram was built based on the combined model. The calibration curves of the presented nomogram for the probability of DFS at 3 or 5 years show an optimal agreement both in the training and validation group.

CLINICAL RELEVANCE/APPLICATION

To our knowledge, this study was firstly estabalished and validated a novel nomogram intergrating ultrasonic features to predict disease-free survival in patients with triple-negative breast cancer (TNBC), which emphasizing the importance of ultrasound in daily clinic work. In addition, preoperative ultrasonic features may be predictive for the prognosis of TNBC, which may help for decision making in clinic work.

SPR-BR-13 Evaluation Of Breast Galactography By Using Digital Breast Tomosynthesis: A Clinical Exploratory Study

Participants
Juan Tao, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the application value of Digital Breast Tomosynthesis (DBT) and full-field digital mammography (FFDM) in breast galactography.*Methods and Materials 128 patients with pathological nipple discharge (PND) were selected to undergo galactography. DBT and FFDM were performed for each patient after injecting the contrast agent; the radiation dose of DBT and FFDM was calculated, and the image quality was evaluated in consensus by two senior breast radiologists. Histopathologic data were found in 49 of the 128 patients. Sensitivity, specificity, PPV and NPV for both FFDM- and DBT-galactography were calculated having histopathologic results as a reference standard. Data were presented as percentages with their 95% confidence intervals

(CI).*Results The average age of the 128 patients was 46.53 years. The average glandular dose (AGD) of DBT-galactography was slightly higher than FFDM-galactograhpy (P<0.001). DBT- galactograhpy was 30.7% higher than FFDM- galactograhpy in CC view, while DBT increased by 21.7% compared with FFDM in ML view. In the catheter anatomic distortion, detail structure, and overall image quality groups, DBT scores were higher than FFDM scores, and there were significant differences in each group(P<0.05). In 49 patients with pathological nipple discharge, we found that the DBT - galactography has higher sensitivity, specificity, PPV and NPV (93.3%,75%,97.7% and 50%) than FFDM-galactography (91.1%,50%,95.3% and 33.3%, respectively).*Conclusions Compared to FFDM-galactography, within the acceptable radiation dose range, DBT-galactography not only improves the image quality but also increases the sensitivity and specificity of lesion detection, providing more confidence for the diagnosis of clinical ductal lesions.*Clinical Relevance/Application This study used tomosynthesis in galactography and compared DBT-with FFDM-galactography from three aspects of AGD, image quality and diagnostic efficiency. As a new technique of catheter imaging, DBT-Galactography increases the confidence of clinical diagnosis of intraductal lesions and better detection of intraductal lesions. It provides more possibilities for image examination.

RESULTS

The average age of the 128 patients was 46.53 years. The average glandular dose (AGD) of DBT-galactography was slightly higher than FFDM-galactograhpy (P<0.001). DBT- galactograhpy was 30.7% higher than FFDM- galactograhpy in CC view, while DBT increased by 21.7% compared with FFDM in ML view. In the catheter anatomic distortion, detail structure, and overall image quality groups, DBT scores were higher than FFDM scores, and there were significant differences in each group(P<0.05). In 49 patients with pathological nipple discharge, we found that the DBT - galactography has higher sensitivity, specificity, PPV and NPV (93.3%,75%,97.7% and 50%) than FFDM-galactography (91.1%,50%,95.3% and 33.3%, respectively).

CLINICAL RELEVANCE/APPLICATION

This study used tomosynthesis in galactography and compared DBT-with FFDM-galactography from three aspects of AGD, image quality and diagnostic efficiency. As a new technique of catheter imaging, DBT-Galactography increases the confidence of clinical diagnosis of intraductal lesions and better detection of intraductal lesions. It provides more possibilities for image examination.

SPR-BR-14　Diffusion-weighted Imaging Derived Parameters Of Breast Cancer As A Predictive Biomarker Of Distant Metastasis-free Survival

Participants
Maya Honda, Osaka, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To investigate whether intravoxel incoherent motion (IVIM) and non-gaussian diffusion parameters are associated with distant metastasis-free survival in breast cancer patients.*Methods and Materials This prospective study was approved by our institutional review board and included 101 patients (mean age 60.0, age range 28-88) with unilateral breast carcinoma who underwent breast MRI from June 2013 to March 2015. All images were acquired using a 3T MR scanner (Tim Trio; Siemens Healthcare, Erlangen, Germany) and a dedicated 16-channel dedicated breast coil. DW images were acquired with b values of 5, 10, 20, 30, 50, 70, 100, 200, 400, 600, 800, 1000, 1500, 2000 and 2500 s/mm2. Two independent radiologists manually drew regions of interest for each patient over the largest lesion to estimate the following parameters: IVIM-derived pseudodiffusion coefficient (D*) and flowing blood volume fraction (fIVIM), ADC0 and kurtosis (K) using kurtosis model, standard ADC calculated using b values of 0 and 800 s/mm2 (ADC0-800) and shifted ADC calculated using b values of 200 and 1500 s/mm2 (sADC200-1500). Distant metastasis-free survival was the primary end point and was defined as the time from the date of MR examination to the date of distant metastasis. Distant metastasis-free survival curves were generated according to the Kaplan-Meier method and were compared by using the log-rank test. Univariable Cox proportional hazards models were used to assess the effects of each parameter on distant metastasis-free survival. All statistical analyses were performed using R-4.0.4. The optimal cut-off values were calculated using the maxstat package.*Results Of the 101 patients, 12 (11.9%) developed distant metastasis, with a median time to metastasis of 79 months (range, 10-92 months). Kaplan-Meier survival analysis showed that the distant metastasis-free survival times were significantly shorter in patients with higher K (> 0.92, p = 0.04) and those with lower ADC0-800 values (< 0.76 x 10-3 mm2/s, p = 0.03). Cox regression analysis showed no statistically significant association between these parameters with distant metastasis-free survival.*Conclusions K and ADC0-800 values can be useful prognostic markers for predicting distant metastasis of breast cancer. The results suggest that non-Gaussian diffusion may be associated with prognosis in breast cancer.*Clinical Relevance/Application Pre-treatment MRI-derived K and ADC0-800 in breast cancer may be used to predict distant metastasis.

RESULTS

Of the 101 patients, 12 (11.9%) developed distant metastasis, with a median time to metastasis of 79 months (range, 10-92 months). Kaplan-Meier survival analysis showed that the distant metastasis-free survival times were significantly shorter in patients with higher K (> 0.92, p = 0.04) and those with lower ADC0-800 values (< 0.76 x 10-3 mm2/s, p = 0.03). Cox regression analysis showed no statistically significant association between these parameters with distant metastasis-free survival.

CLINICAL RELEVANCE/APPLICATION

Pre-treatment MRI-derived K and ADC0-800 in breast cancer may be used to predict distant metastasis.

SPR-BR-15　Change In The ADC Value On Diffusion-Weighted MRI As A Predictive Tool For Pathologic Complete Response In Patients With Breast Cancer Undergoing Neoadjuvant Chemotherapy

Participants
Ahreum Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the efficacy of the apparent diffusion coefficient (ADC) on diffusion-weighted imaging (DWI) for predicting pathological response to neoadjuvant chemotherapy (NAC) in patients with breast cancer.*Methods and Materials Following IRB approval, 434 women with breast cancer who underwent magnetic resonance imaging (MRI) before and after NAC before surgery between 2015 and 2018 were retrospectively identified. The mean ADC values of the tumor on pre- and post-NAC DW MRI (ADCpre and ADCpost, respectively) were measured. The change in the mean tumor ADC value (?ADC) was calculated as follows: ?ADC = ADCpost - ADCpre. The pathological response was classified into either a complete response (pCR) or an incomplete response (non-pCR) according to the Miller & Payne grading system. The predictive value of the ADC for pCR was assessed including the interaction of the tumor subtype, which was categorized as luminal A, luminal B, human epidermal growth factor receptor 2 (HER2)-enriched, and triple-negative tumors.*Results Among 434 women, 103 (23.7%) achieved pCR (pCR group) and 331 (76.3%) did not

(non-pCR group). The ADCpost and ?ADC values were significantly different between the pCR and non-pCR groups (1.5±0.5 vs. 1.2±0.4 and 0.5±0.6 vs. 0.2±0.4, respectively; P<0.001). In the analysis for the potential effect of the interaction, there was a significant interaction between the tumor subtype and ?ADC for predicting pCR (P for interaction=0.016) in the entire cohort. Among the tumor subtypes, ?ADC was significantly associated with pCR in only the HER2-enriched subtype (adjusted odds ratio= 5.70, 95% confidence interval: 1.25, 32.70, P=0.036) in the multivariate analysis including an interaction effect. In the receiver operating characteristic curve analysis, the area under the curve (AUC) was 0.650 in the entire cohort (52.4% sensitivity and 80.7% specificity), and the AUC was 0.766 in patients with the HER2-enriched subtype (81.8% sensitivity and 71.9% specificity).*Conclusions An increase in the mean tumor ADC value on DWI after NAC was useful for predicting pCR. The ?ADC value was an independent predictor for pCR in only patients with the HER2-enriched subtype.*Clinical Relevance/Application The change in the mean tumor ADC value on DWI after neoadjuvant chemotherapy was a useful predictor for pCR, but it depended on the tumor subtype.

RESULTS

Among 434 women, 103 (23.7%) achieved pCR (pCR group) and 331 (76.3%) did not (non-pCR group). The ADCpost and ?ADC values were significantly different between the pCR and non-pCR groups (1.5±0.5 vs. 1.2±0.4 and 0.5±0.6 vs. 0.2±0.4, respectively; P<0.001). In the analysis for the potential effect of the interaction, there was a significant interaction between the tumor subtype and ?ADC for predicting pCR (P for interaction=0.016) in the entire cohort. Among the tumor subtypes, ?ADC was significantly associated with pCR in only the HER2-enriched subtype (adjusted odds ratio= 5.70, 95% confidence interval: 1.25, 32.70, P=0.036) in the multivariate analysis including an interaction effect. In the receiver operating characteristic curve analysis, the area under the curve (AUC) was 0.650 in the entire cohort (52.4% sensitivity and 80.7% specificity), and the AUC was 0.766 in patients with the HER2-enriched subtype (81.8% sensitivity and 71.9% specificity).

CLINICAL RELEVANCE/APPLICATION

The change in the mean tumor ADC value on DWI after neoadjuvant chemotherapy was a useful predictor for pCR, but it depended on the tumor subtype.

SPR-BR-16   3D Amide Proton Transfer-weighted Imaging In Evaluation Of Breast Lesions: Comparison With Diffusion-weighted Imaging

Participants
Ruhua Wang, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the value of 3D amide proton transfer-weighted imaging (APTWI) and its combination with diffusion-weighted imaging (DWI) for discriminating breast benign from malignant lesions.*Methods and Materials Two hundred and twenty-six patients were enrolled in the study prospectively with suspected breast lesions clinically. 3.0T MRI scan was performed in all patients, including T1WI, T2WI, DWI, APTWI and dynamic contrast-enhanced magnetic resonance imaging. The ADC and MTRasym(3.5 ppm) values were obtained from DWI and APTWI. The pathology results were confirmed by surgery or biopsy (totally 226 lesions, with 102 benign lesions and 124 malignant lesions). Receiver operating characteristic (ROC) curve was used to evaluate the diagnostic efficacy of APTWI and DWI for distinguishing breast benign from malignant lesions.*Results The ADC and MTRasym(3.5 ppm) values were significantly lower in breast malignant than in benign lesions (P<0.05, respectively). The areas under ROC curves of ADC and MTRasym(3.5 ppm) values for differentiating breast benign from malignant lesions were 0.817 and 0.752, respectively. Taking the maximum Youden's index of ADC value as the ROC optimal cut-off, the diagnostic sensitivity, specificity and accuracy for distinguishing breast benign from malignant lesions were 94.4% (117/124), 62.7% (64/102) and 80.1% (181/226), respectively. Taking the maximum Youden's index of MTRasym(3.5 ppm) value as the ROC optimal cut-off, the diagnostic sensitivity, specificity and accuracy for distinguishing breast benign from malignant lesions were 73.4% (91/124),64.7% (66/102),69.5% (157/226), respectively. Combing the parameters of both DWI and APTWI, the diagnostic performance was superior to either single parameter (P<0.05, respectively), which the area under the ROC curve was 0.868, and the diagnostic sensitivity, specificity and accuracy for distinguishing breast benign from malignant lesions were 82.3% (102/124),79.4% (81/102) and 81.0% (183/226).*Conclusions APTWI can be used to distinguish breast benign from malignant lesions, and the combination of APTWI and DWI parameters could obtain a better diagnostic performance than the single method.*Clinical Relevance/Application APTWI is a novel technique, which can be used to differentiate breast benign from malignant lesions noninvasively.

RESULTS

The ADC and MTRasym(3.5 ppm) values were significantly lower in breast malignant than in benign lesions (P<0.05, respectively). The areas under ROC curves of ADC and MTRasym(3.5 ppm) values for differentiating breast benign from malignant lesions were 0.817 and 0.752, respectively. Taking the maximum Youden's index of ADC value as the ROC optimal cut-off, the diagnostic sensitivity, specificity and accuracy for distinguishing breast benign from malignant lesions were 94.4% (117/124), 62.7% (64/102) and 80.1% (181/226), respectively. Taking the maximum Youden's index of MTRasym(3.5 ppm) value as the ROC optimal cut-off, the diagnostic sensitivity, specificity and accuracy for distinguishing breast benign from malignant lesions were 73.4% (91/124),64.7% (66/102),69.5% (157/226), respectively. Combing the parameters of both DWI and APTWI, the diagnostic performance was superior to either single parameter (P<0.05, respectively), which the area under the ROC curve was 0.868, and the diagnostic sensitivity, specificity and accuracy for distinguishing breast benign from malignant lesions were 82.3% (102/124),79.4% (81/102) and 81.0% (183/226).

CLINICAL RELEVANCE/APPLICATION

APTWI is a novel technique, which can be used to differentiate breast benign from malignant lesions noninvasively.

SPR-BR-17   Measurement Of Perfusion Heterogeneity With Habitats On MRI And Its Association With Prognosis In Breast Cancer Patients

Participants
Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop intratumoral subregions sharing similar perfusional characteristics (habitats) in DCE MR by unsupervised clustering, to analyze their association with patients' outcomes, and to investigate the reproducibility of these discovered subregions in an independent cohort.*Methods and Materials We identified 455 patients with invasive breast cancer who underwent preoperative MRI from two hospitals. Pre-contrast, early, and delayed phase of contrast-enhanced MR images were utilized to construct

perfusion feature vector (PFV) of delta enhancement of early phase and late phase, and washout ratio for each voxel in the tumor region. K-means clustering was applied to the PFV to identify habitats of the training cohort (n = 308). Properties of the identified habitat were applied to the external validation cohort (n = 147). To measure perfusion heterogeneity, texture features across the habitats were computed. The ratio of each habitat to the whole tumor was also computed. Perfusion heterogeneity score (PHS) was calculated from perfusion heterogeneity measurements. Cox-LASSO model was used to determine the association of the PHS or clinicopathological variables with disease-free survival (DFS). Patients were divided into high- and low-risk groups based on the median PHS of the training cohort.*Results There were five habitats with distinct perfusion patterns. The perfusion patterns of the habitats were correlated with established kinetic features based on early and delayed MR images. On the external validation cohort, adding PHS improved the prediction of a worse DFS (hazard ratio = 4.128, P-value = 0.003, C-index = 0.760) when combined with clinical variables-only model (hazard ratio = 3.232, P-value = 0.018, C-index = 0.748).*Conclusions Measurement of perfusional heterogeneity with habitats on MRI would be useful in predicting patients' outcomes and understanding tumor biology.*Clinical Relevance/Application Habitat analysis is known to more accurately reflect intratumoral heterogeneity than whole-tumor analysis. Perfusional heterogeneity using habitat analysis is a rarely explored option and could affect patients' outcomes.

RESULTS

There were five habitats with distinct perfusion patterns. The perfusion patterns of the habitats were correlated with established kinetic features based on early and delayed MR images. On the external validation cohort, adding PHS improved the prediction of a worse DFS (hazard ratio = 4.128, P-value = 0.003, C-index = 0.760) when combined with clinical variables-only model (hazard ratio = 3.232, P-value = 0.018, C-index = 0.748).

CLINICAL RELEVANCE/APPLICATION

Habitat analysis is known to more accurately reflect intratumoral heterogeneity than whole-tumor analysis. Perfusional heterogeneity using habitat analysis is a rarely explored option and could affect patients' outcomes.

SPR-BR-18　Multiparametric MRI-based Radiogenomics Of Breast Cancer Using BI-RADS Lexicon And Quantitative Image Analysis: Association With RNA Sequencing

Participants
Ah Young Park, MD, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Multiparametric MRI features of breast cancer could be attributed to various genetic alterations. We explored the association between RNA sequencing profiles and multiparametric MRI features of breast cancer regarding tumor morphology, heterogeneity, and angiogenesis, and identified imaging markers to predict prognosis and determine treatment.*Methods and Materials From June 2017 to August 2018, breast MRI of 95 women (mean age, 53 years ± 10 [standard deviation]) with invasive breast cancer was prospectively evaluated. Whole genomic RNA obtained from surgical specimens was analyzed using next-generation sequencing. MRI features were evaluated using the Breast Imaging Reporting and Data System (BI-RADS) lexicon to assess tumor morphology, texture analysis to assess tumor heterogeneity, and enhancement kinetics and perfusion analysis to assess tumor angiogenesis. MRI features were correlated with gene expression profiles. Gene networks, enriched functions, and canonical pathways according to MRI features were analyzed using ingenuity pathway. The P value for differential expression was extracted by using a parametric F test comparing nested linear models.*Results 189 genes were associated with 87 MRI features (more than fourfold upregulated or downregulated; P<.05). Irregular mass shape in the BI-RADS was associated with upregulation of HOXA5 (5.1-fold; P=.001) and STC2 (4.9-fold; P=.02), and these genes are associated with estrogen receptor positivity, apoptosis, and survival in breast cancer. Of the lesion types in the BI-RADS, mass was associated with upregulation of SNORD46 (23.4-fold; P=.022), SNORA38 (20.4-fold; P=.005), and SNORA71B (4.2-fold; P=.009). Various texture and perfusion parameters were associated with breast cancer-related small nucleolar RNAs. Top networks according to entropy at T2-weighted imaging and lesion type were associated with cancer, cell death and survival.*Conclusions Compared with RNA sequencing, multiparametric MRI features regarding morphology, lesion heterogeneity and angiogenesis were associated with gene expressions or enriched functions related to molecular subtype, drug response, and prognosis in breast cancers.*Clinical Relevance/Application Multiparametric MRI analysis of breast cancer morphology, heterogeneity and angiogenesis using BI-RADS and quantitative variables can reflect genetic changes related to treatment and prognosis.

RESULTS

189 genes were associated with 87 MRI features (more than fourfold upregulated or downregulated; P<.05). Irregular mass shape in the BI-RADS was associated with upregulation of HOXA5 (5.1-fold; P=.001) and STC2 (4.9-fold; P=.02), and these genes are associated with estrogen receptor positivity, apoptosis, and survival in breast cancer. Of the lesion types in the BI-RADS, mass was associated with upregulation of SNORD46 (23.4-fold; P=.022), SNORA38 (20.4-fold; P=.005), and SNORA71B (4.2-fold; P=.009). Various texture and perfusion parameters were associated with breast cancer-related small nucleolar RNAs. Top networks according to entropy at T2-weighted imaging and lesion type were associated with cancer, cell death and survival.

CLINICAL RELEVANCE/APPLICATION

Multiparametric MRI analysis of breast cancer morphology, heterogeneity and angiogenesis using BI-RADS and quantitative variables can reflect genetic changes related to treatment and prognosis.

SPR-BR-2　Role Of CEM In Assessing Residual Disease Is Comparable To MR Imaging In Various Breast Cancer Tumor Subtypes Receiving NST

Participants
Bhavika Patel, MD, Phoenix, Arizona (*Presenter*) Research support, GRAIL, Inc;Research Grant, Hologic, Inc;Speaker, Hologic, Inc;

PURPOSE

To compare the diagnostic accuracy of contrast enhanced mammography (CEM) to magnetic resonance imaging (MRI) for the evaluation of residual tumor after neoadjuvant systemic treatment (NST).*Methods and Materials All women with newly diagnosed breast cancer who underwent post NST imaging from September 2014 to June 2020 were retrospectively reviewed. For this study, pathological complete response (pCR) was defined as the absence of invasive cancer or DCIS within the breast at surgery. Radiological complete response (rCR) was defined as no residual tumor seen on post-contrast post-treatment imaging. Size of residual malignancy on post-NST CEM and MRI was compared with surgical pathology.Sensitivity, specificity, PPV and NPV values were calculated. Accuracy was further stratified by various breast cancer tumor subtypes.*Results 371 unique breast cancer patients underwent post-treatment contrast-enhanced imaging, of which 223/371 (60%) patients had both CEM and MRI, 67/371

(18%) CEM only and 54/371 (15%) MR only. Mean age 54 (25-84) yrs, 57% (213/371) post-menopausal, 81% (294/371) white, 64% (237/371) dense breasts. NST: chemotherapy in 74% (274/371) and endocrine therapy in 26% (97/371) patients. Tumor subtype analyses: 38% (141/372) ER+/Her2-, 34% (126/371) HER2+ and 28% (104/371) TNBC. 94% (348/371) tumors were T2, (241/371) 65% had no axillary disease. 60% (221/371) underwent mastectomy, 40% (150/371) underwent BCT.rCR was identified in 48% (140/290) on CEM, 38% (104/277) on MR and 35% (130/371) achieved pCR. Lin's concordance correlation coefficient for CEM and MRI vs surgical pathology was 0.57 and 0.54; concordance between CEM and MR was 0.85. Size differences between CEM and MR were within +/- 1 cm in 79% (293/371) of cases. Comparing CEM versus MRI for assessment of complete response, the sensitivity was 83% versus 69%, specificity 72% versus 80%, positive predictive value 64% versus 66%, and negative predictive value 88% versus 82% respectively.*Conclusions Diagnostic accuracy of assessing residual malignancy in the post treatment patient on CEM imaging is comparable to that of MRI in in all breast cancer tumor subtypes.*Clinical Relevance/Application Given that CEM is comparable to the accuracy of breast MRI for assessing residual disease after NST, use of post treatment contrast mammography should be considered when MRI is contraindicated or not available.

RESULTS

371 unique breast cancer patients underwent post-treatment contrast-enhanced imaging, of which 223/371 (60%) patients had both CEM and MRI, 67/371 (18%) CEM only and 54/371 (15%) MR only. Mean age 54 (25-84) yrs, 57% (213/371) post-menopausal, 81% (294/371) white, 64% (237/371) dense breasts. NST: chemotherapy in 74% (274/371) and endocrine therapy in 26% (97/371) patients. Tumor subtype analyses: 38% (141/372) ER+/Her2-, 34% (126/371) HER2+ and 28% (104/371) TNBC. 94% (348/371) tumors were T2, (241/371) 65% had no axillary disease. 60% (221/371) underwent mastectomy, 40% (150/371) underwent BCT.rCR was identified in 48% (140/290) on CEM, 38% (104/277) on MR and 35% (130/371) achieved pCR. Lin's concordance correlation coefficient for CEM and MRI vs surgical pathology was 0.57 and 0.54; concordance between CEM and MR was 0.85. Size differences between CEM and MR were within +/- 1 cm in 79% (293/371) of cases. Comparing CEM versus MRI for assessment of complete response, the sensitivity was 83% versus 69%, specificity 72% versus 80%, positive predictive value 64% versus 66%, and negative predictive value 88% versus 82% respectively.

CLINICAL RELEVANCE/APPLICATION

Given that CEM is comparable to the accuracy of breast MRI for assessing residual disease after NST, use of post treatment contrast mammography should be considered when MRI is contraindicated or not available.

SPR-BR-20 The Added Value Of Integrating 3D Feature Learning In Developing An Ai-based Imaging Biomarker For Breast Tomosynthesis

Participants
Weonsuk Lee, Seoul, Korea, Republic Of (*Presenter*) Employee, Lunit Inc

PURPOSE

Compared to 2D mammography, digital breast tomosynthesis (DBT) visualizes the 3D morphology of breast cancer, but studies on the advantages of AI that can analyze DBT as 3D volume data are insufficient. In this study, we assessed whether the use of an AI algorithm capable of analyzing DBT as 3D volume data provides an additional benefit for developing a data-driven imaging biomarker for DBT (DIB-DBT), as compared to the AI algorithm analyzing each DBT slice as a 2D image.*Methods and Materials A total of 6,174 four-view DBT exams (1,536 cancer, 3,090 benign, 1,548 normal) were retrospectively collected from eight institutions in the United States and then divided into two sets: 5,174 exams for training (1,286 cancer, 2,590 benign, 1,298 normal) and 1,000 exams for validation (250 cancer, 500 benign, 250 normal), and the training set was used to develop DIB-DBTs for detecting breast cancer in DBT. The additional benefit of analyzing DBT as 3D volume data was evaluated in the validation set by comparing two DIB-DBTs developed with (a) DBT slices and (b) 3D volume data of DBT. This comparison was also conducted in subgroup datasets including cancers that present only as microcalcifications (without associated mass or asymmetry) and those that do not. DeLong's test was used to evaluate two correlated receiver operating characteristic (ROC) curves.*Results The area under the ROC curves (AUROC) of DIB-DBT using DBT slices vs 3D volume data were significantly different (0.908 vs 0.926, P < .001). For cancer lesions presenting only as microcalcifications, a significant difference between DBT slices vs 3D volume data was also demonstrated (AUC of 0.813 vs 0.866, P = .002). On the other hand, the difference between the two methods was not significant for the detection of cancer presenting as mass or asymmetry (AUC of 0.886 vs 0.894, P = .267).*Conclusions This study demonstrated the additional benefit of analyzing DBT as 3D volume data for developing an AI algorithm for breast cancer detection. Particularly in the detection of cancer presenting only as microcalcification, detection performance can be significantly improved by incorporating the spatial characteristics of the 3D volume.*Clinical Relevance/Application Instead of analyzing each DBT slice, analyzing 3D DBT volume is helpful in improving the diagnostic performance of an AI algorithm for breast cancer detection, especially for breast cancers presenting only as microcalcifications.

RESULTS

The area under the ROC curves (AUROC) of DIB-DBT using DBT slices vs 3D volume data were significantly different (0.908 vs 0.926, P < .001). For cancer lesions presenting only as microcalcifications, a significant difference between DBT slices vs 3D volume data was also demonstrated (AUC of 0.813 vs 0.866, P = .002). On the other hand, the difference between the two methods was not significant for the detection of cancer presenting as mass or asymmetry (AUC of 0.886 vs 0.894, P = .267).

CLINICAL RELEVANCE/APPLICATION

Instead of analyzing each DBT slice, analyzing 3D DBT volume is helpful in improving the diagnostic performance of an AI algorithm for breast cancer detection, especially for breast cancers presenting only as microcalcifications.

SPR-BR-21 Data-driven Imaging Biomarker To Detect Breast Cancer On Digital Breast Tomosynthesis: Reducing Texture Variability Across Different Institutions

Participants
Hyun Jae Lee, Seoul, Korea, Republic Of (*Presenter*) Employee, Lunit Inc

PURPOSE

To assess the feasibility of reducing texture variability across different institutions for developing a data-driven imaging biomarker on digital breast tomosynthesis (DIB-DBT, an imaging biomarker for the detection of breast cancer based on deep learning technology).*Methods and Materials A total of 5,492 4-view digital breast tomosynthesis (DBT) exams were retrospectively collected for training and validation from seven institutions according to the following criteria: (a) biopsy-confirmed cancer, (b) suspicious but benign on biopsy, (c) non-suspicious benign, and (d) normal. We divided 5,492 DBT exams into 4,492 exams for

training ((a) 1,117, (b) 1,122, (c) 1,126, (d) 1,127) and 1,000 for validation ((a) 250, (b) 250, (c) 250, (d) 250). For external validation, we collected 655 4-view DBT exams from another institution ((a) 163, (b) 164, (c) 164, (d) 164). The Texture Recalibration Module (TRM) was utilized to alleviate the texture variations inherent in different institutions due to varying devices, scanning settings, etc., which could be irrelevant factors for cancer detection. On top of the residual network, we compare methods of training (i) without TRM and (ii) with TRM for two different tasks - Task 1: discriminating cancer in all exams (i.e. (a) vs (b-d)); Task 2: discriminating cancer given a suspicious exam (i.e. (a) vs (b)). DeLong's test was used to compare two correlated ROC curves.*Results For detecting breast cancer (Task 1), per-exam area under the receiver operating characteristic curve (AUROC) of DIB-DBT without vs with TRM were 0.863 vs 0.879 (P =0.027) and 0.838 vs 0.857 (P = 0.075) in the internal and external validation datasets, respectively. The effects of using TRM were more significant in the task of distinguishing between (a) cancer and (b) suspicious but benign on biopsy. For Task 2, per-exam AUROC of DIB-DBT without vs with TRM were 0.762 vs 0.797 (P=0.002) and 0.785 vs 0.816 (P=0.029) in the internal and external validation datasets, respectively.*Conclusions This study demonstrated the effectiveness of TRM for developing DIB-DBT. It not only improves performance in the internal validation dataset by reducing texture discrepancy across different facilities, but also makes the network more robust to the external validation dataset by restraining unimportant texture. In particular, it shows significant improvement of diagnostic performance in the suspicious group (that is, in discriminating cancer given a suspicious exam).*Clinical Relevance/Application DIB-DBT can detect breast cancer with a high level of accuracy across a variety of devices. With further clinical validation, it could be used in the clinical setting as an effective diagnostic support tool for breast cancer screening.

RESULTS

For detecting breast cancer (Task 1), per-exam area under the receiver operating characteristic curve (AUROC) of DIB-DBT without vs with TRM were 0.863 vs 0.879 (P =0.027) and 0.838 vs 0.857 (P = 0.075) in the internal and external validation datasets, respectively. The effects of using TRM were more significant in the task of distinguishing between (a) cancer and (b) suspicious but benign on biopsy. For Task 2, per-exam AUROC of DIB-DBT without vs with TRM were 0.762 vs 0.797 (P=0.002) and 0.785 vs 0.816 (P=0.029) in the internal and external validation datasets, respectively.

CLINICAL RELEVANCE/APPLICATION

DIB-DBT can detect breast cancer with a high level of accuracy across a variety of devices. With further clinical validation, it could be used in the clinical setting as an effective diagnostic support tool for breast cancer screening.

SPR-BR-22   Vacuum Assisted Excision (VAE): A Potentially Approach For Percutaneous Treatment Of Small Breast Tumors.

Participants
Henrique Couto, PhD, Belo Horizonte, Brazil (*Presenter*) Speakers Bureau, Becton, Dickinson and Company;Speakers Bureau, Hologic, Inc

PURPOSE

Evaluate vacuum assisted excision (VAE) for percutaneous treatment of breast cancers.*Methods and Materials A retrospective analysis of 1061 vacuum assisted biopsies (VAB) and VAE in a breast unit between 04/13/2017-11/28/2020. 133 breast cancers were identified (both invasive (IC) and in situ (DCIS)). In total, 116 cases with complete data from VAB/VAE and surgical excision were evaluated. Excision following VAB/VAE was defined as complete resection (CR) if there was no residual tumor, minimal residual disease (MRD) if residual tumor =3mm, gross residual disease (GRD) if residual tumor >3mm and upgrade from DCIS on VAB/VAE to invasive cancer. CR and MRD were combined as potentially resected and treated percutaneously (PRTP). GRD and those with upgrade to invasion were determined not suitable for percutaneous treatment. Factors predictive of PRTP were evaluated.*Results Median age was 55.8 years (20-91; SD 12.15). Median IC size 7.1mm (1-25mm; SD 5.08), median DCIS size 12.5mm (2-65; SD 11.69). Of the 116 tumours, 29 (25%) were CR, 18 (15.5%) MRD, 64 (55.2%) GRD and 5 (4.3%) upgraded from DCIS to invasion.For 29 tumours with no residual disease at surgery, 21(72.4%) were IC and 8 (27.6%) DCIS. The largest completely resected tumor was 11mm for IC and 6mm for DCIS. 47 (40.5%) tumours were PRTP: 11 (23.4%) DCIS and 36 (76.6%) IC. For 77 tumours =10mm, 45 (58.5%) were PRTP. In multivariate analysis VAE (p 0,017 OR 3.2 95% CI), low/intermediate nuclear grade (p 0,003 OR 5.2 95% C.I.) and absence of DCIS with comedo necrosis (p=0.007 OR 4.0 C.I. 95%) were associated with PRTP. When low/intermediate nuclear grade tumours not associated to DCIS with comedo necrosis undergo VAE the chance of PRTP was 75.6%. Taking 10 mm tumor size cut off the multivariate analysis reveals significance for VAE (p 0,008 OR 4.4 95% CI), low/intermediate nuclear grade (p 0,000 OR 12.5 95% C.I.) and final T (TNM) =10mm (p 0,000 OR 56.3 C.I. 95%). When low/intermediate grade tumors =10mm undergo VAE the chance of PRTP is 81.7%.*Conclusions This data suggests that low/intermediate grade pT1a/b breast tumours can be completely excised with percutaneous VAE. Based on this, small (=10mm) invasive breast tumours of low/intermediate grade could be considered for entry to prospective randomized trials of VAE for local treatment, with long term follow up to assess recurrence rates. Standardization of the procedure should also be recommended.*Clinical Relevance/Application Invasive breast cancers, smaller than 10mm, low/intermediate grade are potentially resected and treated percutaneously by VAE.

RESULTS

Median age was 55.8 years (20-91; SD 12.15). Median IC size 7.1mm (1-25mm; SD 5.08), median DCIS size 12.5mm (2-65; SD 11.69). Of the 116 tumours, 29 (25%) were CR, 18 (15.5%) MRD, 64 (55.2%) GRD and 5 (4.3%) upgraded from DCIS to invasion.For 29 tumours with no residual disease at surgery, 21(72.4%) were IC and 8 (27.6%) DCIS. The largest completely resected tumor was 11mm for IC and 6mm for DCIS. 47 (40.5%) tumours were PRTP: 11 (23.4%) DCIS and 36 (76.6%) IC. For 77 tumours =10mm, 45 (58.5%) were PRTP. In multivariate analysis VAE (p 0,017 OR 3.2 95% CI), low/intermediate nuclear grade (p 0,003 OR 5.2 95% C.I.) and absence of DCIS with comedo necrosis (p=0.007 OR 4.0 C.I. 95%) were associated with PRTP. When low/intermediate nuclear grade tumours not associated to DCIS with comedo necrosis undergo VAE the chance of PRTP was 75.6%. Taking 10 mm tumor size cut off the multivariate analysis reveals significance for VAE (p 0,008 OR 4.4 95% CI), low/intermediate nuclear grade (p 0,000 OR 12.5 95% C.I.) and final T (TNM) =10mm (p 0,000 OR 56.3 C.I. 95%). When low/intermediate grade tumors =10mm undergo VAE the chance of PRTP is 81.7%.

CLINICAL RELEVANCE/APPLICATION

Invasive breast cancers, smaller than 10mm, low/intermediate grade are potentially resected and treated percutaneously by VAE.

SPR-BR-23   Attitude Of Women Towards Screening For Breast Cancer: Readiness To Accept False Positive Vs. False Negative Diagnoses

Participants
Toni Vomweg, Koblenz, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Breast cancer screening is under attack. Opponents argue that mammographic screening is associated with overdiagnosis and false positive findings, leading to harm and additional costs. On the other hand, mammographic screening may not be enough for women with dense breasts, who are at increased risk of a late diagnosis of cancer. However, novel breast cancer screening methods that could improve cancer detection in women with dense breasts usually also increase numbers of false-positive diagnoses. Research on improved breast cancer screening methods is therefore received with increasing skepticism from the general medical community. Little scientific evidence exists on women's preferences in this regard.*Methods and Materials A questionnaire was developed and worded in close cooperation with expert psychologists and women's representatives that first explained, in simple language, the fact that screening methods can cause 'false alarm' (false-positive findings), but can also fail to identify existing cancer (be false-negative), and the interdependence of both errors in breast cancer screening. Women were then asked twice, in simple language and in inverted order, whether they (a) prefer a method that avoids false-negative diagnoses, even if it increased the rate of false-positive findings, or (b), whether they would prefer a method that avoids 'false alarm', even if this meant that cancer may not always be found. The questionnaire was validated in a test cohort and underwent several revisions until the wording was sufficiently comprehensible. Then, consecutive women aged 50-69 who presented for routine screening in an organized mammographic screening program were asked to complete the questionnaire.*Results So far, 1031 women participated in this ongoing study. Questionnaires were incomplete in 125/1031. Of the remaining 906 women, 851 (93.9%; Clopper-Pearson 95%-CI: 92.2%-95.4%) preferred a screening test that ensures detection of breast cancer. A total 55 women (6.1%; CI: 4.6%-7.8%) preferred a test that ensures a low risk of false alarm. This distribution of preferences was stable across all age ranges included, and across different levels of education as indicated by the respective highest school or university degree.*Conclusions Women prefer screening tests that ensure detection of cancer, and are ready to accept more false-positive diagnoses.*Clinical Relevance/Application Knowing about women's views and priorities is important when discussing the tolerability of screening methods.

RESULTS

So far, 1031 women participated in this ongoing study. Questionnaires were incomplete in 125/1031. Of the remaining 906 women, 851 (93.9%; Clopper-Pearson 95%-CI: 92.2%-95.4%) preferred a screening test that ensures detection of breast cancer. A total 55 women (6.1%; CI: 4.6%-7.8%) preferred a test that ensures a low risk of false alarm. This distribution of preferences was stable across all age ranges included, and across different levels of education as indicated by the respective highest school or university degree.

CLINICAL RELEVANCE/APPLICATION

Knowing about women's views and priorities is important when discussing the tolerability of screening methods.

SPR-BR-24 Radiomics Of Multiparametric MRI For Assessing The Tumor Microenvironment In Breast Cancer: Correlation With Quantitative 3D Histological Imaging

Participants
Eun Sil Kim, MD, Ansan, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Tumor microenvironment plays a critical role in tumor progression and treatment response and consists of extracellular matrix, immune cells, and microvessels. Three-dimensional (3D) histological imaging has a larger tissue volume (100-200 µm) compared to two-dimensional histological slides (5 µm) and provides more accurate tissue information. We explored whether radiomic analysis of multiparametric MRI can assess the state of the tumor microenvironment in breast cancer using quantitative 3D histological imaging.*Methods and Materials This prospective study enrolled 48 consecutive women with invasive cancers from June 2020 to January 2021. Dynamic contrast-enhanced T1, T2, and diffusion-weighted imaging were performed at 3T MRI. A total of 144 radiomic features were extracted after 3D tumor segmentation. The features consisted of 66 histogram-based, 14 shape-based, 46 texture-based, and 18 filter-based. Core-needle biopsy breast cancer specimens were processed with CLARITY technique for 3D histological imaging and six immunohistochemical staining was performed to evaluate the tumor microenvironment components (collagen, laminin, nidogen, Foxp3, CD8, and CD34). The degree of positive staining was quantified and histological imaging results were dichotomized based on mean or median values. Mann-Whitney U test was used to evaluate the association between radiomic features and histological findings.*Results 11, 83, 125, 5, 33, and 14 MRI radiomic features were associated with expression of collagen, laminin, nidogen, Foxp3, CD8, and CD34, respectively (P < .05). Expression of collagen, laminin and nidogen (components of extracellular matrix) were associated with histogram- and texture (gray-level co-occurrence matrix)-based radiomic features. Expression of CD34 (marker for microvessels) was associated with shape- and texture (gray-level co-occurrence matrix)-based radiomic features.*Conclusions Multiparametric MRI-derived radiomic features can reflect the state of the tumor microenvironment in breast cancer. The extracellular matrix is ??associated with histogram and texture features, and angiogenesis is associated with shape features of the tumor.*Clinical Relevance/Application MRI-derived radiomics has the potential to assess the tumor microenvironment for predicting prognosis and drug resistance, and could lead to better precision medicine for breast cancer treatment.

RESULTS

11, 83, 125, 5, 33, and 14 MRI radiomic features were associated with expression of collagen, laminin, nidogen, Foxp3, CD8, and CD34, respectively (P < .05). Expression of collagen, laminin and nidogen (components of extracellular matrix) were associated with histogram- and texture (gray-level co-occurrence matrix)-based radiomic features. Expression of CD34 (marker for microvessels) was associated with shape- and texture (gray-level co-occurrence matrix)-based radiomic features.

CLINICAL RELEVANCE/APPLICATION

MRI-derived radiomics has the potential to assess the tumor microenvironment for predicting prognosis and drug resistance, and could lead to better precision medicine for breast cancer treatment.

SPR-BR-25 Missed Breast Cancers On MRI In High Risk Patients

Participants
Julie Bilocq-Lacoste, MD, Chambly, Quebec (*Presenter*) Nothing to Disclose

PURPOSE

To determine if MRI features of breast lesions and histologic subtype influences the detectability of breast cancer on MRI screening

in a high-risk population.*Methods and Materials Screening MRIs carried out between 2006-2020 in patients aged 70 and over less, at high risk of breast cancer (lifetime risk of 25% and over), at Sunnybrook Health Sciences Center in Toronto, were reviewed. Breast cancers were diagnosed within 3 months of an MRI describing a suspicious (BI-RADS 4) or highly suspicious (BI-RADS 5) breast lesion. The lesions' characteristics on MRI at the time of diagnosis (MR B) were compared with the characteristics of the same lesions on previous screening MRI (MR A), where either normal (BI-RADS 1), benign (BI-RADS 2) or probably benign (BI-RADS 3) results had been issued. The missed lesions were either unnoticed (not described in the radiological report of IRMM A) or misinterpreted, described as BIRADS-2 or BI-RADS-3 on MR A and subsequently described as BI-RADS-4 or BI-RADS 5 on MR B. The different characteristics of missed cancers were compared using the exact test Fisher and Wilcoxon's rank sum test.*Results There was no association between MRI characteristics and between the type of receptors and the frequency of missed cancers. The proportion of overlooked versus misinterpreted lesions was also not significantly different. Main factors that increased the false negative rate for misinterpreted lesions were mostly related to a complex history (multiple known breast lesions, prior biopsy or surgery, long term stability). Lesions were mostly overlooked because of their small size and high background parenchymal enhancement (BPE). Among the missed lesions, the ones with type 3/washout and type 2/plateau kinetics on MR B, more often had less suspicious kinetics on MR A, either plateau (45%) or progressive (50%) , respectively (P = 0.001). The lesions with progressive enhancement on MR B all had progressive kinetics on MR A.The proportion of basal subtype cancers was higher in patients carrying the BRCA1 gene (50%), than in non-carriers (12%), p = 0.0001 and the proporton of missed cancers was lower in carriers (p < 0.05).*Conclusions The detectability of breast cancers is not influenced by MRI characteristics or type of receptors. Lesions in a post surgical breast or with high BPE should be assessed with caution and long term stability does not rule out malignancy. Lowering threshold for biopsy for lesions with interval change of kinetic curve for a type 2 or 3 curve should be considered. The lower rate of missed cancers in BRCA 1 patients is attributed to the higher proportion of basal-like cancers, more aggressive in nature.*Clinical Relevance/Application To document the features of missed breast cancers on MRI in the aim of decreasing the number of missed cancers.

RESULTS

There was no association between MRI characteristics and between the type of receptors and the frequency of missed cancers. The proportion of overlooked versus misinterpreted lesions was also not significantly different. Main factors that increased the false negative rate for misinterpreted lesions were mostly related to a complex history (multiple known breast lesions, prior biopsy or surgery, long term stability). Lesions were mostly overlooked because of their small size and high background parenchymal enhancement (BPE). Among the missed lesions, the ones with type 3/washout and type 2/plateau kinetics on MR B, more often had less suspicious kinetics on MR A, either plateau (45%) or progressive (50%) , respectively (P = 0.001). The lesions with progressive enhancement on MR B all had progressive kinetics on MR A.The proportion of basal subtype cancers was higher in patients carrying the BRCA1 gene (50%), than in non-carriers (12%), p = 0.0001 and the proporton of missed cancers was lower in carriers (p < 0.05).

CLINICAL RELEVANCE/APPLICATION

To document the features of missed breast cancers on MRI in the aim of decreasing the number of missed cancers.

SPR-BR-26 Background Parenchymal Enhancement Influences Sensitivity Of Contrast-enhanced Mammography

Participants
Paola Clauser, MD, Vienna, Austria (*Presenter*) Speaker, Siemens AG

PURPOSE

The aim of this study was to evaluate the influence of background parenchymal enhancement (BPE) on the sensitivity of contrast-enhanced mammography (CEM).*Methods and Materials In this retrospective, cross-sectional, IRB approved study 128 patients that underwent CEM due to unclear or suspicious findings on conventional mammography or ultrasound were retrospectively evaluated by two radiologists (R1, R2). The mean age was 58.5 (SD 10.85). Most of the patients were post- or perimenopausal, only 17 patients were premenopausal. CEM was performed after intravenous administration of a iodine-based contrast agent. Only examinations with enhancing lesions were included. A standard of reference (image-guided biopsy or at least one year follow up) was available for all the included cases. Reading of mammography and CEM was performed independently. For each breast, BPE and density were assessed, for each lesion, size and BI-RADS were assessed. BPE was evaluated in 4 groups (a: minimal, b: mild, c: moderate, d: marked) according to BI-RADS. For statistical analysis, cases were divided into two groups: minimal or mild BPE (BPE a-b) and moderate or marked BPE (BPE c-d). The sensitivity of both readers with respect to BPE was calculated and compared. Age and lesion size differences according to BPE were investigated by t-tests. A chi-square test was used to assess the association of breast density with dichotomized BPE. Finally, multivariable logistic regression was performed.*Results For R1 98 cases were classified as having BPE a-b and 30 BPE c-d. For R2 94 cases were classified as having BPE a-b and 34 BPE c-d. Mean age was significantly lower in the BPE c-d group (p=0.004). There were no significant differences in mean lesion size (p=0.1400) and breast density (p=0.250) between the two groups. Sensitivity of CEM was significantly higher in the cases with BPE a-b than with BPE c-d for both readers: sensitivity for R1 decreased from 100% (BPE a-b) to 85.7% (BPE c-d) (p=0.002). Sensitivity for R2 decreased from 100% (BPE a-b) to 89.5% (BPE c-d) (P=0.009). Logistic regression confirmed that age had no significant effect on sensitivity, but BPE did.*Conclusions Distinct BPE is present in a significant number of CEM exams and can significantly reduce sensitivity of CEM, regardless of age, lesion size, and parenchymal density. This should be taken in account to avoid misses if BPE is particular moderate or marked.*Clinical Relevance/Application The level of BPE in CEM should be taken in consideration, as it influences the sensitivity significantly. Lesions can be missed, particularly if BPE is moderate or marked.

RESULTS

For R1 98 cases were classified as having BPE a-b and 30 BPE c-d. For R2 94 cases were classified as having BPE a-b and 34 BPE c-d. Mean age was significantly lower in the BPE c-d group (p=0.004). There were no significant differences in mean lesion size (p=0.1400) and breast density (p=0.250) between the two groups. Sensitivity of CEM was significantly higher in the cases with BPE a-b than with BPE c-d for both readers: sensitivity for R1 decreased from 100% (BPE a-b) to 85.7% (BPE c-d) (p=0.002). Sensitivity for R2 decreased from 100% (BPE a-b) to 89.5% (BPE c-d) (P=0.009). Logistic regression confirmed that age had no significant effect on sensitivity, but BPE did.

CLINICAL RELEVANCE/APPLICATION

The level of BPE in CEM should be taken in consideration, as it influences the sensitivity significantly. Lesions can be missed, particularly if BPE is moderate or marked.

SPR-BR-27 Diagnostic Performance And Image Quality Of Contrast Enhanced Spectral Mammography With Low Dose Contrast Agents In Detecting Breast Lesions

Participants
Huizhi Cao, PhD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the clinical value of contrast enhanced spectral mammography with low dose contrast agents in assessing breast lesions.*Methods and Materials In this IRB-approved retrospective study, 223 patients undergoing CESM were randomly assigned into two protocols: 113 patients were carried out exam with conventional dose (Iohexol at 1.5ml/kg;350 mg/ml), and other 100 patients underwent exam with low dose (Iohecol at 1 ml/kg; 350 mg/ml). All the patients accepted MRI examination within one week. The image of CESM, MRI and the histopathological data were analyzed. The clinical value of CESM and MRI were evaluated according to the histopathological results, respectively. The ROC curve was to applied to analyzed clinical efficiency. The tumor size was measured from CESM, MRI modalities and pathological data. By using the Bland-Altman analysis, the consistency of the maximum tumor size was assessed.*Results Histopathologic result revealed 33 benign and 67 malignant lesions in low dose group, and 35 benign and 78 malignant lesions in conventional group. CESM obtained from conventional group had similar AUC area, sensitivity, specificity, PPV, NPV to MRI imaging (0,928, 0.962, 0.846,0.783,0.821 vs. 0.903,0.974,0.809,0.805,0.856). Importantly, CESM of low dose group showed a comparison of clinical performance to MRI as well. (AUC area: 0.944 vs. 0.925; sensitivity:0.990 vs.0.941; specificity:0.825vs.0.831; PPV:0.802 vs. 0.825; NPV:0.855 vs. 0.895). For tumor size measurement, mean tumor size was 3.51 cm for CESM (conventional group) and 3.61 cm for MRI, compared with 3.38 cm on histopathological results, the average difference of diameters between CESM (conventional group), MRI and Histopathologic size was -0.02, -0.10cm, respectively. Additionally, average sizes were measured as 4.02 cm, 3.76 cm, 3.96 cm for CESM (low dose group), MRI and Histopathologic result, and the difference diameters compared to Pathologic data were -0.05, -0.08. Bland-Altman analysis showed best consistency on tumor size between CESM (low dose group), MRI and pathological results.*Conclusions Low doses of contrast agents used for CESM show a comparison both in diagnostic performance and tumor size assessment, compared to CESM obtained with conventional dose.*Clinical Relevance/Application Contrast enhanced spectral mammography performed at low dose of contrast agents can meet the clinical and imaging requirements without sacrificing diagnostic performance.

RESULTS

Histopathologic result revealed 33 benign and 67 malignant lesions in low dose group, and 35 benign and 78 malignant lesions in conventional group. CESM obtained from conventional group had similar AUC area, sensitivity, specificity, PPV, NPV to MRI imaging (0,928, 0.962, 0.846,0.783,0.821 vs. 0.903,0.974,0.809,0.805,0.856). Importantly, CESM of low dose group showed a comparison of clinical performance to MRI as well. (AUC area: 0.944 vs. 0.925; sensitivity:0.990 vs.0.941; specificity:0.825vs.0.831; PPV:0.802 vs. 0.825; NPV:0.855 vs. 0.895). For tumor size measurement, mean tumor size was 3.51 cm for CESM (conventional group) and 3.61 cm for MRI, compared with 3.38 cm on histopathological results, the average difference of diameters between CESM (conventional group), MRI and Histopathologic size was -0.02, -0.10cm, respectively. Additionally, average sizes were measured as 4.02 cm, 3.76 cm, 3.96 cm for CESM (low dose group), MRI and Histopathologic result, and the difference diameters compared to Pathologic data were -0.05, -0.08. Bland-Altman analysis showed best consistency on tumor size between CESM (low dose group), MRI and pathological results.

CLINICAL RELEVANCE/APPLICATION

Contrast enhanced spectral mammography performed at low dose of contrast agents can meet the clinical and imaging requirements without sacrificing diagnostic performance.

SPR-BR-28 Acquisition Of A Delayed Phase Image In Contrast Enhanced Mammography To Improve Diagnostic Accuracy

Participants
Paola Clauser, MD, Vienna, Austria (*Presenter*) Speaker, Siemens AG

PURPOSE

The aim of the study was to evaluate the diagnostic value of an additional post-contrast view to characterize enhancing lesions on contrast-enhanced mammography (CEM).*Methods and Materials In this cross-sectional, IRB approved study 128 patients that underwent CEM due to unclear or suspicious findings on conventional mammography or ultrasound were retrospectively evaluated by two radiologists (R1, R2). Patients' mean age was 58.5 (SD 10.85). CEM was performed after intravenous administration of an iodine-based contrast agent. After the acquisition of the four standard views, a post-contrast, cranio-caudal (CC), fifth view was performed in the breast with unclear or suspicious findings. Only examinations with enhancing lesions were included in the analysis. A standard of reference (image-guided biopsy or at least one year follow up) was available for all the included cases. Readings of mammography alone, CEM and CEM with the additional CC view were performed independently. For each lesion, a BI-RADS classification was given for 1) mammography, 2) CEM and 3) CEM with additional CC view. Diagnostic accuracy was calculated using the area under the receiver operating characteristic curve (AUC), and AUC were compared. The increase in radiation dose due to the additional view was estimated.*Results A total of 128 lesions were included, 82 malignant and 46 benign. The AUC of mammography was 0.804 for R1 and 0.795 for R2. The evaluation of the early-phase CEM improved the diagnostic accuracy of both readers (R1: 0.810, 95% confidence interval (CI) 0.731-0.874; R2: 0.837 95%CI 0.762-0.897). The evaluation of the additional CC view allowed a further improvement in the diagnostic performance, with an AUC of 0.877 for R1 (95%CI 0.807-0.928, p=0.002 compared to CEM) and of 0.850 for R2 (95%CI 0.776-0.907, p=0.371). The acquisition of the additional view determined an increase in the radiation dose between 19.5% and 26.6%, dependent on breast thickness.*Conclusions The acquisition of an additional CC view in the presence of an enhancing lesion on CEM improved diagnostic accuracy with a minor increase in radiation dose.*Clinical Relevance/Application The evaluation of the enhancement curve with the acquisition of an additional cranio-caudal view could improve lesion characterization with CEM.

RESULTS

A total of 128 lesions were included, 82 malignant and 46 benign. The AUC of mammography was 0.804 for R1 and 0.795 for R2. The evaluation of the early-phase CEM improved the diagnostic accuracy of both readers (R1: 0.810, 95% confidence interval (CI) 0.731-0.874; R2: 0.837 95%CI 0.762-0.897). The evaluation of the additional CC view allowed a further improvement in the diagnostic performance, with an AUC of 0.877 for R1 (95%CI 0.807-0.928, p=0.002 compared to CEM) and of 0.850 for R2 (95%CI 0.776-0.907, p=0.371). The acquisition of the additional view determined an increase in the radiation dose between 19.5% and 26.6%, dependent on breast thickness.

CLINICAL RELEVANCE/APPLICATION

The evaluation of the enhancement curve with the acquisition of an additional cranio-caudal view could improve lesion

SPR-BR-29   Microwave Imaging In Breast Cancer - Results From The First-in-human Trial Of The Wavelia System

Participants
Brian Moloney, MBBCh, Galway, Ireland (*Presenter*) Nothing to Disclose

PURPOSE

Microwave Breast Imaging(MBI) is an emerging non-ionizing technology with the potential to detect and characterize breast pathology. The Wavelia MBI system is a low-power electromagnetic wave prototype that demonstrated the ability to detect dielectric contrast between tumor and fibroglandular tissue in preclinical studies with synthetic breast phantoms. Herein, we evaluate the Wavelia system in the clinical setting and establish the safety profile and patient experience. The ability of the system to estimate lesion size and probability of malignancy of breast lesions is investigated, and the clinical usefulness determined.*Methods and Materials The study was registered with the U.S. National Library of Medicine (ClinicalTrials.gov NCT03475992). Patients were recruited to one of 3 groups: Biopsy-proven breast cancers(Group-1), unaspirated cysts(Group-2) and biopsy-proven benign breast lesions(Group-3). MBI lesion size estimations were compared with conventional imaging and post-surgery histology. A Quadratic Discriminant Analysis(QDA) classifier was trained on shape and texture-based features. A hypersurface partitioning the employed 3D feature space in two disjoint continuous subspaces (malignant and benign lesions subspaces) was defined and the classification loss rate computed. An independent review of the results was performed by two breast radiologists. Subjects were surveyed to assess patient experience.*Results 24 patients were included in final analysis(11 Group-1, 8 Group-2 and 5 Group-3). The MBI system detected 12/13 benign lesions, and 9/11 cancers. This included 1 radiographically occult invasive lobular cancer. The MBI system accurately estimated the size of the majority of cancer lesions, with comparison to post-surgery histology. The QDA classifier discriminated benign from malignant breast lesions in 88.5% of cases. The addition of MBI and the generated probability of malignancy was deemed useful by both radiologists. No negative patient feedback was recorded.*Conclusions Wavelia MBI detected, correctly estimated the size and location, and determined the malignancy risk of the majority of breast lesions. This modality has exciting potential as a non-invasive and non-ionizing adjunct for breast cancer diagnosis. Larger studies will be conducted to validate these findings.*Clinical Relevance/Application In this study, the results of the First-in-Human clinical trial of the Wavelia MBI system is detailed. This imaging system demonstrated the capacity to detect, localize and characterize underlying breast pathology, including biopsy confirmed invasive carcinomas and benign breast diseases.

RESULTS

24 patients were included in final analysis(11 Group-1, 8 Group-2 and 5 Group-3). The MBI system detected 12/13 benign lesions, and 9/11 cancers. This included 1 radiographically occult invasive lobular cancer. The MBI system accurately estimated the size of the majority of cancer lesions, with comparison to post-surgery histology. The QDA classifier discriminated benign from malignant breast lesions in 88.5% of cases. The addition of MBI and the generated probability of malignancy was deemed useful by both radiologists. No negative patient feedback was recorded.

CLINICAL RELEVANCE/APPLICATION

In this study, the results of the First-in-Human clinical trial of the Wavelia MBI system is detailed. This imaging system demonstrated the capacity to detect, localize and characterize underlying breast pathology, including biopsy confirmed invasive carcinomas and benign breast diseases.

SPR-BR-4   Use Of Artificial Intelligence Software To Identify Clinically Aggressive Lesions On Prior Digital Breast Tomosynthesis Exams Based On Molecular Subtypes

Participants
Mary F. Ice, MD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate use of a deep learning artificial intelligence (AI) system to identify and score lesions in prior digital breast tomosynthesis (DBT) screening exams of cancer cases, potentially assisting radiologists to detect clinically relevant breast cancer earlier.*Methods and Materials An IRB approved, HIPAA compliant retrospective study with AI (ProFound AI, iCAD, Nashua NH) was conducted with 505 biopsy-proven index cancers and 749 normal DBT cases with 12-18 month prior normal screening DBT exams from 14 community-based centers in the U.S. Three breast imaging radiologists determined if AI detected malignant lesions on index exams. The radiologists also evaluated if these lesions were visible and actionable on the prior exam and if detected by AI. Case-level sensitivity and specificity of AI, including molecular subtypes of invasive cancers of index exams and prior exams were evaluated with 95% confidence intervals (CIs).*Results AI sensitivity on index exams was 89.3% (451/505; 95% CI: 86.6-92.0%) and specificity was 49.0% (367/749; 95% CI: 45.4-52.6%). Radiologists determined that 40.6% (205/505) of cancers were visible and actionable on prior exams. Case-level AI sensitivity on prior exams based on these areas of interest was 80.5% (165/205; 95% CI: 75.1-89.5%) and for all prior exams was 32.7% (165/505; 95% CI 28.6%, 36.8%). AI specificity on priors was 34.7% (260/749; 95% CI: 31.2-38.1%). Invasive cancers were present in 71.9% (363/505) of cancer cases and visible and actionable on 46.3% (168/363) of prior exams. For index exams, sensitivity for luminal A cases was 90.8% (266/293; 95% CI: 87.5-94.1%), for luminal B cases 95.5% (21/22; 95% CI: 86.8-100%), for triple negative cases 96.7% (29/30; 95% CI: 90.2-100%), for HER2+ cases 75.0% (3/4; 95% CI: 32.6-100%) and for cases with unknown molecular subtype lesions 64.3% (9/14; 95% CI: 39.2-89.4%). Based on visible and actionable lesions on prior exams, sensitivity for luminal A cases was 80.8% (118/146; 95% CI: 74.4-87.2%), for luminal B cases 77.8% (7/9; 95% CI: 50.6-100%), for triple negative cases 62.5% (5/8; 95% CI: 29.0-96.0%), for HER2+ cases 100% (2/2; 95% CI: 100-100%) and for cases with unknown molecular subtype lesions 66.7% (2/3; 95% CI: 13.3-100%).*Conclusions In 32.7% of 505 cancer cases, AI identified visible and actionable lesions on the prior exams, indicating that breast cancer could have been detected 12 to 18 months earlier with the use of AI.*Clinical Relevance/Application An AI system is correctly able to identify 77.8% luminal B and 62.5% triple negative cancers 12-18 months prior to clinical diagnosis. This provides an opportunity to detect more aggressive cancers earlier, potentially leading to better outcomes.

RESULTS

AI sensitivity on index exams was 89.3% (451/505; 95% CI: 86.6-92.0%) and specificity was 49.0% (367/749; 95% CI: 45.4-52.6%). Radiologists determined that 40.6% (205/505) of cancers were visible and actionable on prior exams. Case-level AI sensitivity on prior exams based on these areas of interest was 80.5% (165/205; 95% CI: 75.1-89.5%) and for all prior exams was 32.7% (165/505; 95% CI 28.6%, 36.8%). AI specificity on priors was 34.7% (260/749; 95% CI: 31.2-38.1%). Invasive cancers were present in 71.9% (363/505) of cancer cases and visible and actionable on 46.3% (168/363) of prior exams. For index exams, sensitivity for luminal A cases was 90.8% (266/293; 95% CI: 87.5-94.1%), for luminal B cases 95.5% (21/22; 95% CI: 86.8-100%),

for triple negative cases 96.7% (29/30; 95% CI: 90.2-100%), for HER2+ cases 75.0% (3/4; 95% CI: 32.6-100%) and for cases with unknown molecular subtype lesions 64.3% (9/14; 95% CI: 39.2-89.4%). Based on visible and actionable lesions on prior exams, sensitivity for luminal A cases was 80.8% (118/146; 95% CI: 74.4-87.2%), for luminal B cases 77.8% (7/9; 95% CI: 50.6-100%), for triple negative cases 62.5% (5/8; 95% CI: 29.0-96.0%), for HER2+ cases 100% (2/2; 95% CI: 100-100%) and for cases with unknown molecular subtype lesions 66.7% (2/3; 95% CI: 13.3-100%).

CLINICAL RELEVANCE/APPLICATION

An AI system is correctly able to identify 77.8% luminal B and 62.5% triple negative cancers 12-18 months prior to clinical diagnosis. This provides an opportunity to detect more aggressive cancers earlier, potentially leading to better outcomes.

SPR-BR-5 Prediction Of Pathological Complete Response To Neoadjuvant Systemic Therapy Of Triple Negative Breast Cancers Via Deep Learning

Participants
Zijian Zhou, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Triple-negative breast cancer (TNBC) accounts for approximately 15% of breast cancers and has a relatively poor prognosis. Neoadjuvant systemic therapy (NAST) and surgery are the standard of care treatment, although only approximately 40-50% of the patients achieve pathological complete response (pCR) after NAST. To predict pCR before surgery is currently not possible but would be helpful in guiding treatment and improving patient outcomes. We investigated using deep learning (DL) on sequential MRIs obtained during the early course of NAST for pCR prediction.*Methods and Materials In an ongoing prospective clinical trial (NCT02276443), the baseline and post 4 cycles (C4) of NAST MRIs of 112 TNBC patients were collected; 56 patients (50%) had pCR confirmed at surgery. Positive enhancement integral (PEI) maps derived from the early DCE phase and the b800 DWI were used in our study. Due to the currently limited number of patients, four-fold cross-validation was used for network training and evaluation. The patients were randomly split into four folds. Each fold consisted of 28 patients and had the same pCR:non-pCR ratio of 1. Three folds were grouped and split as the training and internal validation sets with the ratio of 66/18, and the remaining fold was reserved for independent testing. The training/validation/testing process was repeated four rounds and each fold served as the testing set once. Tumor patches from the images were cropped and normalized between [0, 1]. All patches were padded with zeros to the same pixel size of 192×192×64 for PEI, and 192×192×16 for DWI. The DL network was constructed with stacked 3D convolutional and MaxPooling layers, and consisted of four input channels. The extracted features from the four channels were concatenated and used for pCR prediction through three fully connected layers. Binary cross-entropy was used as the loss function, and the network was optimized using an Adam optimizer with the initial learning rate of 0.0001. For each round of testing, the receiver operating characteristic (ROC) curve was plotted and the area under the curve (AUC) was calculated. The final results were the averaged performances of all testing rounds.*Results The DL network achieved an average AUC of 0.81 ± 0.03. The average accuracy was 0.79 ± 0.03, the positive predictive value for pCRs was 0.75 ± 0.05, and the negative predictive value for non-pCRs was 0.88 ± 0.12.*Conclusions Using baseline and C4 PEI and DWI, a deep learning model can potentially predict pCR early during the course of NAST with relatively high AUC.*Clinical Relevance/Application A deep learning model with a high AUC in predicting response early during NAST can potentially help to triage non-responders to alternative treatments, including novel clinical trials for TNBC.

RESULTS

The DL network achieved an average AUC of 0.81 ± 0.03. The average accuracy was 0.79 ± 0.03, the positive predictive value for pCRs was 0.75 ± 0.05, and the negative predictive value for non-pCRs was 0.88 ± 0.12.

CLINICAL RELEVANCE/APPLICATION

A deep learning model with a high AUC in predicting response early during NAST can potentially help to triage non-responders to alternative treatments, including novel clinical trials for TNBC.

SPR-BR-6 The Role Of Magnetic Resonance Imaging (MRI) For Postoperative Surveillance After Mastectomy With Reconstruction Surgery In Breast Cancer Patients

Participants
Jeong Min Lee, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the role of magnetic resonance imaging (MRI) for postoperative surveillance in women who underwent nipple-sparing or skin-sparing mastectomy with immediate reconstruction surgery for breast cancer.*Methods and Materials The 270 consecutive women who underwent nipple-sparing or skin-sparing mastectomy with reconstruction surgery for breast cancer in our institution between August 2016 and March 2019 were included. The women who lacked a postoperative follow-up period less than 2 years, or who did not undergo postoperative MRI, were excluded. Local recurrence which was defined as newly developed breast cancer in the reconstructed breast, was investigated. We assessed the detection rate of MRI and ultrasound for recurrent lesions.*Results One hundred fifty-five patients were finally enrolled. Of 155 patients, 20 recurrent lesions were detected in 16 patients (10.3%). Of 20 recurrent lesions, 11 lesions were symptomatic and 9 were asymptomatic. The asymptomatic lesions were initially detected by MRI (n = 7, 78%) or ultrasound (n = 2, 22%) as routine surveillance, showing significantly higher detection rate of MRI (p = 0.005). Of these MR detected 7 cases, four cases were only detected in MRI. The recurrence interval of asymptomatic lesions was significantly longer (mean 23.9 +/- SD 15.4 months) than that of symptomatic lesions (mean 11.9 +/- SD 5.5 months, p = 0.05). There was no significant difference of size of recurrent lesions between symptomatic lesions (mean 0.74 +/- SD 0.38cm) and asymptomatic lesions (mean 0.72 +/- SD 0.44 cm, p = 0.91).*Conclusions The overall recurrence rate of our study was higher than those of previous studies using mammography only as postoperative surveillance after mastectomy. The detectability of MRI was significantly higher than that of ultrasound, especially in asymptomatic recurrence, which can imply the usefulness of postoperative MRI after nipple-sparing or skin-sparing mastectomy with immediate reconstruction surgery in cancer patients.*Clinical Relevance/Application This study is relevant that it suggests the need for postoperative MR surveillance to detect early disease recurrence in breast cancer patients who underwent nipple-sparing or skin sparing mastectomy with immediate reconstruction surgery.

RESULTS

One hundred fifty-five patients were finally enrolled. Of 155 patients, 20 recurrent lesions were detected in 16 patients (10.3%). Of 20 recurrent lesions, 11 lesions were symptomatic and 9 were asymptomatic. The asymptomatic lesions were initially detected by

MRI (n = 7, 78%) or ultrasound (n = 2, 22%) as routine surveillance, showing significantly higher detection rate of MRI (p = 0.005). Of these MR detected 7 cases, four cases were only detected in MRI. The recurrence interval of asymptomatic lesions was significantly longer (mean 23.9 +/- SD 15.4 months) than that of symptomatic lesions (mean 11.9 +/- SD 5.5 months, p = 0.05). There was no significant difference of size of recurrent lesions between symptomatic lesions (mean 0.74 +/- SD 0.38cm) and asymptomatic lesions (mean 0.72 +/- SD 0.44 cm, p = 0.91).

CLINICAL RELEVANCE/APPLICATION

This study is relevant that it suggests the need for postoperative MR surveillance to detect early disease recurrence in breast cancer patients who underwent nipple-sparing or skin sparing mastectomy with immediate reconstruction surgery.

SPR-BR-7   Abbreviated Screening Breast MRI For Women With A Personal History Of Breast Cancer: Comparison With Full-protocol MRI Using Propensity Score Matching

Participants
Sooyeon Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Screening abbreviated breast MRI (ABMR) has shown reduced scan times and comparable cancer detection rates to full-protocol MRI (FPMR). The application of ABMR has been extended to supplemental screening in women with a personal history of breast cancer (PHBC). However, in most of the prior studies, simulated ABMR protocols were retrospectively evaluated instead of being applied prospectively. Furthermore, few studies have compared the performances of ABMR and FPMR in women with PHBC. Therefore, we aimed to compare the screening performances of ABMR and FPMR in women with PHBC using a matched cohort.*Methods and Materials Women with PHBC underwent FPMR (January 2008-August 2017) or ABMR (September 2017-April 2019) screening. One MRI examination per each woman was randomly selected using stratified random sampling and then a cohort was matched using propensity score matching according to demographic, MRI, and first breast cancer characteristics. Diagnostic performances were compared with biopsy results and at least 1 year of follow-up data.*Results In total, 726 women were allocated to each group. ABMR showed comparable sensitivity (100.0% [15 of 15] vs 69.2% [9 of 13]; P =.086), cancer detection rate (20.7 [15 of 726] vs 12.4 [9 of 726] per 1000; P = .286), and interval cancer rate (0 [0 of 726] vs 5.5 [4 of 726] per 1000; P = .125) along with superior specificity (92.8% [660 of 711] vs 85.8% [612 of 713]; P <.001) compared to FPMR. The BI-RADS category 3 rate of ABMR was less than half that of FPMR (5% [39 of 726] vs 12% [87 of 726]; P <.001). Most (93%; 14 of 15) cancers detected on ABMR were node-negative T1-invasive cancers or ductal carcinoma in situ.*Conclusions ABMR screening showed comparable sensitivity, cancer detection rate, and interval cancer rate along with superior specificity compared to FPMR by reducing unnecessary short-term follow-ups. *Clinical Relevance/Application Abbreviated breast MRI with short scan time might replace full-protocol MRI when screening MRI is considered for women with a personal history of breast cancer.

RESULTS

In total, 726 women were allocated to each group. ABMR showed comparable sensitivity (100.0% [15 of 15] vs 69.2% [9 of 13]; P =.086), cancer detection rate (20.7 [15 of 726] vs 12.4 [9 of 726] per 1000; P = .286), and interval cancer rate (0 [0 of 726] vs 5.5 [4 of 726] per 1000; P = .125) along with superior specificity (92.8% [660 of 711] vs 85.8% [612 of 713]; P <.001) compared to FPMR. The BI-RADS category 3 rate of ABMR was less than half that of FPMR (5% [39 of 726] vs 12% [87 of 726]; P <.001). Most (93%; 14 of 15) cancers detected on ABMR were node-negative T1-invasive cancers or ductal carcinoma in situ.

CLINICAL RELEVANCE/APPLICATION

Abbreviated breast MRI with short scan time might replace full-protocol MRI when screening MRI is considered for women with a personal history of breast cancer.

SPR-BR-8   Survival Outcomes Of Preoperative Breast MRI In Women With Breast Cancer Aged <=35 Years: A Matched Cohort Study

Participants
Ahreum Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate and compare the effect of preoperative breast magnetic resonance imaging (MRI) on overall survival (OS) and recurrence-free survival (RFS) in women with newly diagnosed breast cancer aged 35 years or younger.*Methods and Materials Following IRB approval, 708 women diagnosed with breast cancer (=35 years) between January 2007 and December 2016 were retrospectively identified. Patients who had undergone preoperative MRI (MRI group) were matched to those who had not undergone preoperative MRI (No MRI group) according to 21 variables regarding to patient and tumor characteristics to create a balanced covariate distribution between the two groups. OS and RFS were compared between the MRI and the No MRI groups using the Kaplan-Meier method and the log-rank test. Cox proportional hazard regression analysis was performed to estimate hazard ratios (HR) with a 95% confidence interval (CI).*Results Of total 708 patients, 125 patient pairs from each group were matched. In the matched cohort, no significant association between MRI and No MRI group was observed in the total recurrence (HR, 1.00; p=0.99), locoregional recurrence (HR, 1.31; p=0.42), contralateral breast recurrence (HR, 0.66, p=0.39) and distant recurrence (HR, 0.89, p=0.79). However, improved overall survival was observed in the MRI group, with statistical significance (HR, 0.47; p=0.07). In Cox proportional hazard regression analysis of unmatched cohort, MRI was not a significant independent factor of RFS (HR, 0.99; p=0.95) or OS (HR, 0.65; p=0.14).*Conclusions Although preoperative breast MRI was not a significant prognostic factor for RFS, better overall survival with 53% reduction in the MRI group was observed in women with breast cancer aged 35 years or younger.*Clinical Relevance/Application Preoperative MRI was a significant prognostic factor for improved overall survival in women with breast cancer (=35 years).

RESULTS

Of total 708 patients, 125 patient pairs from each group were matched. In the matched cohort, no significant association between MRI and No MRI group was observed in the total recurrence (HR, 1.00; p=0.99), locoregional recurrence (HR, 1.31; p=0.42), contralateral breast recurrence (HR, 0.66, p=0.39) and distant recurrence (HR, 0.89, p=0.79). However, improved overall survival was observed in the MRI group, with statistical significance (HR, 0.47; p=0.07). In Cox proportional hazard regression analysis of unmatched cohort, MRI was not a significant independent factor of RFS (HR, 0.99; p=0.95) or OS (HR, 0.65; p=0.14).

CLINICAL RELEVANCE/APPLICATION

Preoperative MRI was a significant prognostic factor for improved overall survival in women with breast cancer (=35 years).

SPR-BR-9   **Residual Microcalcifications In Breast Cancer Patients With Complete Response On MRI After Neoadjuvant Chemotherapy: Factors Predicting Residual Malignancy**

Participants
Sohi Kang I, MD,MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate factors that can predict whether the residual microcalcifications are malignant in the patients with complete responseon MRI after neoadjuvant chemotherapy (NAC) for breast cancer.*Methods and Materials We retrospectively reviewed the data base of 2,144 breast cancer patients who underwent neoadjuvant chemotherapy before surgery between January 2017 and December 2019. Consecutive patients who showed radiologic complete response (rCR) on MRI and had surgery for residual mammographic microcalcifications were included. We analyzed patient characteristics, mammographic findings, histologic characteristics of tumors obtained from the percutaneous biopsy before NAC; molecular subtype (ER-positive and HER2-negative, HER2-positive, or triple negative), Ki-67 index, and changes of microcalcifications after NAC. Uni- and multivariate analysis was used to identify predictors of pathological residual malignant calcifications.*Results A total of 134 patients with a median age of 52 years (interquartile range, 42-62 years) showed rCR on breast MRI and residual microcalcifications after NAC. Surgery for residual microcalcifications revealed residual malignancy in 31.3% (42/134) and the other 94 patients had no residua. According to the logistic regression analysis, molecular subtype and Ki-67 were significant independent factors associated with residual malignancy (P < 0.001, P = 0.006). Residual microcalcifications in ER-positive, HER2-negative cancers showed significantly higher malignancy rate (80.0%, 12/15) than those in HER2-positive cancers (22.6%, 21/93) (P < 0.001). The malignancy rate of residual microcalcifications in the cancers with low Ki-76 was significantly higher than that of high Ki-76 (60.0% vs. 15.6%, p = 0.011).*Conclusions Residual microcalcifications in the patients with ER-positive, HER2-negative cancer were mostly malignant despite of rCR on breast MRI. HER2-positive cancer or high Ki-67 index cancer with rCR on breast MRI can achieve pathological CR even with residual microcalcifications on mammography after NAC.*Clinical Relevance/Application Residual microcalcifications in breast cancer patients with complete response on MRI after neoadjuvant chemotherapy (NAC) do not always mean residual malignancy. The results of our study could guide the surgical management of residual microcalcifications after NAC.

RESULTS

A total of 134 patients with a median age of 52 years (interquartile range, 42-62 years) showed rCR on breast MRI and residual microcalcifications after NAC. Surgery for residual microcalcifications revealed residual malignancy in 31.3% (42/134) and the other 94 patients had no residua. According to the logistic regression analysis, molecular subtype and Ki-67 were significant independent factors associated with residual malignancy (P < 0.001, P = 0.006). Residual microcalcifications in ER-positive, HER2-negative cancers showed significantly higher malignancy rate (80.0%, 12/15) than those in HER2-positive cancers (22.6%, 21/93) (P < 0.001). The malignancy rate of residual microcalcifications in the cancers with low Ki-76 was significantly higher than that of high Ki-76 (60.0% vs. 15.6%, p = 0.011).

CLINICAL RELEVANCE/APPLICATION

Residual microcalcifications in breast cancer patients with complete response on MRI after neoadjuvant chemotherapy (NAC) do not always mean residual malignancy. The results of our study could guide the surgical management of residual microcalcifications after NAC.

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Abstract Archives of the RSNA, 2021

SSPD03

Pediatric (Gastrointestinal)

Participants

Andrew Trout, MD, Cincinnati, Ohio (*Moderator*) Author, RELX;Author, Wolters Kluwer nv;Research Grant, Canon Medical Systems Corporation;Research Grant, Siemens AG;Research support, Perspectum Diagnostics Ltd;Consultant, Lantheus Holdings;

Sub-Events

SSPD03-1   Temporal Progression Of Liver Stiffness In Children With Fontan Physiology: Findings From Serial Magnetic Resonance Elastography (MRE)

Participants
Adarsh Ghosh, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Temporal progression of liver and spleen stiffness measured using MRE has not been evaluated in children with Fontan physiology and may represent the progression of hepatic congestion to Fontan associated liver disease (FALD). We assessed the relationship of the temporal evolution of MRE (t-MRE) with biochemical markers of FALD, from which a model for end-stage liver disease (MELD) score was generated.*Methods and Materials In this IRB approved retrospective study, Fontan patients who had more than one liver MRE between 2010-2020 were identified. The annual rate of change in hepatic and splenic stiffness was determined using MRE as a marker of the temporal progression of stiffness.*Results 34 patients with Fontan physiology were identified with age [median (IQR)] at the 1st MRE 15.6 (14.8-17.9) years. The median time interval between completion of Fontan palliation and the 1st MRE was 13.2 (11.6-16.1) years. Twenty-five patients had two temporally separate MRE scans, while 3, 4, and 5 MRE scans were available in 6, 1 and 2 respectively, with a median time interval between the 1st and last scan being 1.9 (1.1-2.6) years. Baseline and subsequent liver stiffness values obtained by MRE were 3.8 (3.4-4.5) kPa and 4.7 (4.1-5.2) kPa with an annual rate of change in liver stiffness = 0.33 (0.11-0.58) kPa/year. Repeated spleen MRE was available for 29 of these 34 patients, with baseline and subsequent splenic stiffness values of 4.9 (3.9-5.8) kPa and 6.2 (5.4-7.7) kPa, respectively. The annual rate of change of splenic stiffness was 0.62 (-0.19 - 1.47) kPa/year. While the temporal change in liver MRE did not correlate with the temporal change in MELD score (r = -0.205, p = 0.372), the temporal change in spleen MRE showed a moderate negative correlation with the MELD score (r = -0.597 p=0.009). There was a strong positive correlation between the temporal changes of liver stiffness and serum Brain Natriuretic Peptide (BNP) (r= 0.602, p= 0.002).*Conclusions In a pediatric cohort, while there is a temporal progression of liver and splenic stiffness, the liver stiffness does not correlate with the changes in MELD score. This is contrary to the findings in adults and may reflect the natural course of FALD, with the congestion predominating in the early years of life. This is further reiterated by the strong correlation between the temporal changes of BNP (a marker of congestion/heart failure) and liver stiffness.*Clinical Relevance/Application In contrast to findings in adults, temporal increase in liver stiffness in a paediatric cohort does not correlate with increase in MELD scores, and may reflect early stages of the progressively increasing congestion from Fontan Physiology prior to the onset of frank FALD.

RESULTS

34 patients with Fontan physiology were identified with age [median (IQR)] at the 1st MRE 15.6 (14.8-17.9) years. The median time interval between completion of Fontan palliation and the 1st MRE was 13.2 (11.6-16.1) years. Twenty-five patients had two temporally separate MRE scans, while 3, 4, and 5 MRE scans were available in 6, 1 and 2 respectively, with a median time interval between the 1st and last scan being 1.9 (1.1-2.6) years. Baseline and subsequent liver stiffness values obtained by MRE were 3.8 (3.4-4.5) kPa and 4.7 (4.1-5.2) kPa with an annual rate of change in liver stiffness = 0.33 (0.11-0.58) kPa/year. Repeated spleen MRE was available for 29 of these 34 patients, with baseline and subsequent splenic stiffness values of 4.9 (3.9-5.8) kPa and 6.2 (5.4-7.7) kPa, respectively. The annual rate of change of splenic stiffness was 0.62 (-0.19 - 1.47) kPa/year. While the temporal change in liver MRE did not correlate with the temporal change in MELD score (r = -0.205, p = 0.372), the temporal change in spleen MRE showed a moderate negative correlation with the MELD score (r = -0.597 p=0.009). There was a strong positive correlation between the temporal changes of liver stiffness and serum Brain Natriuretic Peptide (BNP) (r= 0.602, p= 0.002).

CLINICAL RELEVANCE/APPLICATION

In contrast to findings in adults, temporal increase in liver stiffness in a paediatric cohort does not correlate with increase in MELD scores, and may reflect early stages of the progressively increasing congestion from Fontan Physiology prior to the onset of frank FALD.

SSPD03-2   Change Over Time In Quantitative MRI Metrics In Children And Young Adults With Sclerosing Cholangitis

Participants
Neeraja Mahalingam, MSc,BSC, Cincinnati, Ohio (*Presenter*) Research support, Perspectum Ltd

PURPOSE

Multiple quantitative magnetic resonance imaging (MRI) methods exist to monitor liver disease in patients with Primary Sclerosing Cholangitis (PSC) and Autoimmune Sclerosing Cholangitis (ASC). These include quantitative magnetic resonance cholangiopancreatography (MRCP), MR elastography (MRE), and iron (T2*)-corrected T1 mapping (cT1). The purpose of this study

is to investigate associations between longitudinal change in quantitative MRI metrics over a one-year period in children and young adults with PSC and ASC.*Methods and Materials This single-center, cross-sectional study, was Health Insurance Portability and Accountability Act (HIPAA)-compliant and institutional review board (IRB)-approved. Autoimmune liver disease registry participants underwent research MRI exams of the liver that included: 3D fast spin-echo MRCP, 2D gradient recalled echo MRE, and cT1 mapping (MOLLI sequence) at baseline and one year later. MRCP+ and LiverMultiscan (both Perspectum Ltd., Oxford, UK) and MREplus+ (Resoundant Inc., Rochester, MN) were used to post-process images. Spearman correlation coefficients were used to assess univariate associations.*Results Nineteen patients with PSC or ASC were included in this study. Mean patient age was 14.7 years (range: 8-20 years; 13 males). Change in liver stiffness significantly positively correlated with changes in several quantitative MRCP measurements, including biliary tree volume as well as total number and length of ducts, strictures, and dilations (r=0.44-0.59; p=0.004-0.03). Changes in whole liver mean cT1 and cT1 interquartile range (IQR) significantly positively correlated with changes in median diameter measurements of the right and left hepatic ducts (r=0.56, and 0.47, respectively; p=0.04).*Conclusions Changes in quantitative MRCP metrics over time correlate with changes in liver stiffness, cT1, and cT1 IQR. Worsening cholangiopathy defined by quantitative MRCP metrics is associated with increasing liver stiffness in children and young adults with PSC and ASC.*Clinical Relevance/Application There is need to explore how quantitative MRI metrics change over time in patients with chronic liver disease, thus helping inform which non-invasive imaging methods best characterize disease progression.

RESULTS

Nineteen patients with PSC or ASC were included in this study. Mean patient age was 14.7 years (range: 8-20 years; 13 males). Change in liver stiffness significantly positively correlated with changes in several quantitative MRCP measurements, including biliary tree volume as well as total number and length of ducts, strictures, and dilations (r=0.44-0.59; p=0.004-0.03). Changes in whole liver mean cT1 and cT1 interquartile range (IQR) significantly positively correlated with changes in median diameter measurements of the right and left hepatic ducts (r=0.56, and 0.47, respectively; p=0.04).

CLINICAL RELEVANCE/APPLICATION

There is need to explore how quantitative MRI metrics change over time in patients with chronic liver disease, thus helping inform which non-invasive imaging methods best characterize disease progression.

SSPD03-3 Pediatric Hepatocellular Carcinoma: Does An Underlying Predisposition Affect Clinical And Imaging Features At Presentation?

Participants
Mitchell Rees, MD, Columbus, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate clinical and imaging features of hepatocellular carcinoma (HCC) in children with and without predisposition to HCC.*Methods and Materials This HIPAA compliant, IRB approved, retrospective study included children (=18 years) with classic HCC who underwent multiphase CT or MRI at one of four institutions between July 2009 and April 2019. Clinical data included age, sex, alpha fetoprotein (AFP) levels, presence or absence of distant metastases, and presence (P+) or absence (P-) of underlying predisposition to HCC. Two radiologists, blinded to predisposing conditions, independently assessed each study for imaging features of classic HCC (non-rim arterial hyperenhancement, non-rim washout, capsule), tumor size, tumor-in-vein (TIV), Pre-Treatment Extent of Tumor (PRETEXT) stage, and PRETEXT annotation factors (extrahepatic extension, multifocality, tumor rupture). One-way ANOVA test or Kruskal-Wallis test were performed for numerical covariates. Chi-square test or Fisher's exact test were employed for categorical covariates.*Results 39 children comprised the study cohort: 22 P- (mean age 11 years +/- 5; 12 boys) and 17 P+ (mean age 11 years +/- 5; 9 boys). In 12/17 patients (70%), P+ factor was a cholestatic disorder or hepatic fibrosis. P- patients had a higher AFP level at presentation (mean 185,739 ng/dL) than P+ patients (mean 6,466 ng/dL) (p 0.028). P- patients had larger tumors (Reader1: P- mean 11.9 cm, P+ mean 6 cm, p 0.003; Reader2: P- mean 12.9 cm, P+ mean 6 cm; p <0.001) and more frequent TIV (Reader1: P- 9/22(41%), P+ 0/17(0%), p 0.002; Reader2: P- 8/22(36%); P+ 0/17(0%), p 0.006). No other imaging feature reached statistical significance for each reader. The most common PRETEXT stage was IV for P- (Reader1: 11/22(50%); Reader2: 12/22(55%)) and II for P+ (Reader1: 7/17(41%); Reader2: 8/17(42%)). Presence of classic imaging features ranged from 27% for capsule (Reader2: 6/22 P-) to 59% for arterial-phase hyperenhancement (Reader1: 13/22 P-).*Conclusions Patients with sporadic HCC (P-) presented with larger tumors, more frequent TIV, and higher PRETEXT stage. Classic HCC imaging features were inconsistently observed in the P- and P+ groups.*Clinical Relevance/Application Compared to HCC in children with underlying predisposition, sporadic pediatric HCC tends to present as a larger mass involving multiple hepatic sections with more frequent tumor thrombus.

RESULTS

39 children comprised the study cohort: 22 P- (mean age 11 years +/- 5; 12 boys) and 17 P+ (mean age 11 years +/- 5; 9 boys). In 12/17 patients (70%), P+ factor was a cholestatic disorder or hepatic fibrosis. P- patients had a higher AFP level at presentation (mean 185,739 ng/dL) than P+ patients (mean 6,466 ng/dL) (p 0.028). P- patients had larger tumors (Reader1: P- mean 11.9 cm, P+ mean 6 cm, p 0.003; Reader2: P- mean 12.9 cm, P+ mean 6 cm; p <0.001) and more frequent TIV (Reader1: P- 9/22(41%), P+ 0/17(0%), p 0.002; Reader2: P- 8/22(36%); P+ 0/17(0%), p 0.006). No other imaging feature reached statistical significance for each reader. The most common PRETEXT stage was IV for P- (Reader1: 11/22(50%); Reader2: 12/22(55%)) and II for P+ (Reader1: 7/17(41%); Reader2: 8/17(42%)). Presence of classic imaging features ranged from 27% for capsule (Reader2: 6/22 P-) to 59% for arterial-phase hyperenhancement (Reader1: 13/22 P-).

CLINICAL RELEVANCE/APPLICATION

Compared to HCC in children with underlying predisposition, sporadic pediatric HCC tends to present as a larger mass involving multiple hepatic sections with more frequent tumor thrombus.

SSPD03-5 The Performance Of Ultrasound In The Evaluation Of Midgut Malrotation And Midgut Volvulus: A Multicenter Study

Participants
Haithuy N. Nguyen, MD, Houston, Texas (*Presenter*) Research Grant, Siemens AG

PURPOSE

To determine the performance of abdominal ultrasound (US) in the evaluation of midgut malrotation and midgut volvulus.*Methods and Materials Multicenter retrospective study. Children evaluated by US for suspected midgut malrotation and volvulus from 01/2018 to 03/2021 were included. Children with known heterotaxy, ventral wall defect, and congenital diaphragmatic hernia, as

well as repeat exams, were excluded from the malrotation evaluation. Demographics, US reports, additional imaging studies, surgeries, alternative surgical diagnoses, and clinical follow-up information were recorded. Reference standards for malrotation included surgery, UGI, CT, and MR, and for volvulus included the above plus clinical follow-up. Sensitivity and specificity were determined for malrotation and volvulus separately.*Results Preliminary data from 420 patients (219 male; median age 40 days, range 0 days - 18 years) with 438 exams were examined. 408 US met inclusion criteria to evaluate for malrotation and 438 for volvulus. 103/408 (25.2%) malrotation cases and 90/438 (20.5%) volvulus cases were deemed inconclusive due to overlying bowel gas or did not report on presence or absence of malrotation and volvulus despite the indication. Of the 305/408 diagnostic exams for malrotation the sensitivity and specificity were respectively 92.9% and 96.5%. Of the 348/438 diagnostic exams for volvulus the sensitivity and specificity were respectively 95.5% and 99.4%. Alternate surgical diagnoses were identified in 56/420 (13.3%) patients.*Conclusions US performs well for the diagnosis of midgut malrotation and volvulus in real life with high sensitivity and specificity.*Clinical Relevance/Application Abdominal US is increasingly being clinically used to evaluate for midgut malrotation and volvulus. We provide data on its performance. Alternate diagnoses found on US are not infrequent.

RESULTS

Preliminary data from 420 patients (219 male; median age 40 days, range 0 days - 18 years) with 438 exams were examined. 408 US met inclusion criteria to evaluate for malrotation and 438 for volvulus. 103/408 (25.2%) malrotation cases and 90/438 (20.5%) volvulus cases were deemed inconclusive due to overlying bowel gas or did not report on presence or absence of malrotation and volvulus despite the indication. Of the 305/408 diagnostic exams for malrotation the sensitivity and specificity were respectively 92.9% and 96.5%. Of the 348/438 diagnostic exams for volvulus the sensitivity and specificity were respectively 95.5% and 99.4%. Alternate surgical diagnoses were identified in 56/420 (13.3%) patients.

CLINICAL RELEVANCE/APPLICATION

Abdominal US is increasingly being clinically used to evaluate for midgut malrotation and volvulus. We provide data on its performance. Alternate diagnoses found on US are not infrequent.

Abstract Archives of the RSNA, 2021

Participants

Imon Banerjee, Atlanta, Georgia (*Moderator*) Nothing to Disclose

Sub-Events

SSIN08   Keynote Speaker

Participants

Akshay Chaudhari, PhD, Menlo Park, California (*Presenter*) Research support, General Electric Company;Research support, Koninklijke Philips NV;Research Consultant, Subtle Medical, Inc;Research Consultant, Image Analysis Group;Research Consultant, ICM Bio;Research Consultant, Culvert Engineering Solutions;Research Consultant, Edge AnalyticsRes

SSIN08-3   Using Natural Language Processing To Assign Fleischner Society Pulmonary Nodule Recommendations To Unstructured Chest CT Reports

Participants

Murray D. Becker, MD, PhD, East Brunswick, New Jersey (*Presenter*) Stockholder, Screen Point Medical;Stockholder, Coverahealth

PURPOSE

Use natural language processing to derive Fleischner Society-based recommendations for incidental pulmonary nodules for Chest CT reports. This pilot study employs a simplified 3 category set of guidelines.*Methods and Materials 2,258 Chest CT reports containing Fleischner Society recommendations were used to train an NLP model to derive nodule follow-up recommendations. To generalize to Chest CT reports that do not explicitly contain recommendations, the Fleischner recommendations were used as labels and stripped from the text before training. Three simplified, aggregated Fleischner-type follow-up categories were used: "Category 1" - no follow-up (65% of cases), "Category 2" - chest CT follow-up (15% of cases), and "Category 3" - urgent follow up (Biopsy, PET/CT, or CT at 3 months) (20% of cases). The data set was split in training, validation and test with a 70:15:15 ratio. The NLP model isolated the text from the report's "Impression" section using heuristics. The text was then encoded using a BERT encoder architecture followed by a linear classification layer. For training, the final (12th) layer of the transformer encoder and the linear layer's weights were fine-tuned. The softmax of the logit outputs from the linear layer were used to classify each impression section into the 3 follow-up categories. Two distinct formulations of the models were used: a binary classification of Category 1 versus Category 2 or 3; and a three-class model using all categories.*Results The binary classifier achieved an ROC-AUC of 0.93 with sensitivity of 0.83 and specificity of 0.85. The three class model had an average ROC-AUC of 0.90 with average sensitivity of 0.76 and average specificity of 0.88. For each of the individual classes within the 3-class model, the ROC-AUC, sensitivity and specificity were 0.91, 0.91, 0.74 for "Category 1", 0.87, 0.56, and 0.92 for "Category 2", and 0.93, 0.80, 0.99 for "Category 3".*Conclusions NLP is able to derive a simplified 2 or 3 class incidental pulmonary nodule follow-up recommendation based on Fleischner guidelines. As part of a QA program, this can help understand errors made using guidelines and may even allow automatic inclusion of recommendations into a study's report.*Clinical Relevance/Application NLP can enhance chest CT reporting by ensuring that all reports contain appropriate, standard nodule follow-up recommendations, and also be used as a measurement tool for chest CT QA programs. The information presented in this paper is based on research results that are not commercially available.

RESULTS

The binary classifier achieved an ROC-AUC of 0.93 with sensitivity of 0.83 and specificity of 0.85. The three class model had an average ROC-AUC of 0.90 with average sensitivity of 0.76 and average specificity of 0.88. For each of the individual classes within the 3-class model, the ROC-AUC, sensitivity and specificity were 0.91, 0.91, 0.74 for "Category 1", 0.87, 0.56, and 0.92 for "Category 2", and 0.93, 0.80, 0.99 for "Category 3".

CLINICAL RELEVANCE/APPLICATION

NLP can enhance chest CT reporting by ensuring that all reports contain appropriate, standard nodule follow-up recommendations, and also be used as a measurement tool for chest CT QA programs. The information presented in this paper is based on research results that are not commercially available.

SSIN08-5   Deep Reinforcement Learning For Aortic Branch Localization In CTA Scans Of Patients With Uncomplicated Type B Aortic Dissection: An International Multicenter Study

Participants

Marina Codari, PhD, Palo Alto, California (*Presenter*) Employee, Arterys Inc.;Spouse, Employee, Carl Zeiss AG

PURPOSE

False lumen outflow patterns are associated with late complications in patients with initially uncomplicated type B aortic dissection (uTBAD). Localization of aortic branches is essential for automated assessment of false lumen outflow patterns on computed tomography angiography (CTA). We sought to evaluate the performance of several deep reinforcement learning (DRL) agents in localizing major aortic branches on CTA scans of uTBAD patients.*Methods and Materials We developed six end-to-end trainable DRL algorithms using a dataset of 145 CTA scans from 7 aortic centers. All agents had the same convolutional neural network

architecture and navigated the image volume using a multiresolution approach. To harmonize data across centers, we resampled all scans to an isotropic voxel resolution of 0.5 mm and applied a [-80, 420] Hounsfield unit density window. Each agent localized the ostium of one of the following arteries: left subclavian, celiac trunk, superior and inferior mesenteric, and left and right renal arteries. We randomly split data from 6 centers into training (80%) and validation (20%) sets, while data from the 7th center served as an independent testing set. Manual annotations performed by aortic imaging experts were used as reference standards. Inter-expert variability in landmark annotation was assessed in the testing dataset and compared with the automatic localization error, defined as the Euclidean distance between paired landmarks. Finally, we recorded the processing time on testing data. Descriptive statistics are reported as median and interquartile range. Pairwise comparisons were performed using Wilcoxon tests.*Results The testing data showed no significant difference between automatic and inter-expert localization error for the left subclavian [3.8 (2.4-7.0) mm vs. 3.7 (2.4-5.1) mm; $P=0.424$]; celiac trunk [2.9 (2.1-5.1) mm vs. 3.7 (2.6-4.5) mm; $P=0.694$] and left renal arteries [(2.3 (1.6-4.4) mm vs. 2.6 (2.1-3.4) mm; $P=0.345$]. Significant differences were found for the right renal [(3.9 (2.4-6.3) mm vs. 2.6 (1.5-3.8) mm; $P=0.004$]; superior mesenteric [(3.3 (2.7-4.7) mm vs. 1.9 (1.4-3.6) mm; $P=0.045$] and inferior mesenteric [(3.0 (2.3-15.2) mm vs. 2.0 (1.4-2.6) mm; $P<0.001$] arteries. The median processing time was 0.7 (0.6-0.9) sec per branch.*Conclusions DRL represents a highly efficient approach to localize multiple branch ostia in uTBAD CTA scans. Nevertheless, the proposed method needs optimization to reach expert-level performance in all branches.*Clinical Relevance/Application Efficient localization of aortic branches allows to assess their involvement in the dissection and the determination of false lumen outflow patterns, potentially leading to better risk-stratification of uTBAD patients.

RESULTS

The testing data showed no significant difference between automatic and inter-expert localization error for the left subclavian [3.8 (2.4-7.0) mm vs. 3.7 (2.4-5.1) mm; $P=0.424$]; celiac trunk [2.9 (2.1-5.1) mm vs. 3.7 (2.6-4.5) mm; $P=0.694$] and left renal arteries [(2.3 (1.6-4.4) mm vs. 2.6 (2.1-3.4) mm; $P=0.345$]. Significant differences were found for the right renal [(3.9 (2.4-6.3) mm vs. 2.6 (1.5-3.8) mm; $P=0.004$]; superior mesenteric [(3.3 (2.7-4.7) mm vs. 1.9 (1.4-3.6) mm; $P=0.045$] and inferior mesenteric [(3.0 (2.3-15.2) mm vs. 2.0 (1.4-2.6) mm; $P<0.001$] arteries. The median processing time was 0.7 (0.6-0.9) sec per branch.

CLINICAL RELEVANCE/APPLICATION

Efficient localization of aortic branches allows to assess their involvement in the dissection and the determination of false lumen outflow patterns, potentially leading to better risk-stratification of uTBAD patients.

SSIN08-6   Uncertainty-based Fast Anomaly Detection With Generative Adversarial Networks On Chest Radiographs

Participants
Jaeyeong Ko, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop an uncertainty-based fast anomaly detection framework with generative adversarial networks (GANs) to detect various abnormalities on chest radiographs in an unsupervised manner.*Methods and Materials The training process of our framework is divided into two processes. First, we trained our GAN model with 72,958 normal chest radiographs. The network used in this work was StyleGAN2-ada, and the input images were resized into a resolution of 1024 by 1024. Second, we trained an encoder for latent space mapping with ResNet34 as a backbone. During the encoder training, the generator and discriminator of GAN were fixed. The loss function used for training the encoder were the sum of encoder loss (Lenc), residual loss (Lres), and feature loss (Lfea). In the anomaly detection process, we exploited Monte Carlo Dropout method to consider the uncertainties in residual map (i.e., differences between input and generated normal images). We also developed a novel visualization method for the residual map, so that abnormality area can be more emphasized. We obtained anomaly score for the input images, and the area under curve (AUC) were used for evaluating the performance of our anomaly detection framework.*Results Our GAN model achieved FID (Fréchet inception distance) score of 1.38 at generating normal chest radiographs. The anomaly detection process took about 1-2 seconds for a single input image. The test dataset contains 14 classes: nodule (n=9), pleural effusion (n=9), pneumothorax (n=10), rib fracture (n=10), pneumomediastinum (n=10), subcuemphysema (n=6), pneumoperitoneum (n=10), calcification (n=10), consolidation (n=7), interstitial opacity (n=10), atelectasis (n=10), mediastinal widening (n=7), cardiomegaly (n=10), and normal (n=100). The AUC of our anomaly detection framework was 0.874 for binary classification of normal and abnormal images.*Conclusions Our uncertainty-based fast anomaly detection model can detect various diseases on chest radiographs without training for each disease. Also, the model provides a fast inference speed comparable to that of supervised models. We propose that our framework can overcome the limitation of current CAD system.*Clinical Relevance/Application Our uncertainty-based fast anomaly detection framework provides anomalous areas through residual maps with uncertainties, which could be helpful for evaluation of chest radiographs.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Our uncertainty-based fast anomaly detection framework provides anomalous areas through residual maps with uncertainties, which could be helpful for evaluation of chest radiographs.

Abstract Archives of the RSNA, 2021

Participants

Bachir Taouli, MD, New York, New York (*Moderator*) Research Grant, Bayer AG;Research Grant, Takeda Pharmaceutical Company Limited;Research Grant, Regeneron Pharmaceuticals, Inc;;
Sudhakar K. Venkatesh, MD, FRCR, Rochester, Minnesota (*Moderator*) Nothing to Disclose
Jeong Hee Yoon, MD, Seoul, Korea, Republic Of (*Moderator*) Speaker, Bayer AG

Sub-Events

SSGI08-1   Pilot Prospective Evaluation Of An Oral Dark Borosilicate Contrast Media Using Dual-energy CT In A Multi-institutional Study

Participants
Payam Mohammadinejad, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the ability of a new oral dark borosilicate contrast media (DBCM) to display the GI tract on contrast-enhanced abdomino-pelvic dual-energy CT (DECT).*Methods and Materials Patients with known or suspected bowel or peritoneal disease consented to participate in this IRB-approved study. Patients underwent clinically-indicated CT using commercially available oral contrast followed by DECT using 1200 mL of DBCM (Nextrast, Inc; Hillsborough CA). Two GI radiologists rated bowel wall visualization and distention (from the stomach to the ileum) using 5-point and 4-point Likert scales, respectively. Radiologists also rated preference between oral agents for visualization of each GI tract segment and three abnormal imaging findings (-2 to +2 scale, with ±2 indicating change in diagnostic confidence). The optimal virtual monoenergetic image keV setting for bowel wall visualization was also estimated.*Results 14 patients (5 female) underwent clinically-indicated CT (4 with 1000 mL positive oral agent, abdominal CT; 10 with 1350 mL neutral oral agent, CT enterography) followed by DBCM DECT. No patients had serious adverse effects after ingestion of DBCM. Radiologists identified 19 and 21 bowel/peritoneal findings in 13 pts, respectively. Mean bowel wall visualization score was significantly higher for DBCM for stomach (3.3±0.8 vs. 2.8±0.7; P<.05), duodenum (2.9±0.5 vs. 2.6±0.7; P=.02), jejunum (3.5±0.5 vs. 2.6±0.8; P=.005), and ileum (3.4±0.7 vs. 3.0±0.7; P=.02). Mean distention scores were significantly higher using DBCM for all GI tract segments (P=.042), except for the stomach. Radiologists' mean preferences were higher for DBCM across all GI tract segments and imaging abnormalities (mean preference 0.4-1.1). Use of DBCM yielded visualization of new imaging findings in 2 patients (14%), and improved diagnostic confidence (preference=2) in another 10-16%, depending on reader. Optimal keV for viewing was 40-50 keV, depending on patient size.*Conclusions Compared to commercially available oral contrast agents, the use of DBCM resulted in improved visualization and distention of the GI tract, with increased diagnostic confidence in a substantial number of abnormal imaging findings.*Clinical Relevance/Application Use of a new oral Dark Borosilicate Contrast Material with DECT may improve the evaluation of the gastrointestinal tract and peritoneal disease during contrast-enhanced abdomino-pelvic CT exams.

RESULTS

14 patients (5 female) underwent clinically-indicated CT (4 with 1000 mL positive oral agent, abdominal CT; 10 with 1350 mL neutral oral agent, CT enterography) followed by DBCM DECT. No patients had serious adverse effects after ingestion of DBCM. Radiologists identified 19 and 21 bowel/peritoneal findings in 13 pts, respectively. Mean bowel wall visualization score was significantly higher for DBCM for stomach (3.3±0.8 vs. 2.8±0.7; P<.05), duodenum (2.9±0.5 vs. 2.6±0.7; P=.02), jejunum (3.5±0.5 vs. 2.6±0.8; P=.005), and ileum (3.4±0.7 vs. 3.0±0.7; P=.02). Mean distention scores were significantly higher using DBCM for all GI tract segments (P=.042), except for the stomach. Radiologists' mean preferences were higher for DBCM across all GI tract segments and imaging abnormalities (mean preference 0.4-1.1). Use of DBCM yielded visualization of new imaging findings in 2 patients (14%), and improved diagnostic confidence (preference=2) in another 10-16%, depending on reader. Optimal keV for viewing was 40-50 keV, depending on patient size.

CLINICAL RELEVANCE/APPLICATION

Use of a new oral Dark Borosilicate Contrast Material with DECT may improve the evaluation of the gastrointestinal tract and peritoneal disease during contrast-enhanced abdomino-pelvic CT exams.

SSGI08-4   Detection Of Hepatic Steatosis On Contrast-enhanced Dual-energy CT: Role And Efficacy Of Virtual Non-contrast CT

Participants
Roberta Catania, MD, Chicago, Illinois (*Presenter*) Institutional Research Grant, Siemens AG

PURPOSE

To investigate performance and diagnostic accuracy of virtual non-contrast (VNC) images for detection of hepatic steatosis.*Methods and Materials In this IRB-approved retrospective study, imaging studies of adult patients who had multiphasic liver-protocol dual-energy CT (DECT) using the same scanner (SOMATOM Definition Drive, Siemens Healthcare) between January 2019 and October 2020 were included. VNC set of images were reconstructed based on hepatic arterial phase. Similar-sized region of interests (ROIs) were placed in the left lateral, left medial, right anterior, and right posterior segments of the liver on true non

contrast (TNC) and VNC images. Average liver density was calculated as the mean of the four measurements. Attenuation of the spleen and liver attenuations on portal-venous-phase were also recorded. Receiver operating curves (ROC) and area under the curve (AUC) were calculated to assess the accuracy of VNC for detection of hepatic steatosis (which was defined as liver attenuation <40 HU and less than splenic density on TNC). Paired t-test and Pearson's correlation coefficient (r) were used to compare the liver attenuation on VNC and TNC. Bland-Altman plots were used to depict the agreement between TNC and VNC. A p-value of <0.05 was set as a statistically significant difference.*Results 238 patients were included in the final analysis (125 female; mean age 60 ±15.4 years; mean BMI 27 ±5.7 kg/m²). Mean liver attenuation values were 51.3 ± 10.9 HU and 58.1 ±11.6 HU for TNC and VNC, respectively, which were statistically different (p<0.001) with a mean difference of 6.8 HU. The correlation between TNC and VNC was very strong (r=0.8, p<0.001). The AUCs of TNC for detection of hepatic steatosis were 0.92 (95% CI: 0.86-0.98), 0.92 (95% CI: 0.87-0.97), 0.93 (95% CI: 0.86-0.99), 0.91 (95% CI: 0.85-0.97), and 0.87 (95% CI: 0.80-0.95) for entire liver, left lateral, left medial, right anterior, and right posterior segments, respectively. Sensitivity and specificity of VNC for detection of hepatic steatosis were 70% and 95%, respectively, when a threshold level of 46HU was used. They were 41% and 100%, respectively, when a threshold of 40HU was used.*Conclusions Hepatic liver attenuation on TNC is significantly correlated with that of TNC and showed high accuracy to detect hepatic steatosis.*Clinical Relevance/Application The VNC images may be used for detection of hepatic steatosis with high specificity, when TNC images not available.

RESULTS

238 patients were included in the final analysis (125 female; mean age 60 ±15.4 years; mean BMI 27 ±5.7 kg/m²). Mean liver attenuation values were 51.3 ± 10.9 HU and 58.1 ±11.6 HU for TNC and VNC, respectively, which were statistically different (p<0.001) with a mean difference of 6.8 HU. The correlation between TNC and VNC was very strong (r=0.8, p<0.001). The AUCs of TNC for detection of hepatic steatosis were 0.92 (95% CI: 0.86-0.98), 0.92 (95% CI: 0.87-0.97), 0.93 (95% CI: 0.86-0.99), 0.91 (95% CI: 0.85-0.97), and 0.87 (95% CI: 0.80-0.95) for entire liver, left lateral, left medial, right anterior, and right posterior segments, respectively. Sensitivity and specificity of VNC for detection of hepatic steatosis were 70% and 95%, respectively, when a threshold level of 46HU was used. They were 41% and 100%, respectively, when a threshold of 40HU was used.

CLINICAL RELEVANCE/APPLICATION

The VNC images may be used for detection of hepatic steatosis with high specificity, when TNC images not available.

SSGI08-5　Synthetic Extracellular Volume Fraction Without Hematocrit Sampling For Hepatic Applications

Participants
Narine Mesropyan, Bonn, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Calculation of extracellular volume fraction (ECV) currently receives increasing interest as a potential biomarker for non-invasive assessment of liver fibrosis. ECV calculation requires hematocrit (Hct) sampling, which might be difficult to obtain in a high-throughput radiology department. The aim of this study was to generate synthetic ECV for hepatic applications without the need for Hct sampling.*Methods and Materials In this prospective study participants underwent liver MRI. T1 mapping was performed before and after contrast administration. Blood Hct was obtained prior to MRI. We hypothesized that the relationship between Hct and longitudinal relaxation rate of blood (R1=1/T1blood) could be calibrated and used to generate the equation for synthetic Hct and ECV calculation. Conventional and synthetic ECV were calculated. Pearson correlation, linear regression and Bland-Altman method were used for statistical analysis.*Results 180 consecutive patients were divided into derivation (n=90) and validation (n=90) cohorts. In the derivation cohort, native R1 blood and Hct showed a linear relationship (HctMOLLI = 98.04 x (1/T1blood) - 33.17, R2 =0.75, P<0.001), which was used to calculate synthetic ECV in the validation and whole study cohorts. Synthetic and conventional ECV showed significant correlations in the derivation, validation and in the whole study cohorts (r=0.99, 0.97 and 0.99, respectively, P<0.001 respectively) with minimal bias according to the Bland-Altman analysis.*Conclusions Synthetic ECV offers an alternative method for the non-invasive quantification of hepatic ECV.*Clinical Relevance/Application The application of synthetic ECV may potentially overcome an important barrier to clinical implementation of ECV and thus enables a broader use of hepatic ECV in routine clinical practice.

RESULTS

180 consecutive patients were divided into derivation (n=90) and validation (n=90) cohorts. In the derivation cohort, native R1 blood and Hct showed a linear relationship (HctMOLLI = 98.04 x (1/T1blood) - 33.17, R2 =0.75, P<0.001), which was used to calculate synthetic ECV in the validation and whole study cohorts. Synthetic and conventional ECV showed significant correlations in the derivation, validation and in the whole study cohorts (r=0.99, 0.97 and 0.99, respectively, P<0.001 respectively) with minimal bias according to the Bland-Altman analysis.

CLINICAL RELEVANCE/APPLICATION

The application of synthetic ECV may potentially overcome an important barrier to clinical implementation of ECV and thus enables a broader use of hepatic ECV in routine clinical practice.

SSGI08-6　Liver Fat Quantification With Ultrasound (UDFF): Validation With MRI (PDFF) And Analysis Of Confounding Factors

Participants
Reinhard I. Kubale, MD, Homburg/Saar, Germany (*Presenter*) Research Consultant, Siemens AG

PURPOSE

Aim of the study was to evaluate feasibility and confounding factors of a new quantitative sonographic method based on a combination of attenuation and backscatter coefficients (UDFF: Ultrasound derived fat fraction) in correlation with the fat fraction measured by MRI (PDFF: Proton density fat fraction). *Methods and Materials Examinations were done with 2 US-machines (Sequoia and S2000: Siemens) with 5C1, DAX and 6C1 transducers with an algorithm based on a phantom corrected combination of attenuation (AC) and backscatter coefficient (BSC). Measurements of a ROI of 9 cm2 were correlated with MRI PDFF values of segmented liver (segPDFF) and a ROI in the right liver lobe (RLL) in the same position (Vida, Siemens - LiverLab®). To test the reproducibility we examined in a pilot study 20 patients with two UDFF-measurements on different days. The effect of fasting state was tested by performing UDFF before, 1, 3 and 5 hours after a standard meal. The main study consists of 165 consecutive patients (98 male, 67 female), who received a liver MRI for clinical reasons.*Results In the pilot study PDFF of the segPDFF (10.3±9.4%), was significantly higher than in the corresponding ROI (8.65±9.6%). The correlation of PDFF-measurements with scan heads (5C1, DAX, 6C1) were r=0.94 /0.91 and 0.85. Repeated measurements showed values of r=0.99/0.97 and 0.89 with best

reproducibility of the DAX. Measurements before, 1, 3 and 5 hours after meal showed no significant differences between the time points (Friedmann-Test). The main study shows a significant difference in segPDFF (11.6±9.1%) and the ROI (8.9±9.5%). Although AC and BSC are not linear related to PDFF, the model with both parameters shows a significant correlation between UDFF and PDFF of the whole liver and the corresponding ROI and Voxel for all patients r=0.80/0.7 and 0.6 (6C1). Bland-Altmann shows, that main confounding factors are severe liver cirrhosis with a small RLL, patients after chemotherapy / lipiodol application, sarcoidosis and amyloidosis. Problems in MRI arose in severe Hemochromatosis, patients over 150 kg due to artifacts. *Conclusions UDFF shows a strong positive correlation with PDFF. Confounding factors could be identified hypothetically allowing for improvement in the future.*Clinical Relevance/Application UDFF could be a screening tool for early diagnosis of NAFLD and a biomarker for therapy control.

RESULTS

In the pilot study PDFF of the segPDFF (10.3±9.4%), was significantly higher than in the corresponding ROI (8.65±9.6%). The correlation of PDFF-measurements with scan heads (5C1, DAX, 6C1) were r=0.94 /0.91 and 0.85. Repeated measurements showed values of r=0.99/0.97 and 0.89 with best reproducibility of the DAX. Measurements before, 1, 3 and 5 hours after meal showed no significant differences between the time points (Friedmann-Test). The main study shows a significant difference in segPDFF (11.6±9.1%) and the ROI (8.9±9.5%). Although AC and BSC are not linear related to PDFF, the model with both parameters shows a significant correlation between UDFF and PDFF of the whole liver and the corresponding ROI and Voxel for all patients r=0.80/0.7 and 0.6 (6C1). Bland-Altmann shows, that main confounding factors are severe liver cirrhosis with a small RLL, patients after chemotherapy / lipiodol application, sarcoidosis and amyloidosis. Problems in MRI arose in severe Hemochromatosis, patients over 150 kg due to artifacts.

CLINICAL RELEVANCE/APPLICATION

UDFF could be a screening tool for early diagnosis of NAFLD and a biomarker for therapy control.

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Abstract Archives of the RSNA, 2021

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SSNR01

Science Session with Keynote: Neuroradiology (Brain: Cognition and Memory)

</div>

Participants

Lily L. Wang, MBBS, Cincinnati, Ohio (*Moderator*) Nothing to Disclose

Sub-Events

SSNR01   Keynote Speaker

Participants

Tammie Benzinger, MD, PhD, Saint Louis, Missouri (*Presenter*) Research Grant, Eli Lilly and Company;Investigator, Eli Lilly and Company;Investigator, F. Hoffmann-La Roche Ltd;Consultant, Siemens AG;Consultant, ADM Diagnostics, LLC;Speakers Bureau, Biogen Idec Inc;Advisory Board, Biogen Idec Inc;Speakers Bureau, Eisai Co, Ltd;Advisory Board, Eisai Co, Ltd

SSNR01-3   Longitudinal Changes In Brain Connectivity In Hypertensive Patients From The SPRINT Trial: Intensive Blood Pressure Management Is Associated With Less Decline In Connectivity

Participants

Chintan Shah, MD, MS, Cleveland, Ohio (*Presenter*) Spouse, Employee, Merck & Co, Inc

PURPOSE

The Systolic blood PRessure INTervention (SPRINT) trial randomized 9361 adults with hypertension (HTN) to intensive or standard blood pressure management. Intensive therapy resulted in improved cardiovascular outcomes and slower progression of white matter lesions (WML). Here, we assess longitudinal changes in brain functional connectivity (?FC) to determine (1) whether intensive treatment results in less decline in FC and (2) how ?FC relates to changes in brain structure.*Methods and Materials In this IRB-approved multicenter trial, 549 participants underwent brain MRI including 3D T1, 3D T2 FLAIR, and resting state fMRI (axial BOLD EPI; TR/TE 2000/25 ms, 3.5 mm voxels, 120 volumes). Intracranial tissues were segmented using multiatlas label fusion, and WML were identified using deep-learning based classification. Resting state brain networks were identified via group-level independent component analysis (ICA) using MELODIC, followed by group-information-guided ICA. Mean connectivity score (MCS) was calculated for each network as the average within-network FC. ?MCS was compared between groups for six networks of interest using a 2-sample t-test, followed by voxel-wise t-test for the significant network. Subgroup analysis was performed using age, baseline WML, ?WML, and change in ICV-normalized total brain volume (?TBVr). In the full cohort, adjusted linear regression analysis was performed between ?MCS and both ?WML and ?TBVr.*Results Analysis included 406 participants with two scans that passed quality control. SPRINT participants in the standard BP group demonstrated significantly greater decline in MCS of the Auditory-salience-language network (ASLN) relative to those in the intensive treatment group (p=0.014), but not in other networks. A voxel-wise t-test of the ASLN demonstrated regions of significant difference in the cingulate and right insular regions (Figure). In subgroup analyses, SPRINT participants in high baseline WML, older age, and lower ?TBVr subgroups had significantly greater decline in MCS of the ASLN (p<0.05). Agnostic of treatment group, ?MCS of the DMN demonstrated significant correlation with ?WML and ?TBVr (p<0.05).*Conclusions In HTN patients, longitudinal increase in WML burden or decrease in TBV is associated with declines in FC of the DMN. Intensive treatment is associated with less decline in FC of the ASLN, particularly in older patients or those with higher WML.*Clinical Relevance/Application Intensive management of hypertension demonstrates a protective effect on brain function in addition to previously seen impacts on brain structure and cardiovascular outcomes.

RESULTS

Analysis included 406 participants with two scans that passed quality control. SPRINT participants in the standard BP group demonstrated significantly greater decline in MCS of the Auditory-salience-language network (ASLN) relative to those in the intensive treatment group (p=0.014), but not in other networks. A voxel-wise t-test of the ASLN demonstrated regions of significant difference in the cingulate and right insular regions (Figure). In subgroup analyses, SPRINT participants in high baseline WML, older age, and lower ?TBVr subgroups had significantly greater decline in MCS of the ASLN (p<0.05). Agnostic of treatment group, ?MCS of the DMN demonstrated significant correlation with ?WML and ?TBVr (p<0.05).

CLINICAL RELEVANCE/APPLICATION

Intensive management of hypertension demonstrates a protective effect on brain function in addition to previously seen impacts on brain structure and cardiovascular outcomes.

SSNR01-6   Diagnostic Performance Of The Medial Temporal Lobe Atrophy Scale In Patients With Alzheimer's Disease: A Systematic Review And Meta-analysis

Participants

Sojeong Lee, MD, SEOUL, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic performance and reliability of the medial temporal lobe atrophy (MTA) scale in patients with Alzheimer's disease.*Methods and Materials A systematic literature search of MEDLINE and EMBASE databases was performed to select studies that evaluated the diagnostic performance or reliability of MTA scale, published up to January 21, 2021. Pooled estimates of

sensitivity and specificity were calculated using a bivariate random-effects model. Pooled correlation coefficients for intra- and interobserver agreement were calculated using the random effects model based on Fisher's Z transformation of correlations. Meta-regression was performed to explain the study heterogeneity. Subgroup analysis was performed to compare the diagnostic performance of the MTA scale and hippocampal volumetry.*Results Twenty-one original articles were included. The pooled sensitivity and specificity of the MTA scale in differentiating Alzheimer's disease from healthy control were 74% (95% CI, 68-79%) and 88% (95% CI, 83-91%), respectively. The area under the curve of the MTA scale was 0.88 (95% CI, 0.84-0.90). Meta-regression demonstrated that the difference in the method of rating the MTA scale was significantly associated with study heterogeneity (P = 0.04). No significant difference was observed in five studies regarding the diagnostic performance between MTA scale and hippocampal volumetry (P = 0.40). The pooled correlation coefficient for intra- and interobserver agreement were 0.85 (95% CI, 0.69-0.93) and 0.83 (95% CI, 0.66-0.92), respectively.*Conclusions Our meta-analysis demonstrated a good diagnostic performance and reliability of the MTA scale in Alzheimer's disease.*Clinical Relevance/Application Our study supports the use of the MTA scale in daily clinical practice for the evaluation of patients with cognitive impairment.

RESULTS

Twenty-one original articles were included. The pooled sensitivity and specificity of the MTA scale in differentiating Alzheimer's disease from healthy control were 74% (95% CI, 68-79%) and 88% (95% CI, 83-91%), respectively. The area under the curve of the MTA scale was 0.88 (95% CI, 0.84-0.90). Meta-regression demonstrated that the difference in the method of rating the MTA scale was significantly associated with study heterogeneity (P = 0.04). No significant difference was observed in five studies regarding the diagnostic performance between MTA scale and hippocampal volumetry (P = 0.40). The pooled correlation coefficient for intra- and interobserver agreement were 0.85 (95% CI, 0.69-0.93) and 0.83 (95% CI, 0.66-0.92), respectively.

CLINICAL RELEVANCE/APPLICATION

Our study supports the use of the MTA scale in daily clinical practice for the evaluation of patients with cognitive impairment.

Printed on: 06/28/22

SSMK08

Musculoskeletal (Hardware and Orthopaedic Implants, Infection)

Participants
Hillary Garner, MD, Jacksonville, Florida (*Moderator*) Nothing to Disclose
Scott Wuertzer, MD, Winston Salem, North Carolina (*Moderator*) Nothing to Disclose

Sub-Events

SSMK08-1 Identification Of Bone Marrow Edema In Osteomyelitis Of The Lower Limb: Diagnostic Accuracy Of Dual-energy CT versus MRI

Participants
Giovanni Foti, MD, Negrar, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic accuracy values of dual-energy Computed Tomography (DECT) in identifying bone marrow edema (BME) around osteomyelitis foci of the lower limb.*Methods and Materials This prospective institutional review board-approved study included 20 consecutive patients (12 males and 8 females; mean age of 53.4, range 22-76 years) studied between January 2018 and January 2021. All patients underwent DECT (80 kV and tin filter 150 kV) and MRI within 7 days. DECT data were post-processed on a dedicated offline workstation (SyngoVia® VB20) by using a three-material decomposition algorithm for generating non-calcium images of the knee. Two radiologists (16 and 8 years of experience, respectively), blinded to clinical data, evaluated the presence of BME on dedicated color-coded maps. Also 2D high resolution images were evaluated. Diagnostic accuracy values of DECT were calculated by using MRI images as standard of reference. DECT numbers were assessed by using a region of interest (quantitative assessment). Receiver operator curves (ROC) and relative area under the curve (AUC) were calculated. Inter-observer and intra-observer agreement were calculated with k-statistics. Continuous and categorical variables were evaluated by using t test and x2 or Fisher exact test, as appropriate. A value of $p<0.05$ was considered statistically significant.*Results MRI revealed the presence of BME in 16/20 patients (80.0%), located at the level of femur (n=5), of tibia (n=10), of the foot (n=5). The sensitivity, specificity, and AUC of DECT were 87.5% (14/16), 75.0 % (3/4) with an AUC of 0.880 (95% CI: 0.757-0.912) for R1, and 75% (12/16) and 100% (4/4) with an AUC of 0.862 (95% CI: 0.744-0.906) for R2. DECT numbers were significantly different between positive (mean -15.2 ± 25.2 HU) and negative cases (mean -63.2 ± 41.2HU) with a p value <0.001. The interobserver and intraobsever agreements were near perfect (k=0.82 and k=0.84, respectively).*Conclusions DECT is an accurate imaging tool for the identification of BME around lower limb osteomyelitis foci.*Clinical Relevance/Application DECT represents a fast and accurate imaging tool for demonstration of BME in lower limb osteomyelitis, virtually free from motion artifacts and with the additional advantage to yield high resolution bone window images.

RESULTS

MRI revealed the presence of BME in 16/20 patients (80.0%), located at the level of femur (n=5), of tibia (n=10), of the foot (n=5). The sensitivity, specificity, and AUC of DECT were 87.5% (14/16), 75.0 % (3/4) with an AUC of 0.880 (95% CI: 0.757-0.912) for R1, and 75% (12/16) and 100% (4/4) with an AUC of 0.862 (95% CI: 0.744-0.906) for R2. DECT numbers were significantly different between positive (mean -15.2 ± 25.2 HU) and negative cases (mean -63.2 ± 41.2HU) with a p value <0.001. The interobserver and intraobsever agreements were near perfect (k=0.82 and k=0.84, respectively).

CLINICAL RELEVANCE/APPLICATION

DECT represents a fast and accurate imaging tool for demonstration of BME in lower limb osteomyelitis, virtually free from motion artifacts and with the additional advantage to yield high resolution bone window images.

SSMK08-3 Ultrasound Assessment Of Synovitis In Total Knee Replacements

Participants
Ji Lin, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To determine if Ultrasound (US) can accurately depict the synovial appearances of infection and polymeric wear in total knee replacements.*Methods and Materials IRB approved study consisting of 2 cohorts of patients with painful total knee replacements (TKR). One cohort consisted of 70 patients undergoing MRI who also consented to a diagnostic US. The other cohort consisted of 149 patients with painful TKR undergoing US guided aspiration of the knee, who also had a diagnostic US prior to the aspiration. The diagnostic US in both cohorts consisted of grey scale cine clips and static images of the entire suprapatellar recess and parapatellar gutters in short and long axis planes. US studies were independently reviewed by 2 radiologists, grading the synovium as lamellated, polymeric, or normal/nonspecific, blinded to the MR appearance or the clinical outcome. Each MR exam was reviewed by a 3rd radiologist using the same grading system. Data was analyzed to determine (1) agreement between the MR grader and US graders, (2) agreement between US graders and results from joint fluid analysis and surgical/clinical follow-up, (3) sensitivity, specificity, PPV, and NPV of US.*Results Agreement between US and MRI was poor to fair (grader 1 kappa coefficient (?) 0.167; grader 2 ? 0.322) with moderate inter-rater agreement (? 0.505). Sensitivity and specificity of US for infection in the 2nd cohort was 0.267 and 0.832 for grader 1 and 0.429 and 0.835 for grader 2. PPV and NPV for grader 1 was 0.154 and 0.908. PPV and NPV for grader 2 was 0.115 and 0.967. Sensitivity and specificity of US for polymeric wear in the 2nd cohort was 0.056 and 0.960 for

grader 1 and 0.114 and 0.970 for grader 2. PPV and NPV for grader 1 was 0.375 and 0.889. PPV and NPV for grader 2 was 0.625 and 0.711.*Conclusions Compared to a validated modality (MRI) and aspiration/clinical results, US does not perform well in assessing for infection or polymeric synovitis. Sensitivity and PPV of US compared to aspirate and clinical follow-up was poor for both infection and polymeric synovitis but with good specificity and NPV.*Clinical Relevance/Application US cannot reliably differentiate the various synovial patterns to identify infection or polyethylene wear.

RESULTS

Agreement between US and MRI was poor to fair (grader 1 kappa coefficient (?) 0.167; grader 2 ? 0.322) with moderate inter-rater agreement (? 0.505). Sensitivity and specificity of US for infection in the 2nd cohort was 0.267 and 0.832 for grader 1 and 0.429 and 0.835 for grader 2. PPV and NPV for grader 1 was 0.154 and 0.908. PPV and NPV for grader 2 was 0.115 and 0.967. Sensitivity and specificity of US for polymeric wear in the 2nd cohort was 0.056 and 0.960 for grader 1 and 0.114 and 0.970 for grader 2. PPV and NPV for grader 1 was 0.375 and 0.889. PPV and NPV for grader 2 was 0.625 and 0.711.

CLINICAL RELEVANCE/APPLICATION

US cannot reliably differentiate the various synovial patterns to identify infection or polyethylene wear.

SSMK08-4   Metal Artifact Reduction In Photon-Counting CT Using Monoenergetic Reconstructions - Initial Experience

Participants
Daniel Popp, Augsburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The objective of this study was to investigative to what extent the spectral information in CT acquisitions with a Photon-Counting Detector (PCD) can be utilized for metal artifact reduction in patients with metal implants.*Methods and Materials Here, we present initial data from 10 patients who are part of an ongoing study that will include 100 patients with metal implants. All patients underwent PCD-CT using a spectral acquisition mode on a novel photon counting dual-source CT scanner (NAEOTOM Alpha, Siemens Healthineers, Erlangen, Germany) as part of routine clinical workup. All datasets were evaluated for metal artifacts in monoenergetic reconstructions (50 keV, 70 keV, 100 keV and 160 keV) independently by two observers blinded to the keV value using a five point rating scale (1: no artifacts; 5: non-diagnostic image quality).*Results Across all measurements, readers showed high agreement in metal artifact score (kappa: 0.74). With increasing keV-levels, metal artifacts were rated substantially less pronounced with means of 3.9 ± 0.27, 3.4 ± 0.5, 2.5 ± 0.5 and 1.7 ± 0.6, for 50, 70, 100 and 160 keV, respectively. Differences of the score of the 160 keV reconstructions to all other keV levels were highly significant. While at 70 keV, 40% of datasets were rated as not fully diagnostic, 100% of datasets were rated as fully diagnostic at 160 keV.*Conclusions Monoenergetic reconstructions derived from photon counting CT scans substantially decrease metal artifacts and increase interpretability in patients with metal implants.*Clinical Relevance/Application Especially after spine surgery the presented PCD-based approach for metal artifact reduction greatly facilitates the evaluation of soft tissues in the surgical area.

RESULTS

Across all measurements, readers showed high agreement in metal artifact score (kappa: 0.74). With increasing keV-levels, metal artifacts were rated substantially less pronounced with means of 3.9 ± 0.27, 3.4 ± 0.5, 2.5 ± 0.5 and 1.7 ± 0.6, for 50, 70, 100 and 160 keV, respectively. Differences of the score of the 160 keV reconstructions to all other keV levels were highly significant. While at 70 keV, 40% of datasets were rated as not fully diagnostic, 100% of datasets were rated as fully diagnostic at 160 keV.

CLINICAL RELEVANCE/APPLICATION

Especially after spine surgery the presented PCD-based approach for metal artifact reduction greatly facilitates the evaluation of soft tissues in the surgical area.

SSMK08-6   Quantitative Dual-Energy CT Reveals Fluorine As A Noninvasive Biomarker For Osteomyelitis In A Tyrannosaurus Rex

Participants
Charlie Hamm, MD, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To exploit dual-energy CT (DECT) imaging for the investigation of the diseased left dentary of a Tyrannosaurus rex (T. rex) using a clinical CT-scanner. *Methods and Materials This study investigated the left dentary of the T. rex MB.R. 91216 which is 79.5 cm long and has a max. thickness of 81 mm. CT imaging was performed on a medical 320-row CT scanner with an X-ray absorption measurement range from -32768 to +32767 HU. A dual-energy helical scan mode with 80 and 135 kVp was used that switches between the two energies once during each rotation. Two custom and validated DECT algorithms were applied for the detection of calcium and fluorine, based on a three-material decomposition approach. For quantitative analysis identical regions of interest were placed in different parts of the investigated bone in the calcium and fluorine DECT dataset, respectively, and ANOVA with the Bonferrroni´s multiple comparisons test was applied.*Results The left dentary shows two notable findings on visual inspection and CT imaging, a diffuse thickening of nearly the entire left dentary with a homogenous distribution of calcium and a focal exophytic mass on the ventral surface of the dentary with a significant accumulation of fluorine (p<0.0001). Furthermore, the focal exophytic mass showed diminutive diffuse lucencies extending from the surface to the tooth root of the 5th replacement tooth and demonstrated a tapering shape with a fistular-like center, which also demonstrated a significant fluorine accumulation respectively (p<0.0001). The perseverance of anatomical structures within the mass suggests the diagnosis of tumefactive osteomyelitis.*Conclusions While DECT imaging is a common clinical diagnostic tool, this study presents a novel DECT-based approach for the characterization of tumefactive osteomyelitis in a T. rex. Specifically, the noninvasive density- and element-based material decomposition of fossilized bone revealed that fluorine could serve as an imaging biomarker for areas with decreased bone density, helping paleontologists to investigate fossils without the need to harm their integrity.*Clinical Relevance/Application DECT-based quantification of fluorine revealed a novel noninvasive imaging biomarker for osteomyelitis in vertebrate paleontology, underlining the role of radiology in paleontological research.

RESULTS

The left dentary shows two notable findings on visual inspection and CT imaging, a diffuse thickening of nearly the entire left dentary with a homogenous distribution of calcium and a focal exophytic mass on the ventral surface of the dentary with a

significant accumulation of fluorine (p<0.0001). Furthermore, the focal exophytic mass showed diminutive diffuse lucencies extending from the surface to the tooth root of the 5th replacement tooth and demonstrated a tapering shape with a fistular-like center, which also demonstrated a significant fluorine accumulation respectively (p<0.0001). The perseverance of anatomical structures within the mass suggests the diagnosis of tumefactive osteomyelitis.

CLINICAL RELEVANCE/APPLICATION

DECT-based quantification of fluorine revealed a novel noninvasive imaging biomarker for osteomyelitis in vertebrate paleontology, underlining the role of radiology in paleontological research.

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Participants

Patricia Mergo, MD, Ponte Vedra, Florida (*Moderator*) Nothing to Disclose

U. Joseph Schoepf, MD, Charleston, South Carolina (*Moderator*) Research Grant, Bayer AGResearch Grant, Bracco GroupResearch Grant, Elucid BioImaging IncConsultant, Elucid BioImaging IncResearch Grant: General Electric CompanyResearch Grant, Guerbet SAResearch Grant, Heartflow, IncSpeakers Bureau, Heartflow IncResearc

Sub-Events

SSCH06-1 Free-breathing Radial 3D Fat-suppressed T1-weighted Gradient Echo (R-vibe) Sequence For Assessment Of Pulmonary Lesions: A Prospective Comparison Of CT and MRI

Participants

Xu Yang Zhang, Xianyang, China (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether the pulmonary MR imaging with free-breathing radial 3D fat-suppressed T1-weighted gradient echo (r-VIBE) sequence can detect lung lesions and display lesion profiles with an accuracy comparable to that of computed tomography (CT), which is the reference standard in this study.*Methods and Materials Sixty-three consecutive patients were prospectively enrolled as their chest radiograph or CT raised suspicions of lung cancer between October, 2016 and March, 2017. All the patients received 3T MRI scanning with a free-breathing r-VIBE sequence within 48 hour after CT. Morphologic features of lesions were evaluated by two radiologists with a 5-point system. Chest standard CT were used as reference standard. Weighted kappa analysis and chi-squared test were used to determine both inter-observer agreement and inter-method agreement.*Results A total of 293 solid pulmonary nodules or masses and 1 ground-glass nodule were detected by CT. Compared to CT, r-VIBE correctly detected 94.8% of pulmonary nodules. The inter-method agreements were significant and either "substantial" or "excellent" in the evaluation of following features between r-VIBE and standard-dose CT: including lobulation, spiculation, convergence of vessels, bubble-like attenuation,cavitation and mediastinal lymph node enlargement (0.605=K=1.000; P<0.0001), with the sensitivity of 81.8%, 93.3%, 71.4%, 81.8%, 100% and 88.2%. However, K values for inter-method agreements were significant but "moderate" or "poor" for evaluating pleural tag, halo, and calcification (0.355=K=0.451;P<0.0001) with the sensitivity of 66.7%, 25%, 33.3%.*Conclusions The use of pulmonary MR imaging with r-VIBE showed high detection rate of pulmonary nodules and inter-method agreement with CT.*Clinical Relevance/Application It is also useful for nodule morphologic assessment.

RESULTS

A total of 293 solid pulmonary nodules or masses and 1 ground-glass nodule were detected by CT. Compared to CT, r-VIBE correctly detected 94.8% of pulmonary nodules. The inter-method agreements were significant and either "substantial" or "excellent" in the evaluation of following features between r-VIBE and standard-dose CT: including lobulation, spiculation, convergence of vessels, bubble-like attenuation,cavitation and mediastinal lymph node enlargement (0.605=K=1.000; P<0.0001), with the sensitivity of 81.8%, 93.3%, 71.4%, 81.8%, 100% and 88.2%. However, K values for inter-method agreements were significant but "moderate" or "poor" for evaluating pleural tag, halo, and calcification (0.355=K=0.451;P<0.0001) with the sensitivity of 66.7%, 25%, 33.3%.

CLINICAL RELEVANCE/APPLICATION

It is also useful for nodule morphologic assessment.

SSCH06-3 Impact Of Photon Counting CT In Reader Confidence In Diagnosis Of Interstitial Lung Disease

Participants

Akitoshi Inoue, MD,PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate impact of higher spatial resolution of investigational photon-counting detector (PCD)-CT on radiologist confidence in diagnosis of usual interstitial pneumonia (UIP) compared to conventional energy-integrating detector (EID)-CT.*Methods and Materials Patients suspected of interstitial lung disease were scanned on a prototype PCD-CT system after informed consent and clinically-indicated EID-CT. In two sessions, three thoracic radiologists blinded to clinical history and scanner type evaluated CT images of the right and left lungs separately on EID- or PCD-CT, reviewing each lung once/session, rating confidence in reticulations, traction bronchiectasis, honeycombing, ground-glass opacities (GGO), mosaic pattern, and lower lobe predominance (100-point scale: 0—33, likely absent, 34—66, indeterminate, 67—100, likely present). Radiologists rated confidence for the probability of UIP (0—20, normal; 21—40, inconsistent with UIP; 41—60, indeterminate UIP; 61—81; probable UIP; 81—100, definite UIP), and graded image quality (5-point Likert scale). Because a confidence scale of 50 represented completely equivocal findings, the absolute value of confidence scores from 50 was used for analysis (higher scores were more confident). Reader confidence was compared using linear mixed effects regression. The consistency of findings and diagnosis between two scanners were evaluated using McNemar's test and weighted kappa statistics, respectively.*Results 30 patients (mean age: 68.8 ± 11.0 years, M: F=18:12) underwent conventional EID and research PCD-CT. The confidence scales in PCD-CT were significantly higher than those in EID-CT for reticulation (40.7 v.s 38.3; P=0.023), GGO (34.4 v.s 31.7; P=0.019), and mosaic pattern (38.6 v.s 35.9 ; P=0.013), but not

traction bronchiectasis (41.7 v.s 41.4; P=0.749), honeycombing (42.8 v.s 42.0; P=0.370), or lower lung predominant (28.3 v.s 29.7; P=0.375). GGO and mosaic pattern demonstrated significant differences between interpretations of EID-CT and PCD-CT (P=0.028). Reader confidence in UIP changed significantly for 1/3 readers (p=0.009). PCD-CT had higher scores in overall image quality (4.84 ± 0.38) than those in EID-CT (4.02 ± 0.40; P<0.001).*Conclusions PCD-CT provided better image quality and improved reader's confidence for reticulation, GGO, and mosaic pattern with idiosyncratic effect on reader diagnosis of UIP.*Clinical Relevance/Application PCD-CT provides improved image quality that translates into increased diagnostic confidence in reticulations, mosaic pattern, and ground glass opacities, which may improve imaging diagnosis of UIP.

RESULTS

30 patients (mean age: 68.8 ± 11.0 years, M: F=18:12) underwent conventional EID and research PCD-CT. The confidence scales in PCD-CT were significantly higher than those in EID-CT for reticulation (40.7 v.s 38.3; P=0.023), GGO (34.4 v.s 31.7; P=0.019), and mosaic pattern (38.6 v.s 35.9 ; P=0.013), but not traction bronchiectasis (41.7 v.s 41.4; P=0.749), honeycombing (42.8 v.s 42.0; P=0.370), or lower lung predominant (28.3 v.s 29.7; P=0.375). GGO and mosaic pattern demonstrated significant differences between interpretations of EID-CT and PCD-CT (P=0.028). Reader confidence in UIP changed significantly for 1/3 readers (p=0.009). PCD-CT had higher scores in overall image quality (4.84 ± 0.38) than those in EID-CT (4.02 ± 0.40; P<0.001).

CLINICAL RELEVANCE/APPLICATION

PCD-CT provides improved image quality that translates into increased diagnostic confidence in reticulations, mosaic pattern, and ground glass opacities, which may improve imaging diagnosis of UIP.

SSCH06-4   Quantitative CT Analysis Of Ambient Particulate Matter Exposure-associated Multiscale Structure And Function Alteration In Healthy, Asthma, COPD, And IPF Lungs

Participants
Jiwoong Choi, PhD, Kansas City, Kansas (*Presenter*) Nothing to Disclose

PURPOSE

We explored to associate directly measured ambient particulate matter (PM) exposure with quantitative computed tomography (QCT)-based pulmonary structural and functional alteration in healthy adults and patients with asthma, chronic obstructive pulmonary disease (COPD) and idiopathic pulmonary fibrosis (IPF).*Methods and Materials Inspiratory and expiratory CTs, direct measurements of PM1, PM2.5, PM4, PM10, and total suspended particle (TSP), and pulmonary function test (PFT) results were prospectively collected from 128 participants (age=67.6±8.57, M:F=92:36) with healthy lungs (age=70.4±6.6, M:F=3:17), asthma (age=62.6±10.6, M:F=23:11), COPD (age=68.3±7.0, M:F=47:4), and IPF (age=71.2±6.9, M:F=19:4). 160 QCT features of multiscale structure and function, body composition, and vessel quantification were derived (Figure A). Machine learning analysis such as principal component analysis (PCA) and K-means clustering were used for dimension reduction and subgrouping. ANOVA and post-hoc Kruskal-Wallis test and Pearson's correlation were used for statistical analysis.*Results Four QCT-based clusters were obtained from PCA and K-means clustering. Cluster 1 through 4 (C1, C2, C3, and C4) showed significant differences in exposures to PM4 (C1>C2>C3>C4), PM10 (C1>C2=C3>C4) and TSP (C1>C2=C3>C4) (p<0.05). Highest exposure cluster C1 had significantly increased whole lung high attenuation area percent (HAA%) and significantly decreased mean local lung expansion (J) in all five lobes (p<0.05). Normalized airway diameters were significantly smaller in C1 than the minimally exposed cluster C4 (p<0.05). Airway cross-section circularity and normalized wall thickness in multiple regions were smaller in C1 than in C4 (p<0.05). In each disease type, significant correlations were also found between PM exposures with multiple QCT features (Figures B and C).*Conclusions QCT analysis showed impacts of ambient PM exposure on structural and functional characteristics of healthy, asthma, COPD, and IPF lungs.*Clinical Relevance/Application QCT analysis may provide more precise pathophysiological interpretation of association between ambient PM exposure with regional structural and functional alterations in healthy, asthma, COPD, and IPF lungs.

RESULTS

Four QCT-based clusters were obtained from PCA and K-means clustering. Cluster 1 through 4 (C1, C2, C3, and C4) showed significant differences in exposures to PM4 (C1>C2>C3>C4), PM10 (C1>C2=C3>C4) and TSP (C1>C2=C3>C4) (p<0.05). Highest exposure cluster C1 had significantly increased whole lung high attenuation area percent (HAA%) and significantly decreased mean local lung expansion (J) in all five lobes (p<0.05). Normalized airway diameters were significantly smaller in C1 than the minimally exposed cluster C4 (p<0.05). Airway cross-section circularity and normalized wall thickness in multiple regions were smaller in C1 than in C4 (p<0.05). In each disease type, significant correlations were also found between PM exposures with multiple QCT features (Figures B and C).

CLINICAL RELEVANCE/APPLICATION

QCT analysis may provide more precise pathophysiological interpretation of association between ambient PM exposure with regional structural and functional alterations in healthy, asthma, COPD, and IPF lungs.

SSCH06-5   Magnetic Resonance Imaging Sequences For Interstitial Lung Disease Assessment In Systemic Sclerosis

Participants
Giovanni Morana, MD, Treviso, Italy (*Presenter*) Speakers Bureau, Bracco Group

PURPOSE

Ultrashort Echo Time (UTE) Magnetic Resonance Imaging (MRI) sequences have been improved to counteract signal decay of lung parenchyma. Compressed Sensing (CS) sequences fast acquisitions should permit breath hold scans. We tested two MRI sequences, UTE Spiral VIBE and CS VIBE, in assessing Interstitial Lung Disease (ILD) related to Systemic Sclerosis (SSc), compared to computed tomography (CT). We aimed to tried out MRI for ILD detection and ILD, ground glass opacities (GGO), reticulation (RET), honeycombing (HC) and consolidation (CON) extent analysis.*Methods and Materials SSc patients in clinical need for chest CT were prospectively enrolled. CT, MRI free breathing UTE Spiral VIBE and inspiratory breath hold CS VIBE scans were performed. Two radiologists, independently and in consensus, computed a visual analysis of GGO, RET, HC and CON extents, on MRI and CT (vCT). The sum of the alterations was assumed as ILD extent. As regards ILD detection, patients were considered positive for ILD when ILD extent >5% total lung volume on visual scores. A quantitative texture analysis (qCT) was also performed on CT, providing ILD, GGO, RET and HC extents. Cohen's k was adopted for inter-reader concordance in visual ILD detection. Sensitivity and specificity of MRI for ILD detection were evaluated. Lin's concordance (CCC) was adopted to compute the agreement in extent analysis between readers and between CT and MRI.*Results 54 patients performed CT and MRI. 9 CT were discarded from qCT for inadequate segmentation. 3 UTE Spiral VIBE and 19 CS VIBE were excluded for low image quality. ILD was detected in 25/54 vCT.

Mean extents on vCT were: ILD 14.7%, GGO 7.7%, RET 6.8%. HC and CON extents were irrelevant and excluded. Inter-reader MRI k for ILD detection were 0.56 for UTE Spiral VIBE and 0.53 for CS VIBE, while ILD and GGO extent analysis CCC were 0.89 and 0.79 for UTE Spiral VIBE, 0.71 and 0.80 for CS VIBE, respectively. RET extent had lower inter-reader CCC for both MRI scans. UTE Spiral VIBE sensitivity and specificity in ILD detection were 95.8% and 77.8%, while ILD and GGO extent analysis obtained the following CCC with CT: 0.95 and 0.93 against vCT ILD and 0.89 and 0.88 against qCT, respectively. RET extent analysis obtained lower CCC. CS VIBE showed a sensitivity and specificity in ILD detection of 46.7% and 95.0%, but lower CCC in all extent analyses against CT.*Conclusions MRI UTE Spiral VIBE may suffer for different readers interpretations in ILD detection, presumably at low disease extents. However, UTE spiral VIBE could be a reliable tool in assessing ILD and GGO extent when the ILD is ascertained. CS VIBE are not a reliable tool.*Clinical Relevance/Application UTE Spiral VIBE could be considered for follow up of selected SSc-ILD patients, allowing a reduction of CT x-ray exposure.

RESULTS

54 patients performed CT and MRI. 9 CT were discarded from qCT for inadequate segmentation. 3 UTE Spiral VIBE and 19 CS VIBE were excluded for low image quality. ILD was detected in 25/54 vCT. Mean extents on vCT were: ILD 14.7%, GGO 7.7%, RET 6.8%. HC and CON extents were irrelevant and excluded. Inter-reader MRI k for ILD detection were 0.56 for UTE Spiral VIBE and 0.53 for CS VIBE, while ILD and GGO extent analysis CCC were 0.89 and 0.79 for UTE Spiral VIBE, 0.71 and 0.80 for CS VIBE, respectively. RET extent had lower inter-reader CCC for both MRI scans. UTE Spiral VIBE sensitivity and specificity in ILD detection were 95.8% and 77.8%, while ILD and GGO extent analysis obtained the following CCC with CT: 0.95 and 0.93 against vCT ILD and 0.89 and 0.88 against qCT, respectively. RET extent analysis obtained lower CCC. CS VIBE showed a sensitivity and specificity in ILD detection of 46.7% and 95.0%, but lower CCC in all extent analyses against CT.

CLINICAL RELEVANCE/APPLICATION

UTE Spiral VIBE could be considered for follow up of selected SSc-ILD patients, allowing a reduction of CT x-ray exposure.

SSCH06-6   Spectral Detector CT Derived Pulmonary Perfusion Maps And Pulmonary Parenchyma Characteristics For The Automated Diagnosis And Classification Of Pulmonary Hypertension

Participants
Roman Gertz, MD, Cologne, Germany (*Presenter*) Institutional research contract, Koninklijke Philips NV;

PURPOSE

To evaluate the usefulness of spectral detector CT (SDCT)-derived pulmonary perfusion maps and pulmonary parenchyma characteristics for the automated diagnosis and classification of pulmonary hypertension (PH) and to assess their association with hemodynamics.*Methods and Materials 162 consecutive patients with right heart catheter (RHC) proven PH of different etiologies as defined by the Nice classification who underwent CT pulmonary angiography (CTPA) on a SDCT and 20 patients with an invasive rule-out of PH were included in this retrospective study. Automatic lung segmentation into normal and malperfused areas based on iodine content as well as automatic, virtual non-contrast-based emphysema quantification were performed. Corresponding volumes, histogram features and the ID SkewnessPerfDef-Emphysema-Index (d-index) were computed and compared between groups. The relationship of volumetric parameters to hemodynamics was evaluated using Spearman's correlation, linear regression analysis and area under the receiver operating characteristic curve (AUC).*Results Patients with PH showed a significantly greater extent of malperfused lung areas (VPerfDef) as well as stronger and more homogenous perfusion defects. Perfusion deficits in Nice class 3 and 4 were significantly stronger and more homogenous compared to all other subgroups. The d-index allowed for further subclassification of subgroups 3 and 4 (AUC: 0.92, 95%-CI, 0.85 - 0.99). In pre-capillary PH the VPerfDef was not only in significant correlation with the pulmonary vascular resistance (PVR) but also a strong predictor of the PVR. In subgroup 4 the prognostic value of the VPerfDef remained even after the adjustment for established markers of an increased PVR. Moreover, the VPerfDef yielded a prognostic merit for an increased PVR above NT-pro BNP.*Conclusions The automated SDCT-based analysis of pulmonary perfusion maps and pulmonary parenchyma characteristics can aid the diagnosis of PH. It allows for an automated, reader-independent classification of PH subforms and yield additional value for a non-invasive severity prediction beyond established markers, particularly in the spectrum of pre-capillary PH.*Clinical Relevance/Application Our findings endorse the potential of SDCT to challenge current approaches in PH imaging. This is of urgent clinical need as the accurate diagnosis of PH remains challenging and no meaningful decrease in the time from symptom onset to diagnosis could be achieved throughout the last decades, also accounting for the high morbidity and mortality of PH.

RESULTS

Patients with PH showed a significantly greater extent of malperfused lung areas (VPerfDef) as well as stronger and more homogenous perfusion defects. Perfusion deficits in Nice class 3 and 4 were significantly stronger and more homogenous compared to all other subgroups. The d-index allowed for further subclassification of subgroups 3 and 4 (AUC: 0.92, 95%-CI, 0.85 - 0.99). In pre-capillary PH the VPerfDef was not only in significant correlation with the pulmonary vascular resistance (PVR) but also a strong predictor of the PVR. In subgroup 4 the prognostic value of the VPerfDef remained even after the adjustment for established markers of an increased PVR. Moreover, the VPerfDef yielded a prognostic merit for an increased PVR above NT-pro BNP.

CLINICAL RELEVANCE/APPLICATION

Our findings endorse the potential of SDCT to challenge current approaches in PH imaging. This is of urgent clinical need as the accurate diagnosis of PH remains challenging and no meaningful decrease in the time from symptom onset to diagnosis could be achieved throughout the last decades, also accounting for the high morbidity and mortality of PH.

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Participants

Ran Zhang, PhD, Madison, Wisconsin (*Moderator*) Nothing to Disclose
Jeffrey Siewerdsen, PhD, Baltimore, Maryland (*Moderator*) Research Grant, Siemens AG;Advisory Board, Siemens AG;Research Grant, Medtronic plc;Advisory Board, Carestream Health, Inc;License agreement, Carestream Health, Inc;License agreement, Precision X-Ray, Inc;License agreement, Elekta AB;;;

Sub-Events

SSPH01-2   Low-dose Dynamic Pulmonary CT Perfusion Using Only Two Volume Scans

Participants
Sabee Y. Molloi, PhD, Irvine, California (*Presenter*) Research Grant, Canon Medical Systems Corporation

PURPOSE

Existing dynamic CT perfusion (CTP) techniques are limited by the high radiation dose from multiple scans. The purpose of this study is to validate a low-dose, first-pass analysis (FPA) technique with only two volume scans.*Methods and Materials Seven Yorkshire swine (52.0±6.8 kg) were used in this validation study with 41 independent CTP acquisitions using a 320-slice CT scanner. Intravenous contrast material (370 mg/ml iodine, 0.5ml/kg) and saline chaser (0.5ml/kg) were injected at 5 ml/s for each CTP acquisition. For each swine, both retrospective and prospective dynamic CTP data were acquired. For the retrospective CTP acquisition, an average of twenty volume scans was acquired per acquisition for the CTP measurements and served as the reference standard. For the prospective CTP acquisition, only two volume scans were acquired, where the first low-dose (50 mA) volume scan was acquired before contrast injection and the second diagnostic (200 mA) volume scan was acquired following bolus-tracking in the main pulmonary artery with a time-to-peak delay calculated using the injection time interval. Two different scan modes were used in the prospective acquisition: a volume mode (16cm z-coverage, 0.35s rotation time) and a fast helical mode (25cm z-coverage, 2.5s scan time). All prospective CTP measurements were quantitatively compared to the reference standard CTP measurements using t-test and linear regression. The CT dose index for the retrospective, two-volume prospective, two-helical prospective CTP measurements were 307.3, 70.6 and 72.1mGy, respectively.*Results The prospective CTP measurements using the volume mode (PVOL) and helical mode (PHEL) were related to the reference CTP measurements by PVOL=1.30PRETRO-1.32 ml/min/g (r=0.75) and PHEL=0.97 PRETRO -0.82 ml/min/g (r=0.82), respectively.*Conclusions A low-dose CTP technique was validated in a swine model that can potentially be used for the assessment of pulmonary disease. This novel CTP technique using a helical mode enables dynamic whole-lung perfusion measurement with conventional CT scanners.*Clinical Relevance/Application The results indicate the potential for a significant reduction in radiation dose for accurate CTP measurement that can be used for physiological assessment of pulmonary disease.

RESULTS

The prospective CTP measurements using the volume mode (PVOL) and helical mode (PHEL) were related to the reference CTP measurements by PVOL=1.30PRETRO-1.32 ml/min/g (r=0.75) and PHEL=0.97 PRETRO -0.82 ml/min/g (r=0.82), respectively.

CLINICAL RELEVANCE/APPLICATION

The results indicate the potential for a significant reduction in radiation dose for accurate CTP measurement that can be used for physiological assessment of pulmonary disease.

SSPH01-3   Deep Learning Patient-specific Noise Reduction Framework For High Resolution Chest Photon Counting Detector CT

Participants
Nathan Huber, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this work was to develop a deep learning, patient-specific noise reduction framework and evaluate it for high-resolution chest CT on an investigational photon-counting-detector CT (PCD-CT; NAEOTOM Alpha, Siemens) scanner. Most deep learning noise reduction methods are difficult to implement because they require access to CT projection data and a large patient cohort for training. The framework described is widely accessible since it uses commercially available reconstructed images and can be trained with just one patient exam.*Methods and Materials A convolutional neural network (CNN) was trained and tested on a patient-specific basis. Each patient exam was reconstructed using filtered back projection (FBP) and iterative reconstruction (IR) with thin slice (0.2 mm) and sharp kernel (Qr76). The FBP and IR reconstructions were subtracted to generate a primarily noise-only difference image. A high-pass filter was applied to remove residual low-frequency anatomic structure from the difference image. To obtain a relatively low-noise signal reference image, adjacent IR images were averaged to simulate thick images (1.0 mm). CNN training inputs consisted of noise-only images superimposed on the IR signal reference. Training target consisted of the IR signal reference without added noise. Spatial decorrelation between the noise-only image and IR signal reference was used to avoid overfitting and reduce propagation of IR deficiencies into the CNN model. A U-Net architecture was trained with mean squared error and feature loss. The resulting CNN was applied to the original thin slice and sharp kernel FBP images. This framework was evaluated on three chest CT exams acquired from a PCD-CT scanner (kernel: Qr76, thickness: 0.2 mm).*Results When applied to

three chest FBP exams, the CNN framework reduced noise by 81 ± 2 %. The FBP/CNN difference images were uniform, which indicated that anatomic structures were not altered by the CNN. Line profile assessment showed that fine bronchi structures were preserved by the CNN.*Conclusions This CNN denoising framework provided extensive noise reduction while maintaining fine anatomic detail within high resolution PCD-CT images. Importantly, this method can be implemented on any CT scanner for which IR and FBP reconstruction are available.*Clinical Relevance/Application Recent advances in high resolution PCD-CT come at a cost of elevated noise. The developed technique can be used to mitigate this noise increase without sacrificing spatial resolution.

RESULTS

When applied to three chest FBP exams, the CNN framework reduced noise by 81 ± 2 %. The FBP/CNN difference images were uniform, which indicated that anatomic structures were not altered by the CNN. Line profile assessment showed that fine bronchi structures were preserved by the CNN.

CLINICAL RELEVANCE/APPLICATION

Recent advances in high resolution PCD-CT come at a cost of elevated noise. The developed technique can be used to mitigate this noise increase without sacrificing spatial resolution.

SSPH01-4   Increasing Volumetric Coverage Of A Prototype C-arm Photon Counting CT System Via Step-and-shoot Acquisitions

Participants
Kevin J. Treb, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

An integrated C-arm interventional imaging system was developed by adding a switchable photon counting strip detector (PCD) to the current flat panel detector (FPD)-based imaging platform. This new platform offers quantitative imaging capability using the spectral PCD-CT method and provides much improved low contrast resolution for subtle lesion detection. However, the current cost-effective strip PCD only provides a longitudinal (z) coverage of 4 mm. The purpose of this work was to develop and test a method to increase the volume coverage using a step-and-shoot acquisition mode.*Methods and Materials After the CdTe-based strip PCD was switched into the field-of-view, a step-and-shoot data acquisition mode was triggered to increase the scan volume coverage: In this mode, the gantry is rotated in 10 sweeps (5 forward and 5 backward). During the transition period between the two rotation directions, the couch was translated by 4 mm along z to enable seamless scans of the patient. In each sweep, the C-arm gantry rotates 200 degrees in 7 s. To test the performance of this new step-and-shoot C-arm PCD-CT acquisition mode, image quality of the ramp pattern in the Catphan phantom was studied. The pattern has beads with 0.25 or 1 mm spacing along z. Also used was a head phantom with a realistic vascular tree and an ultra-low contrast lesion. Comparison was made to FPD-CBCT acquired with full beam collimation and matched narrow collimation at the same radiation dose level.*Results All finely and evenly spaced beads over a z-range of 4 cm were clearly distinguishable in the acquired PCD-CT without perceivable distortions or artifacts. PCD-CT images of the head phantom showed much improved visualization of the low-contrast lesion than the FPD-CBCT at matched narrow beam collimation and dose. The whole branching pattern of the anterior cerebral artery can be visualized in the sagittal PCD-CT images and the small vessel conspicuity is effectively improved by PCD-CT over FPD-CBCT.*Conclusions A step-and-shoot data acquisition mode can be used in the C-arm PCD-CT system with a strip detector to increase the volume coverage by a factor of 10 without introducing image artifacts.*Clinical Relevance/Application By increasing the scan volume coverage of the C-arm PCD-CT equipped with a cost-effective strip detector, the new imaging platform offers high quality image-guidance for interventional procedures.

RESULTS

All finely and evenly spaced beads over a z-range of 4 cm were clearly distinguishable in the acquired PCD-CT without perceivable distortions or artifacts. PCD-CT images of the head phantom showed much improved visualization of the low-contrast lesion than the FPD-CBCT at matched narrow beam collimation and dose. The whole branching pattern of the anterior cerebral artery can be visualized in the sagittal PCD-CT images and the small vessel conspicuity is effectively improved by PCD-CT over FPD-CBCT.

CLINICAL RELEVANCE/APPLICATION

By increasing the scan volume coverage of the C-arm PCD-CT equipped with a cost-effective strip detector, the new imaging platform offers high quality image-guidance for interventional procedures.

SSPH01-5   Determination Of In-vivo Kidney Stone Mixed Composition Using High-resolution Photon Counting CT With AI-based Denoising And Deconvolution

Participants
Scott Hsieh, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this work was to develop a convolutional neural network (CNN) to reduce image noise and improve spatial resolution for high-resolution (HR), photon-counting-detector CT (PCD-CT) imaging of urinary stones to assess internal stone morphology in vivo.*Methods and Materials 30 mixed composition human stones were secured in a custom holder that was placed in a 30 cm anthropomorphic water phantom and scanned using HR PCD-CT at a high dose (CTDIvol=30 mGy). Phantom-derived image noise was added to images using a validated technique to generate a noisy training set, with the high-dose low-noise images as the target. A CNN was trained with these data to simultaneously reduce image noise and improve spatial resolution. The resulting network was applied to routine dose (CTDIvol=7.5 mGy) images of the stone phantom. Histograms of stone CT numbers were used to determine stone composition, which was compared to the reference standard from microCT. Under IRB, patients undergoing a clinically indicated stone composition exam on a clinical energy-integrating-detector CT (EID-CT) dual-source scanner (Siemens Healthcare) were scanned with the same clinical dose on an investigational whole-body HR PCD-CT scanner (SOMATOM Count Plus, Siemens Healthcare). Phantom and patient data were evaluated using in-house quantitative stone analysis software.*Results CNN-processed images exhibited a factor of ten reduction in noise (CT number standard deviation) and markedly reduced blurring of internal structures. Stones of mixed composition could be clearly identified and delineated in HR-PCD data, and the relative contribution of the two major components could be determined from the CT number histograms. Two stones (3 and 5 mm maximum dimension) scanned in vivo were shown to have mixed composition using HR PCD-CT, which was indeterminate from the clinical exam.*Conclusions HR PCD-CT with AI-based noise reduction and deconvolution enabled more accurate in vivo characterization of mixed kidney stones at routine radiation doses.*Clinical Relevance/Application Improved assessment of stone size and composition will better inform treatment decisions and thereby may improve patient outcomes.

RESULTS

CNN-processed images exhibited a factor of ten reduction in noise (CT number standard deviation) and markedly reduced blurring of internal structures. Stones of mixed composition could be clearly identified and delineated in HR-PCD data, and the relative contribution of the two major components could be determined from the CT number histograms. Two stones (3 and 5 mm maximum dimension) scanned in vivo were shown to have mixed composition using HR PCD-CT, which was indeterminate from the clinical exam.

CLINICAL RELEVANCE/APPLICATION

Improved assessment of stone size and composition will better inform treatment decisions and thereby may improve patient outcomes.

Participants

Andrew Smith, MD, PhD, Birmingham, Alabama (*Moderator*) CEO, AI Metrics LLC ;Owner, AI Metrics LLC ;CEO, Radiostics LLC;Owner, Radiostics LLC;Research Grant, General Electric Company;Speaker, General Electric Company;Speaker, Canon Medical Systems Corporation;Speaker, AlgoMedica, Inc

Susanna Lee, MD,PhD, Boston, Massachusetts (*Moderator*) Royalties, Wolters Kluwer nvRoyalties, Springer Nature

Sub-Events

SSGI06-2   Automatized Quantification Of Hepatic Tumor Load In Gd-EOB MRI - A Deep Learning Model To Support Therapy Response Assessment In Neuroendocrine Liver Metastases

Participants
Uli Fehrenbach, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Rapid and precise full quantification of liver metastases is an unmet medical need. We therefore trained a deep learning model to fully quantify neuroendocrine liver metastases (NELM) using gadoxetic-acid (Gd-EOB)-enhanced MRI and evaluated its usefulness in therapy response assessment.*Methods and Materials Manual 3D-segmentations of liver parenchyma and NELM were performed in 149 patients (278 Gd-EOB MRI scans) and used to train a neural network based on U-Net architecture. The model's accuracy was validated in a two step approach (internal and external validation) using Matthew's correlation coefficient (f). Clinical usefulness in terms of therapy response assessment was evaluated in another 33 patients who were discussed in our multidisciplinary cancer conference (MCC) and received a Gd-EOB MRI at baseline and as follow-up examination (n = 66). The model's measurements (NELM volume; hepatic tumor load (HTL)) with corresponding absolute and relative changes (?absNELM; ?absHTL; ?relNELM; ?relHTL) were compared to MCC decisions of therapy success or failure.*Results Internal validation of the model's accuracy showed a high overlap for NELM and livers (f: 0.76/0.95, respectively) between manual and the model's segmentations. The model reached higher coefficients in larger NELM volume (0.80 vs. 0.71; p = 0.003). External validation confirmed the model's high accuracy for NELM (f=0.86) and livers (f=0.96). The model's response variables (?absNELM; ?absHTL; ?relNELM; ?relHTL) significantly differentiated between the MCC's decision of therapy success and failure (p < 0.001). The relative variables (?relNELM and ?relHTL) showed optimal discrimination between therapy success or failure (AUC:1.000; p < 0.001).*Conclusions The deep learning model reached high accuracy in 3D-quantification of NELM and HTL in Gd-EOB-MRI and paves the way for fully automated assessment of hepatic disease. The model's measurements correlated well with the decisions of an expert MCC in response evaluation.*Clinical Relevance/Application Complete quantification of liver metastases and their relationship to liver parenchyma is time consuming and not routinely performed. Instead, individual reference lesions are measured in one dimension and observed as they progress. Hepatic tumor burden and its predictive value is also neglected in common response criteria. The model presented here enables rapid and precise quantification of hepatic tumor burden and could aid in the assessment of therapy response comparable to the assessment by an expert MCC.

RESULTS

Internal validation of the model's accuracy showed a high overlap for NELM and livers (f: 0.76/0.95, respectively) between manual and the model's segmentations. The model reached higher coefficients in larger NELM volume (0.80 vs. 0.71; p = 0.003). External validation confirmed the model's high accuracy for NELM (f=0.86) and livers (f=0.96). The model's response variables (?absNELM; ?absHTL; ?relNELM; ?relHTL) significantly differentiated between the MCC's decision of therapy success and failure (p < 0.001). The relative variables (?relNELM and ?relHTL) showed optimal discrimination between therapy success or failure (AUC:1.000; p < 0.001).

CLINICAL RELEVANCE/APPLICATION

Complete quantification of liver metastases and their relationship to liver parenchyma is time consuming and not routinely performed. Instead, individual reference lesions are measured in one dimension and observed as they progress. Hepatic tumor burden and its predictive value is also neglected in common response criteria. The model presented here enables rapid and precise quantification of hepatic tumor burden and could aid in the assessment of therapy response comparable to the assessment by an expert MCC.

SSGI06-3   Machine-learning Based Radiomics To Predict Low-grade Intraductal Papillary Mucinous Neoplasm (IPMN) Of The Pancreas

Participants
Dania Daye, MD, PhD, Medford, Massachusetts (*Presenter*) Research Consultant, Sigilon Therapeutics;Research Consultant, Medtronic plc

PURPOSE

IPMNs exhibit a potential risk of invasive transformation, therefore, they comprise a clinically challenging entity. The aim of this study was to evaluate the role of preoperative machine-learning based radiomic features as predictors of low-grade IPMN.*Methods and Materials In this IRB-approved retrospective study, we identified 109 consecutive patients with 1) a histologically confirmed diagnosis of IPMN, 2) contrast-enhanced CT performed within 6 months of diagnosis, from 2009 to 2017. Patients were classified

into low-grade IPMN group (with low- or moderate-grade dysplasia, n=48) or high-grade IPMN group (high-grade or invasive, n=61), according to the Baltimore consensus classification. Clinicobiological variables were collected. All tumors were semi-automatically volumetrically segmented on pancreatic/delayed phase acquisitions. 112 radiomics features were extracted from each segmented tumor. Patients were divided into a training (n=88) and testing cohort (n=22). A random forest-based machine learning technique was applied to the extracted features. ROC was used to evaluate the performance of the constructed machine learning model.*Results The study enrolled 109 patients with 109 IPMNs (51% female, mean age 69±10 years). The mean lesion size was 2.7±1cm and 4.2±3cm in low- and high-grade groups, respectively (p=0.004). Mild, moderate and severe dilation of the main pancreatic duct was detected in 46%, 50% and 4% of low-grade and 69%, 23% and 8% of the high-grade IPMNs. An increased serum level of CA19-9 (>37 U/ml) was found in 11% of the low- and 30% of the high-grade groups. Univariate regression revealed 4 features (2 first order features and 2 shape features) to be independently associated with low- and moderate-grade dysplasia IPMN (p<0.04 on Wald test for all). A random forest-based machine learning model that included radiomic features resulted in good performance for low-grade IPMN prediction (AUC of 0.83). Specificity was 76% and sensitivity was 82%.*Conclusions Preoperative CT quantitative tumor radiomic features could effectively distinguish patients with low-grade IPMN.*Clinical Relevance/Application The clinical management goal to decrease the risk of invasive cancer is to observe low- and moderate-grade precursor lesions and to resect high-grade precursor lesions. Machine learning-based tumor radiomics may improve treatment methods and promote personalized therapy in patients with IPMNs.

RESULTS

The study enrolled 109 patients with 109 IPMNs (51% female, mean age 69±10 years). The mean lesion size was 2.7±1cm and 4.2±3cm in low- and high-grade groups, respectively (p=0.004). Mild, moderate and severe dilation of the main pancreatic duct was detected in 46%, 50% and 4% of low-grade and 69%, 23% and 8% of the high-grade IPMNs. An increased serum level of CA19-9 (>?37 U/ml) was found in 11% of the low- and 30% of the high-grade groups. Univariate regression revealed 4 features (2 first order features and 2 shape features) to be independently associated with low- and moderate-grade dysplasia IPMN (p<0.04 on Wald test for all). A random forest-based machine learning model that included radiomic features resulted in good performance for low-grade IPMN prediction (AUC of 0.83). Specificity was 76% and sensitivity was 82%.

CLINICAL RELEVANCE/APPLICATION

The clinical management goal to decrease the risk of invasive cancer is to observe low- and moderate-grade precursor lesions and to resect high-grade precursor lesions. Machine learning-based tumor radiomics may improve treatment methods and promote personalized therapy in patients with IPMNs.

SSGI06-4   AI-Powered Fully-automated Detection Of Pancreatic Ductal Adenocarcinoma (PDA) On Standard-of-care CT Scans

Participants
Garima Suman, MD,MBBS, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Incidental PDA lesions tend to be missed on CT scans due to their subtle imaging features or inattentional bias. To address this challenge, our purpose was to develop a convolutional neural network (CNN) for fully automated detection of PDA on standard-of-care CT scans.*Methods and Materials Volumetric pancreas and tumor segmentation was performed by radiologists using 3D Slicer on a highly curated CT dataset (portal-venous phase CTs from 2008-2020, slice thickness = 3.75 mm) of 801 treatment-naïve patients with PDA and 1667 control subjects (median ages: 67 and 59 years, Male: Female=1.2:1 and 1:1, respectively). Training/validation set included randomly selected 522 CTs with PDA and 843 controls. Remaining 1103 CTs (279 CTs with PDA and 824 controls) comprised the test set. A classification CNN was trained utilizing a bounding box, which enveloped segmentations done by radiologists (Fig 1). However, on test cases, the CNN's performance for PDA detection was evaluated using two inputs: 1. Radiologists' segmentations, 2. Automated pancreatic segmentations using a previously described UNET architecture. Augmentations (random translation, artificial corruption of segmentation to simulate over- or under-segmentation errors, intensity shifting and rotations) were utilized to maximize model's performance potential and to compensate for the absence of radiologists' segmentations as input channels. Finally, an Atttention-ResNet classified each axial CT slice through the pancreas into cancer vs. normal.*Results Using the radiologists' segmentations as inputs, the CNN misclassified 9% (25/279) CTs with PDA as 'normal' and 10% (82/824) control CTs as 'cancer' [accuracy 0.90; area under the curve (AUC) 0.97]. In contrast, with automated segmentations as inputs, the CNN correctly classified 94% (1036/1103) of total CTs into 'cancer' versus 'normal' (accuracy 0.94; AUC 0.95). It incorrectly classified 16% (46/279) with PDA as 'normal' and 2.5% (21/824) of control CTs as 'cancer'. There was no difference in the CNN's performance with radiologists' segmentations vs. automated segmentations as inputs (p=0.112, DeLong test).*Conclusions Accurate AI-Powered detection of PDA on portal venous phase CTs is feasible. A fully automated approach shows performance metrics comparable to the approach that requires radiologists' segmentations as inputs.*Clinical Relevance/Application Integration of automated AI models for detection of PDA into clinical workflows can provide pre-screened images to radiologists to potentially reduce the incidence of missed pancreatic cancers.

RESULTS

Using the radiologists' segmentations as inputs, the CNN misclassified 9% (25/279) CTs with PDA as 'normal' and 10% (82/824) control CTs as 'cancer' [accuracy 0.90; area under the curve (AUC) 0.97]. In contrast, with automated segmentations as inputs, the CNN correctly classified 94% (1036/1103) of total CTs into 'cancer' versus 'normal' (accuracy 0.94; AUC 0.95). It incorrectly classified 16% (46/279) with PDA as 'normal' and 2.5% (21/824) of control CTs as 'cancer'. There was no difference in the CNN's performance with radiologists' segmentations vs. automated segmentations as inputs (p=0.112, DeLong test).

CLINICAL RELEVANCE/APPLICATION

Integration of automated AI models for detection of PDA into clinical workflows can provide pre-screened images to radiologists to potentially reduce the incidence of missed pancreatic cancers.

SSGI06-5   Deep-learning Based Software For Response Evaluation In Hepatocellular Carcinoma Treatment.

Participants
Matt Kelly, PhD, Oxford, United Kingdom (*Presenter*) Employee, Perspectum Diagnostics Ltd;Stockholder, Perspectum Diagnostics Ltd

PURPOSE

Clinical trials of novel treatment approaches for hepatocellular carcinoma work within the response evaluation criteria for solid

tumors (RECIST v1.1) which offers a standardized and widely applicable approach for categorizing treatment response. Modified RECIST extends this by focussing on contrast-enhancing tumor tissue.?Discordance between intra-and inter-reader observations has been regularly reported (Yoon E J Cancer 2016). This study describes the application of a new deep-learning based software tool to automatically perform lesion segmentation and diameter estimation of a large dataset from a completed HCC trial.*Methods and Materials Dual phase contrast-enhanced abdominal CT images and central (m)RECIST reads were curated from a database of 166 participants from a multi-center drug trial (TACE2) before and after treatment. A 3D convolutional neural network with two encoders was?trained with 133 samples to segment both liver and lesions, and was validated on the 33 remaining cases. Tumor diameter measurement of the largest lesion was generated for each patient and compared with the diameter reported by central radiologist read.*Results Automatic lesion segmentation masks (Figure 1) were generated and showed high agreement with manually drawn 3D masks (mean validation Dice Similarity Coefficient = 0.73).?The accuracy of automatic diameter measurement compared to central radiologist read was in close agreement (within range considered as stable disease per RECIST) for 76.7% for training and 81.8% for validation set.*Conclusions This?deep-learning based lesion detection and diameter measurement tool?can support radiologists by minimizing subjectivity in (m)RECIST measurements and reducing time per analysis. This has the potential to improve both routine care and clinical trial workflow.*Clinical Relevance/Application Deployment of this deep-learning based tool to support the radiologist may enhance objectivity of tumour response reporting, and improve the clinical trial radiology reporting pipeline.

RESULTS

Automatic lesion segmentation masks (Figure 1) were generated and showed high agreement with manually drawn 3D masks (mean validation Dice Similarity Coefficient = 0.73).?The accuracy of automatic diameter measurement compared to central radiologist read was in close agreement (within range considered as stable disease per RECIST) for 76.7% for training and 81.8% for validation set.

CLINICAL RELEVANCE/APPLICATION

Deployment of this deep-learning based tool to support the radiologist may enhance objectivity of tumour response reporting, and improve the clinical trial radiology reporting pipeline.

Abstract Archives of the RSNA, 2021

Participants
Eric Crotty, MD, Cincinnati, Ohio (*Moderator*) Nothing to Disclose

Sub-Events

SSPD02-1 Semi Automated Measurement Of The Common Carotid Artery Intima Media Thickness In Children: Inter And Intra Observer Validation Study.

Participants
Emilie Alchourron, BSC, Montreal, Quebec (*Presenter*) Nothing to Disclose

PURPOSE

Although atherosclerotic plaques only appear in adulthood, atherogenesis starts during childhood. Common carotid artery Intima media thickness (cIMT) has been proven to be a subclinical radiological marker for early atherosclerosis in adults and children. Validation studies for the semi-automated IMT measurement technique on B-mode ultrasound lack in children. The objective is to validate this technique in children. Specific aim is to study the inter-observer and intra-observer correlation. The study will set the ground for the development of a robust subclinical radiological marker for atherosclerosis risk stratification in children.*Methods and Materials We calculated a sample size of 30 patients who were recruited in a prospective IRB approved study among healthy children presenting to the radiology department between November 2020 and March 2021. Semi-automated Math'SR B-mode ultrasound technique was used to measure cIMT according to the Mannheim recommendations by 2 ultrasonographers. Edge detection and quality index were verified. Measurements were done twice bilaterally. Four additional observers measured IMT later on for a total of 696 measurements. Anthropometric measures included Body mass index (BMI), waist circonference, blood pressure and artery diameter. Student t-test and intra-class correlation coefficient (ICC) were performed using SPSS.*Results The average age was 12.5 years (range 11-14.9), 46.4% were girls. Twenty-one patients had normal BMI and 7 increased BMI (>85th percentile). Two of the obese patients had elevated blood pressure (>95th percentile). Fifty percent of the patients had Tanner stage 4. Intra-observer ICCs for IMT were: 0.87, 0.90, 0.89, 0.90, 0.84 and 0.84 for each of the 6 operators. Intra-observer ICCs for the ratio IMT/carotid diameter were: 0.68, 0.583 0.81, 0.71, 0.52 and 0.65. Inter-observer ICC was 0.97. The mean IMT calculated for healthy children was 0.507 mm (+/-0.004).*Conclusions There is excellent inter and intra-observer agreement using the semi-automated cIMT B-mode technique in children provided operators pay attention to edge-detection. There is no gold standard technique in children. Further studies are needed to compare the reproductibility with the radiofrequency technique and generate normative charts for both techniques for the same cohort.*Clinical Relevance/Application Since early manifestations of atherosclerotic disease are reversible, developing a reliable, safe and quick radiological test assist in the clinical decision to guide treatment. A multidisciplinary team approach could eventually use IMT along other lab markers to better prevent disease progression/assess intervention efficacy in children with risk factors.

RESULTS

The average age was 12.5 years (range 11-14.9), 46.4% were girls. Twenty-one patients had normal BMI and 7 increased BMI (>85th percentile). Two of the obese patients had elevated blood pressure (>95th percentile). Fifty percent of the patients had Tanner stage 4. Intra-observer ICCs for IMT were: 0.87, 0.90, 0.89, 0.90, 0.84 and 0.84 for each of the 6 operators. Intra-observer ICCs for the ratio IMT/carotid diameter were: 0.68, 0.583 0.81, 0.71, 0.52 and 0.65. Inter-observer ICC was 0.97. The mean IMT calculated for healthy children was 0.507 mm (+/-0.004).

CLINICAL RELEVANCE/APPLICATION

Since early manifestations of atherosclerotic disease are reversible, developing a reliable, safe and quick radiological test assist in the clinical decision to guide treatment. A multidisciplinary team approach could eventually use IMT along other lab markers to better prevent disease progression/assess intervention efficacy in children with risk factors.

SSPD02-2 Validation Of Reduced Dose CT For Detection Of Lung Nodules In Children With Cancer

Participants
Samuel Brady, PHD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Reduced dose chest CT is standard of care for lung cancer screening in high-risk adult patients. However, the use of reduced dose chest CT in pediatrics has not been extensively explored. The purpose of this study was to characterize the performance of a reduced dose CT technique for detection of lung nodules in children and young adults with cancer.*Methods and Materials In this Institutional Review Board approved prospective study, between November 2018 to August 2020, we enrolled patients 4-21 years-old with a history of malignancy who were undergoing clinically indicated chest CT with standard radiation dose to undergo a reduced dose CT of the chest in the same encounter. Reduced dose CT was performed with fixed technique. Deidentified CT examinations were reviewed in blinded fashion by three reviewers. A single reviewer performed a delayed review to match nodules between examinations. Agreement was calculated with Cohen's Kappa and intraclass correlation coefficients.*Results 78 patients (mean age=14.9±4.2 years, n=44 [56%] male) were enrolled. 45 (58%) patients had 162 total lung nodules (mean size=3.4±3.3 mm). Mean estimated effective dose was 1.8±1.1 mSv (clinical) and 0.3±0.1 mSv (reduced dose), an 82% reduction. Intra-

observer agreement on the presence of nodules was moderate to substantial (?=0.45-0.67), as assessed on standard radiation dose examination. Sensitivity and specificity of reduced dose CT for nodules ranged from 63-77% and 80-90% respectively per reviewer. Inter-observer agreement on the presence nodules was moderate (?=0.53) for reduced dose CT, similar to clinical CT (?=0.54). 92% of nodules were visible on reduced dose CT.*Conclusions Reduced dose CT depicts >90% of lung nodules in a pediatric cohort with cancer. Reviewers identified the presence of nodules with moderate sensitivity and high specificity. The observed diagnostic performance of reduced dose CT is within the expected range for CT for lung nodules in generally.*Clinical Relevance/Application Our results demonstrate that CT performed at a dose similar to a 2-view chest radiograph has acceptable diagnostic performance for nodule detection in children with cancer.

RESULTS

78 patients (mean age=14.9±4.2 years, n=44 [56%] male) were enrolled. 45 (58%) patients had 162 total lung nodules (mean size=3.4±3.3 mm). Mean estimated effective dose was 1.8±1.1 mSv (clinical) and 0.3±0.1 mSv (reduced dose), an 82% reduction. Intra-observer agreement on the presence of nodules was moderate to substantial (?=0.45-0.67), as assessed on standard radiation dose examination. Sensitivity and specificity of reduced dose CT for nodules ranged from 63-77% and 80-90% respectively per reviewer. Inter-observer agreement on the presence nodules was moderate (?=0.53) for reduced dose CT, similar to clinical CT (?=0.54). 92% of nodules were visible on reduced dose CT.

CLINICAL RELEVANCE/APPLICATION

Our results demonstrate that CT performed at a dose similar to a 2-view chest radiograph has acceptable diagnostic performance for nodule detection in children with cancer.

SSPD02-6 Hyperinflation Is More Clinically Relevant Than Hyperdensity In Neonatal Lung Disease Of Prematurity Via 3D MRI

Participants
Nara Higano, PhD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Bronchopulmonary dysplasia (BPD) is a severe and multifaceted respiratory disease resulting from preterm birth, with both obstructive (air trapping, alveolar simplification) and restrictive (fibrosis, atelectasis, inflammation) components. While reader scores of these combined heterogeneous parenchymal abnormalities on structural chest imaging have demonstrated clinical relevance, it is unclear to what extent each type of pathology affects respiratory outcomes in extremely preterm infants. Here, we quantify the individual clinical relevance of hyperinflation and tissue hyperdensity as surrogates for obstructive and restrictive lung disease, respectively, in neonates with and without BPD using structural 3D ultrashort echo-time (UTE) MRI.*Methods and Materials 3D radial lung UTE MRI (0.7-mm isotropic resolution, proton-density weighting), was obtained in 79 quiet-breathing neonates (8 control, 8 mild BPD, 8 moderate, 55 severe) on a small-footprint, NICU-sited 1.5T scanner. Hyperinflation was quantified by normalizing volumes from whole-lung segmentations by body-surface area. Volume-percent of hyperdense lung tissue (defined as lung density exceeding +1s from mean control density) was quantified after normalizing lung intensity by muscle and noise. Hyperinflation and hyperdensity were compared with BPD severity in all patients and respiratory support at NICU discharge (DC) (4 none, 21 oxygen, 28 ventilator, 2 death prior to DC) in severe BPD (ANOVA, multi-group; unpaired t-test, 2-group).*Results Hyperinflation correlated with BPD severity in all patients (P=0.0011, Fig-A), and was higher in severe BPD than other severity grades (P<0.0001 for all). Likewise, hyperinflation correlated with DC support in severe BPD (P=0.0004, Fig-B). However, hyperdense volume-percent neither correlated with BPD severity in all patients (P=0.15, Fig-C), nor DC support in severe BPD (P=0.11, Fig-D). Hyperdensities did not significantly distinguish between mild, moderate, or severe BPD, nor between oxygen use, ventilator use, or death in severe BPD (P>0.05 for all).*Conclusions Hyperinflation primarily affects patients with severe BPD, while hyperdensity is present in all severity grades. Notably, hyperinflation is a stronger marker of poor clinical trajectories than hyperdensity in severe BPD patients, suggesting that imaging-based pulmonary scoring and quantification in neonatal BPD may be most clinically relevant with stronger emphasis on obstructive, rather than restrictive, components of lung disease.*Clinical Relevance/Application Obstructive lung disease is strongly correlated with respiratory outcomes, while restrictive lung disease is not, in preterm neonates using 3D structural ultrashort echo-time MRI.

RESULTS

Hyperinflation correlated with BPD severity in all patients (P=0.0011, Fig-A), and was higher in severe BPD than other severity grades (P<0.0001 for all). Likewise, hyperinflation correlated with DC support in severe BPD (P=0.0004, Fig-B). However, hyperdense volume-percent neither correlated with BPD severity in all patients (P=0.15, Fig-C), nor DC support in severe BPD (P=0.11, Fig-D). Hyperdensities did not significantly distinguish between mild, moderate, or severe BPD, nor between oxygen use, ventilator use, or death in severe BPD (P>0.05 for all).

CLINICAL RELEVANCE/APPLICATION

Obstructive lung disease is strongly correlated with respiratory outcomes, while restrictive lung disease is not, in preterm neonates using 3D structural ultrashort echo-time MRI.

Abstract Archives of the RSNA, 2021

Sub-Events

SPR-NR-1   Multiparametric Radiogenomic Model To Predict Survival In Patients With Glioblastoma

Participants
Keon Mahmoudi, BS, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Several clinical, histopathological, and imaging variables have been associated with prognosis in patients with glioblastoma (GBM). We aimed to develop a multiparametric radiogenomic model using a combination of MRI texture features, demographic data, and glioma biomarker status to predict prognosis in patients with GBM.*Methods and Materials In this retrospective study, patients were included if they had 1) confirmed diagnosis of GBM, 2) pre- and post-operative MRI including T1c+, FLAIR, and diffusion sequences, and 3) glioma biomarker data (IDH-1, EGFR, MGMT, ATRX). Survival data was obtained from patients' charts and dichotomized (< 18 months, = 18 months). Tumor segmentation was performed using volume-of-interest analysis, and a total of 92 texture features were obtained. From texture features, a predictive imaging model was developed using univariate analysis and Least Absolute Shrinkage and Selection Operator (LASSO) regularization to reduce the risk of overfitting. This imaging model was then inserted into a backward stepwise logistic regression model in conjunction with other variables including age, sex, initial tumor volume, resection volume (percentage), and 4 glioma biomarker (IDH-1, EGFR, MGMT, ATRX) status. Receiver-operating characteristic (ROC) and Kaplan-Meier curve analysis were performed.*Results A total of 116 patients (age: 59.6 ± 13.9, M/F 62/54) met our inclusion criteria. The median (IQR) survival was 12 (18) months. A total of 7 pre-operative texture features were used in generating our imaging model in determination of > 18-months survival with AUC (SE/95%CI) of 0.72 (0.05/0.63-0.80) (P=0.004). In logistic regression analysis, our imaging model remained as a significant (p<0.001) contributor to the final multiparametric model in conjunction with age (p=0.04) and MGMT status (p=0.02). The overall accuracy of this final radiogenomic model was AUC (SE/95%CI) of 0.79 (0.04/0.70-0.86) (p<0.001). Prediction of survival > 18 months yielded a sensitivity of 45.24%, specificity of 87.84%, and accuracy of 72.41%. Using this final radiogenomic model to predict survival, Kaplan-Meiyer analysis showed a significantly (p = 0.002, HR= 2.91) longer overall survival (Figure).*Conclusions Results show that our radiogenomic model generated from radiomic features at baseline (pre-operative) MRI in conjunction with age and MGMT status can predict survival > 18 months in patients with GBM.*Clinical Relevance/Application The model described above combines MRI tissue analysis, glioma biomarker, and demographic data to reliably predict survival in patients with preoperative gliomas. These findings provide valuable prognostic information that can help guide management in patients with treatment-naïve GBM.

RESULTS

A total of 116 patients (age: 59.6 ± 13.9, M/F 62/54) met our inclusion criteria. The median (IQR) survival was 12 (18) months. A total of 7 pre-operative texture features were used in generating our imaging model in determination of > 18-months survival with AUC (SE/95%CI) of 0.72 (0.05/0.63-0.80) (P=0.004). In logistic regression analysis, our imaging model remained as a significant (p<0.001) contributor to the final multiparametric model in conjunction with age (p=0.04) and MGMT status (p=0.02). The overall accuracy of this final radiogenomic model was AUC (SE/95%CI) of 0.79 (0.04/0.70-0.86) (p<0.001). Prediction of survival > 18 months yielded a sensitivity of 45.24%, specificity of 87.84%, and accuracy of 72.41%. Using this final radiogenomic model to predict survival, Kaplan-Meiyer analysis showed a significantly (p = 0.002, HR= 2.91) longer overall survival (Figure).

CLINICAL RELEVANCE/APPLICATION

The model described above combines MRI tissue analysis, glioma biomarker, and demographic data to reliably predict survival in patients with preoperative gliomas. These findings provide valuable prognostic information that can help guide management in patients with treatment-naïve GBM.

SPR-NR-10   7T High-resolution Metabolic Imaging Of Epilepsy: First Results

Participants
Gilbert Hangel, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

We recently introduced high resolution 3D metabolic imaging at 7T based on CRT-FID-MRSI in healthy subjects (Hingerl 2020) and glioma patients (Hangel 2020). Previous MRS techniques lacked resolution and brain coverage for precise localisation of the epileptogenic zone but had identified changes like decreased N-acetylaspartate (NAA) and increased total choline and Creatine (tCho/tCr). We applied our technique to refractory epilepsy, investigating its potential to identify and determine the extent of the epileptogenic zone.*Methods and Materials Fourteen patients (28±7 y, 10f/4m) with refractory focal epilepsy were enrolled in the study after informed consent and with IRB approval. They were measured with a 3D-MRSI protocol at a Siemens Magnetom 7T imager: 15:30 min, 64×64×39 matrix, 220×220×133 mm³ FOV, 3.4 mm nominal resolution. Quantification used LCModel with a basis set including NAA, tCr, tCho, myo-inositol (Ins), glutamate (Glu), glutamine (Gln), and taurine (Tau) with a spectral range of 1.8-4.1 ppm. MRSI maps were compared to clinical neurological assessment based on MRI and EEG and, if available, histology.*Results Acceptable MRSI quality was achieved in 13/14 patients. Metabolic hotspots in the remaining thirteen patients corresponded at least partially to clinical preoperative assessment in 11/13. tCr and tCho were increased in all of these hotspots, while we found variable changes for Glu/Gln/Ins/NAA/Tau. An increase of NAA was found in most patients. In three verified FCD cases, metabolic

findings aligned well to later resection.*Conclusions We established an exploratory dataset of high-resolution metabolic images in thirteen refractory epilepsy patients, with tCr/tCho/Ins/NAA as promising metabolic markers. Our NAA findings contradict previous literature, but tCho to NAA increases corresponded to literature. This could be explained by previous studies missing moderate NAA increases or having difficulty to localise metabolic changes with single voxel spectroscopy or selection-box MRSI. Our study was limited by its small sample size so far and 7T B0- and B1-field inhomogeneities. Further research can overcome these challenges.*Clinical Relevance/Application Metabolic imaging of epilepsy with our new HR-7T-MRSI method could potentially identify epileptogenic zones in structurally normal MRI cases.

RESULTS

Acceptable MRSI quality was achieved in 13/14 patients. Metabolic hotspots in the remaining thirteen patients corresponded at least partially to clinical preoperative assessment in 11/13. tCr and tCho were increased in all of these hotspots, while we found variable changes for Glu/Gln/Ins/NAA/Tau. An increase of NAA was found in most patients. In three verified FCD cases, metabolic findings aligned well to later resection.

CLINICAL RELEVANCE/APPLICATION

Metabolic imaging of epilepsy with our new HR-7T-MRSI method could potentially identify epileptogenic zones in structurally normal MRI cases.

SPR-NR-11 Hypovascular Cellular Tumor In Primary Central Nervous System Lymphoma Is Associated With Treatment Resistance: Tumor Habitat Analysis With Physiologic MRI

Participants
Soyeong Jeong, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The microenvironment of lymphomas is known to be highly variable and closely related with treatment resistance and survival. We tried to develop physiologic MRI-based spatial habitat analysis to identify regions associated with treatment resistance to facilitate prediction of tumor response after initial chemotherapy in patients with primary central nervous system lymphoma (PCNSL).*Methods and Materials Eighty-one patients with pathologically confirmed PCNSL were enrolled. Pretreatment physiologic MRI was obtained, and k-means clustering was used to separate voxels into three spatial habitats according to apparent diffusion coefficient and cerebral blood volume values. Spatial habitats, clinical predictors, and conventional imaging predictors associated with time to progression (TTP) were analyzed using Cox proportional hazard modeling. The performance of significant predictors for TTP was assessed using C-index.*Results The three spatial habitats of hypervascular cellular tumor, hypovascular cellular tumor, and hypocellular tumor were identified. A large hypovascular cellular habitat was significantly associated with short TTP (HR, 2.83; P =.017). Presence of an atypical finding (HR, 4.41; P=.016), high performance score (HR, 5.82; P =.04), and high serum lactate dehydrogenase level (HR, 1.01; P=.013) were significantly associated with TTP. A predictive model constructed using habitat score and other imaging parameters showed a C-index for prediction of TTP of 0.70 (95% CI, 0.54-0.87).*Conclusions A hypovascular cellular tumor habitat is associated with treatment resistance in PCNSL, and its assessment may refine pre-chemotherapy imaging-based response prediction for patients with PCNSL before chemotherapy.*Clinical Relevance/Application The current results suggest that multiparametric physiologic MRI-based spatial habitat analysis provides meaningful results and may provide added value for predicting treatment response after initial chemotherapy in patients with PCNSL before chemotherapy.

RESULTS

The three spatial habitats of hypervascular cellular tumor, hypovascular cellular tumor, and hypocellular tumor were identified. A large hypovascular cellular habitat was significantly associated with short TTP (HR, 2.83; P =.017). Presence of an atypical finding (HR, 4.41; P=.016), high performance score (HR, 5.82; P =.04), and high serum lactate dehydrogenase level (HR, 1.01; P=.013) were significantly associated with TTP. A predictive model constructed using habitat score and other imaging parameters showed a C-index for prediction of TTP of 0.70 (95% CI, 0.54-0.87).

CLINICAL RELEVANCE/APPLICATION

The current results suggest that multiparametric physiologic MRI-based spatial habitat analysis provides meaningful results and may provide added value for predicting treatment response after initial chemotherapy in patients with PCNSL before chemotherapy.

SPR-NR-12 Morphologic And Functional Characteristics Of Intracranial Collateral Status Predict Outcomes Of Patients With Acute Anterior Large Artery Occlusion

Participants
Song Liu, Tianjin, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate differential characteristics of morphologic and functional collateral status in patients with acute anterior large artery occlusion, and to develop a predictive model for the outcomes of patients.*Methods and Materials Sixty-seven patients with middle cerebral artery or internal carotid artery occlusion (<24h) were collected and divided into good outcomes group (90 day mRS 0-2) and poor outcomes group (90 day mRS 3-6). Plain CT, multi-phase CT angiography (mCTA), and CT Perfusion (CTP) scans of all patients were obtained on 256-row Revolution CT. Iopamidol of intravenous contrast was used. Collateral Score of mCTA were assessed as Score 1-5. CBV, CBF, Tmax maps, and Hypoperfusion Intensity Ratio (HIR) with different threshold were assessed by RApid processing of PerfuIon and Diffusion (RAPID) software. Independent sample t test, Mann-Whitney U test, Chi-square test and Fisher's exact test were performed in the difference of variables. Multivariate logistic regression analysis and ROC curve were used to determine the relationship between significant variables and outcomes. P value <0.05 was considered significant for all tests.*Results HIR (rs = 0.669, P < 0.001), CS (rs = -0.359, P = 0.003), and NCCT-ASPECTS (rs = -0.406, P = 0.001) revealed as significant correlations with mRS, respectively. NIHSS of good outcomes group was significant lower than poor outcomes group (10.00 [6.00, 15.00] vs 15.00 [10.00, 20.50], Z=-2.703, P=0.006). Higher CS were seen in patients with good outcomes than that with poor outcomes (Score 5: 0% vs 0%; Score 4: 18.75% vs 11.43%; Score 3: 46.88% vs 37.14%; Score 2: 34.37% vs 34.29%; Score 1: 0% vs 17.14%; Score 0: 0% vs 0%; P=0.041). HIR (0.270 ± 0.180 vs 0.459 ± 0.190, t=-4.166, P=0.014), CBF<38% volume (0 [0, 13.25] vs 28.00 [5.75, 59.75], Z=-3.815, P<0.001) and CBV<42% volume (0 [0, 13.25] vs 33.00 [4.75, 59.25], Z=-3.906, P<0.001), and CBV<38% volume (0 [0, 11.50] vs 27.50 [3.75, 54.75], Z=-3.775, P<0.001) were the significant features in defining good outcomes of patients. Multiple logistic regression analysis showed that HIR (OR 5.290, 95%CI 8.057-48.781) was significantly associated with good outcomes of patients, and its AUC of receiver operating characteristic curves were 0.770.*Conclusions HIR and CS characterized by CTP and mCTA provided morphologic and functional characteristics of intracranial

collateral status of acute anterior circulation occlusion, and they were particularly effective predictive parameters for the outcomes of patients.*Clinical Relevance/Application HIR and CS, derived from CTP and mCTA, could provide complementary information in defined the morphologic and functional features of collateral status in acute anterior circulation occlusion patients.

RESULTS

HIR (rs = 0.669, P < 0.001), CS (rs = -0.359, P = 0.003), and NCCT-ASPECTS (rs = -0.406, P = 0.001) revealed as significant correlations with mRS, respectively. NIHSS of good outcomes group was significant lower than poor outcomes group (10.00 [6.00, 15.00] vs 15.00 [10.00, 20.50], Z=-2.703, P=0.006). Higher CS were seen in patients with good outcomes than that with poor outcomes (Score 5: 0% vs 0%; Score 4: 18.75% vs 11.43%; Score 3: 46.88% vs 37.14%; Score 2: 34.37% vs 34.29%; Score 1: 0% vs 17.14%; Score 0: 0% vs 0%; P=0.041). HIR (0.270 ± 0.180 vs 0.459 ± 0.190, t=-4.166, P=0.014), CBF<38% volume (0 [0, 13.25] vs 28.00 [5.75, 59.75], Z=-3.815, P<0.001) and CBV<42% volume (0 [0, 13.25] vs 33.00 [4.75, 59.25], Z=-3.906, P<0.001), and CBV<38% volume (0 [0, 11.50] vs 27.50 [3.75, 54.75], Z=-3.775, P<0.001) were the significant features in defining good outcomes of patients. Multiple logistic regression analysis showed that HIR (OR 5.290, 95%CI 8.057-48.781) was significantly associated with good outcomes of patients, and its AUC of receiver operating characteristic curves were 0.770.

CLINICAL RELEVANCE/APPLICATION

HIR and CS, derived from CTP and mCTA, could provide complementary information in defined the morphologic and functional features of collateral status in acute anterior circulation occlusion patients.

SPR-NR-13   Relationship Between Collateral Status And CT Perfusion Parameters In Patients With Chronic Cerebral Artery Occlusion

Participants
Ling Li, Bejing, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare collateral status on 4D CTA and single-phase CTA (sCTA) and evaluate the relationship between collateral status and CT perfusion parameters in patients with chronic cerebral artery occlusion.*Methods and Materials Fourteen cases with chronic cerebral artery occlusion who underwent one-stop CT angiography -CT perfusion reviewed retrospectively. Single-phase CTA and 4D CTA were reconstructed from CTP data and collateral status was evaluated by using Tan's scoring systems. CTP parameters such as rCBF, rCBV, and MTT were evaluated by two neuroradiologists independently. The independent sample t-test and Spearman correlation analysis were performed to assess the relationship of CT perfusion parameters and collateral status on sCTA and 4D CTA, separately.*Results Fourteen patients (14.3% of female, mean age 69.1plusminus10.3 years) were recruited. When compared with 4D CTA, sCTA obviously underestimated the status of collateral circulation (4D CTA, score 2.43plusminus0.51; sCTA, score 1.36plusminus0.93; p<0.01). For 4D CTA, rCBF values and MTT values were significantly different between the poor and good collateral status (p<0.05). While for sCTA, only rCBF values were different in the two groups (p<0.05). Both sCTA and 4D CTA collateral score had a positive correlation with rCBF values (r=0.57, p<0.05; r=0.68, p<0.01). 4D CTA had a negative correlation with MTT values (r=dash0.65, p<0.05).*Conclusions In comparison with sCTA, 4D CTA can better estimate the collateral status and correlate well with cerebral hemodynamic status.*Clinical Relevance/Application Collateral status on 4D CTA is recommended to be a relatively optimal technique for chronic cerebral artery occlusion patients.

RESULTS

Fourteen patients (14.3% of female, mean age 69.1plusminus10.3 years) were recruited. When compared with 4D CTA, sCTA obviously underestimated the status of collateral circulation (4D CTA, score 2.43plusminus0.51; sCTA, score 1.36plusminus0.93; p<0.01). For 4D CTA, rCBF values and MTT values were significantly different between the poor and good collateral status (p<0.05). While for sCTA, only rCBF values were different in the two groups (p<0.05). Both sCTA and 4D CTA collateral score had a positive correlation with rCBF values (r=0.57, p<0.05; r=0.68, p<0.01). 4D CTA had a negative correlation with MTT values (r=dash0.65, p<0.05).

CLINICAL RELEVANCE/APPLICATION

Collateral status on 4D CTA is recommended to be a relatively optimal technique for chronic cerebral artery occlusion patients.

SPR-NR-14   Angioarchitecture Analysis And Prognostication Of Intracranial Dural Arteriovenous Fistula - A Comparative Study Of Non-contrast Magnetic Resonance Angiographic Sequences.

Participants
Arun Balasubramanian, MD, APO, India (*Presenter*) Nothing to Disclose

PURPOSE

Intracranial dural arteriovenous fistulas (DAVF) are rare vascular malformations constituting 10 to 15 % of all intracranial vascular malformations with risk of hemorrhagic complications seen in higher grades of fistula. Conventional MR imaging has very limited role in detection and classification of DAVF. Advanced MRI sequences like 3D time of flight Angiography(3D TOF), arterial spin labelling and Susceptibility weighted imaging have shown promise in diagnosis and evaluation of these vascular malformations. The main purpose of this study is to compare the diagnostic performance of 3D time of flight Angiography, arterial spin labelling and Susceptibility weighted angiographic imaging with Digital subtraction angiography in accurate diagnosis and evaluation of DAVF.*Methods and Materials This combined retrospective and prospective study included 40 patients with dural arteriovenous fistula who had undergone both DSA and MR imaging comprising of 3D TOF MRA, 3D pseudocontinuous ASL(3D PCASL) and Susceptibility weighted angiography(SWAN). Two neuroradiologists assessed 3D PCASL, TOF MRA, SWAN with regards to location, number of fistulas, presence of cortical venous reflux, grading of the fistula as per Cognard grading, prominent arterial feeders in TOF MRA, immediate venous drainage in TOF MRA and presence of pseudophlebitic pattern in SWAN. Sensitivity, Positive predictive value, negative predictive value, accuracy, intermodality agreement and correlation analyses were performed to evaluate these sequences on comparison with the gold standard method Digital Subtraction angiography (DSA).*Results 3D ASL and SWAN showed high sensitivity (93% vs 94.5%), specificity (100%), accuracy (99%) and excellent agreement in localisation of fistula and grade the fistula as per Cognard grading. TOF MRA showed 94.4% sensitivity and 100 % specificity for localisation of the fistula as well as the grading of the fistula with good intermodality agreement and correlation. TOF MRA also showed 89% sensitivity in identifying the main arterial feeders and 85% sensitivity in identification of immediate venous drainage with 88 % accuracy. The findings of 3D ASL, SWAN, and TOF MRA showed excellent correlation with DSA(r - 0.99).*Conclusions Non contrast MR angiographic sequences are an excellent armamentarium in diagnosis of DAVF with excellent sensitivity and specificity for the site, grading and angioarchitectural evaluation of dural arteriovenous fistula.*Clinical Relevance/Application These non invasive sequences are very

useful in identification of the fistula and also may be an alternative to the invasive DSA for follow up of these cases post intervention for ruling out residual fistulas

RESULTS

3D ASL and SWAN showed high sensitivity (93% vs 94.5%), specificity (100%), accuracy (99%) and excellent agreement in localisation of fistula and grade the fistula as per Cognard grading. TOF MRA showed 94.4% sensitivity and 100 % specificity for localisation of the fistula as well as the grading of the fistula with good intermodality agreement and correlation. TOF MRA also showed 89% sensitivity in identifying the main arterial feeders and 85% sensitivity in identification of immediate venous drainage with 88 % accuracy. The findings of 3D ASL, SWAN, and TOF MRA showed excellent correlation with DSA(r - 0.99).

CLINICAL RELEVANCE/APPLICATION

These non invasive sequences are very useful in identification of the fistula and also may be an alternative to the invasive DSA for follow up of these cases post intervention for ruling out residual fistulas

SPR-NR-15   T1-weighted Structural Brain Network Assisted Dual-time-point 18F-FDG Uptake Consistency Evaluation Via Integrated PET-MRI Scans

Participants
Gang Feng, MD, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To verify the consistency of 18F-fluorodeoxyglucose (18F-FDG) uptake between two different delayed times after 18F-FDG injection in the frame of 3D high resolution T1 weighted (1mm*1mm*1mm) structural brain network.*Methods and Materials The local ethics committee has approved this study. Written, informed consent was obtained. A cohort of 60 cognitively normal subjects were included who underwent PET-MR scan during Jun. 2019 to Dec. 2020 in our center. Among them 30 subjects (14M/16F, age 51.40±7.70) from group A received a 45 min delayed PET-MR scan (referred as early) while the other 30 subjects(14M/16F, age 52.50±8.82) from group B received delayed scans at 90 min after tracer injection (referred as delayed). Each subject from group A has a counterpart in group B who is of the same age, gender and similar body weight. The whole brain was parcellated into 109 units with FSL and Freesurfer. The FDG uptake was expressed as maximal standard uptake value (SUVmax) in each parcellation unit of the structural brain network. Intraclass correlation coefficient, or ICC was used to test the reliability of brain measurements between the dual-time-point FDG uptake measurements. The quantification of the agreement between the measurements of parcellation units pair of two time points was evaluated with Bland-Altman plot (B-A plot). Limits of agreement between the two measurements are a 95% prediction interval of the difference.*Results There is a reduction of FDG uptake among all brain regions over time in this study, which shows that the values of delayed measurement are always lower than the early measurement. The intraclass correlation coefficients between two groups (values of 24 out of 30 are larger than 0.75) show a strong inter-group reliability for measuring FDG uptake in early as well as delayed scans. Moreover, from the perspective of parcellation-units-wise analysis, most data points of differences of mean FDG uptake values between early and delayed scan locate within 95% limits of agreements, which suggested the variability of FDG uptake of each parcellation units pair between two groups is minimal.*Conclusions The results of the present study demonstrate the consistency of 18F-FDG uptake variation in different delay times. FDG uptake decreases synchronously and proportionally in all parcellation units of brain as delayed time changes.*Clinical Relevance/Application To investigate the 18F-FDG metrics in a parcellation fashion, our study shows a proportional variation of FDG uptake in different delayed times. It promises the feasibility of neuroscience research based on data from multiple centers and different PET scan protocols.

RESULTS

There is a reduction of FDG uptake among all brain regions over time in this study, which shows that the values of delayed measurement are always lower than the early measurement. The intraclass correlation coefficients between two groups (values of 24 out of 30 are larger than 0.75) show a strong inter-group reliability for measuring FDG uptake in early as well as delayed scans. Moreover, from the perspective of parcellation-units-wise analysis, most data points of differences of mean FDG uptake values between early and delayed scan locate within 95% limits of agreements, which suggested the variability of FDG uptake of each parcellation units pair between two groups is minimal.

CLINICAL RELEVANCE/APPLICATION

To investigate the 18F-FDG metrics in a parcellation fashion, our study shows a proportional variation of FDG uptake in different delayed times. It promises the feasibility of neuroscience research based on data from multiple centers and different PET scan protocols.

SPR-NR-16   Arterial Transit Artifacts On Arterial Spin Labelling MRI As An Imaging Marker For The Prediction Of Cerebral Hyperperfusion After Carotid Endarterectomy

Participants
Xiaoyuan Fan, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Cerebral hyperperfusion syndrome is an important cause of hemorrhagic stroke after carotid revascularization. To date, a practical technique that can be regularly implemented in clinical practice for the prediction of postoperative cerebral hyperperfusion (CH) has not been reported. The purpose of this study was to investigate whether arterial transit artifacts (ATAs) on arterial spin labelling (ASL) MRI can be a practical imaging marker to identify patients at high risk of CH after carotid endarterectomy (CEA).*Methods and Materials Consecutive patients with carotid stenosis who underwent CEA between May 2015 and January 2021 were included. Pseudo-continuous ASL MRI was performed before and after CEA. CH was defined as an increase in cerebral blood flow > 100% compared with preoperative values on ASL images. Patients were divided into CH and non-CH groups. Two neuroradiologists scored ASL images based on the presence of ATAs in regions of interest corresponding to ASPECTS methodology: 0, no or minimal ASL signal; 1, low/moderate ASL signal with ATA; 2, high ASL signal with ATA; and 3, normal perfusion without ATA. The optimal cutoff value of ASL score for predicting CH after CEA was assessed by receiver operating characteristic analysis. Degree of stenosis and the status of primary and secondary collaterals were evaluated to correlate with ASL score.*Results Seventy-three patients were included (mean age: 66 ± 7 years, 74% were male). CH after CEA was presented in 18 (27.66%) patients. Preoperative ATA-based ASL score was independently associated with CH after CEA (p < 0.001, Table 1). The optimal cutoff value of preoperative ASL score for predicting CH was = 23 points (94.6% sensitivity, 88.9% specificity, Figure 1). Carotid near-occlusion (p = 0.002), opening of posterior communicating arteries (p = 0.003) and presence of leptomeningeal collaterals (p < 0.001) were associated

with lower ASL scores. A representative case was shown in Figure 2.*Conclusions ATA on ASL images is a comprehensive manifestation of the degree of stenosis and the status of primary and secondary collaterals. Based on the presence of ATAs, ASL can non-invasively predict CH after CEA in patients with carotid stenosis in routine clinical practice.*Clinical Relevance/Application ASL images can be non-invasively obtained using most clinical MRI scanners with the time consumption less than 5 minutes and ATAs were easy to collect from the original ASL images without post-processing steps. Therefore, ASL may be a useful tool that can be applied to routine clinical work for the prediction of CH after CEA.

RESULTS

Seventy-three patients were included (mean age: 66 ± 7 years, 74% were male). CH after CEA was presented in 18 (27.66%) patients. Preoperative ATA-based ASL score was independently associated with CH after CEA (p < 0.001, Table 1). The optimal cutoff value of preoperative ASL score for predicting CH was = 23 points (94.6% sensitivity, 88.9% specificity, Figure 1). Carotid near-occlusion (p = 0.002), opening of posterior communicating arteries (p = 0.003) and presence of leptomeningeal collaterals (p < 0.001) were associated with lower ASL scores. A representative case was shown in Figure 2.

CLINICAL RELEVANCE/APPLICATION

ASL images can be non-invasively obtained using most clinical MRI scanners with the time consumption less than 5 minutes and ATAs were easy to collect from the original ASL images without post-processing steps. Therefore, ASL may be a useful tool that can be applied to routine clinical work for the prediction of CH after CEA.

SPR-NR-18 Early Moderate Blood-brain Barrier Disruption Can Be Reversible While Severe Blood-brain Barrier Disruption Indicates The Risk Of Delayed Cerebral Ischemic Following Aneurysmal Subarachnoid Hemorrhage

Participants
Chao Zhang, MS, Wuhu, China (Presenter) Nothing to Disclose

PURPOSE

To evaluate the changes of blood brain barrier permeability (BBBP) after aneurysmal subarachnoid hemorrhage (aSAH) and find out whether BBBP within 24 h after onset can further improve the prediction of delayed cerebral ischemic (DCI).*Methods and Materials Whole-brain CTP was performed within 24 h after symptom onset and in the DCI time window (DCITW). Whole brain average values of the flow extraction product (mKtrans) derived from CTP, qualitative CTP patterns and quantitative CTP parameters, and clinical data were compared between DCI and non-DCI groups. The changes in mKtrans from admission to the DCITW were analysed using a Paired t test. Multivariate logistic regression analysis and receiver-operating characteristic (ROC) curve analysis were performed to identify predictors of DCI and assess the discriminative ability.*Results One hundred and twenty-eight of 167 patients were included in the study, 44 of whom underwent a follow-up CTP in the DCITW. Forty-one of 128 patients (32%) developed DCI. Patients in the DCI group had a high World Federation of Neurosurgery scale (WFNS), Hunt-Hess grade (H-H), and modified Fisher Score (mFS) (all P<0.05). The mKtrans in the DCI group was significantly higher than that in the non-DCI group both on admission (P<0.001) and in the DCITW (P=0.001). mKtrans decreased significantly in the non-DCI group (P<0.009), but not in DCI group (P=0.474). Stepwise multivariate logistic regression analysis showed that mKtrans (OR=1.07, 95%CI: 1.03-1.11, P<0.001), WFNS (OR=6.47, 95%CI: 1.04-40.12, P=0.045), H-H (OR=0.17, 95%CI: 0.02-1.30, P=0.087), mFS (OR=3.73, 95%CI: 1.23-11.30, P=0.020), and qualitative CTP patterns (OR=3.27, 95%CI: 1.11-9.67, P=0.032) were independent predictors of DCI. The mKtrans produced the largest area under the curve of 0.786 (95%CI: 0.70-0.88), and the threshold was 0.545 ml·100ml-1·min-1 with corresponding sensitivity and specificity of 68% and 82%, respectively.*Conclusions BBBP measurement within 24 h after onset can improve the prediction of DCI following aSAH. Early moderate BBB disruption can be reversible, whereas severe BBBP disruption indicates the risk of DCI.*Clinical Relevance/Application This study further proves the value of early BBBP changes in aSAH. BBBP measurement within 24 h after onset can improve the prediction of DCI following aSAH. Early moderate BBBP disruption can be reversible, whereas severe BBBP disruption indicates the risk of DCI. Therefore, quantitative evaluation of BBBP at the acute stage after aSAH may guide clinical management and improve the functional outcome.

RESULTS

One hundred and twenty-eight of 167 patients were included in the study, 44 of whom underwent a follow-up CTP in the DCITW. Forty-one of 128 patients (32%) developed DCI. Patients in the DCI group had a high World Federation of Neurosurgery scale (WFNS), Hunt-Hess grade (H-H), and modified Fisher Score (mFS) (all P<0.05). The mKtrans in the DCI group was significantly higher than that in the non-DCI group both on admission (P<0.001) and in the DCITW (P=0.001). mKtrans decreased significantly in the non-DCI group (P<0.009), but not in DCI group (P=0.474). Stepwise multivariate logistic regression analysis showed that mKtrans (OR=1.07, 95%CI: 1.03-1.11, P<0.001), WFNS (OR=6.47, 95%CI: 1.04-40.12, P=0.045), H-H (OR=0.17, 95%CI: 0.02-1.30, P=0.087), mFS (OR=3.73, 95%CI: 1.23-11.30, P=0.020), and qualitative CTP patterns (OR=3.27, 95%CI: 1.11-9.67, P=0.032) were independent predictors of DCI. The mKtrans produced the largest area under the curve of 0.786 (95%CI: 0.70-0.88), and the threshold was 0.545 ml·100ml-1·min-1 with corresponding sensitivity and specificity of 68% and 82%, respectively.

CLINICAL RELEVANCE/APPLICATION

This study further proves the value of early BBBP changes in aSAH. BBBP measurement within 24 h after onset can improve the prediction of DCI following aSAH. Early moderate BBBP disruption can be reversible, whereas severe BBBP disruption indicates the risk of DCI. Therefore, quantitative evaluation of BBBP at the acute stage after aSAH may guide clinical management and improve the functional outcome.

SPR-NR-19 Diffusion MRI Connectometry Of Pedunculopontine Nucleus Projections And Motor Disability In Parkinson's Disease

Participants
Pohchoo Seow, PhD,MSc, Singapore, Singapore (Presenter) Nothing to Disclose

PURPOSE

Diffusion spectrum imaging (DSI) is a high-order model-free MRI approach based on generalized q-sampling imaging. It is sensitive to intravoxel heterogeneities and allows for accurate mapping of axonal trajectories through decoupling of restricted and nonrestricted diffusion, and assessment of local inflammation. We investigated changes in local structural connectometry driven by cholinergic denervation in the pedunculopontine nucleus (PPN) in Parkinson's disease (PD) patients and their correlation to motor scores.*Methods and Materials 94 subjects underwent brain MRI with DSI and clinical motor assessments viz Unified Parkinson's

Disease Rating Scale subscore (UPDRS III) and Hoehn and Yahr scale (H&Y). Deterministic tractography was conducted to track axonal PPN projections after registration to the Human Connectome Project diffusion MRI template. DSI data were normalized to the standard template and pre-processed to generate restricted (RDI) and non-restricted (NRDI) diffusion indices which represent the density of intra- and extra-cellular diffusing spins. Connectometry analysis was performed for voxel-by-voxel correlation between RDI/NRDI in the PPN projections with motor scores.*Results There were 36 PD patients (9 women; mean age 64.6 years, H&Y 1.93, UPDRS III 31.9) and 58 healthy controls (32 women; mean age 64.9 years, H&Y 0.04, UPDRS III 5.24). Patients showed reduced RDI and NRDI in the PPN projections connected to the thalamic intralaminar and ventral posterolateral subnuclei, subthalamic nucleus, and substantia nigra compared to controls, and these demonstrated significant negative correlations (false-discovery-rate<0.05) with worse motor scores.*Conclusions Using diffusion MR connectometry, we found local changes in PPN projections to different deep grey nuclei in PD patients which correlated with the degree of motor disability. Our findings provide imaging evidence of dysregulation of PPN projections, in support of Braak's hypothesis, and congruent with literature proposing progressive neuroinflammation and neurodegeneration.*Clinical Relevance/Application DSI shows potential as an objective tool for monitoring of disease progression in Parkinson's disease and evaluation for deep brain stimulation surgery.

RESULTS

There were 36 PD patients (9 women; mean age 64.6 years, H&Y 1.93, UPDRS III 31.9) and 58 healthy controls (32 women; mean age 64.9 years, H&Y 0.04, UPDRS III 5.24). Patients showed reduced RDI and NRDI in the PPN projections connected to the thalamic intralaminar and ventral posterolateral subnuclei, subthalamic nucleus, and substantia nigra compared to controls, and these demonstrated significant negative correlations (false-discovery-rate<0.05) with worse motor scores.

CLINICAL RELEVANCE/APPLICATION

DSI shows potential as an objective tool for monitoring of disease progression in Parkinson's disease and evaluation for deep brain stimulation surgery.

SPR-NR-21 The Impact Of Brain Frailty On Collateral Status And Clinical Outcome In Acute Ischemic Stroke

Participants
Jia-Ying Zhou, Nanjing, China (*Presenter*) Nothing to Disclose

PURPOSE

We investigate the association of preexisting brain frailty markers with the collateral status and functional outcome in acute ischemic stroke.*Methods and Materials Consecutive stroke patients with proximal artery occlusion/severe stenosis presenting within 24 hours after symptom onset and who underwent baseline multiphase CTA and MRI within 5 days after onset from 2018 to 2020 were included. We graded the collateral status on multiphase CTA using Menon's six-point ordinal scale, and rated imaging markers of brain frailty on MRI (including atrophy [0-2 score], leukoaraiosis [0-2 score], evidence of old lacunes, and evidence of enlarged perivascular space). Total brain frailty burden scores were also quantified by adding the presence of atrophy, leukoaraiosis, and old lacunes (including severe burden score, slight burden score, and severe burden score without atrophy). Modified Rankin Scale (mRS) score at discharge was recorded as the clinical outcome. Multivariable ordinal logistic regression was performed to explore the associations between brain frailty markers with collaterals and mRS.*Results Of the 119 eligible patients (median age, 70 years; 61.3% men), 89.1% patients showed brain frailty imaging markers. Severe atrophy (P<0.001, P=0.002), severe leukoaraiosis (P<0.001, P=0.032) were always associated with the collateral score when using individual markers or combining all markers. Total burden scores were all significantly associated with collateral score (P<0.001), and severe burden score had the most marked effect (OR 4.38, 95% CI 2.67-7.19). Severe burden score (OR 1.74, 95% CI 1.07-2.81) was also an independent risk factor of worse mRS at discharge, and decreased the protective effect of collaterals on mRS (from OR 0.42 [95%CI 0.29-0.60], to OR 0.53 [95%CI 0.36-0.79]). Moreover, there was a significant interaction between severe burden score and collateral score (P=0.003, OR 1.27 [95%CI, 1.00-1.61]) in determining the excellent clinical outcome (mRS score 0-1).*Conclusions Preexisting brain frailty markers are significantly associated with poor collateral status and could mediate the prognostic value of collaterals on functional outcomes after stroke. These imply that therapies aimed at reducing the progression of brain frailty may protect against poor clinical outcomes via improving collateral status.*Clinical Relevance/Application Pre-stroke brain frailty markers are determinants of poor collateral status and functional outcomes after stroke, implying that therapies aimed at reducing the progression of brain frailty, especially atrophy and leukoaraiosis, may protect against poor clinical outcomes via improving collateral status.

RESULTS

Of the 119 eligible patients (median age, 70 years; 61.3% men), 89.1% patients showed brain frailty imaging markers. Severe atrophy (P<0.001, P=0.002), severe leukoaraiosis (P<0.001, P=0.032) were always associated with the collateral score when using individual markers or combining all markers. Total burden scores were all significantly associated with collateral score (P<0.001), and severe burden score had the most marked effect (OR 4.38, 95% CI 2.67-7.19). Severe burden score (OR 1.74, 95% CI 1.07-2.81) was also an independent risk factor of worse mRS at discharge, and decreased the protective effect of collaterals on mRS (from OR 0.42 [95%CI 0.29-0.60], to OR 0.53 [95%CI 0.36-0.79]). Moreover, there was a significant interaction between severe burden score and collateral score (P=0.003, OR 1.27 [95%CI, 1.00-1.61]) in determining the excellent clinical outcome (mRS score 0-1).

CLINICAL RELEVANCE/APPLICATION

Pre-stroke brain frailty markers are determinants of poor collateral status and functional outcomes after stroke, implying that therapies aimed at reducing the progression of brain frailty, especially atrophy and leukoaraiosis, may protect against poor clinical outcomes via improving collateral status.

SPR-NR-23 Diagnostic Yield Of Susceptibility-weighted Brain MR Imaging In Patients With Cognitive Impairment: Large Cohort Study With 6,977 Patients

Participants
Chong Hyun Suh, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

There is paucity of evidence for the need of susceptibility-weighted imaging (SWI) in patients attending outpatient clinic for cognitive impairment. We aimed to evaluate diagnostic yield of SWI in patients attending outpatient clinic for cognitive impairment.*Methods and Materials This retrospective, observational, single-institution study included 6,977 consecutive patients (mean age ± SD, 70 ± 11; 4,394 women) attending outpatient clinic for cognitive impairment who underwent brain MRI with SWI from January 2013 to February 2020. Patients with microbleeds were identified, and those meeting the criteria for cerebral amyloid

angiopathy (CAA) and hypertensive angiopathy were recognized. Diagnostic yield was defined as the proportion of patients with positive findings on SWI among all patients and exact 95% CIs were determined. Subgroup analyses were performed by age groups and sex, and Chi-square test was performed to compare the diagnostic yields between groups.*Results The overall diagnostic yield of SWI in patients with cognitive impairment was 23.1% (1,613/6,977; 95% CI, 22.1-24.1%). The diagnostic yield was 17.1% (1,193/6,977; 95% CI, 16.2-18.0%) for microbleeds. The diagnostic yield was 2.5% (175/6,977; 95% CI, 2.2-2.9%) for cerebral amyloid angiopathy, 1.1% (74/6,977; 95% CI, 0.83-1.3%) for hypertensive angiopathy, 0.95% (66/6,977; 95% CI, 0.73-1.2%) for mixed cerebral amyloid and hypertensive angiopathy and 0.69% (48/6,977; 95% CI, 0.51-0.91%) for superficial siderosis. The diagnostic yield was 0.54% (38/6,977; 95% CI, 0.39-0.75%) for cavernous malformation and 0.17% (12/6,977; 95% CI, 0.09-0.30%) for diffuse axonal injury or trauma. The diagnostic yield of SWI was higher in the older age group with = 70 years (41.4% vs 10.5%, P < .001). There was an incremental increase of the diagnostic yield from the age group 50-59 years (8.7%; 69/787) to 80-89 years (33.6%; 413/1,229).*Conclusions The diagnostic yield of SWI in patients with cognitive impairment was high with higher diagnostic yield in the older age group, and SWI identified microbleeds that meet the criteria for CAA, hypertensive angiopathy or both.*Clinical Relevance/Application This supports the need for SWI in evaluation of patients with cognitive impairment.

RESULTS

The overall diagnostic yield of SWI in patients with cognitive impairment was 23.1% (1,613/6,977; 95% CI, 22.1-24.1%). The diagnostic yield was 17.1% (1,193/6,977; 95% CI, 16.2-18.0%) for microbleeds. The diagnostic yield was 2.5% (175/6,977; 95% CI, 2.2-2.9%) for cerebral amyloid angiopathy, 1.1% (74/6,977; 95% CI, 0.83-1.3%) for hypertensive angiopathy, 0.95% (66/6,977; 95% CI, 0.73-1.2%) for mixed cerebral amyloid and hypertensive angiopathy and 0.69% (48/6,977; 95% CI, 0.51-0.91%) for superficial siderosis. The diagnostic yield was 0.54% (38/6,977; 95% CI, 0.39-0.75%) for cavernous malformation and 0.17% (12/6,977; 95% CI, 0.09-0.30%) for diffuse axonal injury or trauma. The diagnostic yield of SWI was higher in the older age group with = 70 years (41.4% vs 10.5%, P < .001). There was an incremental increase of the diagnostic yield from the age group 50-59 years (8.7%; 69/787) to 80-89 years (33.6%; 413/1,229).

CLINICAL RELEVANCE/APPLICATION

This supports the need for SWI in evaluation of patients with cognitive impairment.

SPR-NR-24 Progressive Microstructural Alterations In Gray Matter In Parkinson'S Disease

Participants
Xueqin Bai, Hangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the microstructural and macrostructural alterations in gray matter in Parkinson's disease (PD) at different stages using diffusion model of Neurite Orientation Dispersion and Density Imaging (NODDI) with gray matter-based spatial statistics (GBSS) and T1 imaging, respectively.*Methods and Materials 108 PD patients (64 patients in early-stage PD group (EPD) and 44 patients in moderate-late-stage PD group (MLPD)) and 64 healthy controls (HC) were included. Gray matter microstructural alterations were evaluated by neurite density (NDI), and orientation dispersion (ODI) and fraction of the isotropic compartment (fiso). Cortical thickness analyses were evaluated by T1 imaging with FreeSurfer. Randomize tool was used to examine the relationship between diffusion metrics and motor score of Unified Parkinson's Disease Rating Scale part-III (UPDRS-III).*Results For GBSS, compared with HC, EPD patients showed higher fiso and lower ODI in posterior cortical regions (occipital, temporal lobes), while MLPD patients showed diffuse higher fiso and lower ODI across bilateral frontal, parietal, temporal, occipital lobes and cingulate cortex (all Pfwe< 0.05). Compared with EPD, MLPD patients showed extensive higher fiso in bilateral frontal, occipital, cingulate cortex and right temporal lobes and lower ODI across bilateral frontal, parietal, temporal, occipital lobes and cingulate cortex (all Pfwe< 0.05). However, cortical thickness analyses failed to detect any GM differences in EPD and MLPD.*Conclusions PD has progressive microstructural alterations in the gary matter. NODDI is more sensitive than macrostructural imaging to detect cortical alterations during PD progression.*Clinical Relevance/Application Exploring the degenerative changes in gray matter in PD patients at different stages will improve the understanding of PD pathophysiology and will promote the identification of new markers to monitor disease progression in vivo. Our study also provides evidence supporting the notion that microstructural changes precede morphological changes in PD.

RESULTS

For GBSS, compared with HC, EPD patients showed higher fiso and lower ODI in posterior cortical regions (occipital, temporal lobes), while MLPD patients showed diffuse higher fiso and lower ODI across bilateral frontal, parietal, temporal, occipital lobes and cingulate cortex (all Pfwe< 0.05). Compared with EPD, MLPD patients showed extensive higher fiso in bilateral frontal, occipital, cingulate cortex and right temporal lobes and lower ODI across bilateral frontal, parietal, temporal, occipital lobes and cingulate cortex (all Pfwe< 0.05). However, cortical thickness analyses failed to detect any GM differences in EPD and MLPD.

CLINICAL RELEVANCE/APPLICATION

Exploring the degenerative changes in gray matter in PD patients at different stages will improve the understanding of PD pathophysiology and will promote the identification of new markers to monitor disease progression in vivo. Our study also provides evidence supporting the notion that microstructural changes precede morphological changes in PD.

SPR-NR-26 Perfusion And Atrophy Patterns Of Cerebral Deep Nucleus And Cerebellar Regions In Parkinson'S Disease And Parkinsonism-plus Syndrome

Participants
Zhaoxi Liu, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore discriminative patterns of deep nucleus arophy and cerebral blood flow (CBF) between patients with PD and PPS*Methods and Materials Two hundred and thirty-one subjects [81 patients with PD, 39 patients with progressive supranuclear palsy (PSP), 21 patients with Parkinson variant of multiple system atrophy (MSA-P), and 90 healthy controls (HCs)] underwent a morphometric and arterial spin labeling (ASL) MRI to measure volume and perfusion values within the deep nucleus and cerebellum. The PD 25 template was used for the deep nucleus (including 16 regions, figure 1). The SUIT template was used for segmenting cerebellar ROIs (including 34 regions). An ANOVA followed by post-hoc with Bonferroni correction was employed to identify significant differences among the groups*Results Patients with PD, PSP and MSA-P showed lower perfusion values than HCs in several regions (bilateral caudate nucleus, putamen, globuspallidus-externa, right V, bilateral VI, vermis VI, vermis VIIb, vermis VIIIa and right interposed nucleus) (all p <0.05). In particular, CBF in the bilateral caudate nucleus in the PSP group was significantly

lower than that in the PD, MSA-P and HC groups (p <0.05). The PSP group showed a higher degree of atrophy in left caudate nucleus (p <0.05) and bilateral thalami than those in HCs (p <0.001). Patients with MSA-P showed a higher atrophy in the left caudate, bilatral putamen and several cerebellar regions than that in the HCs. Additionally, the GM voluem of bilateral putmen and right V in the MSA-P group was significantly smaller than that of other groups (all p <0.05)*Conclusions Significant perfusion reduction in bilateral caudate nucleus could be a characteristic of PSP, while significant atrophy of bilateral putamen and right V may be a feature of MSA-P*Clinical Relevance/Application To aid the differential diagnosis among Parkinson disease (PD), progressive supranuclear palsy (PSP) and Parkinson variant of multiple system atrophy (MSA-P).

RESULTS

Patients with PD, PSP and MSA-P showed lower perfusion values than HCs in several regions (bilateral caudate nucleus, putamen, globuspallidus-externa, right V, bilateral VI, vermis VI, vermis VIIb, vermis VIIIa and right interposed nucleus) (all p <0.05). In particular, CBF in the bilateral caudate nucleus in the PSP group was significantly lower than that in the PD, MSA-P and HC groups (p <0.05). The PSP group showed a higher degree of atrophy in left caudate nucleus (p <0.05) and bilateral thalami than those in HCs (p <0.001). Patients with MSA-P showed a higher atrophy in the left caudate, bilatral putamen and several cerebellar regions than that in the HCs. Additionally, the GM voluem of bilateral putmen and right V in the MSA-P group was significantly smaller than that of other groups (all p <0.05)

CLINICAL RELEVANCE/APPLICATION

To aid the differential diagnosis among Parkinson disease (PD), progressive supranuclear palsy (PSP) and Parkinson variant of multiple system atrophy (MSA-P).

SPR-NR-27 Effects Of Aortic Arch Anatomy And Carotid Artery Tortuosity On Mechanical Thrombectomy Procedure Length And Complications

Participants
Elena Cora, MD, Halifax, Nova Scotia (*Presenter*) Nothing to Disclose

PURPOSE

Endovascular thrombectomy (EVT) is a procedure used to treat acute ischemic stroke. Given that the technical success of clot removal to achieve reperfusion has direct implications for patient outcomes, understanding the impact of anatomical variation on procedural success is important. Here we sought to characterize relevant anatomical characteristics and their impact on the success of EVT and related patient outcomes.*Methods and Materials We retrospectively reviewed all consecutive patients who underwent EVT for acute ischemic stroke due to large vessel occlusion in the anterior circulation at our institution from January 2019 to February 2021. Pre-procedure CT imaging was reviewed and scored independently by a board certified neuroradiologist. The type of aortic arch and tortuosity of the internal and common carotid arteries were scored. Using univariate analysis, the effect of these anatomical scores on patient outcomes, including time to final recanalization, mTICI, and mRS scores were analyzed.*Results A total of 128 patients were assessed, 55% females (70/128), mean age 71 (SD 12), median presenting NIHSS 15 and median ASPECTS score 9. Univariate analysis showed that more difficult arch anatomy corresponded to significantly increased fluoroscopic time throughout the procedures (p=0.035). Increasing common carotid arterial tortuosity was associated with a higher radiation dose (p=0.040) and there were more procedural complications (p=0.008), both of these being statistically significant. There was also a trend towards less successful recanalizations (p=0.076) with common carotid tortuosity. Internal carotid arterial tortuosity also showed a trend towards less successful recanalizations (p=0.079).*Conclusions Aortic arch, common and internal carotid tortuosity are important anatomical factors as they show association with multiple parameters that can lead to adverse clinical outcomes, including longer procedures with less successful recanalizations and more procedural complications in patients undergoing EVT.*Clinical Relevance/Application The vascular anatomy of the aortic arch and carotid arteries when routinely evaluated for tortuosity prior to undergoing EVT may be helpful in clinical decision making including deciding which tools to use, whether to perform the procedure under conscious sedation or a general anaesthetic and when discussing risks versus benefits during informed consent discussions.

RESULTS

A total of 128 patients were assessed, 55% females (70/128), mean age 71 (SD 12), median presenting NIHSS 15 and median ASPECTS score 9. Univariate analysis showed that more difficult arch anatomy corresponded to significantly increased fluoroscopic time throughout the procedures (p=0.035). Increasing common carotid arterial tortuosity was associated with a higher radiation dose (p=0.040) and there were more procedural complications (p=0.008), both of these being statistically significant. There was also a trend towards less successful recanalizations (p=0.076) with common carotid tortuosity. Internal carotid arterial tortuosity also showed a trend towards less successful recanalizations (p=0.079).

CLINICAL RELEVANCE/APPLICATION

The vascular anatomy of the aortic arch and carotid arteries when routinely evaluated for tortuosity prior to undergoing EVT may be helpful in clinical decision making including deciding which tools to use, whether to perform the procedure under conscious sedation or a general anaesthetic and when discussing risks versus benefits during informed consent discussions.

SPR-NR-29 Cerebral Small Vessel Disease In Patients With Carotid Stenosis: Relationship With Carotid Intraplaque Hemorrhage And Symptoms

Participants
Xiaoqian Zhang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the association between carotid intraplaque hemorrhage (IPH) and total burden of cerebral small vessel disease (CSVD) in patients with carotid stenosis, and to identify the imaging features that best help distinguish between symptomatic and asymptomatic patients with carotid stenosis.*Methods and Materials Consecutive 71 patients (mean age was 66 ± 7 years, and 84.3% were male) with unilateral carotid stenosis were included and brain magnetic resonance imaging (MRI) were performed. The total burden of CSVD was calculated by accumulating one point according to the presence of each of the four MRI markers: white matter hyperintensities, lacunes, perivascular spaces and cerebral microbleeds. Ordered logistic regression analysis was performed to evaluate the association between IPH and CSVD burdens. Age, sex, vascular risk factors, degree of stenosis and completeness of circle of Willis were also included as covariates. The symmetry of CSVD burdens between ipsilateral and contralateral hemispheres was tested. Clinical symptoms including absent/non-specific symptoms, transient ischemic attack, amaurosis and ischemic stroke were evaluated by a vascular surgeon. MRI features (CSVD score, degree of stenosis, IPH and complete circle of

Willis) were correlated with severity of clinical symptoms by using Kruskal-Wallis H tests and Fisher's exact tests.*Results IPH (OR = 4.12, 95% CI [1.48, 11.45], p = 0.007) was independently associated with a higher CSVD score, adjusted for other risk factors (Table 1). The presence of unilateral IPH was independently associated with the interhemispheric CSVD score difference (p = 0.046, Figure 1). The association between clinical symptoms and imaging characteristics are shown in Figure 2. CSVD score was the only imaging factor associated with more severe clinical symptoms (p < 0.001). The association between IPH and clinical symptoms was marginally significant (p = 0.064), while degree of stenosis (p = 0.115) and completeness of circle of Willis (p = 0.94) were not associated with symptomatic status.*Conclusions Carotid IPH is associated with a higher total burden of CSVD in patients with carotid stenosis. Compared with degree of stenosis or IPH, the total CSVD score is a more effective imaging marker linked with clinical symptoms.*Clinical Relevance/Application In patients with carotid stenosis, the total CSVD score as an imaging marker is worthy of attention. We found the total CSVD score was an effective imaging marker linked with clinical symptoms and in the future, the diagnostic and predictive value of the total CSVD burden needs to be further tested in patients with carotid stenosis.

RESULTS

IPH (OR = 4.12, 95% CI [1.48, 11.45], p = 0.007) was independently associated with a higher CSVD score, adjusted for other risk factors (Table 1). The presence of unilateral IPH was independently associated with the interhemispheric CSVD score difference (p = 0.046, Figure 1). The association between clinical symptoms and imaging characteristics are shown in Figure 2. CSVD score was the only imaging factor associated with more severe clinical symptoms (p < 0.001). The association between IPH and clinical symptoms was marginally significant (p = 0.064), while degree of stenosis (p = 0.115) and completeness of circle of Willis (p = 0.94) were not associated with symptomatic status.

CLINICAL RELEVANCE/APPLICATION

In patients with carotid stenosis, the total CSVD score as an imaging marker is worthy of attention. We found the total CSVD score was an effective imaging marker linked with clinical symptoms and in the future, the diagnostic and predictive value of the total CSVD burden needs to be further tested in patients with carotid stenosis.

SPR-NR-31 Comparison Of Flat Panel CT And Photon-counting Detector- Based Spectral CT To Evaluate Contrast Enhancement Of Chronic Subdural Hematomas After Embolization Of The Middle Meningeal Artery

Participants
Christoph Maurer, MD, Augsburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Middle meningeal artery (MMA) embolization targets the leaky dural vascular networks of chronic subdural hematoma (cSDH) to prevent hematoma re-accumulation. Post interventional flat panel CT imaging often shows enhancement of the dural membranes and the cSDH itself. Spectral CT can add additional information by differentiating between enhancement by iodine-based contrast agents and hemorrhage.*Methods and Materials All 105 patients who underwent MMA embolization in our institution between May 2018 and April 2021 were retrospectively reviewed. Post-procedural CT was either performed on a flat panel CT in the angio suit or on Photon-Counting Detector based CT(Quantum Technology, Siemens Healthineers, Germany) using a spectral acquisition technique. Flat panel CTs were evaluated for dural enhancement, enhancement of the hematoma and possible hemorrhage. Spectral CT acquisitions were post-processed to differentiate between iodine enhancement and blood. Available follow-up images were reviewed for hematoma re-accumulation.*Results Illustrative cases will be presented to compare the differences between postinterventional flat-panel CT and post procedural Spectral CT for patients undergoing MMA embolization. The potential of Spectral CT with a photon counting detector to discriminate between contrast enhancement and blood will be highlighted. Follow-up data on cSDH will be correlated with initial dural enhancement as well as enhancement of the hematoma.*Conclusions Preliminary results suggest that compared to post interventional flat panel CT Spectral CT facilitates differentiation between hematoma re-accumulation and contrast leakage and provides improved visualization of contrast enhancement of membranes within the cSDH and the dura itself. Postinterventional contrast enhancement of cSDHs might be a predictor of successful MMA embolization.*Clinical Relevance/Application Spectral CT provides additional prognostic and thereputic information after neuroradiological endovascular interventions.

RESULTS

Illustrative cases will be presented to compare the differences between postinterventional flat-panel CT and post procedural Spectral CT for patients undergoing MMA embolization. The potential of Spectral CT with a photon counting detector to discriminate between contrast enhancement and blood will be highlighted. Follow-up data on cSDH will be correlated with initial dural enhancement as well as enhancement of the hematoma.

CLINICAL RELEVANCE/APPLICATION

Spectral CT provides additional prognostic and thereputic information after neuroradiological endovascular interventions.

SPR-NR-32 Convergent And Divergent Intranetwork And Internetwork Connectivity Patterns In Drug-naïve Patients With Early Parkinson's Disease

Participants
Wenliang Fan, BMedSc,PhD, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the difference of intra- and internetwork architecture at three different level between individuals with Parkinson's disease (PD) and healthy controls (HC).*Methods and Materials A case-control study of 50 early-stage drug-naïve PD and 50 HC participants were collected. All participants were underwent resting-state functional MRI as well as a series of questionnaires to assess the severity of disease and the status of psychiatry. The intra- and internetwork architecture of resting state brain network of all participants were analysed at integrity level, network level and edge level. The scores of UPDRS-III, MMSE, MOCA, HAMA and HAMD reflecting the motor and non-motor symptoms of PD were collected for further regression analysis.*Results Compared to HC, reduced degree of functional connectivity were mainly observed in VSN, SMN, LBN and DGN (P<0.05, FDR corrected). Intra-network analysis indicates decreased functional connectivity of DGN, SMN, VAN and LBN. Inter-network analysis indicates reduced functional connectivity in nine pairs of RSNs. At edge level, LBN is the center of abnormal functional connectivity (P<0.05, FDR corrected). Regression analysis shows that the score of MOCA is associated with intra-network of DGN and inter-network of DGN-VAN.*Conclusions Our study demonstrated the variation of whole brain connection in drug-naïve patients with early PD compared with age-matched HC for the first time. It can be concluded that main changes focus on SMN, DGN, LBN and VSN, which may be relevant to the motor and non-motor symptoms in early PD. Meanwhile, our results reveal the changes of convergent and dvergent

intranetwork and internetwork connectivity patterns of drug-naïve patients with early Parkinson's disease.*Clinical Relevance/Application The present study provides neuroimaging evidence of the functional brain connectome alterations at three level in drug-naïve patients with early Parkinson's disease and corresponding potential biomarkers for clinical diagnosis and assessment of PD.

RESULTS

Compared to HC, reduced degree of functional connectivity were mainly observed in VSN, SMN, LBN and DGN (P<0.05, FDR corrected). Intra-network analysis indicates decreased functional connectivity of DGN, SMN, VAN and LBN. Inter-network analysis indicates reduced functional connectivity in nine pairs of RSNs. At edge level, LBN is the center of abnormal functional connectivity (P<0.05, FDR corrected). Regression analysis shows that the score of MOCA is associated with intra-network of DGN and inter-network of DGN-VAN.

CLINICAL RELEVANCE/APPLICATION

The present study provides neuroimaging evidence of the functional brain connectome alterations at three level in drug-naïve patients with early Parkinson's disease and corresponding potential biomarkers for clinical diagnosis and assessment of PD.

SPR-NR-33   Multiparametric MR-based Radiofusionomics Modeling For Differentiation Of Glioblastoma Multiforme From Solitary Brain Metastasis

Participants
Ruili Wei, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the diagnostic potential of a novel RadioFusionOmics (RFO) model in differentiating GBM and SBM through information fusion from multiple MR sequences and various classifiers based on the optimal volumetric lesion component.*Methods and Materials This retrospective study collected 183 patients diagnosed and treated in two institutions between September 2007 and September 2020, including 94 GBM patients and 89 SBM patients. Three volume of interests (VOIs) were delineated on the conventional axial MR images (T1WI, T2WI, T2_FLAIR and CE_T1WI), including the volumetric non-enhanced tumor (nET), enhanced tumor (ET), and peritumoral edema (pTE). Using the RFO model, radiomics features extracted from different combinations of multiparametric MRI sequence(s) and VOI(s) were fused by a novel feature fusion method and cross-validated by 15 classification models. The best sequence and VOI (or combinations) were determined. The top predictive models were ranked and screened out on the training/validation set. Model fusion, a procedure analogous to multidisciplinary consultation, was performed on the top-3 models to generate a final model, which was validated on an independent testing set. The top features were identified and the discrimination performance of RFO was compared with three board-certified radiologists.*Results Image features extracted from the volumetric ET (VOIET) showed dominant predictive performances over features from other VOIs combination. Fusion of VOIET features from the T1WI and T2_FLAIR sequences via the RFO model have achieved discrimination accuracy of AUC = 0.9249, accuracy = 0.8548, sensitivity = 0.8561, and specificity = 0.8529 on the independent testing set, which significantly outperformed three experienced radiologists (p=0.03, 0.01 and 0.02). The top-10 features included five first-order based features, four shape-based features, and one texture feature.*Conclusions Fusion of multiple MRI sequences and multiple classifiers can provide multifaceted information regarding tumor characteristics. The proposed RFO model may serve as a promising tool for computer-aided diagnosis of GBM vs. SBM in the clinical settings.*Clinical Relevance/Application A high-performing RadioFusionOmics model was built and could serve as a promising tool for computer-aided diagnosis of GBM vs. SBM.

RESULTS

Image features extracted from the volumetric ET (VOIET) showed dominant predictive performances over features from other VOIs combination. Fusion of VOIET features from the T1WI and T2_FLAIR sequences via the RFO model have achieved discrimination accuracy of AUC = 0.9249, accuracy = 0.8548, sensitivity = 0.8561, and specificity = 0.8529 on the independent testing set, which significantly outperformed three experienced radiologists (p=0.03, 0.01 and 0.02). The top-10 features included five first-order based features, four shape-based features, and one texture feature.

CLINICAL RELEVANCE/APPLICATION

A high-performing RadioFusionOmics model was built and could serve as a promising tool for computer-aided diagnosis of GBM vs. SBM.

SPR-NR-34   Cycle-consistent Adversarial Networks Increases Robustness Of Radiomics Model In Grading Meningiomas On External Validation

Participants
Yaewon Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The heterogeneity of MRI protocol is one of the major reason of decreased performance of the radiomics model in the external validation stage. We aimed to establish a robust model for predicting grade of meningiomas combining radiomics and Cycle-Consistent Adversarial Networks (CycleGAN) on external validation.*Methods and Materials A total of 257 patients with meningioma (162 low-grade, 95 high-grade) who underwent a brain magnetic resonance imaging protocol including contrast-enhanced T1 images were included in the institutional training set. After radiomics feature selection (n = 214), various combinations of classifiers were fine-tuned. The models were validated in the external validation set consisting of 61 patients with meningiomas (46 low-grade, 15 high-grade). To reduce the decrease of performance associated with the inter-institutional heterogeneity of MRI, we translated the style of the small image set of the external validation into the large image set style of the institutional training set using CycleGAN.*Results In the institutional training set, the area under the curve (AUC), accuracy, sensitivity, and specificity was 0.87 (95% confidence interval [CI 0.84-0.90], 77.1%, 82.2%, and 72.0%, respectively. In the original external validation dataset, the AUC, accuracy, sensitivity, and specificity were 0.62 (95% CI 0.46-0.78), 58.6%, 46.2%, and 62.2%, respectively. In the style-transferred external validation dataset, the AUC, accuracy, sensitivity, and specificity were 0.82 (95% CI 0.70-0.94), 70.7%, 76.9%, and 68.9%, respectively. The performance significantly increased in the external validation set after style-transfer was performed (P = 0.046).*Conclusions CycleGAN may be helpful to increase the robustness of a radiomics model in differentang meningioma grade on external validation.*Clinical Relevance/Application In our study, we focused on a practical and crucial problem encountered in implementing a machine learning model in medical imaging, which is increasing the robustness of an radiomics model on external validation. The inter-institutional heterogeneity of MRI protocol is one of the major reason of decreased performance. CycleGANs are a relatively newly type of Generative Adversarial Network (GAN), which has received much attention because of

their ability to capture characteristics of one image collection and figure generate synthetic images in the absence of any paired training examples. As there is no 'ground truth' dataset of paired training examples (consisting of internal and external MRI exams of identical patients at the same period) in real-world clinical practice, our method may serve as a useful approach to solve inter-institutional heterogeneity of image data.

RESULTS

In the institutional training set, the area under the curve (AUC), accuracy, sensitivity, and specificity was 0.87 (95% confidence interval [CI 0.84-0.90], 77.1%, 82.2%, and 72.0%, respectively. In the original external validation dataset, the AUC, accuracy, sensitivity, and specificity were 0.62 (95% CI 0.46-0.78), 58.6%, 46.2%, and 62.2%, respectively. In the style-transferred external validation dataset, the AUC, accuracy, sensitivity, and specificity were 0.82 (95% CI 0.70-0.94), 70.7%, 76.9%, and 68.9%, respectively. The performance significantly increased in the external validation set after style-transfer was performed (P = 0.046).

CLINICAL RELEVANCE/APPLICATION

In our study, we focused on a practical and crucial problem encountered in implementing a machine learning model in medical imaging, which is increasing the robustness of an radiomics model on external validation. The inter-institutional heterogeneity of MRI protocol is one of the major reason of decreased performance. CycleGANs are a relatively newly type of Generative Adversarial Network (GAN), which has received much attention because of their ability to capture characteristics of one image collection and figure generate synthetic images in the absence of any paired training examples. As there is no 'ground truth' dataset of paired training examples (consisting of internal and external MRI exams of identical patients at the same period) in real-world clinical practice, our method may serve as a useful approach to solve inter-institutional heterogeneity of image data.

SPR-NR-37   Chemical Exchange Saturation Transfer (CEST) Imaging In Various Brain Tumor Patients: Comparison Of Capability For Molecular-based Assessment Between 2D Spin Echo- And 3D Gradient Echo-based Sequences

Participants
Kazuhiro Murayama, MD, Toyoake, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation

PURPOSE

To prospectively and directly compare the capability of chemical exchange saturation transfer (CEST) imaging for molecular-based assessment between 2D spin echo (SE) based and 3D gradient echo (GRE) based sequences in various brain tumor patients.*Methods and Materials 50 consecutive patients with 54 pathologically diagnosed brain tumors underwent CEST imaging by using 2D SE-based and 3D GRE-based sequences (i.e. 2D CEST and 3D CEST) at a 3T MR system. In each lesion, magnetization transfer ratio asymmetry (MTRasym) at 3.5ppm was calculated from z-spectra from each CEST data, and MTRasym map was computationally generated by pixel-by-pixel analysis. Then, MTRasym in each lesion was determined by ROI measurements on both MTRasym maps. To evaluate the relationship of MTRasym between two methods, Pearson's correlation was performed. Then, Bland-Altman analysis was performed to evaluate difference of MTRasym between 2D and 3D CEST data within same lesion. To compare MTRasyms from 2D and 3D CEST data between low-grade gliomas (Grade II) and high-grade glioma (Grade III or IV), Student t test was performed. Then, feasible threshold value of each MTRasym was determined by ROC-based positive test. Finally, when applied each feasible threshold value, diagnostic accuracy to differentiate high-grade gliomas from low-grade gliomas was compared between two methods by McNemar's test.*Results 3D CEST imaging had significant and excellent correlation with 2D CEST imaging (r=0.79, p<0.0001). The limits of agreement between 2D and 3D CEST imaging was -0.029±1.43% (mean±1.96standard deviation) and small enough for clinical purpose. MTRasym of high-grade gliomas of each method were significantly higher than those of low-grade gliomas (p<0.001). Accuracy for distinguishing from high-grade from low-grade gliomas had no significant difference between 2D CEST imaging (87.5 [21/24] %) and 3D CEST imaging (95.8 [23/24] %, p=0.480).*Conclusions 3D CEST imaging is considered at least as valuable as 2D CEST image in various brain tumor patients, although former has a superior potential to evaluate whole brain CEST assessment in routine clinical practice.*Clinical Relevance/Application 3D CEST imaging is considered at least as valuable as 2D CEST image in various brain tumor patients, although former has a superior potential to evaluate whole brain CEST assessment in routine clinical practice.

RESULTS

3D CEST imaging had significant and excellent correlation with 2D CEST imaging (r=0.79, p<0.0001). The limits of agreement between 2D and 3D CEST imaging was -0.029±1.43% (mean±1.96standard deviation) and small enough for clinical purpose. MTRasym of high-grade gliomas of each method were significantly higher than those of low-grade gliomas (p<0.001). Accuracy for distinguishing from high-grade from low-grade gliomas had no significant difference between 2D CEST imaging (87.5 [21/24] %) and 3D CEST imaging (95.8 [23/24] %, p=0.480).

CLINICAL RELEVANCE/APPLICATION

3D CEST imaging is considered at least as valuable as 2D CEST image in various brain tumor patients, although former has a superior potential to evaluate whole brain CEST assessment in routine clinical practice.

SPR-NR-38   Cost-effectiveness Of Emergency Short Protocol Brain MRI After Negative Head CT For Patients With Mild And Unspecific Neurologic Symptoms

Participants
Daniel Puhr-Westerheide, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the cost-effectiveness of additional short-protocol brain MRI after negative non-contrast CT for the detection of minor strokes in patients with mild and unspecific neurological symptoms presenting to the emergency department.*Methods and Materials The economic evaluation was based on a prospective single-center diagnostic accuracy study validating the use of short-protocol brain MRI in the emergency setting. A decision-analytic Markov model distinguished the strategies "no additional imaging" and "additional short-protocol MRI" for evaluation. Minor stroke was assumed to be missed in 40% of patients without short-protocol MRI in the initial evaluation. Specialized post-stroke care with immediate secondary prophylaxis was assumed for patients with detected minor stroke. Utilities and quality of life measures were estimated as quality-adjusted life years (QALYs). Input parameters were obtained from the literature. The Markov model simulated a follow-up period of up to 30 years. Willingness-to-pay was set to $100,000 per QALY. Cost-effectiveness was calculated and deterministic and probabilistic sensitivity analysis was performed.*Results Additional short-protocol MRI turned out as the dominant strategy with overall costs of $26,304 (CT-only:

$27,109). Cumulative calculated effectiveness in the CT-only group was 14.25 QALYs (short-protocol MRI group: 14.31 QALYs). In the deterministic sensitivity analysis, additional short-protocol MRI remained the dominant strategy in all investigated ranges. Probabilistic sensitivity analysis results from the base case analysis were confirmed and additional short-protocol MRI resulted in lower costs and higher effectiveness.*Conclusions Additional short-protocol MRI in emergency patients with mild and unspecific neurological symptoms enables timely secondary prophylaxis through detection of minor strokes, resulting in lower costs and higher cumulative QALYs.*Clinical Relevance/Application Providing emergency short-protocol MRI is cost-effective as it helps to identify minor strokes for a timely initiation of secondary prophylaxis to prevent subsequent major strokes.

RESULTS

Additional short-protocol MRI turned out as the dominant strategy with overall costs of $26,304 (CT-only: $27,109). Cumulative calculated effectiveness in the CT-only group was 14.25 QALYs (short-protocol MRI group: 14.31 QALYs). In the deterministic sensitivity analysis, additional short-protocol MRI remained the dominant strategy in all investigated ranges. Probabilistic sensitivity analysis results from the base case analysis were confirmed and additional short-protocol MRI resulted in lower costs and higher effectiveness.

CLINICAL RELEVANCE/APPLICATION

Providing emergency short-protocol MRI is cost-effective as it helps to identify minor strokes for a timely initiation of secondary prophylaxis to prevent subsequent major strokes.

SPR-NR-39 Single-visit MRI-driven Stratification Of Multiple Sclerosis Patients Using Unsupervised Machine Learning

Participants
Giuseppe Pontillo, MD, Naples, Italy (*Presenter*) Nothing to Disclose

PURPOSE

We used a recently developed unsupervised machine learning algorithm (SuStaIn) to stratify Multiple Sclerosis (MS) patients based on volumetric features derived from brain MRI scans, aiming to demonstrate the biological reliability and clinical relevance of this approach.*Methods and Materials Baseline and longitudinal 3T brain MRIs of relapsing remitting MS patients including 3D-T1w and FLAIR-T2w sequences were collected, along with EDSS scores and long-term (10±2y) clinical outcomes (EDSS, cognition and transition to progressive course). From structural MRI, volumes of demyelinating lesions (TLV) and 116 atlas-defined GM regions were automatically segmented and expressed as z-scores referenced to an external population of healthy subjects. From baseline MRI scans, features that were mostly altered in MS patients were selected and fed into the SuStaIn algorithm, which estimates a set of subtypes characterized by distinct patterns of biomarker evolution, assigning each subject to a specific subtype and stage. The trained model was then applied to longitudinal MRIs.The stability of SuStaIn subtypes over time and the annualized change of SuStaIn stage were assessed via Krippendorf's a and multilevel linear regression models, respectively, while the clinical relevance of the SuStaIn classification was assessed with ordinal/logistic regression analyses.*Results A total of 425 MS patients were selected, corresponding to 1129 MRI visits. Based on 11 biomarkers surviving feature selection (TLV and volumes of 10 GM regions), two subtypes were identified, designated as "deep gray matter (DGM)-first" subtype (N=238) and "cortex-first" subtype (N=187) in view of the initial atrophy pattern. Disease subtypes were consistent over time (a=0.806), with significant annual increase in disease stage (b=0.20;p<0.001). Baseline EDSS correlated with SuStaIn stage (b=0.042;p<0.001) and the DGM-first subtype (b=-0.280;p=0.02), with baseline stage also predicting long-term disability (b=0.030; p=0.007) and transition to progressive course (b=0.079;p=0.03). Long-term cognitive impairment was associated with baseline stage (b=0.048;p<0.001) and the DGM-first subtype (b=-0.442;p=0.005).*Conclusions Unsupervised learning modelling of volumetric features derived from clinical brain MRI scans provides a biologically reliable and prognostically meaningful stratification of MS patients, with relevant implications for both clinical trials design and routine neurological practice.*Clinical Relevance/Application Using unsupervised machine learning, we obtained a single-visit MRI-driven stratification of MS patients which is both biologically reliable and prognostically relevant.

RESULTS

A total of 425 MS patients were selected, corresponding to 1129 MRI visits. Based on 11 biomarkers surviving feature selection (TLV and volumes of 10 GM regions), two subtypes were identified, designated as "deep gray matter (DGM)-first" subtype (N=238) and "cortex-first" subtype (N=187) in view of the initial atrophy pattern. Disease subtypes were consistent over time (a=0.806), with significant annual increase in disease stage (b=0.20;p<0.001). Baseline EDSS correlated with SuStaIn stage (b=0.042;p<0.001) and the DGM-first subtype (b=-0.280;p=0.02), with baseline stage also predicting long-term disability (b=0.030; p=0.007) and transition to progressive course (b=0.079;p=0.03). Long-term cognitive impairment was associated with baseline stage (b=0.048;p<0.001) and the DGM-first subtype (b=-0.442;p=0.005).

CLINICAL RELEVANCE/APPLICATION

Using unsupervised machine learning, we obtained a single-visit MRI-driven stratification of MS patients which is both biologically reliable and prognostically relevant.

SPR-NR-4 Basal Ganglia Manganese Deposition In Patients With HHT

Participants
Robert Weinstein, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To describe the clinical characteristics of Manganese (Mn) accumulation in the brain in patients with hereditary hemorrhagic telangiectasia (HHT). Manganese deposits specifically in the Basal Ganglia, resulting in symptoms resembling that of Parkinson's disease. Mn also shares iron absorption mechanisms and may accumulate in the setting of iron deficiency anemia. The purpose of this study was to define the relationship between HHT, iron deficiency anemia, and the location of arteriovenous malformations.*Methods and Materials The institutional HHT database included 627 patients was searched for patients with brain MRI scans that were found to have Mn deposition in the basal ganglia. Of the 463 patients with a brain MRI available for review, 20 patients were found to have signal changes within the Basal Ganglia consistent with Mn deposition. These patients' electronic medical records were reviewed for clinical presentations and medical history.*Results Of the 20 patients identified, 95% (19/20) had bilateral Mn deposition in the Basal Ganglia, and 5% (1/20) had unilateral deposition. Of the same cohort, 80% (16/20) were diagnosed with Iron Deficiency Anemia. Five patients were genetically tested, and 80% (4/5) tested positive for pathogenic mutations in the ACVRL1 gene. It was discovered that 80% (16/20) of these patients had hepatic AVMs, compared to 45% (9/20) with pulmonary AVMs, and 5% (1/20) with cerebrospinal AVMs. On presenting labs, 45% (9/20) patients were found to have

elevated Liver Function Tests (LFTs). Clinically, 20% (4/20) of the patients suffered from motor symptoms such as tremors, rigidity, and/or restless leg syndrome. Additionally, 65% (13/20) of the patients experienced neuropsychiatric symptoms including depression, headaches, and/or memory loss.*Conclusions Neuropsychiatric symptoms were more common than Parkinsonian motor impairments in this series of patients with HHT related Mn basal ganglia deposition. Both hepatic AVM and iron deficiency anemia were found in 80% of the cohort, suggesting a possible connection with Mn-BG deposition in patients with HHT.*Clinical Relevance/Application This research underlines the importance of recognizing Mn deposition in HHT patients, especially for those with hepatic AVMs and iron deficiency anemia. Neuropsychological evaluation of patients with Mn Basal Ganglia deposition could be implemented in patients with HHT.

RESULTS

Of the 20 patients identified, 95% (19/20) had bilateral Mn deposition in the Basal Ganglia, and 5% (1/20) had unilateral deposition. Of the same cohort, 80% (16/20) were diagnosed with Iron Deficiency Anemia. Five patients were genetically tested, and 80% (4/5) tested positive for pathogenic mutations in the ACVRL1 gene. It was discovered that 80% (16/20) of these patients had hepatic AVMs, compared to 45% (9/20) with pulmonary AVMs, and 5% (1/20) with cerebrospinal AVMs. On presenting labs, 45% (9/20) patients were found to have elevated Liver Function Tests (LFTs). Clinically, 20% (4/20) of the patients suffered from motor symptoms such as tremors, rigidity, and/or restless leg syndrome. Additionally, 65% (13/20) of the patients experienced neuropsychiatric symptoms including depression, headaches, and/or memory loss.

CLINICAL RELEVANCE/APPLICATION

This research underlines the importance of recognizing Mn deposition in HHT patients, especially for those with hepatic AVMs and iron deficiency anemia. Neuropsychological evaluation of patients with Mn Basal Ganglia deposition could be implemented in patients with HHT.

SPR-NR-7   Weakly Supervised Segmentation Of Intracranial Hemorrhage In Head CT Using Class Activation Maps

Participants
Ian Pan, MD, Brookline, Massachusetts (*Presenter*) Consultant, MD.ai, Inc;Consultant, Centaur Labs;Consultant, Diagnósticos da América SA (Dasa);Consultant, CoRead AI

PURPOSE

To develop a deep learning model for segmentation of intracranial hemorrhage (ICH) using only classification labels.*Methods and Materials 739,336 images from 21,351 studies across 18,689 patients from the RSNA Intracranial Hemorrhage Detection challenge were used for this study. Data were split at the patient level. The training and validation sets comprised 19,258 studies (667,175 images) and 2,093 studies (72,161 images), respectively. The test set comprised 96 randomly sampled positive cases that were segmented by a radiologist (3-11 years of experience). All test cases were then reviewed and the segmentations adjusted as needed by a subspecialty-trained neuroradiologist. A ResNeSt-101 convolutional neural network (CNN) was trained to perform multi-label classification of the 6 ICH labels (epidural, subdural, intraparenchymal, intraventricular, subarachnoid, any hemorrhage). During inference, the final feature maps were extracted and averaged using the class-associated weights from the final linear layer to produce class activation maps (CAMs). For each slice, the CAM for the "any ICH" class was used as the segmentation prediction, only if the ICH class prediction was greater than 0.5. The prediction was post-processed such that only segmentation pixels in the range of 40 to 100 Hounsfield units were included. Binary closing and opening operations were applied for smoothing. The Dice score was used to evaluate performance.*Results Prior to post-processing, the naive CAM segmentation prediction achieved a mean Dice score of 0.374 (95% CI: 0.335, 0.413). After post-processing, the CAM segmentation achieved a mean Dice score of 0.471 (95% CI: 0.423, 0.517). Volumetric measurements from ground truth and predicted segmentations exhibited a correlation of 0.825.*Conclusions Using only classification labels, post-processed CAMs produced by a CNN were able to accurately segment ICH in head CT. Future work will focus on segmenting individual subtypes of ICH and improving overall performance.*Clinical Relevance/Application CAMs can be used to predict accurate segmentations of intracranial hemorrhage without the need for expensive segmentation labels, allowing for improved localization and quantitation of pathology and enhanced interpretability of model predictions.

RESULTS

Prior to post-processing, the naive CAM segmentation prediction achieved a mean Dice score of 0.374 (95% CI: 0.335, 0.413). After post-processing, the CAM segmentation achieved a mean Dice score of 0.471 (95% CI: 0.423, 0.517). Volumetric measurements from ground truth and predicted segmentations exhibited a correlation of 0.825.

CLINICAL RELEVANCE/APPLICATION

CAMs can be used to predict accurate segmentations of intracranial hemorrhage without the need for expensive segmentation labels, allowing for improved localization and quantitation of pathology and enhanced interpretability of model predictions.

SPR-NR-9   Visualization Of Cisternal Components By Deep Learning Reconstruction Of Twelve-fold Accelerated Submillimeter Whole Brain MR Cisternography

Participants
Yasutaka Fushimi, MD, PhD, Kyoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Two-dimensional parallel imaging has been applied for 3D MR imaging, and but image noise associated with high acceleration factor degrades the image quality of the image sequence. Recently developed deep learning reconstruction (DLR) is expected to reduce noise with keeping imaging quality. The denoising is performed in consideration of the g-factor distribution, therefore, adaptive removal of the spatially non-uniform noise caused by parallel imaging becomes possible. Effective denoising is expected even for high-speed imaging with a high g-factor. In this study, we applied twelve-fold accelerated submillimeter 3D MR cisternography with DLR.*Methods and Materials 61 patients (37 females, 65 [58-73] years) underwent 3D MR cisternography (Fast Advanced Spin Echo, FASE, an equivalent sequence of half Fourier single-shot turbo spine echo, HASTE) at MR unit (Vantage Galan 3T/ZGO, Canon Medical Systems Corporation, Otawara, Japan) with 32-channel head coil. 3D FASE was performed with slice thickness of 0.7 mm, resolution of 0.28 × 0.28 mm; acceleration factor of PE and SE, 3 × 4 and scan time of 2 min 6 sec. Interpeduncular cistern, pituitary stalk, abducens nerve, and Liliequist membrane were visually evaluated. ROI analysis was performed for the lateral ventricles and the genu of corpus callosum. Contrast noise ratio of each structure was evaluated. Sharpness of abducens nerves was calculated with the line profile function.*Results MR cisternography with DLR achieved clear visualization of the interpeduncular cistern in all patients, while that without DLR showed noisy visualization in 58 of 61 patients. Pituitary stalk was clearly visible in all

patients on both MR cisternography. Abducens nerves were clearly visualized in 55 of 61 patients on MR cisternography with DLR, and visible in 55 patients on that without DLR. Liliequist membrane was identified in 26 of 61 patients on MR cisternography with DLR, and in 12 of 61 patients on that without DLR. CNR of the lateral ventricles on MR cisternography was 5.39 ± 0.91 without DLR and 15.02 ± 4.42 with DLR (P<0.001). CNR of the genu was 1.30 ± 0.22 without DLR and 4.03 ± 1.13 with DLR (P<0.001). Sharpness of the abducens nerves was 9072.56 ±11804.44 without DLR and 7084.15 ± 2664.20 with DLR (P=0.07).*Conclusions Twelve-fold accelerated submillimeter whole brain 3D MR cisternography with DLR showed better image quality compared with that without DLR, and the delineation of fine structure such as the abducens nerves was preserved after DLR processing.*Clinical Relevance/Application We have demonstrated 12-fold accelerated submillimeter whole brain MR cisternography with DLR showed better contrast noise ratio compared with that without DLR. The delineation of cisternal structures is preserved after DLR processing.

RESULTS

MR cisternography with DLR achieved clear visualization of the interpeduncular cistern in all patients, while that without DLR showed noisy visualization in 58 of 61 patients. Pituitary stalk was clearly visible in all patients on both MR cisternography. Abducens nerves were clearly visualized in 55 of 61 patients on MR cisternography with DLR, and visible in 55 patients on that without DLR. Liliequist membrane was identified in 26 of 61 patients on MR cisternography with DLR, and in 12 of 61 patients on that without DLR. CNR of the lateral ventricles on MR cisternography was 5.39 ± 0.91 without DLR and 15.02 ± 4.42 with DLR (P<0.001). CNR of the genu was 1.30 ± 0.22 without DLR and 4.03 ± 1.13 with DLR (P<0.001). Sharpness of the abducens nerves was 9072.56 ±11804.44 without DLR and 7084.15 ± 2664.20 with DLR (P=0.07).

CLINICAL RELEVANCE/APPLICATION

We have demonstrated 12-fold accelerated submillimeter whole brain MR cisternography with DLR showed better contrast noise ratio compared with that without DLR. The delineation of cisternal structures is preserved after DLR processing.

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SSIR02
Interventional Radiology (Clinical/Basic Science)

Participants
Gregory J. Nadolski II, MD, Fort Washington, Pennsylvania (*Moderator*) Nothing to Disclose
Yilun Koethe, MD, Portland, Oregon (*Moderator*) Consultant, Johnson & Johnson

Sub-Events

SSIR02-1   Preliminary Results From A Prospective Study On The Immunological Effects Of Conventional Transarterial Chemoembolisation In Patients With Hepatocellular Carcinoma

Participants
Robin Schmidt, Berlin, Germany (*Presenter*) Travel support, Berliner Krebsgesellschaft e.V.;Traval Grant, German Roentgen Society;Traval Grant, Rolf W. Günter Foundation for Radiological Sciences

PURPOSE

To characterize the immune cell profiles of patients with hepatocellular carcinoma (HCC) and alterations induced by conventional transarterial chemoembolisation (TACE).*Methods and Materials This interim report of an ongoing single-site prospective clinical trial included 23 consecutive patients with unresectable HCC, who underwent TACE 08/2020-03/2021. Institutional review board approval and informed consent were obtained. Peripheral blood was sampled before and 24h and 8 weeks (wk) after TACE for spectral fluorescence-activated cell sorting (FACS, Cytek Aurora) analysis. A 24-color multiplex staining panel was applied to quantify lymphoid and myeloid cell populations and expression of checkpoint molecules. Absolute cell counts were obtained by adding precision count beads. FACS data was processed using a robust gating strategy including CD3, CD4, CD8, CD45, PD-1 and HLA-DR. Lipiodol distribution was assessed on non-contrast CT 24h post-TACE. Statistics included normality testing and paired mixed-effects with post-hoc testing.*Results FACS data at baseline, 24h, and 8wk post-TACE were available for n=23, n=22, and n=15 patients, respectively. Compared to baseline (CD4+ 65.3%, CD8+ 24.0%), a decrease in CD4+ T helper cells (59.3%, p=0.001) and an increase in CD8+ effector T cells (28.9%, p=0.006) were observed 24h post-TACE, respectively, while levels returned to baseline at 8wk. Multi-segmental Lipiodol distribution was associated with larger variations in both T cell subsets as compared to selective tumoral deposition. Specifically, activated HLA-DR+ CD8+ T cells were significantly elevated in patients with tumoral Lipiodol deposition (24h p=0.025; 8wk p=0.475) but decreased in those with less selective distribution (p=0.123; p=0.002). Similar trends were observed for PD1+ CD8+ T cell levels but without statistical significance.*Conclusions The preliminary results of this prospective trial show a consistent trend suggesting a possibly favorable TACE-induced boost in antitumoral T cell responses, thereby revealing Lipiodol as a potential indicator of the functional T cell status. While the most relevant changes are observed early after TACE, durable effects remain limited.*Clinical Relevance/Application If confirmed in a complete cohort, these results may help exploit TACE-induced immune-activation and guide personalized treatments using combinations of TACE with immuno-oncological therapies.

RESULTS

FACS data at baseline, 24h, and 8wk post-TACE were available for n=23, n=22, and n=15 patients, respectively. Compared to baseline (CD4+ 65.3%, CD8+ 24.0%), a decrease in CD4+ T helper cells (59.3%, p=0.001) and an increase in CD8+ effector T cells (28.9%, p=0.006) were observed 24h post-TACE, respectively, while levels returned to baseline at 8wk. Multi-segmental Lipiodol distribution was associated with larger variations in both T cell subsets as compared to selective tumoral deposition. Specifically, activated HLA-DR+ CD8+ T cells were significantly elevated in patients with tumoral Lipiodol deposition (24h p=0.025; 8wk p=0.475) but decreased in those with less selective distribution (p=0.123; p=0.002). Similar trends were observed for PD1+ CD8+ T cell levels but without statistical significance.

CLINICAL RELEVANCE/APPLICATION

If confirmed in a complete cohort, these results may help exploit TACE-induced immune-activation and guide personalized treatments using combinations of TACE with immuno-oncological therapies.

SSIR02-2   Transarterial Embolization With Lactate Dehydrogenase Inhibitor Provides Survival Benefit As Compared To Bland Embolization

Participants
Alexey Gurevich, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Hepatocellular carcinoma (HCC) is one of the most common causes of mortality worldwide. Locoregional therapy such as transarterial embolization (TAE) is the most commonly performed procedure for HCC. It takes advantage of the vascular biology of HCCs, which are primarily supplied by the hepatic artery, to embolize appropriate hepatic branches. Despite best practices, recurrences are still common as HCC cells undergo metabolic reprogramming to utilize anaerobic metabolic pathway via lactate dehydrogenase (LDH), enabling their survival. The goal of this study was to perform a translational study comparing response following administration of TAE along with an LDH inhibitor (LDHi) as compared to bland TAE and sham TAE.*Methods and Materials Wistar rats bearing DEN-induced autochthonous HCCs were tracked until the target tumor was in the 100mm^3 to 200mm^3 range. TAEs with LDHi (n=7) were performed using 100 uL of 50-100um Embosphere Microspheres (Merit Medical Systems) and 10ug/kg of

LDHi. Bland TAEs (n=6) were performed with 40-120um Embosphere Microspheres alone. Sham TAE controls (n=5) were performed using 100 uL of saline alone. After embolization, each rat underwent 3 MRI scans per week until a recurrence was noted. Recurrence was noted as tumor growth of 50% since previous scan. After recurrence, scans were performed once weekly until either natural expiration or until one of the criteria for euthanasia was met. Statistical analysis was performed with GraphPad Prism 8.0(GraphPad Software).*Results Statistical analysis demonstrated a significant difference in progression free survival (PFS, time to recurrence or death) between TAE with LDHi and Bland or Sham TAE (23.4±7 days vs 12.7±4.7 days P=0.0063, 23.4±7 days vs 4.2±1.6 days P<0.0001 respectively, Figure 1). In addition, the overall survival (OS) was also statistically different between the LDHi TAE and Bland or Sham TAE (23±6.8 days vs 11.6±4.3 days P=0.0058, 23±6.8 days vs 15±1.9 days P=0.0477 respectively, Figure 2).*Conclusions TAE with a metabolic inhibitor of LDH demonstrates significantly prolonged PFS and OS as compared to both Bland and Sham TAE. These findings emphasize the role of TAE in modulating the tumor microenvironment to generate targetable dependencies for improved outcomes.*Clinical Relevance/Application Hepatocellular carcinoma is a common disease that is difficult to target appropriately. Here we show how to leverage the innate tumor metabolism and locoregional therapy to improve outcomes in the animal model. These data provide motivation for an incipient clinical trial combining LDH inhibition with TAE.

RESULTS

Statistical analysis demonstrated a significant difference in progression free survival (PFS, time to recurrence or death) between TAE with LDHi and Bland or Sham TAE (23.4±7 days vs 12.7±4.7 days P=0.0063, 23.4±7 days vs 4.2±1.6 days P<0.0001 respectively, Figure 1). In addition, the overall survival (OS) was also statistically different between the LDHi TAE and Bland or Sham TAE (23±6.8 days vs 11.6±4.3 days P=0.0058, 23±6.8 days vs 15±1.9 days P=0.0477 respectively, Figure 2).

CLINICAL RELEVANCE/APPLICATION

Hepatocellular carcinoma is a common disease that is difficult to target appropriately. Here we show how to leverage the innate tumor metabolism and locoregional therapy to improve outcomes in the animal model. These data provide motivation for an incipient clinical trial combining LDH inhibition with TAE.

SSIR02-3   Biochemical Safety Of Ablative Yttrium-90 Transarterial Radioembolization For Hepatocellular Carcinoma As A Function Of Percent Liver Treated

Participants
Cynthia De la Garza Ramos, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

PURPOSE

Transarterial radioembolization can serve as an ablative therapy for early-stage hepatocellular carcinoma (HCC) when targeting tumors with a Medical Internal Radiation Dose (MIRD) >190 Gy. This study aimed to establish percent liver treated (%LT) biochemical safety thresholds for segmental ablative radioembolization.*Methods and Materials A retrospective cohort of HCC patients treated at a tertiary care center with a single session of glass microsphere radioembolization and a MIRD =190 Gy from January 2017 through October 2020 was analyzed. %LT was calculated as treatment angiosome volume divided by whole liver volume. Biochemical toxicity events were defined as increases in Albumin-Bilirubin (ALBI) grade or Child-Pugh (CP) class compared to baseline, and the development of albumin or bilirubin adverse events (AE) per CTCAE v5.0 at 3- and 6 months. ROC curves were used to determine volumetric thresholds associated with these events. Multivariate logistic regression analysis assessed the impact of significant %LT thresholds on toxicities.*Results A total of 141 patients with a median age of 68 years were included. Baseline hepatic function distribution was 75 (53%) ALBI 1 vs 64 (45%) ALBI 2, and 111 (79%) CP-A vs 30 (21%) CP-B. At 3 months, increases were seen in 20 (27%) ALBI 1, 8 (12%) ALBI 2, 18 (16%) CP-A, and 6 (20%) CP-B. At 6 months, increases were reported in 17 (23%) ALBI 1, 6 (9%) ALBI 2, 12 (11%) CP-A, and 4 (13%) CP-B. A %LT =14.5% was significantly associated with increases in ALBI 2 patients at 3- (AUC: 0.84, sensitivity: 87%, specificity: 73%, p=0.002) and 6 months (AUC: 0.83, sensitivity: 83%, specificity: 79%, p=0.01), and CP-B at 6 months (AUC: 0.84, sensitivity: 100%, specificity: 85%, p=0.026). No significant threshold was found for ALBI 1 or CP-A patients. Logistic regression analysis showed a %LT =14.5% as an independent predictor of events in the ALBI 2 and CP-B groups (p<0.01). No grade 3/4 albumin or bilirubin AEs were observed. Grade 2 AEs occurred in 23 (16%) patients at 3 months and 15 (10%) at 6 months, with a whole liver volume <1.3 L associated to this toxicity (p=0.01).*Conclusions Primary HCC therapy with ablative radioembolization is generally well tolerated with a low frequency of AEs. ALBI 2 or CP-B patients receiving a MIRD =190 Gy to =14.5% of the liver are less likely to increase grade/class. No definitive %LT was associated to toxicities in ALBI 1 and CP-A within the parameters of this study. Grade 2 albumin or bilirubin AEs are more likely with a whole liver volume of <1.3 L.*Clinical Relevance/Application Segmental ablative transarterial radioembolization (>190 Gy) is emerging as a definitive therapy for early-stage HCC. Given the high volumetric variability of hepatic segments, %LT safety thresholds are necessary.

RESULTS

A total of 141 patients with a median age of 68 years were included. Baseline hepatic function distribution was 75 (53%) ALBI 1 vs 64 (45%) ALBI 2, and 111 (79%) CP-A vs 30 (21%) CP-B. At 3 months, increases were seen in 20 (27%) ALBI 1, 8 (12%) ALBI 2, 18 (16%) CP-A, and 6 (20%) CP-B. At 6 months, increases were reported in 17 (23%) ALBI 1, 6 (9%) ALBI 2, 12 (11%) CP-A, and 4 (13%) CP-B. A %LT =14.5% was significantly associated with increases in ALBI 2 patients at 3- (AUC: 0.84, sensitivity: 87%, specificity: 73%, p=0.002) and 6 months (AUC: 0.83, sensitivity: 83%, specificity: 79%, p=0.01), and CP-B at 6 months (AUC: 0.84, sensitivity: 100%, specificity: 85%, p=0.026). No significant threshold was found for ALBI 1 or CP-A patients. Logistic regression analysis showed a %LT =14.5% as an independent predictor of events in the ALBI 2 and CP-B groups (p<0.01). No grade 3/4 albumin or bilirubin AEs were observed. Grade 2 AEs occurred in 23 (16%) patients at 3 months and 15 (10%) at 6 months, with a whole liver volume <1.3 L associated to this toxicity (p=0.01).

CLINICAL RELEVANCE/APPLICATION

Segmental ablative transarterial radioembolization (>190 Gy) is emerging as a definitive therapy for early-stage HCC. Given the high volumetric variability of hepatic segments, %LT safety thresholds are necessary.

SSIR02-4   Utility Of CBCT And AVD For Intraprocedural Diagnosis And Treatment Of Gastrointestinal Bleeds

Participants
Leland Pung, MENG, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

Interventional Radiology (IR) management of gastrointestinal bleeding (GIB) is limited due to significant negative intraprocedural diagnostic rates. Empiric embolization of feeding vessels seen on CT angiography (CTA) has had limited adoption due to inability of

2D digital subtraction angiography (DSA) to conclusively identify feeding vessels. We assess whether intraprocedural Cone Beam CT (CBCT) improves diagnosis and embolization rates of acute GIB and if automatic vessel detection (AVD) software can identify feeding vessels(FV) for empiric embolization*Methods and Materials All patients who underwent procedures for GIB in IR between June 2020 and April 2021 were compiled for analysis. Patients with inconclusive DSA findings had CBCT performed at the discretion of the primary operator. Patients who had both CTA and subsequent CBCT underwent retrospective analysis with AVD software. Charts were analyzed for preprocedural imaging and clinical outcomes. Accuracy of CBCT was defined as the ability to detect a GIB site while clinical success was defined as successful embolization without evidence of rebleeding or death within 30 days. AVD success was defined by the ability to identify the FV on both CTA and CBCT upon independent review by 3 blinded IRs, who also assigned a degree of certainty on a 5-point Likert scale.*Results 70 patients had procedures for GIB in an IR suite capable of CBCT and AVD. Of these, 21 patients with GIB on pre-procedural CTA and inconclusive DSA underwent CBCT. In 18 patients (85.7%) the FV was not identified by DSA. In 3 cases, initial DSA identified a single FV but concern remained for additional FVs. Use of CBCT identified 8 bleeds not seen on DSA and an additional source artery in 1 case representing a 43% change in intraprocedural management as all findings were embolized. Clinical success was 85.7% for patients who underwent DSA and CBCT compared to 74.5% for patients who had DSA only. When a bleed could be identified on CBCT, the FV could be delineated on AVD 100% of the time, with an average certainty of 4.3. When a bleed could not be identified on CBCT, but the FV could be identified on CTA, the same suspected FV could be selected on AVD 62% of the time with an average certainty of 4.0.*Conclusions CBCT is useful in the intraprocedural detection of GIB when DSA is indeterminate, changing management in 43% of indeterminant cases. Furthermore, AVD software can be utilized to accurately identify FVs for empiric treatment when intraprocedural imaging is inconclusive, identifying 62% of vessels on CBCT.*Clinical Relevance/Application CBCT combined with AVD software can increase intraprocedural diagnostic sensitivity for GI bleeds and improve operator confidence for empiric embolization.

RESULTS

70 patients had procedures for GIB in an IR suite capable of CBCT and AVD. Of these, 21 patients with GIB on pre-procedural CTA and inconclusive DSA underwent CBCT. In 18 patients (85.7%) the FV was not identified by DSA. In 3 cases, initial DSA identified a single FV but concern remained for additional FVs. Use of CBCT identified 8 bleeds not seen on DSA and an additional source artery in 1 case representing a 43% change in intraprocedural management as all findings were embolized. Clinical success was 85.7% for patients who underwent DSA and CBCT compared to 74.5% for patients who had DSA only. When a bleed could be identified on CBCT, the FV could be delineated on AVD 100% of the time, with an average certainty of 4.3. When a bleed could not be identified on CBCT, but the FV could be identified on CTA, the same suspected FV could be selected on AVD 62% of the time with an average certainty of 4.0.

CLINICAL RELEVANCE/APPLICATION

CBCT combined with AVD software can increase intraprocedural diagnostic sensitivity for GI bleeds and improve operator confidence for empiric embolization.

SSIR02-5 **When Nothing Else Works Anymore: European Multicenter Study On Degradable Starch Microspheres Transarterial Chemoembolization (DSM-TACE) In HCC With High Tumor Burden Ineligible For Or Failing Other Palliative Therapies**

Participants
Johannes Ludwig, MD, Essen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the safety and efficacy of transarterial chemoembolization with degradable starch microspheres (DSM-TACE) for the treatment of patients with unresectable hepatocellular carcinoma (HCC) with high tumor burden ineligible for or failing other palliative therapies.*Methods and Materials One hundred twenty-one patients (median of 77 years old, 81% male) with high tumor burden (63.6% bilobar disease, 61.2%, and >3 HCC nodules in vascular invasion in 26.4%) from three European centers first treated between 03/2009 - 08/2018 were assessed retrospectively. Five hundred fifty-eight treatments with a median of four (range: 2-12) per patient were performed. mRECIST criteria were used for response assessment. Kaplan-Meier (KP) analysis for determining median overall survival and time to progression (OS/TTP in months) was performed. Cox proportional hazard model for uni- (UVA) & multivariate (MVA) analyses (hazard ratio; 95%CI, p-value) were assessed. Adverse events (AEs) were staged according to the CIRSE classification system (clinical AEs) and CTCAE v5 (laboratory AEs).*Results The median OS was 15.5 (13.3-18.7) months. UVA detected a survival benefit for patients with a lower Child-Pugh class (A/B/C: 17/15.2/8.95 months), lower BCLC-stage (A/B/C/D: 20.9/17.7/12.7/6.6 months), unilobar disease (19 vs. 13.6 months for bilobar), absence of vascular invasion (16.9 vs. 13.8 months for vascular invasion), lesions ? 10 cm (11.5 vs. 16.9 months for >10 cm), and absence of extrahepatic metastases (17.7 vs. 11.2 months with metastases). MVA identified tumors smaller than 10 cm (0.34; 0.17-0.68, p=0.002) and unilobar disease (0.63; 0.4-0.98, p=0.042) as independent prognostic factors for longer OS.Median TTP was 9.5 (7.6-10.3) months. The best response was achieved after a median of 3 (range: 1-6) treatments with CR/PR/SD/PD in 13.5%/44.5%/25.2%/16.8%, respectively. DSM-TACE was well tolerated with no major clinical AE and only limited major laboratory AEs. After repetitive DSM-TACE, preserved liver function was observed even when the liver was treated as a whole.*Conclusions DSM-TACE is an effective and safe alternative palliative treatment option for patients with a high tumor burden not suitable for or failing other therapies. Moreover, repetitive DSM-TACE preserves liver function over time, even in patients whose liver is treated as a whole.*Clinical Relevance/Application DSM-TACE is an effective treatment option for patients with high tumor burden HCC ineligible for or failing other palliative therapies (e.g., conventional TACE, radioembolization, or systemic therapy). Repetitive DSM-TACE can be performed safely with low adverse event rates and liver function preservation over time.

RESULTS

The median OS was 15.5 (13.3-18.7) months. UVA detected a survival benefit for patients with a lower Child-Pugh class (A/B/C: 17/15.2/8.95 months), lower BCLC-stage (A/B/C/D: 20.9/17.7/12.7/6.6 months), unilobar disease (19 vs. 13.6 months for bilobar), absence of vascular invasion (16.9 vs. 13.8 months for vascular invasion), lesions ? 10 cm (11.5 vs. 16.9 months for >10 cm), and absence of extrahepatic metastases (17.7 vs. 11.2 months with metastases). MVA identified tumors smaller than 10 cm (0.34; 0.17-0.68, p=0.002) and unilobar disease (0.63; 0.4-0.98, p=0.042) as independent prognostic factors for longer OS.Median TTP was 9.5 (7.6-10.3) months. The best response was achieved after a median of 3 (range: 1-6) treatments with CR/PR/SD/PD in 13.5%/44.5%/25.2%/16.8%, respectively. DSM-TACE was well tolerated with no major clinical AE and only limited major laboratory AEs. After repetitive DSM-TACE, preserved liver function was observed even when the liver was treated as a whole.

CLINICAL RELEVANCE/APPLICATION

DSM-TACE is an effective treatment option for patients with high tumor burden HCC ineligible for or failing other palliative therapies (e.g., conventional TACE, radioembolization, or systemic therapy). Repetitive DSM-TACE can be performed safely with low adverse

event rates and liver function preservation over time.

SSIR02-6 Magnetic Resonance Guided Focused Ultrasound Versus External Beam Radiation Therapy For The Treatment Of Pain In Bone Metastases: A Phase II Trial

Participants
Giulia Alfieri, MD, Rome, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To assess the efficacy of MR guided Focused Ultrasound (MRgFUS) for the palliative treatment of painful bone metastases in comparison to external beam radiation therapy (EBRT).*Methods and Materials This prospective double-arm phase II study was conducted between January 2019 and March 2019. Participants with painful bone metastases were included in the trial and underwent either MRgFUS or EBRT. The primary end point was improvement in self-reported pain score assessed by using Visual Analogue Scale (VAS) 1 month after treatment. Secondary end point was the improvement in VAS at 12-month and quality of life (QoL) assessed by QoL Questionnaire Cancer 15 Palliative Care (C15-PAL) and QoL Questionnaire Bone Metastases 22 (BM22). Statistical analysis was conducted using a per-protocol principle.*Results 198 study participants were included; 100 participants (mean age, 63.2 years ± 13.4) underwent MRgFUS and 98 (mean age, 65.3 years ± 14.5) underwent EBRT. Response rate for the primary endpoint was 55% in the MRgFUS arm and 30% in the EBRT (p= 0.001). No significant difference between groups was found for BM22 and C15-PAL. Subtests analysis of C15-PAL for areas of physical function (p=0.002), appetite (p<0.001), nausea and vomiting (p<0.001), dyspnea (p<0.001) and quality of life (p<0.001) showed significant differences in favor of MRgFUS.*Conclusions MRgFUS in comparison to EBRT showed promising response when used as a palliative treatment in patients with painful bone metastases.*Clinical Relevance/Application MRgFUS may represent a valid option for the palliative treatment of patients with metastatic bone disease, with promising results in terms of pain relief and quality of life when compared to EBRT

RESULTS

198 study participants were included; 100 participants (mean age, 63.2 years ± 13.4) underwent MRgFUS and 98 (mean age, 65.3 years ± 14.5) underwent EBRT. Response rate for the primary endpoint was 55% in the MRgFUS arm and 30% in the EBRT (p= 0.001). No significant difference between groups was found for BM22 and C15-PAL. Subtests analysis of C15-PAL for areas of physical function (p=0.002), appetite (p<0.001), nausea and vomiting (p<0.001), dyspnea (p<0.001) and quality of life (p<0.001) showed significant differences in favor of MRgFUS.

CLINICAL RELEVANCE/APPLICATION

MRgFUS may represent a valid option for the palliative treatment of patients with metastatic bone disease, with promising results in terms of pain relief and quality of life when compared to EBRT

Abstract Archives of the RSNA, 2021

<table>
<tr><td>SSMK06</td></tr>
<tr><td>**Musculoskeletal (Knee)**</td></tr>
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Participants
Jenny T. Bencardino, MD, Philadelphia, Pennsylvania (*Moderator*) Nothing to Disclose
Hilary R. Umans, MD, Ardsley, New York (*Moderator*) Nothing to Disclose

Sub-Events

SSMK06-4 The Relationship Between Bone Marrow Lesion Worsening And Statin Use In Knee Osteoarthritis Patients With Heberden's Nodes: Data From The Osteoarthritis Initiative

Participants
Bahram Mohajer, MD,MPH, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

There has been an interest for more than a decade in the potential disease-modifying osteoarthritis (OA) drug (DMOAD) properties of statins and result of previous studies are inconclusive. While no completed and published clinical trial is available, in a preliminary report from an ongoing trial authors reported statins reduced OA progression in OA patients with no baseline subchondral bone marrow lesions (BMLs). Other reports have suggested statins may be beneficial in generalized OA (GOA) phenotype. Here we aimed to explore potential responders to statin and assess the relationship between statin therapy and knee MRI-detected subchondral BML worsening in patients with Heberden's nodes (HNs) as the hallmark of GOA phenotype.*Methods and Materials We assessed worsening in BMLs volume and number of affected subregions in participants from the Osteoarthritis Initiative (OAI) cohort with HNs at baseline clinical examination (HN+), using the semi-quantitative MRI Osteoarthritis Knee Scores at baseline and 24 months. Participants were classified according to baseline BML involvement as "no/minimal" (=2 of 14 knee subregions affected and maximum BML score =1) or "moderate/severe." Potential confounders by indication were assessed using direct acyclic graph (age, sex, race, alcohol use, smoking, BMI, cardiovascular comorbidities, and physical activity). Missing data of covariates (<1.5% data) was imputed and statins users and non-users were selected using 1:1 propensity-score matching. Adjusted mixed-effect regression models were used to assess the association between statin use and increasing BML score and the number of affected subregions.*Results The propensity-score matched HN+ with no/minimal and moderate/severe BML cohorts consisted of 332 (166:166, statin user: non-users) and 380 (190:190) knees of participants respectively. In the HN+ participants with no/minimal BML, statin use was associated with lower odds of both BML score worsening (odds ratio, 95% confidence interval: 0.62, 0.39-0.98) and an increase in the number of affected subregions (0.54, 0.33-0.88). There was no such association in those HN+ patients with baseline moderate/severe BMLs or all HN- participants. Sensitivity analysis showed results were not sensitive to propensity-score matching.*Conclusions In subjects with GOA phenotype (HN+), statin use may be protective against the progression of OA-related subchondral bone changes only in subjects with no/minimal baseline BML.*Clinical Relevance/Application These findings insists on the role of subchondral bone and its lesions as the route of apparent statin DMOAD properties. Future mechanistic studies may enable the identification of potential statin responders for proper subject selection in clinical trials.

RESULTS

The propensity-score matched HN+ with no/minimal and moderate/severe BML cohorts consisted of 332 (166:166, statin user: non-users) and 380 (190:190) knees of participants respectively. In the HN+ participants with no/minimal BML, statin use was associated with lower odds of both BML score worsening (odds ratio, 95% confidence interval: 0.62, 0.39-0.98) and an increase in the number of affected subregions (0.54, 0.33-0.88). There was no such association in those HN+ patients with baseline moderate/severe BMLs or all HN- participants. Sensitivity analysis showed results were not sensitive to propensity-score matching.

CLINICAL RELEVANCE/APPLICATION

These findings insists on the role of subchondral bone and its lesions as the route of apparent statin DMOAD properties. Future mechanistic studies may enable the identification of potential statin responders for proper subject selection in clinical trials.

SSMK06-6 Color-coded Dual-energy CT Collagen Imaging For The Assessment Of The Crucial Ligaments After Acute Trauma: Initial Results Of A Multireader Diagnostic Accuracy Study

Participants
Christian Booz, MD, Frankfurt am Main, Germany (*Presenter*) Speaker, Siemens AG

PURPOSE

To evaluate the diagnostic accuracy of colored dual-energy CT collagen imaging for the assessment of the crucial ligaments after acute trauma.*Methods and Materials Data from 141 consecutive patients (70 male) with acute knee trauma who had undergone clinically indicated third-generation dual-source dual-energy CT and additional arthroscopy or MRI between January 2017 and February 2021 were retrospectively analyzed. Five blinded radiologists independently assessed the anterior crucial ligament (ACL) and posterior crucial ligament (PCL) using colored dual-energy CT collagen maps, which are based on collagen material decomposition. Arthroscopy (n = 77) or MRI (n = 64) served as reference standard (maximal time interval 7 days between dual-energy CT and the reference standard). Arthroscopy was performed by three board-certified surgeons (24, 13 and 10 years of experience in arthroscopy), MRI was evaluated by two board-certified radiologists (10 and 34 years of experience in knee MRI) in consensus reading sessions.*Results The reference standard revealed a total of 56 complete tears (ACL, 33; PCL, 23) and 93

partial tears (ACL, 52; PCL, 41) of the crucial ligaments. Color-coded collagen maps showed high overall sensitivity 92% (95%), specificity 90% (94%), and accuracy 91% (94%) for the assessment of complete ACL (PCL) tears. Regarding partial ACL (PCL) tears, sensitivity was 87% (91%), specificity was 92% (94%), and the accuracy was 90% (93%). Intact ACL (PCL) was detected with a sensitivity of 95% (96%), specificity of 96% (97%), and an accuracy of 95% (96%).*Conclusions Color-coded dual-energy CT collagen imaging yields excellent diagnostic accuracy for the assessment of the crucial ligaments by application of collagen material decomposition.*Clinical Relevance/Application Through application of dual-energy CT collagen imaging earlier detection of crucial ligament injuries may be achieved in case of limited MRI availability or contraindications, potentially improving patient management and clinical outcome.

RESULTS

The reference standard revealed a total of 56 complete tears (ACL, 33; PCL, 23) and 93 partial tears (ACL, 52; PCL, 41) of the crucial ligaments. Color-coded collagen maps showed high overall sensitivity 92% (95%), specificity 90% (94%), and accuracy 91% (94%) for the assessment of complete ACL (PCL) tears. Regarding partial ACL (PCL) tears, sensitivity was 87% (91%), specificity was 92% (94%), and the accuracy was 90% (93%). Intact ACL (PCL) was detected with a sensitivity of 95% (96%), specificity of 96% (97%), and an accuracy of 95% (96%).

CLINICAL RELEVANCE/APPLICATION

Through application of dual-energy CT collagen imaging earlier detection of crucial ligament injuries may be achieved in case of limited MRI availability or contraindications, potentially improving patient management and clinical outcome.

SSMK06-7 MRI Predictors Of Outcome After Arthroscopic Partial Meniscectomy

Participants
Naveen Subhas, MD, Cleveland, Ohio (*Presenter*) Research support, Siemens AG;

PURPOSE

Outcomes after arthroscopic partial meniscectomy (APM) in older patients is mixed and difficult to predict. The study objectives were to identify the preoperative baseline status, demographics factors and imaging findings predictive of outcome and test if preoperative knee MRI improves outcome prediction.*Methods and Materials Patients 45 years and older having undergone APM with Knee injury and Osteoarthritis Outcome Score for pain (KOOSpain) at the time of surgery and at least 1-year after surgery and knee MRI obtained within 6 months prior to surgery were included. Patients with any concomitant procedure performed with APM except for chondroplasty were excluded. Multi-variable regression model with only demographic and baseline status variables was constructed including all statistically significant predictors using a significance level of 0.10. MRI findings were then added and tested using a significance level of 0.05. The effect of MRI was quantified by the change in area under the ROC curve (AUC) between the model with and without MRI findings.*Results The 923 patient cohort had a mean age of 58.2 years (range 45 - 90) and were 49% female and 87% white with baseline KOOSpain = 47.1 (sd 17.1). The following factors were significant predictors (p < 0.05) of worse outcome in the model without MRI: higher baseline KOOSpain, lower mental component summary (MCS) score (a mental and emotional health metric), higher area deprivation index (ADI) scores (a socioeconomic status metric), female gender, BMI in the middle range, age between 50 - 70, and cigarette smoking as well as interactions between gender and age and BMI and baseline pain. After including MRI, these additional factors were significant predictors (p < 0.05) of worse outcome: more severe cartilage defects in the lateral femoral condyle and medial tibial plateau and lateral meniscal tears. The baseline model had an AUC of 0.657 and 95% confidence interval [0.614, 0.700] for a 10-point improvement in KOOSpain with an R2= 0.24 and the addition of MRI findings significantly increased the AUC to 0.710 (p=0.003) with an R2 = 0.28.*Conclusions MRI findings, specifically lateral meniscal tears and more severe cartilage defects, are independent predictors of worse outcome after APM and significantly improve the ability to predict which patients will not benefit from surgery when added to demographic factors and baseline status.*Clinical Relevance/Application The preoperative predictive factors of outcome identified in this study can be used to build prediction tools that can guide patients and surgeons when deciding on whether or not to proceed with APM.

RESULTS

The 923 patient cohort had a mean age of 58.2 years (range 45 - 90) and were 49% female and 87% white with baseline KOOSpain = 47.1 (sd 17.1). The following factors were significant predictors (p < 0.05) of worse outcome in the model without MRI: higher baseline KOOSpain, lower mental component summary (MCS) score (a mental and emotional health metric), higher area deprivation index (ADI) scores (a socioeconomic status metric), female gender, BMI in the middle range, age between 50 - 70, and cigarette smoking as well as interactions between gender and age and BMI and baseline pain. After including MRI, these additional factors were significant predictors (p < 0.05) of worse outcome: more severe cartilage defects in the lateral femoral condyle and medial tibial plateau and lateral meniscal tears. The baseline model had an AUC of 0.657 and 95% confidence interval [0.614, 0.700] for a 10-point improvement in KOOSpain with an R2= 0.24 and the addition of MRI findings significantly increased the AUC to 0.710 (p=0.003) with an R2 = 0.28.

CLINICAL RELEVANCE/APPLICATION

The preoperative predictive factors of outcome identified in this study can be used to build prediction tools that can guide patients and surgeons when deciding on whether or not to proceed with APM.

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Vascular Imaging (Peripheral Vascular Imaging/Artificial Intelligence in Vascular Imaging)

Participants

Dominik Fleischmann, MD, Palo Alto, California (*Moderator*) Research Grant, Siemens AG;Stockholder, iSchemaView, Inc;Stockholder, Segmed, Inc

Kate Hanneman, MD, FRCPC, Toronto, Ontario (*Moderator*) Speaker, sanofi-aventis Group;Speaker, Amicus Therapeutics, Inc

Sub-Events

SSVA02-1   Deep Learning Automated Phase Error Correction For Abdominopelvic 4D Flow MRI

Participants
Sophie You, BA, San Diego, California (*Presenter*) Nothing to Disclose

PURPOSE

4D Flow MRI has the potential to provide hemodynamic insights in a variety of abdominopelvic vascular diseases, but it is currently impaired by eddy current-related background phase error. Image-based phase error correction can be challenging to perform and limits the clinical utility of this MRI technique. In this study, we assessed the feasibility of using convolutional neural networks (CNNs) to automatically perform image-based background phase error correction, and to evaluate their effectiveness for phase error correction relative to manual image-based correction.*Methods and Materials With HIPAA compliance, IRB approval, and waiver of informed consent, we retrospectively collected 140 abdominopelvic 4D Flow MRI acquisitions from 140 patients performed as part of routine clinical MRI examinations between January 2016 and July 2020. Manual phase error correction was performed using dedicated software (Arterys, San Francisco, CA). After reserving 40 examinations for testing, the remaining data was divided into two cohorts: 86% for training and 14% for validation. These were used to train a multichannel 3D U-Net. To evaluate performance, flow volume measurements were obtained for the infrarenal aorta, common iliac arteries, common iliac veins, and inferior vena cava. Statistical analyses of inflow-outflow consistency included Pearson correlation, Bland-Altman analysis, and F-tests with Holm correction.*Results After manually correcting phase error in test set MRI exams, mean infrarenal aortic flow was 1.63 L/min (range 0.67-3.21 L/min) and mean common iliac arterial flow was 0.69 L/min (range 0.28-1.43 L/min). Correlation of inflow and outflow improved following manual correction (?=0.95) compared to before (?=0.55). CNN-automated correction showed similar results (?=0.91) and demonstrated very strong correlation with manual correction (?=0.98). Both manual and CNN-automated correction methods reduced inflow-outflow variance of volumetric flow measurements (p<0.001, F-test) reducing limits of agreement from [-1.76, 1.46] L/min (uncorrected) to [-0.41, 0.54] L/min (manual) and [-0.46, 0.68] L/min (CNN-automated). Inflow-outflow variance was narrower for manual correction compared to automatic correction (p<0.001, F-test).*Conclusions CNN-based automated phase-error correction visually and quantitatively improved flow measurements from 4D Flow MRI, reducing inflow-outflow discrepancies with results comparable to manual image-based correction.*Clinical Relevance/Application CNNs can automatically recognize and correct phase error in 4D Flow MRI, a critical bottleneck in the clinical application of this technology for assessing abdominopelvic blood flow.

RESULTS

After manually correcting phase error in test set MRI exams, mean infrarenal aortic flow was 1.63 L/min (range 0.67-3.21 L/min) and mean common iliac arterial flow was 0.69 L/min (range 0.28-1.43 L/min). Correlation of inflow and outflow improved following manual correction (?=0.95) compared to before (?=0.55). CNN-automated correction showed similar results (?=0.91) and demonstrated very strong correlation with manual correction (?=0.98). Both manual and CNN-automated correction methods reduced inflow-outflow variance of volumetric flow measurements (p<0.001, F-test) reducing limits of agreement from [-1.76, 1.46] L/min (uncorrected) to [-0.41, 0.54] L/min (manual) and [-0.46, 0.68] L/min (CNN-automated). Inflow-outflow variance was narrower for manual correction compared to automatic correction (p<0.001, F-test).

CLINICAL RELEVANCE/APPLICATION

CNNs can automatically recognize and correct phase error in 4D Flow MRI, a critical bottleneck in the clinical application of this technology for assessing abdominopelvic blood flow.

SSVA02-2   Accuracy Subanalysis Of A Deep Learning Neural Network Specific For The Identification Of Infrarenal Abdominal Aortic Aneurysms

Participants
Justin Camara, MD, Loma Linda, California (*Presenter*) Nothing to Disclose

PURPOSE

To analyze the anatomic variables that influence the diagnostic accuracy of a trained convolutional neural network (CNN) that can identify infrarenal abdominal aortic aneurysms (AAA) on computed tomography angiogram (CTA) scans.*Methods and Materials From January 2015 to January 2020, a HIPAA-compliant, institutional review board-approved, retrospective clinical study was used to develop a AAA-specific trained CNN based on transfer learning of the VGG16 base model. Model accuracy and AUC were analyzed based on size of data sets (segmented, balanced or unbalanced), aneurysm size, extra-abdominal extension, dissections, and mural thrombus. Misjudgments were analyzed through a review of heatmaps generated via gradient weighted class activation mapping overlaid on original CT images.*Results The trained custom CNN model reported high test group accuracies of 94.1%, 99.1%, and

99.6% and AUC of 0.99, 0.9998, and 0.9993 in segmented (n = 120), balanced (n = 3,704), and unbalanced image sets (n = 31,899), respectively. Despite an eight fold difference between balanced and unbalanced image sets, the CNN model demonstrated high test group sensitivities (99.9% vs. 98.9%) and specificities (94.8% vs 99.3%) in unbalanced and balanced image sets, respectively. In regard to aneurysm size, the CNN model demonstrated improving accuracy based on larger aneurysm size: 47% (16/34) misjudgments for aneurysms less than 3.3 cm, 32% (11/34) misjudgments for aneurysms between 3.3 and 5 cm, and 20% (7/34) misjudgments for aneurysms greater than 5 cm. Aneurysms containing measurable mural thrombus were over-represented within type II (false negative) misjudgements compared to type I (false positive) misjudgements (71% versus 15%, p < 0.05). Other factors such as inclusion extra-abdominal aneurysm extension (thoracic or iliac artery) or dissection flaps in these imaging sets did not decrease the model's overall accuracy.*Conclusions Preliminary subanalysis of an AAA-specific CNN model can accurately screen and identify CTA findings of infrarenal abdominal aortic aneurysms despite varying aneurysm pathology and quantitative data sets. Pathologically, the highest anatomic misjudgments were seen in cases with small aneurysms (< 3.3 cm) or the presence of mural thrombus. Accuracy of the CNN model is maintained despite the inclusion of extra-abdominal pathology and imbalanced data sets.*Clinical Relevance/Application To analyze the anatomic variables that influence the diagnostic accuracy of a trained convolutional neural network (CNN) that can identify infrarenal abdominal aortic aneurysms (AAA) on computed tomography angiogram (CTA) scans.

RESULTS

The trained custom CNN model reported high test group accuracies of 94.1%, 99.1%, and 99.6% and AUC of 0.99, 0.9998, and 0.9993 in segmented (n = 120), balanced (n = 3,704), and unbalanced image sets (n = 31,899), respectively. Despite an eight fold difference between balanced and unbalanced image sets, the CNN model demonstrated high test group sensitivities (99.9% vs. 98.9%) and specificities (94.8% vs 99.3%) in unbalanced and balanced image sets, respectively. In regard to aneurysm size, the CNN model demonstrated improving accuracy based on larger aneurysm size: 47% (16/34) misjudgments for aneurysms less than 3.3 cm, 32% (11/34) misjudgments for aneurysms between 3.3 and 5 cm, and 20% (7/34) misjudgments for aneurysms greater than 5 cm. Aneurysms containing measurable mural thrombus were over-represented within type II (false negative) misjudgements compared to type I (false positive) misjudgements (71% versus 15%, p < 0.05). Other factors such as inclusion extra-abdominal aneurysm extension (thoracic or iliac artery) or dissection flaps in these imaging sets did not decrease the model's overall accuracy.

CLINICAL RELEVANCE/APPLICATION

To analyze the anatomic variables that influence the diagnostic accuracy of a trained convolutional neural network (CNN) that can identify infrarenal abdominal aortic aneurysms (AAA) on computed tomography angiogram (CTA) scans.

SSVA02-3 Multireader Evaluation Of The Impact Of High-Matrix Size Reconstructions In Image Quality And Diagnostic Confidence Of Peripheral Artery Disease In Arterial Runoff Studies Of The Lower Extremities

Participants
Fides Schwartz, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether reconstruction with a higher than standard matrix size improves image quality and clinical decision making for lower extremity CTA studies.*Methods and Materials Raw data from 31 consecutive lower extremity CTA studies acquired on two MDCT scanners (SOMATOM Flash and Force) in patients with peripheral arterial disease (PAD) were identified. Data were reconstructed with standard (512x512) and higher resolution (768x768 and 1024x1024) matrix sizes using a prototype based on Precision Matrix technology (Siemens Healthineers). Three blinded readers (one diagnostic and one interventional radiologist, and one vascular surgeon with 7, 5, and 12 years experience, respectively) reviewed representative transverse images, containing soft or calcified vascular plaque, reconstructed with each matrix size in randomized order (3 images/patient). Using a scale of 0 (worst) - 100 (best), readers graded image quality for vascular wall definition, image noise, and ability to confidently determine the grade of stenosis. Scores were compared between reconstructions (overall and separately for tibial and femoropopliteal arteries) using mixed effects linear regression with matrix treated as a fixed effect and subject and reader as random effects. Inter-reader agreement was determined using Spearman's rank correlation test.*Results Reconstructions with a 1024x1024 matrix were ranked significantly better for wall definition (mean score 72, 95% CI=61-84), noise (74, CI=59-88), and confidence (70, CI=59-80) compared to 512x512 (wall definition=65, CI=53-77; noise=67, CI=52-81; confidence=62, CI=52-73; p=0.003, p=0.01, and p=0.004, respectively). There was no significant difference between 768x768 and 512x512 sizes. Compared to 512x512 the 1024x1204 matrix improved image quality in the tibial arteries (wall definition=50 vs 59, p=0.02; noise=55 vs 64, p=0.06; confidence=46 vs 56, p=0.007) to a greater degree than the femoral-popliteal arteries (wall definition=80 vs 85, p=0.05; noise=78 vs 83, p=0.06; confidence=78 vs 83, p=0.12). Inter-reader agreement was moderate at rho=0.5.*Conclusions Higher matrix reconstructions of 1024x1024 may improve image quality with higher resolution and enable more confident assessment of PAD.*Clinical Relevance/Application Higher matrix reconstructions of 1024x1024 instead of 512x512 should be the standard reconstructions for challenging examinations that need high resolution images such as arterial runoff studies.

RESULTS

Reconstructions with a 1024x1024 matrix were ranked significantly better for wall definition (mean score 72, 95% CI=61-84), noise (74, CI=59-88), and confidence (70, CI=59-80) compared to 512x512 (wall definition=65, CI=53-77; noise=67, CI=52-81; confidence=62, CI=52-73; p=0.003, p=0.01, and p=0.004, respectively). There was no significant difference between 768x768 and 512x512 sizes. Compared to 512x512 the 1024x1204 matrix improved image quality in the tibial arteries (wall definition=50 vs 59, p=0.02; noise=55 vs 64, p=0.06; confidence=46 vs 56, p=0.007) to a greater degree than the femoral-popliteal arteries (wall definition=80 vs 85, p=0.05; noise=78 vs 83, p=0.06; confidence=78 vs 83, p=0.12). Inter-reader agreement was moderate at rho=0.5.

CLINICAL RELEVANCE/APPLICATION

Higher matrix reconstructions of 1024x1024 instead of 512x512 should be the standard reconstructions for challenging examinations that need high resolution images such as arterial runoff studies.

SSVA02-5 Diagnostic Value Of Standardized Mr Angiography Protocol In The Evaluation Of Thoracic Outlet Syndrome

Participants
Cammillo Talei Franzesi, Milan, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic performance of a standardized MR angiography (MRA) protocol in the study of Thoracic Outlet Syndrome (TOS).*Methods and Materials From September 2016 to March 2020, a total of 20 patients who underwent MRA study to investigate vascular TOS were retrospectively enrolled. Protocol sequences includes Balanced Fast Field Echo M2D, Turbo Spin Echo T1 weighted, high-resolution TSE T1 weighted, HR TSE DIXON T2 weighted, contrast-enhanced MRA (CE- MRA), pre and post-contrast T1-weighted High Resolution Isotropic Volume Examination.Baseline sequences were performed with the arms in adduction, CE-MRA sequences were performed both with arms in adduction and abduction, with injection of contrast media repeated for each arms' position (Gadobutrol 1.0 mol/L; 5 + 5 ml). The overall total acquisition time is about 20 minutes.*Results Sixteen patients showed unilateral TOS (n=16, 80%), with the left side more frequently involved (n=10, 64.5%) than the right one (n=6, 45.5%). Thirteen patients showed venous compression (vTOS) (65%), 3 patients arterial TOS (aTOS) (15%), only in one case an overlap between vTOS-aTOS (5%) was reported.Eight patients showed compression with the arm in abduction (50%), 8 with the arm both in adduction and abduction (50%).In 5 cases TOS was caused by an osseus abnormalities both post-traumatic or post-surgical.In 6 patients (30%) vTOS was associated with thrombosis. Twenty percent of TOS were caused by muscle hypertrophy or wrong insertion.Five out of sixteen case involved the scalene triangle (31%), 8/16 the costo-clavicular space (50%) and 3/16 patients the subacromial-pectoralis space (19%). In 4/20 patients vascular TOS was not identified (20%).*Conclusions Angio-MRI protocol with CE-MRA sequence with arms in adduction and abduction allows to identify the presence of vascular TOS, along with the identification of the intrinsic and extrinsic abnormalities causing pathology.*Clinical Relevance/Application The proposed protocol is extremely effective in identifying vascular TOS, resulting in a valuable integration to clinical data for understanding the cause of symptoms and to guide the correct management.

RESULTS

Sixteen patients showed unilateral TOS (n=16, 80%), with the left side more frequently involved (n=10, 64.5%) than the right one (n=6, 45.5%). Thirteen patients showed venous compression (vTOS) (65%), 3 patients arterial TOS (aTOS) (15%), only in one case an overlap between vTOS-aTOS (5%) was reported.Eight patients showed compression with the arm in abduction (50%), 8 with the arm both in adduction and abduction (50%).In 5 cases TOS was caused by an osseus abnormalities both post-traumatic or post-surgical.In 6 patients (30%) vTOS was associated with thrombosis. Twenty percent of TOS were caused by muscle hypertrophy or wrong insertion.Five out of sixteen case involved the scalene triangle (31%), 8/16 the costo-clavicular space (50%) and 3/16 patients the subacromial-pectoralis space (19%). In 4/20 patients vascular TOS was not identified (20%).

CLINICAL RELEVANCE/APPLICATION

The proposed protocol is extremely effective in identifying vascular TOS, resulting in a valuable integration to clinical data for understanding the cause of symptoms and to guide the correct management.

Printed on: 06/28/22

Participants

Jonathan G. Goldin, MBChB, PhD, Santa Monica, California (*Moderator*) Founder, MedQIA Imaging Core Laboratory
Brett M. Elicker, MD, San Francisco, California (*Moderator*) Nothing to Disclose

Sub-Events

SSCH05   Keynote Speaker

Participants
Jonathan G. Goldin, MBChB, PhD, Santa Monica, California (*Presenter*) Founder, MedQIA Imaging Core Laboratory

SSCH05-2   A Pattern Based Approach To CT Of Interstitial Lung Disease Can Elevate The Differential Diagnosis Of Non-specialists To Equal That Of Specialist Thoracic Radiologists

Participants
Ali Dhanaliwala, MD,PhD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Interstitial lung diseases ((ILDs) can be difficult to diagnose for novices as well as non-thoracic trained radiologists. For new trainees, imaging findings can be non-specific making it difficult to create a useful differential diagnosis. While for general radiologists, the low incidence of ILD limits exposure to these studies and can result in missed diagnoses.*Methods and Materials A varied group of non-expert and expert readers were recruited including first year radiology residents, pulmonary medicine fellows, early career general radiologists, and cardio-thoracic fellowship radiologists. Readers were given a set of chest CTs and asked to identify the disease. The chest CTs were randomly assigned from a curated database of ILD cases identified through an imaging search of the radiology archives at our institution and verified through retrospective chart review. Following a washout period, the readers were given a short training module and flowsheet describing a pattern based approach for identifying key features in the CT and an "if this then that" algorithm for converting findings into a useful differential. Readers were then asked to re-read their cases and identify the most likely pattern and their top three differential in descending order of probability. Paired t-test analysis was used to compare the pre and post training module results.*Results Non-expert readers showed an overall 17% improvement in including the correct ILD within their top three differential diagnoses and an overall 11% improvement in correctly identifying as their top diagnosis, the four most common conditions within the database (connective tissue disease related ILD, idiopathic pulmonary fibrosis, sarcoid, and hypersensitivity pneumonitis). In addition, post training, non-experts correctly placed the correct diagnosis within their top three differential at a similar rate as experts.*Conclusions A pattern recognition approach and an "if this then that" flowsheet can improve the identification of ILDs by non-experts to levels approaching that of fellowship trained cardio-thoracic radiologists.*Clinical Relevance/Application Our training module for diagnosing diffuse parenchymal lung diseases from CT elevated non-expert radiologists to the level of cardiothoracic-trained radiologists in the creation of a differential diagnosis.

RESULTS

Non-expert readers showed an overall 17% improvement in including the correct ILD within their top three differential diagnoses and an overall 11% improvement in correctly identifying as their top diagnosis, the four most common conditions within the database (connective tissue disease related ILD, idiopathic pulmonary fibrosis, sarcoid, and hypersensitivity pneumonitis). In addition, post training, non-experts correctly placed the correct diagnosis within their top three differential at a similar rate as experts.

CLINICAL RELEVANCE/APPLICATION

Our training module for diagnosing diffuse parenchymal lung diseases from CT elevated non-expert radiologists to the level of cardiothoracic-trained radiologists in the creation of a differential diagnosis.

SSCH05-3   Antisynthetase Syndrome Related Interstitial Lung Disease: Longitudinal Imaging Findings

Participants
Wei Wu, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

Interstitial lung disease (ILD) is a major determinant of morbidity and mortality in Antisynthetase syndrome (ASyS). However, initial and evolving patterns of ASyS-ILD on CT (computed tomography) chest are not well described. We sought to describe evolution of CT findings in ASyS-ILD and association with serological biomarkers and outcome.*Methods and Materials Serological biomarkers, longitudinal chest CT scans and clinical outcome data were retrospectively abstracted from medical records of 47 patients diagnosed with ASyS-ILD, followed at our center. Predominant imaging findings and radiographic patterns were analyzed for all CT scans. Fibrosis severity was qualitatively scored using an arbitrary visual scale of 10-30. Association between imaging features, serological biomarkers and outcomes were analyzed.*Results 31patients had Anti-Jo1 antibodies while 16 patients did not. 191 CT scans were analyzed with average of 4±2 CT scans per patient within median follow-up time of 46 (IQR:27-80) months. 7 patients died during follow-up. Initial radiographic patterns were consistent with non-specific interstitial pneumonia (NSIP) (38.3%), organizing pneumonia (OP) (29.8%), NSIP-OP overlap (14.9%), usual interstitial pneumonia (UIP) (8.5%) and unspecified (8.5%).

Patterns at last follow up were NSIP (59.6%), UIP (19.1%), OP (12.8%), NSIP-OP overlap (6.4%), and unspecified (6.4%). CT pattern evolved in 23 patients during follow-up; Evolution occurred more in OP and NSIP-OP overlap groups and less often in fibrotic NSIP and UIP groups (p=0.01). Median fibrosis score did not change over 40 months median follow up (0, range: -2, 18). Predominant ground-glass opacities (GGO) pattern on initial CT was associated with increased survival (p=0.03.) There were no significant associations between imaging pattern and type of antibody.*Conclusions Among patients with ASyS-ILD in this cohort, the most common initial imaging patterns were NSIP and OP. ILD pattern evolved in half of the patients during a median follow up of 4 years. The most frequent pattern change was from OP, NSIP-OP overlap or cNSIP to fNSIP. fNSIP or UIP patterns generally did not progress further or evolve. GGO predominance at initial CT was associated with increased survival.*Clinical Relevance/Application The study describes initial and subsequent imaging findings of ASyS-ILD that may have prognostic implications.

RESULTS

31patients had Anti-Jo1 antibodies while 16 patients did not. 191 CT scans were analyzed with average of 4±2 CT scans per patient within median follow-up time of 46 (IQR:27-80) months. 7 patients died during follow-up. Initial radiographic patterns were consistent with non-specific interstitial pneumonia (NSIP) (38.3%), organizing pneumonia (OP) (29.8%), NSIP-OP overlap (14.9%), usual interstitial pneumonia (UIP) (8.5%) and unspecified (8.5%). Patterns at last follow up were NSIP (59.6%), UIP (19.1%), OP (12.8%), NSIP-OP overlap (6.4%), and unspecified (6.4%). CT pattern evolved in 23 patients during follow-up; Evolution occurred more in OP and NSIP-OP overlap groups and less often in fibrotic NSIP and UIP groups (p=0.01). Median fibrosis score did not change over 40 months median follow up (0, range: -2, 18). Predominant ground-glass opacities (GGO) pattern on initial CT was associated with increased survival (p=0.03.) There were no significant associations between imaging pattern and type of antibody.

CLINICAL RELEVANCE/APPLICATION

The study describes initial and subsequent imaging findings of ASyS-ILD that may have prognostic implications.

SSCH05-6   Kurtosis Of Quantitative Evaluation Of Deep Learning-extracted Features To Classify IPF

Participants
Hyung Kim, PhD, Los Angeles, California (*Presenter*) Research Consultant, MedQIA Imaging Core Laboratory;Research Grant, Boehringer Ingelheim GmbH

PURPOSE

To be useful in medical imaging, artificial intelligence must be explainable. Attention mechanism, which is one attempt towards explainable artificial intelligence (XAI), can achieve accurate predictions and provide case-level "attention maps" (deep learning-extracted features) that highlight specific clinically meaningful outputs. However, the evaluation of attention maps is usually subjective. Distribution of Hounsfield units and measures of this distribution, including kurtosis, has been used to classify different forms of lung parenchyma disease processes, including idiopathic pulmonary fibrosis (IPF). Inspired by this, this study uses kurtosis to assess the attention maps as a quantitative explainability index to identify patients with IPF from other causes of pulmonary fibrosis.*Methods and Materials Using the previously developed explainable models with guided attentions, the model performance of the top three candidates was AUC of 0.98 using non-contrast HRCT images to distinguish IPF (N=279) from non-IPF with interstitial lung disease (ILD) (N=423). All three models were trained with different hyperparameters and each with five-fold cross-validation. To quantify the distribution of attention maps in two classes (IPF versus non-IPF), we use the estimated attention maps (dimension, X*Y*Z*# of channel, 64*64*32*8) for all IPF and non-IPF subjects, respectively. The attention maps resemble the classification of ILD patterns of pulmonary fibrosis (See Figure 1). We averaged whole lung and peripheral lung voxels, respectively, for each channel and model fold. A linear model was built to include both model fold, channel, interaction term, and a clinical diagnosis factor. One-sided hypothesis testing was conducted to test if IPF subjects have a lower kurtosis of attention maps than that of non-IPF population.*Results Means of kurtosis of the averaged attention maps among IPF subjects were 0.83, 1.23, and 1.99, which were significantly lower for two out of three constructed models with the means of 1.45, 2.13, and 1.54 among non-IPF subjects in the whole lung (whole lung: P < 0.001 and P=0.02; peripheral lung: P < 0.001 and P=0.05); not significant for one model (whole lung: P=0.82; peripheral: P=0.61).*Conclusions Kurtosis can be an effective measure for evaluating the explainability of deep learning-extracted features after building an IPF diagnosis model. Finding a quantitative explainable index for deep learning algorithms is feasible using prior domain knowledge and the output from attention maps.*Clinical Relevance/Application Evaluation of quantitative index for assessing deep learning-extracted features, such as using kurtosis to evaluate attention maps, is a necessary step of building XAI towards clinical utilization.

RESULTS

Means of kurtosis of the averaged attention maps among IPF subjects were 0.83, 1.23, and 1.99, which were significantly lower for two out of three constructed models with the means of 1.45, 2.13, and 1.54 among non-IPF subjects in the whole lung (whole lung: P < 0.001 and P=0.02; peripheral lung: P < 0.001 and P=0.05); not significant for one model (whole lung: P=0.82; peripheral: P=0.61).

CLINICAL RELEVANCE/APPLICATION

Evaluation of quantitative index for assessing deep learning-extracted features, such as using kurtosis to evaluate attention maps, is a necessary step of building XAI towards clinical utilization.

Abstract Archives of the RSNA, 2021

Participants

Hersh Chandarana, MD, Scarsdale, New York (*Moderator*) As part of institutional Master Research Agreement:Equipment support, Siemens AGSoftware support, Siemens AG
Candice W. Bolan, MD, Jacksonville, Florida (*Moderator*) Nothing to Disclose
Benjamin M. Yeh, MD, Hillsborough, California (*Moderator*) Grant, Koninklijke Philips NVGrant, General Electric CompanyConsultant, Canon Medical Systems CorporationSpeaker, Canon Medical Systems CorporationRoyalties, Oxford University PressShareholder, Board Member Nextrast, Inc

Sub-Events

SSGI11-1 **Novel Point-of-care Perfusion Phantom Improves The Reproducibility Of Quantitative DCE-MRI Measurement Of Abdominal Tissues**

Participants
Martin Holland I, BEng,MENG, Homewood, Alabama (*Presenter*) Nothing to Disclose

PURPOSE

Purpose To develop a ready-to-use Point-of-care Portable Perfusion Phantom (P4) and demonstrate its ability to reduce the inter-scanner variability of quantitative Dynamic Contrast-Enhanced Magnetic Resonance Imaging (qDCE-MRI) measurement of human subjects.*Methods and Materials Methods: The P4 phantom was designed to fit beneath a patient in an MRI machine, acting as a reference to detect the scanner-driven errors in qDCE-MRI measurement. The contrast enhancement curve (CEC) of the P4 phantom was generated with the samples collected from the phantom using liquid chromatography-mass spectrometry (LC-MS), and its repeatability was determined with the measurements from five different P4 phantoms. Five healthy human volunteers (23-41 years of age; female) were recruited. Each subject was imaged together with the P4 phantom in three different 3T MRI scanners. The Ktrans of the liver, spleen, pancreas and prevertebral muscle were calculated based on Tofts model (TM), extended Tofts model (ETM), and shutter speed model (SSM). The reproducibility of Ktrans measurement was assessed with the intra-class correlation coefficients (ICC) before and after P4-based error correction.*Results Results The CEC of the P4 phantom was linear for 10 minutes after infusing an MR contrast agent (gadoteridol) (0.17 mM/min) with 96% of measurement accuracy. The repeatability of the CEC was 0.997 when assessed with ICC. The reproducibility of the Ktrans measurement based on TM, ETM, and SSM were 0.319, 0.384, and 0.730, respectively, before P4-based error correction, but those were improved to 0.904, 0.986, and 0.829, respectively, after correction.*Conclusions Conclusions The reproducibility of Ktrans measurement across three different scanners was markedly improved after P4-based error correction regardless of pharmacokinetic models.*Clinical Relevance/Application The proposed methodology shows significant potential to improve data consistency in a multi-institutional clinical trial employing qDCE-MRI for a new drug or therapeutic strategy development.

RESULTS

Results The CEC of the P4 phantom was linear for 10 minutes after infusing an MR contrast agent (gadoteridol) (0.17 mM/min) with 96% of measurement accuracy. The repeatability of the CEC was 0.997 when assessed with ICC. The reproducibility of the Ktrans measurement based on TM, ETM, and SSM were 0.319, 0.384, and 0.730, respectively, before P4-based error correction, but those were improved to 0.904, 0.986, and 0.829, respectively, after correction.

CLINICAL RELEVANCE/APPLICATION

The proposed methodology shows significant potential to improve data consistency in a multi-institutional clinical trial employing qDCE-MRI for a new drug or therapeutic strategy development.

SSGI11-2 **Quantitative Peritumoral MRI Fingerprinting Improves Machine Learning-based Prediction Of Overall Survival In Patients With Colon Cancer**

Participants
Dania Daye, MD, PhD, Medford, Massachusetts (*Presenter*) Research Consultant, Sigilon Therapeutics;Research Consultant, Medtronic plc

PURPOSE

This study investigates the role of MRI-based peritumoral heterogeneity as predictors of overall survival in patients with metastatic colorectal cancer.*Methods and Materials In this IRB-approved retrospective study, we identified 48 patients with colon cancer who underwent MRI from 2007-2015 for liver metastasis evaluation. Patient survival data was available for up to 95 months. Standard clinical and pathologic prognostic variables were extracted from the medical record. All metastatic hepatic lesions were identified on portal venous phase T1-weighted fat-suppressed post-contrast images and semi-automatically volumetrically segmented, for a total of 94 tumors. A vector consisting of 112 radiomic features (shape, first-order, texture) was extracted from a 1 cm region surrounding each segmented tumor. The dataset was divided into training and testing set at a ratio of 4:1. The random forest model was applied. Recursive feature elimination was used to select and test the effectiveness of different number of radiomic features. ROC analysis was used to assess the model performance. Survival curves were generated using Kaplan-Meier analysis.*Results A total of 48 patients were enrolled in the study (M:F 23:25; age 55.3 ± 18 years). 42% of tumors had high

microsatellite instability and KRAS mutation was detected in 68/94 (72%) tumors. Mean survival time was 35±21 months for the study population. 36% pf patients exhibited metastatic disease progression. Univariate regression revealed 21 textures features (9 first order and 12 GLCM features) to be independently associated with metastatic disease progression (all p<0.03). The trained random forest machine model resulted in an area under the ROC curve of 0.88.*Conclusions MRI-based peritumoral texture features may be used as predictive biomarkers for metastatic disease progression and patient survival in metastatic colorectal cancer.*Clinical Relevance/Application Peritumoral texture features may be used to help guide management decisions in patients with metastatic colorectal cancer.

RESULTS

A total of 48 patients were enrolled in the study (M:F 23:25; age 55.3 ± 18 years). 42% of tumors had high microsatellite instability and KRAS mutation was detected in 68/94 (72%) tumors. Mean survival time was 35±21 months for the study population. 36% pf patients exhibited metastatic disease progression. Univariate regression revealed 21 textures features (9 first order and 12 GLCM features) to be independently associated with metastatic disease progression (all p<0.03). The trained random forest machine model resulted in an area under the ROC curve of 0.88.

CLINICAL RELEVANCE/APPLICATION

Peritumoral texture features may be used to help guide management decisions in patients with metastatic colorectal cancer.

SSGI11-3   Fully-automated CT Biomarkers For Type 2 Diabetes Using Deep Learning

Participants
Hima Tallam, Wayne, New Jersey (*Presenter*) Nothing to Disclose

PURPOSE

To investigate CT biomarkers for type 2 diabetes in a large clinical dataset using fully-automated deep learning.*Methods and Materials The patient population consisted of 8,992 patients who underwent colorectal cancer screening with CT colonography, of whom?572 had type 2 diabetes (T2D) and 1,880 were dysglycemic.?The pancreas was segmented using a fully-automated deep learning method that outputs measurements of interest (biomarkers), including CT attenuation,?volume, fat content,?and?fractal dimension of the pancreas.?Additional biomarkers assessed from the scans included visceral fat and atherosclerotic plaque. Univariable and multivariable analyses were performed after separating patients into groups based on time between T2D diagnosis and CT scan date. Clinical factors (sex, age, BMI, BMI>30) were included. The best set of predictors for T2D were determined using multinomial logistic regressions.*Results The deep learning model had an average Dice similarity coefficient for the pancreas in the test set of 0.69 +/- 0.17, which is state-of-the-art for noncontrast CT. The univariable analysis showed that diabetics had on average lower pancreas CT attenuation (18.74 +/- 16.54 HU vs. 29.99 +/- 13.41 HU, P<0.0001) and higher visceral fat (235.0 +/- 108.6 mL vs. 130.9 +/- 96.3 mL, P<0.0001) than nondiabetics. Diabetics also showed a decrease in CT attenuation with greater duration of disease. The final multivariate model showed pairwise AUCs of 0.79 and 0.83 between nondiabetics and diabetics 0-2500 days pre and post diagnosis, respectively. Adding clinical data did not significantly improve upon CT-based AUC performance. The best predictors of T2D included standard deviation of pancreas CT attenuation, fractal dimension of the pancreas, visceral fat volume, severity of abdominal aortic plaque, BMI, and if patients had a BMI higher than 30 kg/m2.*Conclusions The diagnosis of diabetes is associated with CT biomarkers, especially measures of pancreas CT attenuation and visceral fat.*Clinical Relevance/Application Fully-automated CT biomarkers can be used for the opportunistic detection and prediction of type 2 diabetes on scans performed for other indications.

RESULTS

The deep learning model had an average Dice similarity coefficient for the pancreas in the test set of 0.69 +/- 0.17, which is state-of-the-art for noncontrast CT. The univariable analysis showed that diabetics had on average lower pancreas CT attenuation (18.74 +/- 16.54 HU vs. 29.99 +/- 13.41 HU, P<0.0001) and higher visceral fat (235.0 +/- 108.6 mL vs. 130.9 +/- 96.3 mL, P<0.0001) than nondiabetics. Diabetics also showed a decrease in CT attenuation with greater duration of disease. The final multivariate model showed pairwise AUCs of 0.79 and 0.83 between nondiabetics and diabetics 0-2500 days pre and post diagnosis, respectively. Adding clinical data did not significantly improve upon CT-based AUC performance. The best predictors of T2D included standard deviation of pancreas CT attenuation, fractal dimension of the pancreas, visceral fat volume, severity of abdominal aortic plaque, BMI, and if patients had a BMI higher than 30 kg/m2.

CLINICAL RELEVANCE/APPLICATION

Fully-automated CT biomarkers can be used for the opportunistic detection and prediction of type 2 diabetes on scans performed for other indications.

SSGI11-5   Pre-operative Radiomics Model For Prognostication In Resectable Pancreatic Adenocarcinoma: Multi-institutional Development And External Validation

Participants
Gerard Healy, BMBCh, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

In patients with resectable pancreatic ductal adenocarcinoma (PDAC), there are few strictly pre-operative biomarkers available to guide therapy decisions. Radiomics has demonstrated potential value for prognostication, but lacks external validation. We aimed to develop and externally validate a pre-operative clinical-radiomic model.*Methods and Materials Retrospective international, multi-center study in patients with resectable PDAC who underwent pre-operative contrast-enhanced CT, without neoadjuvant therapy. 352 patients underwent CTs at five North-American hospitals and subsequently underwent resection at our center. Penalized Cox proportional hazard models were developed, incorporating (a) pre-operative clinical factors (clinical), (b) CT-based radiomics (Rad-score) and (c) pre-operative clinical plus radiomics features (clinical-radiomic). Outcomes were overall (OS) and disease-free survival (DFS). A post-operative model incorporating pathological findings (TNM) served as reference standard. The external test cohort consistent of 215 patients who underwent resection at a European center, following pre-operative CTs performed at 34 hospitals.*Results Four features (two attenuation and two heterogeneity) were selected for the Rad-score. In the external cohort, Rad-score was the dominant predictor of OS and DFS, with adjusted Hazard Ratios of 2.87 (95% CI 1.40-5.87, p<0.001) and 5.28 (95% CI 2.35-11.86, p<0.001) respectively, along with age (HR 1.02 for both, p<0.05). No other clinical features were significantly associated with OS and DFS. Median OS was 22.9 / 37 months (p=0.0092) and DFS 14.2 / 29.8 (p=0.0023) for the high / low risk groups in the external cohort. Calibration was moderate in the external cohort, with mean absolute error 0.074 and 0.132 for OS at 3 and 5 years. The clinical-radiomic model demonstrated significantly better discrimination performance than the clinical model

(p<0.001) and was similar to TNM (p=0.55). *Conclusions A pre-operative model containing clinical variables and radiomics significantly improved prognostication for patients with resectable PDAC compared to using clinical information alone and was similar to using pathological information, which are only available post-operatively. Our model may be useful for pre-operative therapy decisions.*Clinical Relevance/Application Incorporating radiomic data into a pre-operative prognostic model for PDAC improves performance. This clinical-radiomics model generalizes to a large external population and may help guide pre-operative therapy decisions.

RESULTS

Four features (two attenuation and two heterogeneity) were selected for the Rad-score. In the external cohort, Rad-score was the dominant predictor of OS and DFS, with adjusted Hazard Ratios of 2.87 (95% CI 1.40-5.87, p<0.001) and 5.28 (95% CI 2.35-11.86, p<0.001) respectively, along with age (HR 1.02 for both, p<0.05). No other clinical features were significantly associated with OS and DFS. Median OS was 22.9 / 37 months (p=0.0092) and DFS 14.2 / 29.8 (p=0.0023) for the high / low risk groups in the external cohort. Calibration was moderate in the external cohort, with mean absolute error 0.074 and 0.132 for OS at 3 and 5 years. The clinical-radiomic model demonstrated significantly better discrimination performance than the clinical model (p<0.001) and was similar to TNM (p=0.55).

CLINICAL RELEVANCE/APPLICATION

Incorporating radiomic data into a pre-operative prognostic model for PDAC improves performance. This clinical-radiomics model generalizes to a large external population and may help guide pre-operative therapy decisions.

SSGI11-6   Task-specific Shape Radiomic Features Of Mesenteric-portal Axis For Prediction Of Survival Of Patients With Pancreatic Ductal Adenocarcinoma.

Participants
Francesca Rigiroli, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To identify task-specific shape radiomic features of mesenteric-portal axis (MPA) tumor encasement that are associated with survival in patients with pancreatic ductal adenocarcinoma (PDAC).*Methods and Materials In an IRB-approved study, patients from 2 institutions who underwent neoadjuvant therapy and subsequent surgery for PDAC were included between January 2013 and December 2018. Two radiologists performed a volumetric segmentation of primary tumor and mesenteric-portal axis (MPA) from the intrahepatic segment to the first jejunal branch using a prototype segmentation software (Radiomics, Siemens Heathineers) on CT scans before (CTtp0) and after (CTtp1) neoadjuvant therapy. Segmentation masks and CT scans were exported into MATLAB and resampled into uniform 0.625 mm voxels to develop shape radiomic features (n=57). These features, derived from mathematical functions, aimed to assess MPA shape in CTtp0 and CTtp1 (original features), MPA narrowing by the tumor compared to its healthy segment (ratio features), changes in shape and diameter between CTtp0 and CTtp1 (difference features, D) and length of MPA segment affected by the tumor (tumor length features). A Kaplan-Meier curve was generated to estimate the survival function for the subjects. To identify reliable radiomic features that are associated with survival, a cox proportional hazards model was evaluated. The radiomic features were considered as candidate variables for the final cox proportional effects model using a variation of Collett's approach. Features that had an ICC = 0.80 and a statistically significant p-value < 0.05 were included in the univariable model. Relevant clinical features (sex, age, CA 19-9, and neoadjuvant therapy type) were included in the model a priori.*Results A total of 107 patients (60 men) who received chemoradiation, chemotherapy, or chemotherapy followed by chemoradiation, were included in this study. The median survival time was 895 days (95% CI: 717, 1061). Overall, 74 individuals died, and 33 individuals were lost to follow-up. The feature "ratio 1", calculated from the ratio between the narrowed segment and the healthy segment of the MPA on CTtp1, was selected for the model. For every unit increase in the z-score of ratio 1, there was a 33% reduced risk of death (Hazard Ratio=0.67; 95% CI: 0.50, 0.91; p=0.01), after accounting for sex, age, CA19-9, and neoadjuvant therapy type.*Conclusions Our preliminary results suggest that the developed shape radiomic features are correlated with survival in patients with PDAC.*Clinical Relevance/Application Task-specific shape radiomic features of MPA may provide critical information for the assessment of survival in patients with PDAC, therefore improving the clinical management of these patients.

RESULTS

A total of 107 patients (60 men) who received chemoradiation, chemotherapy, or chemotherapy followed by chemoradiation, were included in this study. The median survival time was 895 days (95% CI: 717, 1061). Overall, 74 individuals died, and 33 individuals were lost to follow-up. The feature "ratio 1", calculated from the ratio between the narrowed segment and the healthy segment of the MPA on CTtp1, was selected for the model. For every unit increase in the z-score of ratio 1, there was a 33% reduced risk of death (Hazard Ratio=0.67; 95% CI: 0.50, 0.91; p=0.01), after accounting for sex, age, CA19-9, and neoadjuvant therapy type.

CLINICAL RELEVANCE/APPLICATION

Task-specific shape radiomic features of MPA may provide critical information for the assessment of survival in patients with PDAC, therefore improving the clinical management of these patients.

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Abstract Archives of the RSNA, 2021

Participants
Mary C. Frates, MD, Sharon, Massachusetts (*Moderator*) Nothing to Disclose

Sub-Events

SSRI02   Keynote Speaker

Participants
Elizabeth A. Sadowski, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

SSRI02-2   Brain Myelination: Can It Be Visualized In Utero Using MRI?

Participants
Daniela Prayer, MD, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

The image quality of the currently used T1-weighted sequences to assess fetal myelination in utero is limited due to insufficient contrast. An optimized T1-weighted sequence with improved contrast is the snapshot inversion recovery sequence (SNAPIR, Malamateniou C. et al, Radiology, 2011). We aimed to evaluate the advantage of SNAPIR and SNAPIR compressed sense (SNAPIR-CS) sequences over standard used T1 fast field echo (T1FFE) sequence for the qualitative and quantitative assessment of fetal brain myelination/ premyelination.*Methods and Materials Fetal brain MRI examinations containing all three SNAPIR, SNAPIR-CS and T1FFE sequences were reviewed. Two readers, blinded to gestational age (GA) of the fetuses, qualitatively scored fetal myelination on all three sequences at five brain regions (medulla oblongata, pons, mesencephalon, thalamus, central region) and findings were compared using the paired t test. Pearson's correlation analysis was used to detect correlations between GA and the fetal myelin total score (MTS) on each sequence. One rater performed region-of-interest analysis at the same five brain regions and the signal intensities were compared between the three sequences using regression analysis.*Results A total of 125 MRI examinations performed in the axial (n=48) and coronal (n=77) plane (GA between 20 and 39 weeks, mean 29.1 weeks) were included in the qualitative analysis. Sixty-nine MRI examinations performed in the axial plane (GA between 20 and 39 weeks, mean GA 28.5 weeks) were included in the quantitative analysis. On all three sequences the fetal MTS positively correlated with GA with r values ranging between 0.524 and 0.875. However, MTS measured on both axial and coronal plane was significantly higher on SNAPIR and SNAPIR-CS compared to T1FFE (p<0.001). Also, the signal intensities at the five brain regions on SNAPIR and SNAPIR-CS showed a steeper increase with GA in comparison to T1FFE.*Conclusions SNAPIR sequence is superior to T1FFE sequence in the visualization of fetal brain myelination/premyelination, as established by qualitative and quantitative methods.*Clinical Relevance/Application Snapshot inversion recovery sequence should be included into the fetal brain MRI protocol for assessment of brain myelination/premyelination.

RESULTS

A total of 125 MRI examinations performed in the axial (n=48) and coronal (n=77) plane (GA between 20 and 39 weeks, mean 29.1 weeks) were included in the qualitative analysis. Sixty-nine MRI examinations performed in the axial plane (GA between 20 and 39 weeks, mean GA 28.5 weeks) were included in the quantitative analysis. On all three sequences the fetal MTS positively correlated with GA with r values ranging between 0.524 and 0.875. However, MTS measured on both axial and coronal plane was significantly higher on SNAPIR and SNAPIR-CS compared to T1FFE (p<0.001). Also, the signal intensities at the five brain regions on SNAPIR and SNAPIR-CS showed a steeper increase with GA in comparison to T1FFE.

CLINICAL RELEVANCE/APPLICATION

Snapshot inversion recovery sequence should be included into the fetal brain MRI protocol for assessment of brain myelination/premyelination.

SSRI02-3   SARS-CoV-2 Infection During Pregnancy: Does Fetal MRI Show Signs Of Impaired Fetal Brain Development?

Participants
Sergio Grosu, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The world is kept in suspense by the ongoing pandemic of the novel coronavirus (SARS-CoV-2). While pregnant women seem to be more vulnerable to COVID-19 and therefore may show more severe courses of the disease, the likelihood and impact of a vertical transmission to the fetus remains unclear. The purpose of this study was to use fetal MRI to investigate whether fetal brain development is affected in cases of SARS-CoV-2 infection during pregnancy.*Methods and Materials 33 patients with SARS-CoV-2 infection during pregnancy were prospectively examined; fetal-MRI scans were acquired at 1.5 Tesla. T2-, T1-, and diffusion-weighted brain images were evaluated in consensus by two board-certified radiologists with 3 and 4 years of experience in fetal MRI. Structures of the brain stem and the posterior fossa were assessed quantitatively.*Results Mean gestational age (GA) was 28.4 weeks (min. 18 weeks; max. 39 weeks). Mean onset of symptoms was at 18.3 weeks GA, ranging from 4 to 34 weeks. Most common maternal symptoms were anosmia/hypoosmia (29/33; 87.9%), ageusia (26/33; 78.8%), dry cough (19/33; 57.6%), fever

(9/33; 27.3%) with a maximum temperature of 40.8°C (mean 38.6°C) and dyspnea (10/33; 30.3%). The assessed opercularisation of the Sylvian fissure, the cortical folding and the transverse cerebellar diameter were age-appropriate in all fetuses. Furthermore, a.p.-diameter and craniocaudal extent of pons, medulla oblongata, midbrain and cerebellar vermis were all within age-appropriate limits compared to an independent age-cohort (Dovjak et al., OUG 2021). No calcifications, edema or ventricular enlargement were detected. 7 fetuses showed mild asymmetry of the lateral ventricles with a maximum difference of 4 mm.*Conclusions In 33 cases of SARS-CoV-2 infection during various stages of pregnancy all fetuses showed normal brain development, including cortical folding and brain stem segmentation. There were no findings indicative of infection of the fetal brain.*Clinical Relevance/Application While evidence regarding vertical transmission of SARS-CoV-2 during pregnancy remains sparse our study did not reveal signs of infection or impaired development of the fetal brain on fetal MRI.

RESULTS

Mean gestational age (GA) was 28.4 weeks (min. 18 weeks; max. 39 weeks). Mean onset of symptoms was at 18.3 weeks GA, ranging from 4 to 34 weeks. Most common maternal symptoms were anosmia/hypoosmia (29/33; 87.9%), ageusia (26/33; 78.8%), dry cough (19/33; 57.6%), fever (9/33; 27.3%) with a maximum temperature of 40.8°C (mean 38.6°C) and dyspnea (10/33; 30.3%). The assessed opercularisation of the Sylvian fissure, the cortical folding and the transverse cerebellar diameter were age-appropriate in all fetuses. Furthermore, a.p.-diameter and craniocaudal extent of pons, medulla oblongata, midbrain and cerebellar vermis were all within age-appropriate limits compared to an independent age-cohort (Dovjak et al., OUG 2021). No calcifications, edema or ventricular enlargement were detected. 7 fetuses showed mild asymmetry of the lateral ventricles with a maximum difference of 4 mm.

CLINICAL RELEVANCE/APPLICATION

While evidence regarding vertical transmission of SARS-CoV-2 during pregnancy remains sparse our study did not reveal signs of infection or impaired development of the fetal brain on fetal MRI.

SSRI02-5   Accuracy Of Reported Adenomyosis On Pelvic Ultrasound And MRI Compared To Surgical Pathology

Participants
Nicole Zanolli, BA, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To demonstrate the accuracy of pelvic ultrasound and MRI adenomyosis reporting compared to histopathology in common clinical practice.*Methods and Materials An institutional database was searched for women 18 years of age or older who had undergone both a pelvic ultrasound and pelvic MRI with subsequent hysterectomy with documented pathology between 1/2014 and 12/2018. Imaging findings were abstracted from radiology and pathology reports, and the reported presence or absence of adenomyosis was documented for each modality.*Results 180 women met inclusion criteria. The mean age at the time of MRI was 49.1. Self-identified race was Asian (3.9%), Black (43.9%), Hispanic/Latino (8.3%), White (42.2%), and Other (5.1%). Adenomyosis was present in 64 (35.6%) cases on final pathology, however was only reported in 9 ultrasound and 36 MRI dictations. For the finding of adenomyosis, pelvic ultrasound had a sensitivity of 10.9%, specificity of 98.3%, positive predictive value (PPV) of 77.8%, negative predictive value (NPV) of 66.7% and accuracy of 67.2%. Pelvic MRI had a sensitivity of 29.7%, specificity of 85.3%, PPV of 52.8%, NPV of 68.8% and accuracy of 65.6%. 143 (79.4%) patients had concordant ultrasound and MRI findings, with an underlying adenomyosis prevalence of 30.8% on final pathology. With concordant imaging there was a sensitivity of 6.8%, specificity of 99.0%, PPV of 75.0% and NPV of 70.5%.*Conclusions Pelvic imaging reports were more specific than sensitive for adenomyosis. Compared to prior published data, the lower accuracies demonstrated in this study suggest that when not evaluated for in the setting of a clinical trial, adenomyosis may be under- and incorrectly reported. Even when ultrasound and MRI were concordant, sensitivity remained low, while specificity approached 99%. Given the infrequent reporting of adenomyosis on ultrasound, when reported, ultrasound may be more reliable than MRI at ruling in adenomyosis, while neither modality demonstrated a strong ability to rule out the presence of adenomyosis.*Clinical Relevance/Application Adenomyosis may be underreported on ultrasound and MRI. This is a consideration in the evaluation for procedures such as uterine artery embolization, when adenomyosis may change clinical management.

RESULTS

180 women met inclusion criteria. The mean age at the time of MRI was 49.1. Self-identified race was Asian (3.9%), Black (43.9%), Hispanic/Latino (8.3%), White (42.2%), and Other (5.1%). Adenomyosis was present in 64 (35.6%) cases on final pathology, however was only reported in 9 ultrasound and 36 MRI dictations. For the finding of adenomyosis, pelvic ultrasound had a sensitivity of 10.9%, specificity of 98.3%, positive predictive value (PPV) of 77.8%, negative predictive value (NPV) of 66.7% and accuracy of 67.2%. Pelvic MRI had a sensitivity of 29.7%, specificity of 85.3%, PPV of 52.8%, NPV of 68.8% and accuracy of 65.6%. 143 (79.4%) patients had concordant ultrasound and MRI findings, with an underlying adenomyosis prevalence of 30.8% on final pathology. With concordant imaging there was a sensitivity of 6.8%, specificity of 99.0%, PPV of 75.0% and NPV of 70.5%.

CLINICAL RELEVANCE/APPLICATION

Adenomyosis may be underreported on ultrasound and MRI. This is a consideration in the evaluation for procedures such as uterine artery embolization, when adenomyosis may change clinical management.

SSRI02-8   Classic Versus Non-classic Adnexal Lesions: Risk Of Ovarian Cancer In 878 Women

Participants
Elizabeth A. Sadowski, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

1. Categorize adnexal lesions (ALs) in the general patient population using a simple risk classification scheme of classic versus non-classic ultrasound (US) appearance, and determine rate of malignancy in each group. 2. Determine if age or any specific imaging features help predict risk of malignancy in an AL.*Methods and Materials This retrospective, IRB approved, HIPAA compliant multicentric study was performed in non-selected women presenting to radiology departments for pelvic US. Fellowship trained abdominal radiologists reviewed the US images. All ovarian cysts >3 cm in pre-menopausal women and >1 cm in post-menopausal women were included and classified as either classic (simple cysts, hemorrhagic cysts, endometriomas, and teratomas) or non-classic based on the US appearance. The lesions were then correlated with surgical histopathologic results or a minimum 2 years of clinical or imaging follow up. The sensitivity and specificity of this imaging classification scheme was evaluated. Frequency of malignancy was calculated based on patient's age, classification scheme and specific imaging features. Univariate and multivariate analyses were performed and lesion category comparisons were performed using Fisher's exact test.*Results Out of 970 ALs in 878

women who met inclusion criteria, 53 lesions (5.5%) were malignant. The frequency of malignancy was significantly higher in non-classic lesions (16.5%; 49/297) compared to classic lesions (0.6%; 4/673), (p<0.0001). The frequency of malignancy was also significantly higher in lesions with blood flow (32.0%; 33/103) compared to lesions without blood flow (8.3%; 16/194), (p<0.0001). Women older than 60 had a higher risk of malignancy (50%; 10/20) than women =60 years of age (27.7%; 23/83), however this difference did not reach statistical significance (p=.066). The sensitivity and specificity of this classification scheme (classic vs. non-classic) was 92.5% and 73.1%, respectively.*Conclusions Using a simple US classification scheme of identifying ALs as classic or non-classic results in high sensitivity and specificity for diagnosing malignancy similar to recently published risk categorization schemes. The highest risk of cancer was noted in non-classic lesions with vascular components, particularly in women over 60.*Clinical Relevance/Application Multiple US based classification systems can be clinically utilized for categorizing ALs as benign or potentially malignant. Due to their complexity and heterogeneity, there is a learning curve to implementing these in daily practice, particularly given the low prevalence of malignancy in the population undergoing the exam. A simple US classification scheme assessing risk of malignancy in an AL may be helpful in a busy clinical practice.

RESULTS

Out of 970 ALs in 878 women who met inclusion criteria, 53 lesions (5.5%) were malignant. The frequency of malignancy was significantly higher in non-classic lesions (16.5%; 49/297) compared to classic lesions (0.6%; 4/673), (p<0.0001). The frequency of malignancy was also significantly higher in lesions with blood flow (32.0%; 33/103) compared to lesions without blood flow (8.3%; 16/194), (p<0.0001). Women older than 60 had a higher risk of malignancy (50%; 10/20) than women =60 years of age (27.7%; 23/83), however this difference did not reach statistical significance (p=.066). The sensitivity and specificity of this classification scheme (classic vs. non-classic) was 92.5% and 73.1%, respectively.

CLINICAL RELEVANCE/APPLICATION

Multiple US based classification systems can be clinically utilized for categorizing ALs as benign or potentially malignant. Due to their complexity and heterogeneity, there is a learning curve to implementing these in daily practice, particularly given the low prevalence of malignancy in the population undergoing the exam. A simple US classification scheme assessing risk of malignancy in an AL may be helpful in a busy clinical practice.

SSRI02-9   Evaluation Of Placental Heterogeneity Using DWI In Placenta Accreta Spectrum

Participants
Mariana Meyers, MD, Aurora, Colorado (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the differences of placental apparent diffusion coefficient (ADC) assessed by low b-value diffusion-weighted imaging (DWI) in regions of normal placental development and abnormal placental adherence (placenta accreta spectrum disorder, PAS).*Methods and Materials A retrospective analysis was performed on thirty-one pregnant patients who were imaged between February 2019 and March 2021 for evaluation of PAS. Patients were grouped into no PAS (controls, n=13), accreta/increta (PAS Grade 1 and 2, n=8), and percreta (PAS Grades 3A, 3D, and 3E, n=10) based on operative and surgical pathology reports. Diffusion-weighted MRI data were collected at 1.5T with b-values = 10, 50, 100 s/mm2 and ADC was calculated. Regions of interest (ROIs) were defined throughout the placenta by a radiologist with 11 years of clinical experience in areas of normal placenta for all patients and areas of concern for patients with confirmed PAS. The average and standard deviation (serving as a measure of heterogeneity) of the ADC was computed across all ROIs.Controls were compared to all PAS cases for differences of mean ADC and ADC heterogeneity in both regions of normal placenta and areas of concern. Additionally, a repeated measures ANOVA was used to compare normal and invasive regions between accreta and percreta.*Results No differences were identified between the mean and standard deviation in controls compared to normal regions in PAS cases (mean ADC = 3.85×10^{-3} mm2/s, p=0.61). Areas of concern for abnormal placental adherence showed more heterogeneity compared to the normal placenta in controls (p=0.042), but no difference of the mean ADC (p=0.85). Repeated measures ANOVA tests showed differences of mean ADC (p=0.025) between accreta and percreta cases, and of ADC heterogeneity between normal and invasive regions (p=0.008).*Conclusions Low b-value DWI heterogeneity may be useful to differentiate normal implantation versus regions of suspected adherent or invasive placenta. Addition of advanced, quantitative imaging methods, including expansion of b-value range for IVIM processing could provide insight into microvascular blood flow changes that exist between normal and abnormally invaded regions of the uterine wall by the placenta.*Clinical Relevance/Application DW-MRI signal heterogeneity is increased in areas of suspected adherent or invading placenta and may help in the diagnosis and evaluation of placenta accreta spectrum disorder, ultimately guiding appropriate clinical management.

RESULTS

No differences were identified between the mean and standard deviation in controls compared to normal regions in PAS cases (mean ADC = 3.85×10^{-3} mm2/s, p=0.61). Areas of concern for abnormal placental adherence showed more heterogeneity compared to the normal placenta in controls (p=0.042), but no difference of the mean ADC (p=0.85). Repeated measures ANOVA tests showed differences of mean ADC (p=0.025) between accreta and percreta cases, and of ADC heterogeneity between normal and invasive regions (p=0.008).

CLINICAL RELEVANCE/APPLICATION

DW-MRI signal heterogeneity is increased in areas of suspected adherent or invading placenta and may help in the diagnosis and evaluation of placenta accreta spectrum disorder, ultimately guiding appropriate clinical management.

Participants
William E. Palmer, MD, Boston, Massachusetts (*Moderator*) Nothing to Disclose
Rob Campbell, MBBCh, Liverpool, United Kingdom (*Moderator*) Nothing to Disclose

Sub-Events

SSMK01-2   Assessment Of Thoracic Disk Herniation By Using Virtual Noncalcium Dual-energy CT In Comparison With Standard Grayscale CT

Participants
Vitali Koch, MD, Frankfurt am Main, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To determine the diagnostic accuracy of dual-energy CT (DECT) virtual noncalcium (VNCa) reconstructions for assessing thoracic disk herniation compared to standard grayscale CT.*Methods and Materials In this retrospective study, 87 patients (1131 intervertebral disks; mean age, 66 years; 47 women) who underwent third-generation dual-source DECT and 3.0-Tesla MRI within 3 weeks between November 2016 and April 2020 were included. Five blinded radiologists analyzed standard DECT and color-coded VNCa images after a time interval of 8 weeks for the presence and degree of thoracic disk herniation and spinal nerve root impingement. Consensus reading of independently evaluated MRI series served as the reference standard, assessed by two separate experienced readers. Additionally, image ratings were carried out by using five-point Likert scales.*Results MRI revealed a total of 133 herniated thoracic disks. Color-coded VNCa images yielded higher overall sensitivity (624/665 [94%; 95% CI, 0.89-0.96] vs 485/665 [73%; 95% CI, 0.67-0.80]), specificity (4775/4990 [96%; 95% CI, 0.90-0.98] vs 4066/4990 [82%; 95% CI, 0.79-0.84]) and accuracy (5399/5655 [96%; 95% CI, 0.93-0.98] vs 4551/5655 [81%; 95% CI, 0.74-0.86]) for the assessment of thoracic disk herniation compared to standard CT (all P < .001). Interrater agreement was excellent for VNCa and fair for standard CT (? = 0.82 vs 0.37; P < .001). In addition, VNCa imaging achieved higher scores regarding diagnostic confidence, image quality, and noise compared to standard CT (all P < .001).*Conclusions Color-coded VNCa imaging yielded substantially higher diagnostic accuracy and confidence for assessing thoracic disk herniation compared to standard CT.*Clinical Relevance/Application • Color-coded VNCa reconstructions derived from third-generation dual source dual-energy CT yielded significantly higher diagnostic accuracy for the assessment of thoracic disk herniation and spinal nerve root impingement compared to standard grayscale CT. • VNCa imaging provided higher diagnostic confidence and image quality at lower noise levels compared to standard grayscale CT. • Color-coded VNCa images may potentially serve as a viable imaging alternative to MRI under circumstances where MRI is unavailable or contraindicated.

RESULTS

MRI revealed a total of 133 herniated thoracic disks. Color-coded VNCa images yielded higher overall sensitivity (624/665 [94%; 95% CI, 0.89-0.96] vs 485/665 [73%; 95% CI, 0.67-0.80]), specificity (4775/4990 [96%; 95% CI, 0.90-0.98] vs 4066/4990 [82%; 95% CI, 0.79-0.84]) and accuracy (5399/5655 [96%; 95% CI, 0.93-0.98] vs 4551/5655 [81%; 95% CI, 0.74-0.86]) for the assessment of thoracic disk herniation compared to standard CT (all P < .001). Interrater agreement was excellent for VNCa and fair for standard CT (? = 0.82 vs 0.37; P < .001). In addition, VNCa imaging achieved higher scores regarding diagnostic confidence, image quality, and noise compared to standard CT (all P < .001).

CLINICAL RELEVANCE/APPLICATION

• Color-coded VNCa reconstructions derived from third-generation dual source dual-energy CT yielded significantly higher diagnostic accuracy for the assessment of thoracic disk herniation and spinal nerve root impingement compared to standard grayscale CT. • VNCa imaging provided higher diagnostic confidence and image quality at lower noise levels compared to standard grayscale CT. • Color-coded VNCa images may potentially serve as a viable imaging alternative to MRI under circumstances where MRI is unavailable or contraindicated.

SSMK01-3   Synthetic T2-weighted Contrasts Of The Lumbar Spine Derived From Highly-undersampled K-space Data At Arbitrary Chosen Echo Times - Offsetting Clinical Time Cost Of T2 Mapping

Participants
Marcus Raudner, MD, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study was to investigate, whether synthetic T2w images derived by GRAPPATINI show contrast-to-noise ratios comparable to conventional T2w TSE images and sufficient interrater and intrarater agreements in the assessment of Pfirrmann classifications, annular tears and lumbar disk herniation. GRAPPATINI is a combination of a model-based approach for rapid T2 and M0 quantification (MARTINI) extended by generalized autocalibrating partial parallel acquistion (GRAPPA) and uses highly undersampled k-space data.*Methods and Materials In total, 58 individuals (26 female, 32 male, aged 23.3±8.1 years) were examined at 3 Tesla with sagittal and axial T2w turbo spin echo (TSE) sequences compared to synthetic T2-weighted contrasts derived at identical effective echo times and spatial resolutions. Two readers, blinded for clinical information, graded disk degeneration (Pfirrmann Classification) and evaluated the lumbar intervertebral disks for present herniation or annular tear. One

reader reassessed all studies after four weeks. Weighted kappa statistics were calculated to assess interrater and intrarater agreement. Also, all studies were segmented manually by one reader to compute contrast ratios (CR) and contrast-to-noise ratios (CNR) of the nucleus pulposus and the annulus fibrosus.*Results The interrater agreement was substantial to almost perfect (? = 0.808-0.925) with the intrarater agreement also substantial to almost perfect (? = 0.862-0.963). Overall, the CRT2w was 4.45±1.80 and CRT2synth was 4.71±2.14. Both correlated (rsp=0.768;p<0.001) and differed (0.26±1.38;p=0.002) significantly. The CNRT2w was 1.73±0.52 and CNRT2synth was 1.63±0.50. Both correlated (rsp=0.875;p<0.001) and differed (-0.10±0.25;p<0.001) significantly.*Conclusions This study concludes that synthetic T2w images derived by GRAPPATINI can be used for clinical routine assessment with inter-rater and intra-rater agreements comparable to conventional T2w TSE.*Clinical Relevance/Application This study shows that GRPAPATINI, a prototype multi-echo spin-echo sequence designed for accelerated T2 mapping using a combination of undersampling, model-based reconstruction and GRAPPA, can also deliver diagnostic T2-weighted images. This could potentially offset the additional time cost for T2 mapping in clinical routine.

RESULTS

The interrater agreement was substantial to almost perfect (? = 0.808-0.925) with the intrarater agreement also substantial to almost perfect (? = 0.862-0.963). Overall, the CRT2w was 4.45±1.80 and CRT2synth was 4.71±2.14. Both correlated (rsp=0.768;p<0.001) and differed (0.26±1.38;p=0.002) significantly. The CNRT2w was 1.73±0.52 and CNRT2synth was 1.63±0.50. Both correlated (rsp=0.875;p<0.001) and differed (-0.10±0.25;p<0.001) significantly.

CLINICAL RELEVANCE/APPLICATION

This study shows that GRPAPATINI, a prototype multi-echo spin-echo sequence designed for accelerated T2 mapping using a combination of undersampling, model-based reconstruction and GRAPPA, can also deliver diagnostic T2-weighted images. This could potentially offset the additional time cost for T2 mapping in clinical routine.

SSMK01-5   Intervertebral Disc Regeneration Techniques: Viable Allograft For Intervertebral Disc Supplementation - Viable Allograft Supplemented Disc Regeneration Trial (VAST)

Participants
Edward Yoon, MD, New York, New York (*Presenter*) Speaker, Vivex Biomedical, Inc;Research Consultant, Surgalign Holdings;

PURPOSE

To evaluate clinical and radiologic outcomes after intradiscal allograft augmentation for chronic discogenic back pain.*Methods and Materials 236 subjects with painful discogenic low back pain were screened at 15 U.S. sites with 224 entering the trial which was divided into a treatment group, a non-surgical management (NSM) group and a placebo control group with a 3.5:1:1 randomization ratio. The first 24 participants were assessed with a one month visit after enrollment. Two co-primary endpoints - back pain Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) were evaluated along with safety data including reported adverse events (AEs) and changes in clinical laboratory evaluations. Data was collected at baseline, and at 3, 6 and 12 months. Structural outcomes were evaluated by x-rays and Magnetic Resonance Imaging (MRI) at 6 and at 12 months.*Results At 12 months, clinically meaningful improvements in mean VASPI and ODI scoreswere achieved in the investigational allograft and saline groups. Although mean clinical outcomes were not statistically significant between the treatment groups, a responder analysis demonstrated, a clinically meaningful reduction in ODI of =15 points at 12 months that was statistically significant; 76.5% of subjects randomized to allograft were responders (p = 0.03) as compared to 56.7% in the saline group. In the allograft group, 11 safety adverse events occurred in 141 subjects (3.5%) and there were no persistently symptomatic AEs.*Conclusions This large, prospective blinded RCT demonstrated safety and results indicating that viable disc tissue allograft may be a beneficial nonsurgical treatment for patients who have chronically painful lumbar degenerative discs.*Clinical Relevance/Application This is the largest randomized blinded prospective trial for treatment of single or two level degenerated disc disease with disc tissue allograft augmentation in patients with chronic discogenic back pain.

RESULTS

At 12 months, clinically meaningful improvements in mean VASPI and ODI scoreswere achieved in the investigational allograft and saline groups. Although mean clinical outcomes were not statistically significant between the treatment groups, a responder analysis demonstrated, a clinically meaningful reduction in ODI of =15 points at 12 months that was statistically significant; 76.5% of subjects randomized to allograft were responders (p = 0.03) as compared to 56.7% in the saline group. In the allograft group, 11 safety adverse events occurred in 141 subjects (3.5%) and there were no persistently symptomatic AEs.

CLINICAL RELEVANCE/APPLICATION

This is the largest randomized blinded prospective trial for treatment of single or two level degenerated disc disease with disc tissue allograft augmentation in patients with chronic discogenic back pain.

SSGU04
Genitourinary (Prostate II)

Participants
Lyndon Luk, MD, New York, New York (*Moderator*) Nothing to Disclose
Senta Berggruen, MD, Shorewood, Illinois (*Moderator*) Nothing to Disclose

Sub-Events

SSGU04-3 Contrast Free Prostate MRI Using Arterial Spin Labelling As Perfusion Imaging Alternative Can Visualize Prostate Cancer As Good As DCE

Participants
Matthias Boschheidgen, Dusseldorf, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To determine the capability of gadolinium-free arterial spin labelling (ASL) sequences as contrast-free, non-invasive alternative perfusion imaging method to differentiate prostate cancer (PCA) from benign prostate tissue compared to conventional DCE MRI.*Methods and Materials Thirty men with histologically confirmed PCA were included in this prospectively enrolled single center cohort study. All patients received multiparametric MRI (T2, DWI, DCE) at 3T with additional ASL of the PCA lesion. Primary endpoint was differentiability of PCA versus normal prostate tissue in ASL in comparison to DCE. Secondary objectives were differences in signal intensities (SI), contrast ratios (CR), and differences in the attenuation pattern of peripheral (PZ) and transition zone (TZ) PCA.*Results In both, ASL and DCE, average SI of PCA areas differed significantly from SI in reference areas in the TZ and PZ (p<0,01, respectively). ASL had significantly higher CR discerning PCA and benign tissue in PZ and TZ (PZ=5.2; TZ=6.5) compared to DCE (PZ=1.6; TZ=1.4) (p<0.01, respectively). In subjective evaluation, ASL could visualize PCA in 28 patients, compared to 29 in DCE.*Conclusions ASL had significantly higher contrast-ratios discerning PCA from benign tissue in PZ and TZ compared to DCE and visual discrimination of PCA does not differ significantly between the two sequences. As perfusion gadolinium-based contrast media is seen more critical in the last few years, ASL seems to be a promising alternative to DCE in PCA detection.*Clinical Relevance/Application Arterial spin labelling can visualize prostate cancer as good as conventional dynamic contrast-enhanced magnet resonance imaging of the prostate andmay be a promising, contrast free alternative.

RESULTS

In both, ASL and DCE, average SI of PCA areas differed significantly from SI in reference areas in the TZ and PZ (p<0,01, respectively). ASL had significantly higher CR discerning PCA and benign tissue in PZ and TZ (PZ=5.2; TZ=6.5) compared to DCE (PZ=1.6; TZ=1.4) (p<0.01, respectively). In subjective evaluation, ASL could visualize PCA in 28 patients, compared to 29 in DCE.

CLINICAL RELEVANCE/APPLICATION

Arterial spin labelling can visualize prostate cancer as good as conventional dynamic contrast-enhanced magnet resonance imaging of the prostate andmay be a promising, contrast free alternative.

SSGU04-4 The Impact Of 18F-DCFPyL PET/CT On The Management Of Patients With Recurrent Prostate Cancer: Results Of A Prospective, Multicenter Trial.

Participants
Ur Metser, MD, FRCPC, Toronto, Ontario (*Presenter*) Consultant, POINT Biopharma Inc

PURPOSE

To assess the disease detection rate of 18F-DCFPyL PET/CT (=PSMA PET) and the PET-directed change in the clinical management of men with suspected limited recurrent prostate cancer after primary therapy.*Methods and Materials This prospective, multicenter registry trial enrolled 1289 patients (Dec 2018-Sept 2020). Eligibility included biochemical failure after primary therapy, 0-4 sites of disease on conventional imaging (CT and bone scintigraphy) and one of the following predefined clinical cohorts: 1. Node positive or detectable serum PSA after radical prostatectomy (RP) 2. Post RP; 3. Post RP and pelvic radiotherapy; 4. Post RP or primary radiotherapy (RT) and androgen deprivation therapy; 5. Post lesion directed treatment for oligometastases (=4 sites); 6. Post primary RT.*Results 841/1289 men (65.2%) had disease detected with PSMA PET. PET detection rates among men with negative conventional imaging was 615/999 (61.6%). Detection rate of any lesion by serum PSA level (ng/ml) at enrollment were 160/424 (37.7%) for PSA <0.5; 107/171 (62.6%) 0.5-1.0 and 573/692 (82.8%) for PSA >1.0. On PSMA PET 399/1289 men (31.0%) had locoregional failure (limited to pelvis), 314/1289 men (24.4%) had oligometastatic disease and 128/1289 men (9.9%) had extensive metastatic disease (Table 1; results by cohort). Post PSMA PET, a change in planned management was recorded in 748/1289 men (58.0%) and in 371/1250 men (29.7%), there was a change in management intent, most commonly from palliative to potentially curative intent (255/1289; 19.8%); Figure 1. The most common change was conversion from observation or systemic therapy to salvage radiation or surgery for locoregional (236/1289;18.3%) or oligometastatic disease (132/1289; 10.2%). In 89 additional patients (6.9%) nodal-directed therapy was added to management plan after PET.*Conclusions PSMA-PET detects additional sites of disease compared with standard of care imaging in most men with biochemical failure and suspected low volume metastatic disease, resulting in frequent change in management including a change from palliative to curative/radical intent therapy in 20% of men. Long term follow-up is needed to determine whether this impacts disease control.*Clinical Relevance/Application The detection of additional disease sites on PSMA PET in men with biochemical failure after primary therapy and suspected low

volume metastatic disease results in a frequent change in management.

RESULTS

841/1289 men (65.2%) had disease detected with PSMA PET. PET detection rates among men with negative conventional imaging was 615/999 (61.6%). Detection rate of any lesion by serum PSA level (ng/ml) at enrollment were 160/424 (37.7%) for PSA <0.5; 107/171 (62.6%) 0.5-1.0 and 573/692 (82.8%) for PSA >1.0. On PSMA PET 399/1289 men (31.0%) had locoregional failure (limited to pelvis), 314/1289 men (24.4%) had oligometastatic disease and 128/1289 men (9.9%) had extensive metastatic disease (Table 1; results by cohort). Post PSMA PET, a change in planned management was recorded in 748/1289 men (58.0%) and in 371/1250 men (29.7%), there was a change in management intent, most commonly from palliative to potentially curative intent (255/1289; 19.8%); Figure 1. The most common change was conversion from observation or systemic therapy to salvage radiation or surgery for locoregional (236/1289;18.3%) or oligometastatic disease (132/1289; 10.2%). In 89 additional patients (6.9%) nodal-directed therapy was added to management plan after PET.

CLINICAL RELEVANCE/APPLICATION

The detection of additional disease sites on PSMA PET in men with biochemical failure after primary therapy and suspected low volume metastatic disease results in a frequent change in management.

SSGU04-5 Validation Of Prostate Tissue Composition Measurement Using Hybrid Multi-dimensional MRI: Agreement With Pathologists' Measures

Participants
Aritrick Chatterjee, PhD, Chicago, Illinois (*Presenter*) Stockholder, QMIS LLC

PURPOSE

To validate prostate tissue composition measured using Hybrid Multi-dimensional MRI (HM-MRI) by comparing with reference standard results from pathologists' interpretation of clinical histopathology slides following whole mount prostatectomy.*Methods and Materials 36 prospective participants with biopsy-confirmed prostate cancer underwent 3T MRI prior to radical prostatectomy. Axial HM-MRI was acquired with all combinations of echo times of 57, 70, 150, 200 ms and b-values of 0, 150, 750, 1500 s/mm2 and data was fitted using a 3-compartment signal model to generate volumes for each tissue component (stroma, epithelium, lumen). Three experienced genitourinary pathologists independently as well as in consensus reviewed each histology image and provide an estimate of percentage of epithelium and lumen for regions-of-interest corresponding to MRI (n = 165; 64 prostate cancers and 101 normal tissue). Agreement statistics using total deviation index (TDI0.9) was performed for tissue composition measured using HM-MRI and reference standard results from pathologists' consensus.*Results Based on the initial results showing typical variation among pathologists TDI0.9=25%, we determined we will declare acceptable agreement if the 95% one-sided upper confident limit of TDI0.9 is less than 30%. Tissue composition measured using HM-MRI and pathologists' consensus were similar for epithelium 28.3 ± 12.8 vs 27.7 ± 18.0% and lumen volume 26.3 ± 12.8 vs 36.6 ± 10.0%. The results of tissue composition measurement from HM-MRI compared to ground truth results from the consensus of 3 pathologists, reveal that ninety percent of absolute paired differences (TDI0.9) were within 18.8% and 22.4% in measuring epithelium and lumen, respectively. We are 95% confident that 90% of absolute paired differences were within 20.6% and 24.2% in measuring epithelium and lumen, respectively. These were less than our criterion of 30% and inter-pathologists' agreement (22.3% for epithelium and 24.2% for lumen) and therefore we accept the agreement performance of HM-MRI. The results revealed excellent area under the ROC curve for differentiating cancer from benign tissue based on epithelium (HM-MRI: 0.87, pathologists: 0.97) and lumen volume (HM-MRI: 0.85, pathologists: 0.77).*Conclusions The agreement in tissue composition measurement using hybrid-multidimensional MRI and consensus of pathologists is on par with the inter-raters (pathologists) agreement.*Clinical Relevance/Application HM-MRI can potentially be used for non-invasive prostate cancer diagnosis using tissue composition that are similar to measurements from pathologists' interpretation of clinical histopathology slides following whole mount prostatectomy.

RESULTS

Based on the initial results showing typical variation among pathologists TDI0.9=25%, we determined we will declare acceptable agreement if the 95% one-sided upper confident limit of TDI0.9 is less than 30%. Tissue composition measured using HM-MRI and pathologists' consensus were similar for epithelium 28.3 ± 12.8 vs 27.7 ± 18.0% and lumen volume 26.3 ± 12.8 vs 36.6 ± 10.0%. The results of tissue composition measurement from HM-MRI compared to ground truth results from the consensus of 3 pathologists, reveal that ninety percent of absolute paired differences (TDI0.9) were within 18.8% and 22.4% in measuring epithelium and lumen, respectively. We are 95% confident that 90% of absolute paired differences were within 20.6% and 24.2% in measuring epithelium and lumen, respectively. These were less than our criterion of 30% and inter-pathologists' agreement (22.3% for epithelium and 24.2% for lumen) and therefore we accept the agreement performance of HM-MRI. The results revealed excellent area under the ROC curve for differentiating cancer from benign tissue based on epithelium (HM-MRI: 0.87, pathologists: 0.97) and lumen volume (HM-MRI: 0.85, pathologists: 0.77).

CLINICAL RELEVANCE/APPLICATION

HM-MRI can potentially be used for non-invasive prostate cancer diagnosis using tissue composition that are similar to measurements from pathologists' interpretation of clinical histopathology slides following whole mount prostatectomy.

Abstract Archives of the RSNA, 2021

Participants
Jared D. Christensen, MD,MBA, Durham, North Carolina (*Moderator*) Advisory Board, Riverain Technologies, LLC
Mark Hammer, MD, Boston, Massachusetts (*Moderator*) Nothing to Disclose

Sub-Events

SSCH08   Keynote Speaker

Participants
Mark Hammer, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

SSCH08-2   Progression Of Clinical Findings Of Smokers With Bronchiectasis On Baseline Low-dose CT Screening For Lung Cancer

Participants
Natthaya Triphuridet, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To assess progression of clinical findings of smokers with bronchiectasis in a program of low-dose CT (LDCT) screening for lung cancer.*Methods and Materials Among 504 smokers with bronchiectasis on their initial LDCT, retrospective medical record review was performed of 131 participants with ELCAP-Bronchiectasis-Score (ELCAP-BrS) in the highest quartile to document respiratory symptoms, acute events, and investigations during two years before and after the LDCT.*Results Among the 131 participants, 128(97.7%) had right middle lobe and/or lingula bronchiectasis. Of the 73 participants with available records during the four-year review, 54(74.0%) participants had respiratory symptoms, 42(57.5%) had dyspnea, 36(49.3%) had chronic cough, and 29(39.7%) had acute event(s) before screening. The ELCAP-BrS was significantly higher among those with symptoms than those without symptoms (19.0 vs. 17.0, p=0.04). After screening, there was a significant increase in dyspnea with activity limitation (35.6% to 46.6%, p=0.01), exacerbations (35.6% to 50.7%, p=0.03), and positive cultures (20.0% to 77.8%, p=0.01). Among the positive cultures, NTM growth in the two years after screening was identified in 57.1% (4 of 7). A higher proportion of participants with chronic obstructive pulmonary disease (COPD) than those without COPD had symptoms (100% vs. 53.7%, p<0.001), acute events (56.3% vs. 26.8%, p=0.02) and hospitalization (15.6% vs. 0%, p=0.01).*Conclusions Most smokers with bronchiectasis in 4th quartile of ELCAP-BrS were symptomatic. Clinical deterioration was seen in participants with and without COPD, particularly dyspnea with activity limitation and exacerbation. For almost all, bronchiectasis involved the mid lung region and 57.1% (4 of 7) of the participants who had non-tuberculous mycobacteria diagnosed in respiratory cultures. Bronchiectasis should be reported in participants undergoing LDCT screening for lung cancer as they are older smokers, and recommend pulmonary consultation for appropriate investigation and treatment.*Clinical Relevance/Application • Most of smokers with bronchiectasis in 4th quartile of ELCAP-Bronchiectasis-Score had mid lung involvement, symptoms, and significant clinical deterioration, thus early detection of bronchiectasis and bronchiectasis-related diseases would be beneficial.

RESULTS

Among the 131 participants, 128(97.7%) had right middle lobe and/or lingula bronchiectasis. Of the 73 participants with available records during the four-year review, 54(74.0%) participants had respiratory symptoms, 42(57.5%) had dyspnea, 36(49.3%) had chronic cough, and 29(39.7%) had acute event(s) before screening. The ELCAP-BrS was significantly higher among those with symptoms than those without symptoms (19.0 vs. 17.0, p=0.04). After screening, there was a significant increase in dyspnea with activity limitation (35.6% to 46.6%, p=0.01), exacerbations (35.6% to 50.7%, p=0.03), and positive cultures (20.0% to 77.8%, p=0.01). Among the positive cultures, NTM growth in the two years after screening was identified in 57.1% (4 of 7). A higher proportion of participants with chronic obstructive pulmonary disease (COPD) than those without COPD had symptoms (100% vs. 53.7%, p<0.001), acute events (56.3% vs. 26.8%, p=0.02) and hospitalization (15.6% vs. 0%, p=0.01).

CLINICAL RELEVANCE/APPLICATION

• Most of smokers with bronchiectasis in 4th quartile of ELCAP-Bronchiectasis-Score had mid lung involvement, symptoms, and significant clinical deterioration, thus early detection of bronchiectasis and bronchiectasis-related diseases would be beneficial.

SSCH08-3   Lung Cancer Screening And Smoking Cessation: An Opportunity For Community Radiologists To Partner With Behavioral Health Specialists

Participants
Grayson Baird, PhD, Providence, Rhode Island (*Presenter*) Nothing to Disclose

PURPOSE

To examine smoking attitudes among current smokers undergoing lung cancer screening to better inform cessation intervention opportunities and efforts for this population.*Methods and Materials A voluntary assessment of smoking behaviors and attitudes was conducted among 1472 current smokers who presented for annual CT lung cancer screening from 04/19-05/20. Active smokers were eligible for a lung cancer screening if they were at least 30 pack year smokers and 55-77 years old. Data were modeled using

generalized linear modeling.*Results Nearly all participants (86.6%, 1175/1357) smoked cigarettes daily, while 30.1% smoked cigars daily; 98.2% of daily cigar smokers were also daily cigarette smokers. In total, 91.4% of participants were at least somewhat interested in quitting smoking, and 74.1% were seriously thinking about quitting within the next 6 months. Participants reported they would smoke less if told their screen was positive for cancer compared to negative (0.31, 95% CI [0.27, 0.34] vs. 0.77, 95% CI [0.72, 0.81]), p<.0001, although patients reported the desire to smoke less regardless of the result (see Figure 1). Only 8.4% of current smokers believe they do not have an inherent ability to stop smoking, while 22%, 37%, 19%, and 14% believe they have a little, somewhat, mostly, or completely inherent ability to quit if they wanted. For every one-unit increase in ability to quit, the odds of planning to quit increased 49% (OR: 1.492, 95% CI [1.4, 1.6], p<.0001.*Conclusions The number of smokers who undergo lung screening is expected to increase due to expanded guidelines adopted in 2021. Cessation interventions tailored to this population and setting should be developed as patients are interested in quitting and report planning to reduce how much they smoke regardless of their lung cancer screening result.*Clinical Relevance/Application Federal guidelines require that smoking cessation treatment is given during lung cancer screens. These data suggest the population will be receptive to well-designed treatment efforts. The community radiology setting provides an excellent opportunity to engage smokers about smoking cessation by directing them to behavioral medicine colleagues who can design and oversee tailored smoking cessation efforts.

RESULTS

Nearly all participants (86.6%, 1175/1357) smoked cigarettes daily, while 30.1% smoked cigars daily; 98.2% of daily cigar smokers were also daily cigarette smokers. In total, 91.4% of participants were at least somewhat interested in quitting smoking, and 74.1% were seriously thinking about quitting within the next 6 months. Participants reported they would smoke less if told their screen was positive for cancer compared to negative (0.31, 95% CI [0.27, 0.34] vs. 0.77, 95% CI [0.72, 0.81]), p<.0001, although patients reported the desire to smoke less regardless of the result (see Figure 1). Only 8.4% of current smokers believe they do not have an inherent ability to stop smoking, while 22%, 37%, 19%, and 14% believe they have a little, somewhat, mostly, or completely inherent ability to quit if they wanted. For every one-unit increase in ability to quit, the odds of planning to quit increased 49% (OR: 1.492, 95% CI [1.4, 1.6], p<.0001.

CLINICAL RELEVANCE/APPLICATION

Federal guidelines require that smoking cessation treatment is given during lung cancer screens. These data suggest the population will be receptive to well-designed treatment efforts. The community radiology setting provides an excellent opportunity to engage smokers about smoking cessation by directing them to behavioral medicine colleagues who can design and oversee tailored smoking cessation efforts.

SSCH08-4   The Potential Management Impact Of Interval Diagnostic Chest CTs In Lung Cancer Screening Patients

Participants
Pegah Khoshpouri, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

PURPOSE

Lung cancer screening (LCS) participants may obtain diagnostic chest CT (DCT) outside of their recommended LCS schedule. At present, the American College of Radiology Lung- RADS guidelines recommend that LCS CT (LCSCT) be performed on an annual basis without consideration for intervening DCTs. We aimed to quantify the incidence of interval DCT, which has not been previously reported, and to assess the potential effect of these scans on LCSCT follow up.*Methods and Materials IRB approval was obtained for this HIPAA-compliant study. Among 8,073 LCSCTs obtained, 790 patients with at least two LCSCTs between 1/2016 and 8/2019 were identified. The medical record of these patients was reviewed to identify DCTs obtained between baseline and follow-up LCSCTs. Thirty-two patients had interval DCTs. Baseline and follow-up LCSCTs were reviewed and assigned Lung-RADS designations. Interval DCTs were reviewed and compared to both baseline and follow-up LCSCT to determine the potential impact on follow-up management recommendations.*Results Our cohort included 790 patients (404, 51.1% women; mean age 67+6 years). Thirty-two (4.1%) patients had interval DCTs. Median interval DCT was 163 (range 2-686) days from baseline LCSCT and 221 (range 30-454) days before the follow-up LCSCT. DCT images were unavailable in two cases, resulting in 30 scans available. Baseline nodules were obscured by new consolidation on one (3.3%) interval DCT which had resolved on the subsequent annual LCSCT. One (3.3%) interval DCT demonstrated an increase in nodule size which resolved on follow-up LCSCT. Pulmonary nodules were resolved on 2 (6.7%) interval DCTs which was confirmed on follow-up LCSCT. One (3.3%) case demonstrated development of a nodule flagged as "highly suspicious for lung cancer" on interval DCT and categorized as Lung-RADS 4X on follow-up LCSCT. In the majority of cases (28 patients, 93.3%) the findings on follow-up LCSCT did not add further clinical value to the interval DCT.*Conclusions DCTs performed between baseline and follow-up LCSCT were obtained in 4.1% of LCS participants. In a majority of patients (93.3%), nodule findings on interval DCT are similar to those on follow-up LCSCT. Therefore, follow-up and incidence LCSCT may potentially be timed using an interval DCT as a new baseline evaluation.*Clinical Relevance/Application In LCS participants, findings on interval DCTs can potentially be used to adjust the timing of subsequent LCSCT follow-up.

RESULTS

Our cohort included 790 patients (404, 51.1% women; mean age 67+6 years). Thirty-two (4.1%) patients had interval DCTs. Median interval DCT was 163 (range 2-686) days from baseline LCSCT and 221 (range 30-454) days before the follow-up LCSCT. DCT images were unavailable in two cases, resulting in 30 scans available. Baseline nodules were obscured by new consolidation on one (3.3%) interval DCT which had resolved on the subsequent annual LCSCT. One (3.3%) interval DCT demonstrated an increase in nodule size which resolved on follow-up LCSCT. Pulmonary nodules were resolved on 2 (6.7%) interval DCTs which was confirmed on follow-up LCSCT. One (3.3%) case demonstrated development of a nodule flagged as "highly suspicious for lung cancer" on interval DCT and categorized as Lung-RADS 4X on follow-up LCSCT. In the majority of cases (28 patients, 93.3%) the findings on follow-up LCSCT did not add further clinical value to the interval DCT.

CLINICAL RELEVANCE/APPLICATION

In LCS participants, findings on interval DCTs can potentially be used to adjust the timing of subsequent LCSCT follow-up.

SSCH08-5   Lung-rads 1.1: Evaluation Of Pleural Nodules Using The National Lung Screening Trial Dataset

Participants
Lydia Chelala, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To determine the frequency of malignancy during lung cancer screening (LCS) associated with pleural nodules measuring 6mm to

10mm and assess the rate of reclassification of a benign subset of such nodules if managed like perifissural nodules in Lung-RADS 1.1.*Methods and Materials A secondary analysis of the NLST was performed. Non-calcified nodules measuring 6 to 10 mm found on incident scans were evaluated to identify the largest nodule. Nodules were categorized as pleural and non-pleural nodules. Pleural nodules were defined as directly abutting the costal or paramediastinal pleura. Relationship of the dominant nodule to the pleura, nodule location and nodule morphology (benign e.g. lentiform/nonbenign e.g. irregular) were determined by a reader blinded to benign vs malignant outcome. The impact of down-classification of pleural nodules was assessed.*Results 2,813 patients (62±5 years, 1717 men) with 4,408 non-calcified nodules (NCNs) were studied. 1073 nodules measuring 6-10 mm were included. Of these, 348 (32.4%) were pleural. The adoption of a classification scheme of pleural nodules equivalent to that for perifissural nodules per Lung-RADS 1.1 allowed down-classification of 310 nodules: 198 (89.2%) of category 3 nodules and 112 (88.9%) of category 4 pleural nodules to a category 2. None of the newly classified category 2 nodules were associated with malignancy. Only 2 out of total 348 pleural nodules (0.57%) were malignant (both non-benign morphology).*Conclusions This study demonstrates the low malignant potential of pleural nodules measuring 6mm to 10mm when benign in morphology. Extrapolating the current management of perifissural nodules to pleural nodules we estimate that 4.9% of patients would be down-classified to category 2 using Lung-RADS 1.1. This would lead to meaningful reduction of short-term follow-ups and false positive results.*Clinical Relevance/Application Pleural nodules constitute a significant proportion of nodules identified at LCS. Managing such nodules similar to perifissural nodules would help reduce false positive results.

RESULTS

2,813 patients (62±5 years, 1717 men) with 4,408 non-calcified nodules (NCNs) were studied. 1073 nodules measuring 6-10 mm were included. Of these, 348 (32.4%) were pleural. The adoption of a classification scheme of pleural nodules equivalent to that for perifissural nodules per Lung-RADS 1.1 allowed down-classification of 310 nodules: 198 (89.2%) of category 3 nodules and 112 (88.9%) of category 4 pleural nodules to a category 2. None of the newly classified category 2 nodules were associated with malignancy. Only 2 out of total 348 pleural nodules (0.57%) were malignant (both non-benign morphology).

CLINICAL RELEVANCE/APPLICATION

Pleural nodules constitute a significant proportion of nodules identified at LCS. Managing such nodules similar to perifissural nodules would help reduce false positive results.

SSCH08-6   **Might Lung Cancer Screening Mortality Benefits Be Even Greater Than Expected Once More African American/Black Smokers Are Included?**

Participants
Ashley Prosper, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

The National Lung Screening Trial demonstrated a 20% reduction in lung cancer mortality with annual lung cancer screening using low dose CT of the chest (LDCT) as compared to chest radiography. African American/Black (AA/Black) individuals comprised 4.4% of the NLST study population. Recognizing that AA/Black individuals are disproportionately affected by lung cancer, but experienced greater mortality reduction benefits with LDCT screening as compared to White individuals in the NLST, we sought to estimate mortality reduction benefits for synthetic populations with higher proportions of AA/Black individuals.*Methods and Materials Aiming to extrapolate results from the NLST to target populations with varying proportions of AA/Black individuals, a transportability formula was applied in secondary analysis of original NLST data. Transportability allows for extrapolation of treatment effects seen in randomized clinical trials to target populations in which the treatments or interventions are being considered. NLST results were transported to synthetic populations with 1) varying proportions of AA/Black individuals, 2) varying proportions AA/Black and female individuals, 3) varying proportions AA/Black and current smokers. The 95% confidence intervals (CIs) were calculated by repeating the analyses on 200 bootstrapped samples. All statistical analyses were performed with R version 4.0.2.*Results Increasing the proportions of AA/Black individuals in our synthetic populations resulted in greater relative reduction of lung cancer mortality with LDCT screening than seen in the NLST. For example, in a population with 40% AA/Black individuals, relative reduction in lung cancer mortality with LDCT screening increased to 26% (95% CI: 3-42) across the population as compared to 20% in the NLST.*Conclusions Extrapolating results from the NLST to populations with higher proportions of AA/Black individuals suggests that the mortality benefit achievable across a population with LDCT may be greater than that estimated by the NLST.*Clinical Relevance/Application These results emphasize the importance of building equitable and inclusive screening programs.

RESULTS

Increasing the proportions of AA/Black individuals in our synthetic populations resulted in greater relative reduction of lung cancer mortality with LDCT screening than seen in the NLST. For example, in a population with 40% AA/Black individuals, relative reduction in lung cancer mortality with LDCT screening increased to 26% (95% CI: 3-42) across the population as compared to 20% in the NLST.

CLINICAL RELEVANCE/APPLICATION

These results emphasize the importance of building equitable and inclusive screening programs.

Printed on: 06/28/22

SSPD05
Pediatric (Musculoskeletal and Oncology)

Participants
Judy Squires, MD, Pittsburgh, Pennsylvania (*Moderator*) Nothing to Disclose
Arthur B. Meyers, MD, Cincinnati, Ohio (*Moderator*) Author with royalties, Reed Elsevier;Editor with royalties, Reed Elsevier

Sub-Events

SSPD05-3   Physeal Diffusion Tensor Tractography ROI Automation With A 3D Convolutional Neural Network

Participants
Simukayi Mutasa, MD, Newport Beach, California (*Presenter*) Nothing to Disclose

PURPOSE

There is growing research in diffusion tensor imaging (DTI) for providing metrics and images of physeal structure and function, particularly in evaluating children with possible growth disorders. There is a need for a faster automated process to segment the diffusion data, however. We utilized a deep learning algorithm to automatically generate a region of interest (ROI) for use in fully automatic diffusion tensor tractography of cartilage columns in the distal femoral physis.*Methods and Materials Following IRB approval, the authors retrospectively analyzed 80 knee DTI studies from 40 children including 20 neuroblastoma survivors with growth failure and 20 matched controls. Manual binary segmentation of the femoral physis on B0 images was performed on all 80 sequences. Saved volumes were automatically cropped to a 40x24x40 voxel 3-dimensional ROI including the distal femoral physis, femoral condyles, and proximal tibia. A novel, fully connected CNN based on a 3D modification of the U-Net architecture was trained on the output volumes (n=70) to generate segmentation masks of only the distal femoral physis. A holdout set of B0 sequences (n=10) was segregated prior to training to serve as the testing set. Training data augmentation mainly included random rigid affine rotation of the input volumes about the 3 axes and simulated Gaussian noise generation. The segmentation network was trained for 600 epochs. Software code was written in Python v3.6 using the TensorFlow v1.13 module on a Linux workstation with two NVidia Titan X GPUs.*Results The overall mean Dice correlation coefficient was 0.680 with a Matthews Correlation Coefficient of 0.672. Manual extraction and segmentation took 10 minutes per volume and had an interobserver correlation of 0.82, whereas DL segmentation took <1 second per volume and was deterministic, always producing the same result for a given input.*Conclusions Deep learning (DL) techniques can be applied to B0 sequences in DTI examinations in order to generate a deterministic ROI of the distal femoral physis. DL automates physeal mapping, increasing speed, and decreasing variability of tractography.*Clinical Relevance/Application Speeding up the process of tractography estimation can accelerate research in measuring physeal volume change which can illuminate disorders in children's growth and development. Along with guide surgical treatment for adolescence with injuries involving or near the physis.

RESULTS

The overall mean Dice correlation coefficient was 0.680 with a Matthews Correlation Coefficient of 0.672. Manual extraction and segmentation took 10 minutes per volume and had an interobserver correlation of 0.82, whereas DL segmentation took <1 second per volume and was deterministic, always producing the same result for a given input.

CLINICAL RELEVANCE/APPLICATION

Speeding up the process of tractography estimation can accelerate research in measuring physeal volume change which can illuminate disorders in children's growth and development. Along with guide surgical treatment for adolescence with injuries involving or near the physis.

SSPD05-4   Diagnosis Of Bone Marrow Metastases In Children And Young Adults With Solid Tumors:18F-FDG-PET Or DW-MRI?

Participants
Ali Rashidi, MD, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic performance of 18F-labeled fluorodeoxyglucose (18F-FDG) enhanced positron emission tomography (PET) and diffusion-weighted magnetic resonance imaging (DW-MRI) in the diagnosis of bone marrow metastases in children and young adults with solid malignancies.*Methods and Materials In a prospective clinical trial, we performed 64 simultaneous 18F-FDG-PET and DW-MRI scans (with a gadolinium chelate (gadobutrol, Gd) or an iron oxide nanoparticle compound (ferumoxytol)), including 21 baseline and 43 post-chemotherapy scans on twenty-three children and young adults (mean age 16.8 +/- 5.1 years, 16 males, 7 females) with bone marrow metastases. Four reviewers determined the presence or absence of 925 bone marrow metastases on 18F-FDG-PET and DW-MRI and measured the tumor-to-bone marrow contrast on 18F-FDG-PET and DW-MRI by calculating the difference between tumor and bone marrow standardized uptake values (SUV) and signal-to-noise ratios (SNR), respectively. The one-sample Wilcoxon test and Generalized Estimation Equation were used for statistical analysis.*Results At baseline, a high tumor-to-bone marrow contrast was detected in DW-MRI (SNR: 1069.57 +/- 815.45%) and 18F-FDG-PET (SUV: 1258.39 +/- 1325.95%, p=0.539). The sensitivities and specificities were 87.7% and 100%, respectively, for DW-MRI, as well as 95.4%, and 100% for 18F-FDG-PET, (p = 0.206). On post-treatment scans, the lesion-to-bone marrow contrast was higher on DW-MRI (SNR: 794.44 +/- 721.89%) compared to 18F-FDG-PET (SUV: 501.98 +/- 727.36 %; p=0.064). The sensitivities and specificities were 89.7% and

100% respectively, for DW-MRI and 89.1% and 100% for 18F-FDG-PET (p>0.999). Ferumoxytol-enhanced DW-MRI scans had higher diagnostic accuracy compared to Gd-enhanced DW-MRI scans (p=0.002). At both baseline and post-treatment scans, each modality missed lesions while the combination of DW-MRI and 18F-FDG-PET led to significantly higher sensitivities and specificities of 100% Compared to either technique alone (p<0.001).*Conclusions While either 18F-FDG-PET or DW-MRI can miss bone marrow metastases, the combined 18F-FDG-PET and DW-MRI is the most precise modality in the detection of bone marrow metastases in children and young adults.*Clinical Relevance/Application Both DW-MRI and 18F-FDG-PET can miss bone marrow metastases. The combined 18F-FDG-PET and DW-MRI can detect accurately the lesions missed on either modality alone.

RESULTS

At baseline, a high tumor-to-bone marrow contrast was detected in DW-MRI (SNR: 1069.57 +/- 815.45%) and 18F-FDG-PET (SUV: 1258.39 +/- 1325.95%, p=0.539). The sensitivities and specificities were 87.7% and 100%, respectively, for DW-MRI, as well as 95.4%, and 100% for 18F-FDG-PET, (p = 0.206). On post-treatment scans, the lesion-to-bone marrow contrast was higher on DW-MRI (SNR: 794.44 +/- 721.89%) compared to 18F-FDG-PET (SUV: 501.98 +/- 727.36 %; p=0.064). The sensitivities and specificities were 89.7% and 100% respectively, for DW-MRI and 89.1% and 100% for 18F-FDG-PET (p>0.999). Ferumoxytol-enhanced DW-MRI scans had higher diagnostic accuracy compared to Gd-enhanced DW-MRI scans (p=0.002). At both baseline and post-treatment scans, each modality missed lesions while the combination of DW-MRI and 18F-FDG-PET led to significantly higher sensitivities and specificities of 100% Compared to either technique alone (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Both DW-MRI and 18F-FDG-PET can miss bone marrow metastases. The combined 18F-FDG-PET and DW-MRI can detect accurately the lesions missed on either modality alone.

SSPD05-5 Quantitative Magnetic Resonance Imaging Features Characterizing Pediatric Neuroblastic Tumours At Diagnosis

Participants
Andrea S. Doria, MD, Toronto, Ontario (*Presenter*) Research Grant, Shire plc;Research Grant, Novo Nordisk AS;

PURPOSE

Pediatric neuroblastoma is the most common solid tumour in childhood, comprising of malignant and benign types. These neoplasms derive from neural crest cells and arise from the dorsal root ganglion of the spinal cord or the medulla of the adrenal gland. Currently, there are no quantifiable non-invasive predictors of severity of disease, which relies on histopathological findings obtained through biopsy or at surgical diagnosis.The purpose of this study is To determine the relationship between magnetic resonance imaging (MRI) features and severity of neuroblastic tumours at the time of diagnosis. In particular, the study aims to establish the diagnostic accuracy of quantifiable MRI features to differentiate between malignant and benign types.Hypothesis: The hypothesis of this study is that quantifiable magnetic resonance imaging features can accurately predict the histopathology diagnosis.*Methods and Materials The study design is retrospective cross-sectional with the series of cases derived from a single study site (SickKids Hospital in Toronto, Canada) diagnosed between 2008 to 2020. Research Ethics Board approval was granted in accordance with ethical considerations. Inclusion criteria: diagnosis with one of the neuroblastic tumours by histopathology reference standard and diffusion-weighted imaging (DWI) MRI obtained within a month of pathology date. Exclusion criteria: no pathology or in-house DWI. The primary outcome measured was the diagnostic accuracy of two quantifiable MRI features, apparent diffusion coefficient (ADC) from DWI and total tumour volume.*Results Preliminary results indicate that the lower the ADC value, the more likely the neuroblastic tumour is a malignant type (neuroblastoma or ganglioneuroblastoma-nodular). The diagnostic accuracy of ADC, determined by the area under the curve (AUC) was 84%. An ADC cut-off value of 1.08 x 10^3 mm/s (to distinguish malignant from benign neuroblastic tumours) was determined by the peak of the ROC curve (86% sensitivity, 73% specificity).*Conclusions MRI is a non-invasive imaging procedure with no ionizing radiation exposure. Calculation of ADC from DWI does not require contrast and thus can avoid potential contrast issues. ADC derived from DWI-MRI can differentiate malignant from benign neuroblastic tumours with high accuracy. Given the low risks and high accuracy, we recommend that this quantifiable MRI feature be included in the diagnostic assessment of all neuroblastic tumours.*Clinical Relevance/Application This knowledge can help guide clinical decisions such as the need for further testing and treatment.

RESULTS

Preliminary results indicate that the lower the ADC value, the more likely the neuroblastic tumour is a malignant type (neuroblastoma or ganglioneuroblastoma-nodular). The diagnostic accuracy of ADC, determined by the area under the curve (AUC) was 84%. An ADC cut-off value of 1.08 x 10^3 mm/s (to distinguish malignant from benign neuroblastic tumours) was determined by the peak of the ROC curve (86% sensitivity, 73% specificity).

CLINICAL RELEVANCE/APPLICATION

This knowledge can help guide clinical decisions such as the need for further testing and treatment.

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![RSNA 2021 Redefining Radiology, November 28 to December 2]

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Participants

Alice W. Fung, MD, Portland, Oregon (*Moderator*) Nothing to Disclose
Kathryn Fowler, MD, San Diego, California (*Moderator*) Consultant, Bayer AG;Research support, General Electric Company;Research Grant, Pfizer Inc;Institutional Grant, MEDIAN Technologies;Consultant, General Electric Company
Claude Sirlin, MD, San Diego, California (*Moderator*) Research Grant, General Electric Company;Research Grant, Siemens AG;Research Grant, Bayer AG;Research Grant, Gilead Sciences, Inc;Research collaboration, Gilead Sciences, Inc;Research Grant, Koninklijke Philips NV;Research Grant, Pfizer Inc;Consultant, Pfizer Inc;Consultant, Blade Therapeutics, Inc;Consultant, Boehringer Ingelheim GmbH;Consultant, Epigenomics AG;Consultant, IBM Corporation;Consultant, AMRA AB;Consultant, Bristol-Myers Squibb Company;Consultant, Exact Sciences Corporation;Research collaboration, Enanta Pharmaceuticals, Inc;Research collaboration, ICON plc;Research collaboration, Intercept Pharmaceuticals, Inc;Research collaboration, NuSirt Biopharma, Inc;Research collaboration, Shire plc;Research collaboration, Takeda Pharmaceutical Company Limited;Research collaboration, Alexion Pharmaceuticals, Inc;Royalties, Wolters Kluwer nv;Speaker, Medscape, LLC;Stock options, Livivos, Inc;Advisor, Quantix Bio LLC

Sub-Events

SSGI03-2   MRI Features Of HCC Histology Subtypes And Combined HCC-cholangiocarcinoma In American And French Cohort

Participants
Ali Serhal, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the prevalence of hepatocellular carcinoma (HCC) histology subtypes and combined hepatocellular-cholangiocarcinoma (cHCC-CCA) and to look for characteristics imaging features of the subtypes in a North American and European patient population recruited from tertiary centers.*Methods and Materials 120 HCCs and 19 cHCC-CCAs in 116 patients were included in the first subgroup (United States) and 190 HCCs and 44 cHCC-CCAs in 216 patients were included in the second subgroup (France). All patients had preoperative MRI and were classified into different histology subtypes based on surgical pathology. A radiologist scored all lesions on MRI for different parameters including LI-RADS features, type of enhancement, fat, diffusion signal, T2 signal and necrosis. Underlying liver disease and different parameters were compared between both groups.*Results 73 % were male. The most common causes of chronic liver disease were HCV infection (27%), alcohol abuse (18%), HBV (16%), NASH (14%), combined HCV and alcohol abuse (6%). Conventional HCC subtype was by far the most common subtype (56%), followed by combined hepatocellular-cholangiocarcinoma (cHCC-CCA, 14%), macrotrabecular massive (MTM) subtype (15%), steatohepatitic subtype (13%), and lymphoepithelioma like rich subtype (2.9%). Fat in mass was consistently seen more frequently in the steatohepatitic HCCs (70% versus 16%, p<0.01). Substantial necrosis was consistently seen in the MTM HCCs (61% versus 11%, p<0.01). The presence of rim-like enhancement (LR-M) and capsular retraction were more consistent with cHCC-CCAs (65% versus 8% and 31.5% versus 0% respectively, p<0.01). Sarcomatoid and neutrophil rich tumors although uncommon were more often large with necrosis.*Conclusions Our preliminary results suggest that imaging can play a role in differentiating HCC histologic subtypes and cHCC-CCAs with possible prognostic implications. imaging characteristics of the relevant subtypes were similar between the two subgroups, as well as those associated with cHCC-CCAs.*Clinical Relevance/Application Hepatocellular carcinoma can be divided into several distinct histologic subtypes of HCC which have distinct growth and morphological and prognostic implications. We aim to evaluate the imaging features of different subtype.

RESULTS

73 % were male. The most common causes of chronic liver disease were HCV infection (27%), alcohol abuse (18%), HBV (16%), NASH (14%), combined HCV and alcohol abuse (6%). Conventional HCC subtype was by far the most common subtype (56%), followed by combined hepatocellular-cholangiocarcinoma (cHCC-CCA, 14%), macrotrabecular massive (MTM) subtype (15%), steatohepatitic subtype (13%), and lymphoepithelioma like rich subtype (2.9%). Fat in mass was consistently seen more frequently in the steatohepatitic HCCs (70% versus 16%, p<0.01). Substantial necrosis was consistently seen in the MTM HCCs (61% versus 11%, p<0.01). The presence of rim-like enhancement (LR-M) and capsular retraction were more consistent with cHCC-CCAs (65% versus 8% and 31.5% versus 0% respectively, p<0.01). Sarcomatoid and neutrophil rich tumors although uncommon were more often large with necrosis.

CLINICAL RELEVANCE/APPLICATION

Hepatocellular carcinoma can be divided into several distinct histologic subtypes of HCC which have distinct growth and morphological and prognostic implications. We aim to evaluate the imaging features of different subtype.

SSGI03-4   Early Sonographic Features Of Gangrenous Cholecystitis: Mucosal Discontinuity And Echogenic Pericholecystic Fat

Participants
Justin Tse, MD, Cerritos, California (*Presenter*) Research Grant, General Electric Company ;Research Grant, Bayer AG

PURPOSE

To identify early sonographic features of gangrenous cholecystitis.*Methods and Materials 101 patients with acute cholecystitis

To identify early sonographic features of gangrenous cholecystitis.*Methods and Materials 101 patients with acute cholecystitis and a pre-operative sonogram were retrospectively reviewed by 3 radiologists in this IRB-approved and HIPAA-compliant study. Imaging data were correlated with histologic findings and compared using the Fisher's exact test or Student t test with p<0.05 to determine statistical significance.*Results 48 patients had gangrenous cholecystitis and 53 had non-gangrenous acute cholecystitis. Patients with gangrenous cholecystitis tended to be older (67±17 vs 48±18 years; p=0.0001), male (ratio of male:female 2:1 vs 0.6:1; p=0.005), tachycardic (60% vs 28%; p=0.001), and have a history of diabetes mellitus (25% vs 8%; p=0.001). Median time between pre-operative sonogram and surgery was 1 day. On imaging, patients with gangrenous cholecystitis were more likely to have echogenic pericholecystic fat (p=0.001), mucosal discontinuity (p=0.010), and frank perforation (p=0.004), while no statistically significant differences were seen in presence of sloughed mucosa (p=0.104), pericholecystic fluid (p=0.523) or wall striations (p=0.839). In patients with gangrenous cholecystitis and echogenic pericholecystic fat, a smaller subset had concurrent mucosal discontinuity (57%), and a smaller subset of those with mucosal discontinuity also had concurrent frank perforation (58%). The positive likelihood ratios for gangrenous cholecystitis with echogenic fat and mucosal discontinuity were 4.6 (95% confidence interval 1.9-11.3) and 14.4 (2.0-106), respectively. All patients with frank perforation had gangrenous cholecystitis.*Conclusions Among surgical patients presenting with acute cholecystitis, echogenic pericholecystic fat and mucosal discontinuity may be early precursors to frank perforation and were all associated with gangrenous cholecystitis.*Clinical Relevance/Application Echogenic pericholecystic fat and mucosal discontinuity are early sonographic findings that may suggest gangrenous cholecystitis prior to late findings of frank perforation.

RESULTS

48 patients had gangrenous cholecystitis and 53 had non-gangrenous acute cholecystitis. Patients with gangrenous cholecystitis tended to be older (67±17 vs 48±18 years; p=0.0001), male (ratio of male:female 2:1 vs 0.6:1; p=0.005), tachycardic (60% vs 28%; p=0.001), and have a history of diabetes mellitus (25% vs 8%; p=0.001). Median time between pre-operative sonogram and surgery was 1 day. On imaging, patients with gangrenous cholecystitis were more likely to have echogenic pericholecystic fat (p=0.001), mucosal discontinuity (p=0.010), and frank perforation (p=0.004), while no statistically significant differences were seen in presence of sloughed mucosa (p=0.104), pericholecystic fluid (p=0.523) or wall striations (p=0.839). In patients with gangrenous cholecystitis and echogenic pericholecystic fat, a smaller subset had concurrent mucosal discontinuity (57%), and a smaller subset of those with mucosal discontinuity also had concurrent frank perforation (58%). The positive likelihood ratios for gangrenous cholecystitis with echogenic fat and mucosal discontinuity were 4.6 (95% confidence interval 1.9-11.3) and 14.4 (2.0-106), respectively. All patients with frank perforation had gangrenous cholecystitis.

CLINICAL RELEVANCE/APPLICATION

Echogenic pericholecystic fat and mucosal discontinuity are early sonographic findings that may suggest gangrenous cholecystitis prior to late findings of frank perforation.

SSGI03-5 Using Nonparametric Bootstrap Method To Evaluate Normative (Reference) Ranges For Biliary System Measurements In Quantitative MRCP

Participants
Matt Kelly, PhD, Oxford, United Kingdom (*Presenter*) Employee, Perspectum Diagnostics Ltd;Stockholder, Perspectum Diagnostics Ltd

PURPOSE

Currently, ultrasound, endoscopic retrograde and magnetic resonance cholangiopancreatography (ERCP, MRCP) are the most commonly used imaging modalities to assess the biliary system and common bile duct (CBD), however, these qualitative assessments are subjective and lack robust quantitative characterisation. Quantitative MRCP (MRCP+) is a novel method which builds three-dimensional models of the biliary tree and enables measurement of bile duct widths and automatic detection of candidate strictures and dilatations. This study aimed to measure the normative ranges for individual duct-related metrics, tree-level summary metrics and bile duct abnormality related metrics generated from MRCP+ using the non-parametric bootstrap method.*Methods and Materials 20 healthy volunteers underwent 3D heavily T2-weighted MRCP imaging on a Siemens Prisma 3T. The acquired images were then post-processed with MRCP+ and 92 variables were generated, including 34 biliary anatomy related metrics (e.g. biliary tree volume, CBD diameter), and 58 bile duct abnormality related metrics (e.g., the total length of dilated/strictured ducts). The non-parametric bootstrap method [Coskun et al. 2013] was used to increase the sample size before the lower and upper limits of each variable were calculated.*Results Normative ranges for each individual duct metric can be seen in Table 1. A normative range for the median CBD diameter of 3.2 - 5.0 mm was found. This range is comparable to those reported in literature, where upper limits have been shown to range from 5-8 mm. Normative ranges of 2.7 - 6.9 ml and 4.4 - 20.2 ml were obtained for biliary tree volume and gallbladder volume, respectively. The normative range for the total length of the ducts affected by a candidate stricture/dilatation was calculated as 26.0 - 121.0 mm. Due to the common and uncommon anatomic variations present in 42% of the healthy population, the presence of candidate strictures/dilatations can be considered part of the "normal" biliary anatomy and is not representative of disease pathology in healthy volunteers, and the values are typically elevated in the diseased population.*Conclusions The ranges of biliary anatomy related metrics in this study agreed with those previously reported assessment., moreover, it is the first time to report the normative (reference) ranges for whole biliary tree and bile duct abnormality related metrics (e.g. the length of ducts affected by candidate strictures/dilatations) in quantitative MRCP using the non-parametric bootstrap method in a small cohort of healthy volunteers.*Clinical Relevance/Application Normative (reference) ranges for biliary-related variables obtained from MRCP+ have the potential to improve clinical management of patients with biliary diseases.

RESULTS

Normative ranges for each individual duct metric can be seen in Table 1. A normative range for the median CBD diameter of 3.2 - 5.0 mm was found. This range is comparable to those reported in literature, where upper limits have been shown to range from 5-8 mm. Normative ranges of 2.7 - 6.9 ml and 4.4 - 20.2 ml were obtained for biliary tree volume and gallbladder volume, respectively. The normative range for the total length of the ducts affected by a candidate stricture/dilatation was calculated as 26.0 - 121.0 mm. Due to the common and uncommon anatomic variations present in 42% of the healthy population, the presence of candidate strictures/dilatations can be considered part of the "normal" biliary anatomy and is not representative of disease pathology in healthy volunteers, and the values are typically elevated in the diseased population.

CLINICAL RELEVANCE/APPLICATION

Normative (reference) ranges for biliary-related variables obtained from MRCP+ have the potential to improve clinical management of patients with biliary diseases.

SSGI03-6   Participants

Preoperative CT-body Composition In Patients With Perihilar Cholangiocarcinoma - Specific Body Composition Types In Correlation To Perioperative Morbidity And Outcome

Laura Segger, MD, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

As sarcopenic cancer patients appear to have a poor outcome during cancer treatments the aim of this study was to evaluate specific body composition types (sarcopenia, sarcopenic obesity and myosteatosis) in patients with perihilar cholangiocarcinoma (pCC) to evaluate the influence on peri- and postoperative morbidity and outcome.*Methods and Materials In this retrospective study, preoperative CT datasets of 197 patients with pCC, who underwent extended hemihepatectomy were evaluated. Single slice segmentations (lumbar vertebra 3 as landmark) of the psoas muscle, total abdominal muscle mass (TAMA), visceral and subcutaneous adipose tissue were performed. Lumbar skeletal muscle index (LSMI) was calculated by normalizing the TAMA by patients' height and was used to define sarcopenia, and sarcopenic obesity. Myosteatosis was based on the density (HU) of the segmented muscles. These body composition parameters were correlated to postoperative complications and outcome.*Results 61,4% (121/197) of the patients were sarcopenic, 3,6% (7/197) had sarcopenic obesity and 20,8% (41/197) had myosteatosis. Neither sarcopenia nor sarcopenic obesity were independent risk factors for the occurrence of peri- or postoperative complications. However, in patients with sarcopenic obesity the 90-day-survival was significantly decreased (p=0.009). Myosteatosis was associated with a prolonged ICU stay (p=0.014), poorer disease-free survival (p=0.003) and overall survival (p<0.001).*Conclusions Sarcopenia does not increase perioperative morbidity in patients with pCC undergoing extended hemihepatectomy, but sarcopenic obesity is associated with a poorer 90-day-survival. Myosteatosis is linked to prolonged ICU stays and decreased disease-free survival and overall survival.*Clinical Relevance/Application Preoperative staging CT scans are routinely performed in every patient, however body composition is usually neglected. Our study shows the value of identifying certain body composition types to optimize individual risk and outcome assessment, and should encourage their implementation into routine clinical practice.

RESULTS

61,4% (121/197) of the patients were sarcopenic, 3,6% (7/197) had sarcopenic obesity and 20,8% (41/197) had myosteatosis. Neither sarcopenia nor sarcopenic obesity were independent risk factors for the occurrence of peri- or postoperative complications. However, in patients with sarcopenic obesity the 90-day-survival was significantly decreased (p=0.009). Myosteatosis was associated with a prolonged ICU stay (p=0.014), poorer disease-free survival (p=0.003) and overall survival (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Preoperative staging CT scans are routinely performed in every patient, however body composition is usually neglected. Our study shows the value of identifying certain body composition types to optimize individual risk and outcome assessment, and should encourage their implementation into routine clinical practice.

Abstract Archives of the RSNA, 2021

Participants
Ingrid Reiser, PhD, Chicago, Illinois (*Moderator*) Nothing to Disclose
Heang-Ping Chan, PhD, Ann Arbor, Michigan (*Moderator*) Institutional Research Grant, General Electric Company

Sub-Events

SSPH02-2   The Potential Benefits Of Pre-training In AI Algorithm Development For COVID-19 Classification Models Using Chest X-ray Images

Participants
Xin Tie, BS, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

Development of artificially intelligent (AI) classification algorithms for COVID-19 patient stratification is of great clinical significance. Due to the fast-growing nature of the pandemic and the difficulty in sharing medical data, models are often trained from small datasets. The purpose of this work was to study the benefit of pre-training in this setting.*Methods and Materials A binary classification model was developed to differentiate high risk COVID-19 cases from non-COVID-19 patients using chest x-ray radiographs (CXR). Three datasets were used for model development: an NIH (CXR) dataset curated in the pre-COVID era, a COVID dataset from the Henry Ford Health System, and a COVID-19 dataset curated and made publicly available in Spain (BIMCV). To investigate the potential benefits of pre-training for AI model development, we studied its impact in the following two different scenarios: 1) Development of a site-specific model from scratch for the Henry Ford dataset and 2) transfer learning from the Henry Ford model from 1) to the Spain data set with varying amounts of training data sizes (from 200 patients to 4,938 patients). The performance of the model was quantified by the area under the receiver operating characteristics curve (AUC).*Results 1) Using the NIH dataset for pre-training, the AUC of the Henry Ford site-specific model on both the internal test sets and external test sets were significantly improved (>0.04), when compared to the model without pre-training. 2) In transfer learning from the Henry Ford model to the Spain model, with pre-training using the Henry Ford dataset, AUC improved by 0.01 to 0.03 for the varying training dataset from the Spain dataset. All the reported performance improvements were statistically significant.*Conclusions Pre-training using a publicly available NIH chest x-ray image dataset or a COVID data set from another site improves the performance of the classification model under the two different scenarios studied.*Clinical Relevance/Application The results reported in this study shed new light on AI model development and clinical deployment from one site to another by transfer learning.

RESULTS

1) Using the NIH dataset for pre-training, the AUC of the Henry Ford site-specific model on both the internal test sets and external test sets were significantly improved (>0.04), when compared to the model without pre-training. 2) In transfer learning from the Henry Ford model to the Spain model, with pre-training using the Henry Ford dataset, AUC improved by 0.01 to 0.03 for the varying training dataset from the Spain dataset. All the reported performance improvements were statistically significant.

CLINICAL RELEVANCE/APPLICATION

The results reported in this study shed new light on AI model development and clinical deployment from one site to another by transfer learning.

SSPH02-5   Fully Automated Artifact Reduction Method For Time-resolved Cone-beam CT Angiography

Participants
Chengzhu Zhang, BS, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

Cone-beam CT angiography (CBCTA) acquired in the angiography suite often presents mis-registration artifacts due to patient motion and gantry instability. In this work, an automated machine learning method was developed to effectively eliminate artifacts in time-resolved CBCTA for image guidance in angiography suites.*Methods and Materials In the developed method, image voxels in initially acquired time-resolved CBCTA image volumes are classified into four clusters using a K-means clustering algorithm. For each cluster, a pre-trained deep learning model was used to score each cluster as artifacts or vessels. If the score is higher than 0.5, the cluster is considered to be a vessel, otherwise it is considered an artifact. This process of clustering-classifying is iteratively proceeded until the stopping criterion is satisfied. This fully automated algorithm was tested on a clinical cohort of 55 time-resolved CBCTA exams. Among them, 5 clinical cases were used for the training of the deep classifier. The remaining 50 clinical cases were used to test the performance. There are 14 cases with few artifacts, 15 cases with moderate artifacts, and 21 cases with severe artifacts. Time-to-arrival (TOA) color maps were used to visualize the result (warm color indicates earlier enhancement). To quantify artifact reduction level, a metric of image sparsity defined by the percentage of non-zero voxels was used.*Results 1) Significant artifact reduction has been achieved for all 50 clinical cases in the test cohort regardless of their initial artifact levels. 2) After artifact reduction, the visualization of TOA maps clearly shows different contrast enhancement phases of vessels with image sparsity of 5.1±3.4%, meaning >90% 'artifact' voxels are removed.*Conclusions The automated artifact reduction machine learning algorithm can effectively eliminate most of the mis-registration artifacts in time-resolved CBCTA.*Clinical Relevance/Application With artifact reduction using the developed fully automated method, time-resolved CBCTA image quality is

significantly improved for clinical uses in image-guided interventions.

RESULTS

1) Significant artifact reduction has been achieved for all 50 clinical cases in the test cohort regardless of their initial artifact levels. 2) After artifact reduction, the visualization of TOA maps clearly shows different contrast enhancement phases of vessels with image sparsity of 5.1±3.4%, meaning >90% 'artifact' voxels are removed.

CLINICAL RELEVANCE/APPLICATION

With artifact reduction using the developed fully automated method, time-resolved CBCTA image quality is significantly improved for clinical uses in image-guided interventions.

SSPH02-6   Accurate And Reliable Liver Steatosis Assessment From Conventional Ultrasound Images Trained With Subjective Ratings

Participants
Bowen Li, Bethesda, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Conventional ultrasound (US) is the frontline screening modality for liver steatosis. However, US-based diagnoses suffer from low intra- and inter-rater consistency. Other modalities, e.g., FibroScan, can provide quantitative measurements but their availability is limited. Computer-aided diagnosis (CAD) models applied directly to US could provide a quantitative assessment. But, training on subjective US diagnosis datasets, the only viable source of large-scale data, will expose them to contradictory label noise and biases. To address this challenge, we introduce auto-decoded deep latent embeddings (ADDLE).*Methods and Materials We retrospectively collected conventional US images from 3,405 patients, 32,188 studies, and 275,291 images. Images from 16 types of US scanners were used. Patients with hepatitis B (34.2%), hepatitis C (41.7%), nonalcoholic steatohepatitis (12.3%) and other diseases (11.8%) were all included. US diagnoses were produced by 65 different raters over the course of their clinical work. ADDLE explicitly models the tendencies of each rater, does not expect multiple raters per image in training, and does not increase in complexity as more raters are added. We use the ResNet18 deep learning model as the ADDLE backbone and train it to predict liver steatosis severity (as healthy, mild, moderate, or severe). Images from 4 liver viewpoints were used (left liver lobe, right liver lobe, liver-kidney contrast, and subcostal), and the final predictions correspond to the average across viewpoints. A dataset with 148 patients with gold standard histopathology fatty percentage served as the evaluation cohort.*Results High diagnostic performance was observed: area under the curve (AUC) of the ROC curve to classify greater or equal to mild steatosis, greater or equal to moderate steatosis, and equal to severe steatosis grades were 0.957, 0.931, and 0.899, respectively. The partial AUC (AUCp) for diagnosing severe steatosis was over 10% better than standard ResNet18, where we only consider the region with false positive rate<0.30. ADDLE also outperformed several competitor label-denoising methods and FibroScan.*Conclusions We proposed ADDLE to model the tendencies of subjective raters in a large-scale US steatosis dataset. Reported AUROCs were high and outperformed FibroScan.*Clinical Relevance/Application Our CAD system can provide an objective liver steatosis assessment to complement other important clinical biomarkers and factors. This can add additional support for accessible clinical decision making.

RESULTS

High diagnostic performance was observed: area under the curve (AUC) of the ROC curve to classify greater or equal to mild steatosis, greater or equal to moderate steatosis, and equal to severe steatosis grades were 0.957, 0.931, and 0.899, respectively. The partial AUC (AUCp) for diagnosing severe steatosis was over 10% better than standard ResNet18, where we only consider the region with false positive rate<0.30. ADDLE also outperformed several competitor label-denoising methods and FibroScan.

CLINICAL RELEVANCE/APPLICATION

Our CAD system can provide an objective liver steatosis assessment to complement other important clinical biomarkers and factors. This can add additional support for accessible clinical decision making.

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SSHN01

Head and Neck (Thyroid/Parathyroid)

Participants
C. Douglas Phillips, MD, New York, New York (*Moderator*) Nothing to Disclose

Sub-Events

SSHN01-1   Combined Machine Learning And Resting-state FMRI Reveals Aberrant Static And Dynamic Interhemispheric Functional Connectivity In Patients With Thyroid-associated Ophthalmopathy

Participants
Qian Wu, Nanjing, China (*Presenter*) Nothing to Disclose

PURPOSE

Thyroid-associated ophthalmopathy (TAO) is a debilitating and sight-threatening autoimmune orbital disease that severely impairs patients' quality of life. Besides the most common ophthalmic manifestations, the emotional and psychiatric disturbances are also usually observed in clinical settings. This study was to investigate the interhemispheric functional connectivity alterations in TAO patients using resting-state functional magnetic resonance imaging (rs-fMRI).*Methods and Materials Twenty-eight TAO patients and 22 healthy controls (HCs) underwent rs-fMRI scans. Static and dynamic voxel-mirrored homotopic connectivity (VMHC) values were calculated and compared between the two groups. A linear support vector machine (SVM) classifier was used to examine the performance of static and dynamic VMHC differences in distinguishing TAOs from HCs.*Results Compared with HCs, TAOs showed decreased static VMHC in lingual gyrus (LG)/calcarine (CAL), middle occipital gyrus, postcentral gyrus, superior parietal lobule, inferior parietal lobule and precuneus. Meanwhile, TAOs demonstrated increased dynamic VMHC in orbitofrontal cortex (OFC). In TAOs, static VMHC in LG/CAL was positively correlated with visual acuity ($r = 0.412$, $P = 0.036$), whilst dynamic VMHC in OFC was positively correlated with HARS score ($r = 0.397$, $P = 0.044$) and HDRS score ($r = 0.401$, $P = 0.042$). The SVM model showed good performance in distinguishing TAOs from HCs (area under the curve, 0.971; average accuracy, 94%).*Conclusions TAO patients had altered static and dynamic VMHC in the occipital, parietal and orbitofrontal areas, which could serve as personalized neuroimaging prediction markers of TAO.*Clinical Relevance/Application This study provided novel insights into brain function abnormalities in TAO patients, and indicated that neuropsychological aspect of the disease should be noticed in clinical diagnosis and treatment.

RESULTS

Compared with HCs, TAOs showed decreased static VMHC in lingual gyrus (LG)/calcarine (CAL), middle occipital gyrus, postcentral gyrus, superior parietal lobule, inferior parietal lobule and precuneus. Meanwhile, TAOs demonstrated increased dynamic VMHC in orbitofrontal cortex (OFC). In TAOs, static VMHC in LG/CAL was positively correlated with visual acuity ($r = 0.412$, $P = 0.036$), whilst dynamic VMHC in OFC was positively correlated with HARS score ($r = 0.397$, $P = 0.044$) and HDRS score ($r = 0.401$, $P = 0.042$). The SVM model showed good performance in distinguishing TAOs from HCs (area under the curve, 0.971; average accuracy, 94%).

CLINICAL RELEVANCE/APPLICATION

This study provided novel insights into brain function abnormalities in TAO patients, and indicated that neuropsychological aspect of the disease should be noticed in clinical diagnosis and treatment.

SSHN01-2   Papillary Thyroid Cancer At Dual-energy CT: Iodine Maps Based Radiomics To Predict Extrathyroidal Extension And Recurrence

Participants
Qian Wu, Nanjing, China (*Presenter*) Nothing to Disclose

PURPOSE

To conduct iodine maps based radiomics to predict extrathyroidal extension (ETE) and to explore its prognostic value for recurrence-free survival (RFS) in papillary thyroid cancer (PTC).*Methods and Materials Total 452 PTC patients between June 2017 and June 2020 were retrospectively recruited. Radiomics features were extracted from non-contrast images, dual-phase mixed images and iodine maps, respectively. Random forest (RF) and least absolute shrinkage and selection operator (LASSO) were applied to build six rad-scores (non-contrast rad-score_RF; non-contrast rad-score_Lasso; mixed rad-score_RF; mixed rad-score_Lasso; iodine rad-score_RF; iodine rad-score_Lasso) respectively. Logistic regression was used to construct six radiomics models incorporating six rad-scores with clinical risk factors, and compared with clinical model alone. A Radiomics model that achieved highest performance was presented as a nomogram. Nomogram performance was determined by discrimination, calibration, clinical usefulness and prognosis evaluation.*Results Iodine rad-scores performed significantly better than mixed rad-scores no matter RF or LASSO used. Both of them outperformed non-contrast rad-scores. Iodine maps based radiomics models significantly surpassed clinical model. A radiomics nomogram incorporating size, capsule contact and iodine rad-score_RF was built with highest performance (training set, AUC = 0.784; validation set, AUC = 0.835). Stratified analysis confirmed the nomogram stability, especially in CT-reported ETE negative group (AUC = 0.692). Nomogram-predicted ETE risk was an independent preoperative predictor for RFS. High risk for ETE portended significantly lower RFS than that for low risk ($p < 0.001$).*Conclusions Iodine maps based radiomics might be a supporting tool for predicting ETE and subsequent recurrence risk in PTC patients, thus facilitate clinical decision making.*Clinical Relevance/Application Although PTC has a favorable prognosis, it is prone to local-regional recurrence. ETE

has been considered as an adverse prognostic factor for recurrence for PTC. Conventional imaging (US and CT) and clinical risk factors are insufficient in diagnosing or predicting ETE. Our study conducted radiomics analysis of iodine maps and compared it with the performance of conventional CT (mixed images) and a clinical model. We found radiomics of iodine maps performed significantly better than that of conventional CT images. An iodine maps based radiomics nomogram significantly surpassed the clinical model in predicting ETE and subsequent recurrence risk. The nomogram can help accurate prediction of ETE and prognosis for PTC patients, thus determine individualized treatment plans and reduce recurrence.

RESULTS

Iodine rad-scores performed significantly better than mixed rad-scores no matter RF or LASSO used. Both of them outperformed non-contrast rad-scores. Iodine maps based radiomics models significantly surpassed clinical model. A radiomics nomogram incorporating size, capsule contact and iodine rad-score_RF was built with highest performance (training set, AUC = 0.784; validation set, AUC = 0.835). Stratified analysis confirmed the nomogram stability, especially in CT-reported ETE negative group (AUC = 0.692). Nomogram-predicted ETE risk was an independent preoperative predictor for RFS. High risk for ETE portended significantly lower RFS than that for low risk (p < 0.001).

CLINICAL RELEVANCE/APPLICATION

Although PTC has a favorable prognosis, it is prone to local-regional recurrence. ETE has been considered as an adverse prognostic factor for recurrence for PTC. Conventional imaging (US and CT) and clinical risk factors are insufficient in diagnosing or predicting ETE. Our study conducted radiomics analysis of iodine maps and compared it with the performance of conventional CT (mixed images) and a clinical model. We found radiomics of iodine maps performed significantly better than that of conventional CT images. An iodine maps based radiomics nomogram significantly surpassed the clinical model in predicting ETE and subsequent recurrence risk. The nomogram can help accurate prediction of ETE and prognosis for PTC patients, thus determine individualized treatment plans and reduce recurrence.

SSHN01-6   Could Parathyroid Gland Assessment On Routine CT Prevent Morbidity From Undiagnosed Primary Hyperparathyroidism?

Participants
Christopher Nguyen, Winston Salem, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

Primary hyperparathyroidism (PHPT) conveys substantial patient morbidity and healthcare costs. Diagnosis often lags years behind initial disease manifestations. Failure to recognize PHPT delays curative therapy, and disease duration correlates with end-organ damage.We hypothesize that assessment for enlarged parathyroids on routine imaging (e.g., neck CT, chest CT) could facilitate earlier diagnosis of unrecognized PHPT. Our purposes are to determine visibility of abnormal parathyroid glands on routine contrast-enhanced CT (CECT) acquired prior to PHPT diagnosis and assess associated, potentially preventable PHPT-related morbidity.*Methods and Materials This single institution, retrospective study included patients undergoing parathyroidectomy for PHPT from 10/2015 to 10/2020 with at least one CECT prior to PHPT diagnosis.A neuroradiologist reviewed prior CECTs for enlarged parathyroid glands (estimated weight >60 mg using 0.63 mg/mm3 x L (mm) x W (mm) x H (mm)), blinded to subsequent localization imaging and operative reports. Enlarged glands were marked in PACS. A parathyroid surgeon then reviewed operative notes and pathology reports to determine whether the marked glands corresponded to pathologically-proven parathyroid lesions.PHPT-related comorbidities, including renal (kidney stones and declining renal function), bone (fragility fractures and declining bone density), and neurocognitive (memory loss and depression) manifestations were abstracted from the electronic medical record.*Results The final cohort included 39 patients with PHPT and a prior CECT (8 male, 31 female, median age 66 years).Enlarged glands were identified on prior CECT in 29 (74%), and these CECTs predated screening for PHPT by an average of 3.25 years. Marked glands corresponded to proven parathyroid lesions in 26 (90%), but clinical evidence of residual parathyroid disease remained in the 3 for whom marked glands were not removed.Of the 29 with enlarged glands on prior CECT, 13 (45%) developed at least 1 new PHPT-related renal (21%), bone (17%) or neurocognitive (17%) comorbidity in the interval between the CECT and first screening for PHPT. Most also complained of the common PHPT symptoms fatigue (79%) and weakness (52%).*Conclusions Enlarged parathyroid glands are frequently visible on routine CECTs acquired years prior to PHPT diagnosis. Screening for PHPT on the basis of enlarged glands could potentially prevent associated complications in almost half of such patients.*Clinical Relevance/Application By routinely assessing for enlarged parathyroid glands, radiologists may identify patients who would benefit from PHPT screening, which may decrease PHPT-associated morbidity and costs through earlier curative intervention.

RESULTS

The final cohort included 39 patients with PHPT and a prior CECT (8 male, 31 female, median age 66 years).Enlarged glands were identified on prior CECT in 29 (74%), and these CECTs predated screening for PHPT by an average of 3.25 years. Marked glands corresponded to proven parathyroid lesions in 26 (90%), but clinical evidence of residual parathyroid disease remained in the 3 for whom marked glands were not removed.Of the 29 with enlarged glands on prior CECT, 13 (45%) developed at least 1 new PHPT-related renal (21%), bone (17%) or neurocognitive (17%) comorbidity in the interval between the CECT and first screening for PHPT. Most also complained of the common PHPT symptoms fatigue (79%) and weakness (52%).

CLINICAL RELEVANCE/APPLICATION

By routinely assessing for enlarged parathyroid glands, radiologists may identify patients who would benefit from PHPT screening, which may decrease PHPT-associated morbidity and costs through earlier curative intervention.

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Participants

Victoria Mango, MD, Maplewood, New Jersey (*Moderator*) Consultant, Bayer AG;Research Grant, Pfizer Inc;

Sub-Events

SSBR02   Keynote Speaker

Participants
Sarah J. Vinnicombe, FRCR,MRCP, Cheltenham, United Kingdom (*Presenter*) Consultant for Advisory Board, Bayer

SSBR02-3   Radiomic Features On Breast MRI Predict Upgrade Of DCIS Lesions To Invasive Breast Cancer

Participants
Dana Ataya, MD, Tampa, Florida (*Presenter*) Nothing to Disclose

PURPOSE

Identification of the subset of ductal carcinoma in-situ (DCIS) lesions diagnosed on core biopsy which will be upgraded to invasive breast cancer on excision would impact clinical and surgical management of patients. Using dynamic contrast-enhanced (DCE) breast MRI in patients imaged prior to excision, DCIS lesion voxels with similar DCE characteristics may be segmented into sub-regions (habitats) to quantify lesion heterogeneity. In this study, we investigated whether intralesional and peri-lesional heterogeneity quantified on DCE-MRI predicted DCIS upgrade to invasive malignancy.*Methods and Materials 76 DCIS lesions in 74 women were divided into training (43) and validation (33) cohorts. DCIS lesions were segmented by two radiologists on pre-operative DCE-MRI. Four perfusion parameters were used to generate voxel multi-parametric maps: wash-in (WIS) and washout (WOS) slopes, percentage enhancement (PE), and signal enhancement ratio (SER). Consensus clustering and superpixel maps divided each tumor into low, moderate, and high perfusion habitats. A fourth habitat included the breast parenchyma in two 3-mm concentric rings bordering the DCIS lesion. For each DCIS lesion, a 4x4 multiregional spatial interaction matrix produced 22 features. A network-based strategy explored feature similarities. A spectral clustering algorithm stratified two groups of high and low DCIS risk. A machine learning model clustered multiparametric maps in the validation set into tumor habitats. A semi-supervised label propagation algorithm tested the ability of the model to predict upgrade of DCIS lesions to invasive malignancy. The Pearson correlation coefficient, Wilcoxon signed-rank test, and a least absolute shrinkage and selection operator (LASSO) multivariable logistic regression method were used to analyze the data.*Results Patient age, DCIS lesion size, ER positivity, and grade were similar between the cohorts. The frequency of upgrade was similar in both cohorts (16.3% training; 18.2% validation). Distributions of the four perfusion parameters in each subregion and within both cohorts were examined. When whole-tumor and surrounding rings (WT+Ring) were investigated, the model predicted upgrade to invasive malignancy with 86% accuracy in training and 79% in the validation cohort. Subregion 2 significantly predicted upgrade in training [AUC: 0.74] and validation [AUC: 0.72] (p=0.0317).*Conclusions Intratumoral perfusion heterogeneity on dynamic contrast enhanced breast MRI shows promise in stratifying DCIS lesions at low-risk and high-risk of upgrade to invasive malignancy.*Clinical Relevance/Application Radiomic features on DCE-MRI can assist in stratifying DCIS lesions, impacting clinical and surgical management of patients.

RESULTS

Patient age, DCIS lesion size, ER positivity, and grade were similar between the cohorts. The frequency of upgrade was similar in both cohorts (16.3% training; 18.2% validation). Distributions of the four perfusion parameters in each subregion and within both cohorts were examined. When whole-tumor and surrounding rings (WT+Ring) were investigated, the model predicted upgrade to invasive malignancy with 86% accuracy in training and 79% in the validation cohort. Subregion 2 significantly predicted upgrade in training [AUC: 0.74] and validation [AUC: 0.72] (p=0.0317).

CLINICAL RELEVANCE/APPLICATION

Radiomic features on DCE-MRI can assist in stratifying DCIS lesions, impacting clinical and surgical management of patients.

SSBR02-5   Abbreviation Of Breast MRI In A Real-world Scenario: How Relevant Is An Abbreviation Of The Imaging Protocol?

Participants
Philipp Stelzer, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

Magnetic resonance mammography (MRM) is the most sensitive test for detection of breast cancer. As a way to increase patient throughput, MRM protocols are increasingly abbreviated, thereby saving table time (TT). Currently, there is no consensus on what "abbreviated" MRM is and approaches vary. However, the number of patients that can be examined per MRI unit in a given time also critically depends on the table switching time (TST) between patients. This institutional audit aimed to collect breast MRI measurement times in different clinical scenarios.*Methods and Materials The IRB waived the necessity for informed consent for this institutional audit. Data collection was performed without informing the operating personnel about the audit to avoid bias. Data collection included the TT and TST of consecutive examinations in a large tertiary care center (n=49) and an out-patient radiology

center (n=30). We also calculated virtual TT based on the data from our institution for two further abbreviated protocols (T2 + T1 native + early post-contrast and T1 native + early post-contrast only). TST, TT, switch-imaging-ratio (TST/TT) and relative switching time (TST/(TST+TT)) are presented as Median with IQR, statistic testing was done using Mann-Whitney-U-Test with an alpha of 0.05 to indicate significance.*Results TST ranged between 3,67-23,67 minutes in the out-patient center and 1,72-28,72 minutes in the tertiary care center. There was no significant difference in median TST between the tertiary care center (5,5 min; IQR 5,1-7,0) and out-patient exams (5,7 min., IQR 4,7-7,7) (p = 0,68). Median TT was significantly (p < 0,001) shorter in the out-patient setting (10,2 min, IQR 10,1-11,2) than at tertiary care center (13,3 min, IQR 12,3-13,3). Switching-imaging ratio and relative switching time were significantly lower in the tertiary care setting (0,43 vs. 0,58 min, p < 0,002 and 0,32 vs. 0,37, p < 0,002). The simulated switching-imaging ratio of the two abbreviated protocols was 0,63 (0,58-0,79) for T2 with T1 pre- and post-contrast and 0,83 (0,76-1,03) for T1 pre- and post-contrast only.*Conclusions TST significantly contribute to total examination time and challenge the use of protocol abbreviation. A reduction of this workflow-related parameter, e.g. by employing a dedicated radiotechnician for patient preparation, could provide a viable strategy to increase MRM capacity and cost-efficacy.*Clinical Relevance/Application We identified TST as an important parameter in the MRM workflow. To improve patient throughput in clinical practice, improvements should rather focus on this organizational problem rather than omitting diagnostically useful image acquisition.

RESULTS

TST ranged between 3,67-23,67 minutes in the out-patient center and 1,72-28,72 minutes in the tertiary care center. There was no significant difference in median TST between the tertiary care center (5,5 min; IQR 5,1-7,0) and out-patient exams (5,7 min., IQR 4,7-7,7) (p = 0,68). Median TT was significantly (p < 0,001) shorter in the out-patient setting (10,2 min, IQR 10,1-11,2) than at tertiary care center (13,3 min, IQR 12,3-13,3). Switching-imaging ratio and relative switching time were significantly lower in the tertiary care setting (0,43 vs. 0,58 min, p < 0,002 and 0,32 vs. 0,37, p < 0,002). The simulated switching-imaging ratio of the two abbreviated protocols was 0,63 (0,58-0,79) for T2 with T1 pre- and post-contrast and 0,83 (0,76-1,03) for T1 pre- and post-contrast only.

CLINICAL RELEVANCE/APPLICATION

We identified TST as an important parameter in the MRM workflow. To improve patient throughput in clinical practice, improvements should rather focus on this organizational problem rather than omitting diagnostically useful image acquisition.

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Participants

Paul Yi, MD, Baltimore, Maryland (*Moderator*) Consultant, FH Orthopedics SAS;Consultant, BunkerHill Health
Dania Daye, MD, PhD, Medford, Massachusetts (*Moderator*) Research Consultant, Sigilon Therapeutics;Research Consultant, Medtronic plc

Sub-Events

SSIN04-2 Improving Automated Clinical Decision Making By Allowing Machine-learning Models To Say "I Don't Know": Balancing Performance Against Abstention

Participants
Philipp Wesp, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To transform a machine-learning classification task into a trade-off problem where the model has the ability to say "I don't know", by abstaining from predictions based on output scores and thereby increase classification performance for the remaining cases. We propose to extend the classification threshold to a window and to exclude cases with scores inside the window from classification ("abstention"). We hypothesize increased classification performance at the cost of abstention and explore this in a cancer screening setting.*Methods and Materials The trade-off between increased performance and abstention was explored by evaluating a machine-learning model from a previously reported radiomics study. In this study, a radiomics approach differentiated benign (hyperplastic polyp or regular mucosa) and premalignant (adenoma) colorectal polyps of all size categories and morphologies detected with CT colonography in an asymptomatic screening population. Two independent parameters, threshold position and window width, controlled the trade-off and different threshold-window combinations were explored. Performance was evaluated with Youden's index (=sensitivity+specificity-1), which combined sensitivity and specificity into a single metric.*Results Baseline Youden's index (threshold = 0.5, window = 0.0) for model predictions in 118 exemplifying cases without abstaining from decisions was 0.67 (sensitivity = 82%, specificity = 85%). For different threshold-window combinations (threshold range = 0.0 to 1.0, window range = 0.0 to 0.5), Youden's index was improved by 0.06 per 10% additional abstention on average. Youden's index reached a maximum of 0.96 (sensitivity = 96%, specificity = 100%) at the cost of abstaining from 57/118 (48%) decisions for a threshold of 0.46 and a window of 0.39.*Conclusions The demonstrated trade-off used machine-learning model output scores to abstain from making decisions in uncertain cases. Classification performance for the remaining samples increased with higher abstention rates. Abstention might highlight difficult cases which require particular investigation and could serve as a practical approach for radiologists to improve the quality of automated clinical decision making.*Clinical Relevance/Application Automated clinical decisions require high confidence, which is not guaranteed for all cases. Abstaining from decisions in uncertain cases may boost classification performance for the remaining cases.

RESULTS

Baseline Youden's index (threshold = 0.5, window = 0.0) for model predictions in 118 exemplifying cases without abstaining from decisions was 0.67 (sensitivity = 82%, specificity = 85%). For different threshold-window combinations (threshold range = 0.0 to 1.0, window range = 0.0 to 0.5), Youden's index was improved by 0.06 per 10% additional abstention on average. Youden's index reached a maximum of 0.96 (sensitivity = 96%, specificity = 100%) at the cost of abstaining from 57/118 (48%) decisions for a threshold of 0.46 and a window of 0.39.

CLINICAL RELEVANCE/APPLICATION

Automated clinical decisions require high confidence, which is not guaranteed for all cases. Abstaining from decisions in uncertain cases may boost classification performance for the remaining cases.

SSIN04-4 Decompose And Blend: Collaborative Utilization Of Gan-based Anomaly Detection And Supervised Learning In Chest Radiograph

Participants
Yisak Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Generative adversarial network (GAN)-based anomaly detection (AD) is considered to be a decent way to identify abnormal chest radiograph (CXR) classes that were not in the training data, since it only needs normal CXRs in training. However, it shows relatively lower performance than supervised learning since the final decision is commonly made by simply summing up the number of pixels of the anomaly area. Here, we propose an alternative way to collaboratively use robustness of AD and excellent performance of supervised learning; decomposing the anomaly region from CXR to distillate the knowledge of AD model and blending them again to train supervised learning model.*Methods and Materials A total of 56,596 and 40,533 CXRs with normal and abnormal findings (pulmonary nodules, tuberculosis, pneumonia, or pneumothorax) collected from single center were used to develop the algorithm, respectively. From here, 4,000 CXRs (2,000 normal, 2,000 abnormal) were randomly selected for internal validation. External validation was performed using two different datasets, 200 temporally independent CXRs (97 normal, 103 abnormal) reviewed by five radiologists and a public dataset that named CheXpert, consists of a total of 202 CXRs (26 normal, 176 abnormal) reviewed by

three radiologists. Fixed-Points-GAN, an AD model, was implemented to decompose anomaly by calculating residue map between original CXR and synthesized normal image, and then alpha-blending residue map and original CXR to generate blended image. We compared three different methods to classify abnormal CXRs; a) comparing the number of pixels in the residue maps as a traditional AD method, using supervised learning(Densenet121) trained with original CXRs and c) blended images, respectively.*Results The proposed method of using blended images showed significant improvements of areas under the receiver operating characteristics curve (AUROC) in all three validation sets: internal, temporally independent, and CheXpert (0.926 to 0.987, 0.907 to 0.965, 0.802 to 0.898; all p < .001). The performances of the proposed method and method using original CXRs showed no significant difference in internal validation (AUROC 0.987 for both). The proposed method showed significantly higher AUROC than the method using original CXRs in temporally independent CXRs and CheXpert (0.954 to 0.965, 0.881 to 0.898; all p < .05).*Conclusions Using blended image of original CXR and residue map in training supervised model may retain both the robustness of AD for the unseen abnormal classes and the excellent performance of the supervised learning.*Clinical Relevance/Application Using decomposed anomaly-related information may improve robustness of deep learning based automated system identifying abnormal findings in CXR.

RESULTS

The proposed method of using blended images showed significant improvements of areas under the receiver operating characteristics curve (AUROC) in all three validation sets: internal, temporally independent, and CheXpert (0.926 to 0.987, 0.907 to 0.965, 0.802 to 0.898; all p < .001). The performances of the proposed method and method using original CXRs showed no significant difference in internal validation (AUROC 0.987 for both). The proposed method showed significantly higher AUROC than the method using original CXRs in temporally independent CXRs and CheXpert (0.954 to 0.965, 0.881 to 0.898; all p < .05).

CLINICAL RELEVANCE/APPLICATION

Using decomposed anomaly-related information may improve robustness of deep learning based automated system identifying abnormal findings in CXR.

SSIN04-5   Improved Reader Design To Circumvent Bias In Artificial Intelligence Model Testing

Participants
Tara Retson, MD,PhD, San Diego, California (*Presenter*) Research writing, CureMetrix Inc

PURPOSE

Reader studies can be designed with biased test sets of "easy" rather than difficult cases, thereby falsely bolstering results with a given artificial intelligence (AI) algorithm. Also, many AI algorithms may be of greatest clinical benefit for difficult cases that are not obvious to all readers. Reader studies should include a measurable number of difficult exams to truly evaluate their potential impact in practice. We present an AI-based study design that yields greater statistical significance and a better proxy for clinical performance through creation of challenging test sets.*Methods and Materials A clinical reader study test set method was developed to incorporate difficult cases rather than only cases with high consensus or single reviewer validated. The aim was to include sufficient numbers of cases at varying levels of difficulty to ensure statistical significance. Image difficulty level is measured based on the number of readers in consensus, where the difficulty level increases as the reader consensus decreases. For example, a cancer case missed by the majority of readers is more difficult than a case where all readers identify the lesion. We illustrate this study design using the example of a mammography algorithm (cmDensity, CureMetrix, Inc, La Jolla, CA) using 7 readers and a set of 928 digital mammograms.*Results The test set was proven as high difficulty, as shown by the large number of cases that were not full reader consensus. As expected, the density algorithm showed higher agreement with the readers as reader consensus increased; from 4/7 to 7/ 7 reader consensus, with kappa = 0.65,0.82,0.94,0.97 respectively. Reader study results showed statistical significance in algorithm benefit across the spectrum of difficulty levels, especially for the high difficulty cases.*Conclusions The reported efficacy of an AI model is highly dependent on the choice of test data. AI models should include testing on difficult cases,which circumvents reporting of false high agreement results. Through this AI-based creation of measurable difficulty bins within a test set, a better sense of range in "real world" algorithm performance is provided.*Clinical Relevance/Application Through improved study design with more challenging cases, AI algorithm reader studies are better assessed and compared. The "shades of gray" of clinical reality can and should be incorporated and quantified in study design for AI reader studies.

RESULTS

The test set was proven as high difficulty, as shown by the large number of cases that were not full reader consensus. As expected, the density algorithm showed higher agreement with the readers as reader consensus increased; from 4/7 to 7/ 7 reader consensus, with kappa = 0.65,0.82,0.94,0.97 respectively. Reader study results showed statistical significance in algorithm benefit across the spectrum of difficulty levels, especially for the high difficulty cases.

CLINICAL RELEVANCE/APPLICATION

Through improved study design with more challenging cases, AI algorithm reader studies are better assessed and compared. The "shades of gray" of clinical reality can and should be incorporated and quantified in study design for AI reader studies.

SSIN04-6   Identifying Bias In Deep Learning Models For Edema Detection On Chest Radiographs: Is AUC Enough?

Participants
Paul Yi, MD, Baltimore, Maryland (*Presenter*) Consultant, FH Orthopedics SAS;Consultant, BunkerHill Health

PURPOSE

Deep convolutional neural networks (DCNNs) trained with unequal sex representation have shown bias against the underrepresented sex for disease identification on chest radiographs (CXRs) using differences in area under the receiver operating characteristic curve (AUC) as a proxy for fairness. However, it is unclear whether different definitions of fairness will result in different conclusions about the presence of bias in a model.The purpose of this study was to evaluate if sex imbalance produces biased DCNNs for detecting pulmonary edema and whether different definitions of fairness impact the identification of biased models.*Methods and Materials CXRs from the NIH ChestX-ray14 database were used to create 20 datasets, each consisting of 1196 images, curated through random undersampling to control for pathology labels and sex. Each dataset was divided into subsets of 100% male, 100% female, and equal male/female and split into 80%/10%/10% training/validation/test sets. Using DenseNet-121 DCNNs pre-trained on ImageNet, "male" and "female" models were developed using only male and female images, respectively, and "balanced" models using images with equal sex representation.Each model was evaluated on held-out test sets with equal sex representation. Fairness was evaluated by comparing mean AUCs between models and two definitions which have achieved consensus in the statistics

literature: 1) equality of opportunity (EOO) [defined as equal true positive rate (TPR)] and 2) equalized odds (EO) [defined as equal TPR and false positive rate (FPR)].*Results DCNNs developed using exclusively male/female and balanced images achieved mean AUCs of 0.82 to 0.85 (p>0.05) [Fig.1], suggesting no bias. However, more rigorous definitions of fairness revealed that most models were biased with fewer satisfying EO than EOO. For example, allowing for maximum 5% TPR/FPR disparity between subgroups, <30% of models would be fair under EOO and <10% under EO (Fig. 2).*Conclusions Conclusions about presence of bias in DCNNs trained for CXR pulmonary edema detection vary widely depending on the definition of fairness used. AUC comparison suggested unbiased/fair models, while more rigorous definitions of fairness uncovered high prevalence of bias against the underrepresented sex. We recommend caution in using AUC comparisons alone as a proxy for fairness in evaluation of deep learning models without consideration of other definitions of fairness, such as EOO and EO.*Clinical Relevance/Application More rigorous definitions of fairness reveal that CXR CNN models with similar AUCs are biased for pulmonary edema detection. This study showcases the limitations of evaluating fairness through performance metrics, such as AUC, which are commonly used in the literature.

RESULTS

DCNNs developed using exclusively male/female and balanced images achieved mean AUCs of 0.82 to 0.85 (p>0.05) [Fig.1], suggesting no bias. However, more rigorous definitions of fairness revealed that most models were biased with fewer satisfying EO than EOO. For example, allowing for maximum 5% TPR/FPR disparity between subgroups, <30% of models would be fair under EOO and <10% under EO (Fig. 2).

CLINICAL RELEVANCE/APPLICATION

More rigorous definitions of fairness reveal that CXR CNN models with similar AUCs are biased for pulmonary edema detection. This study showcases the limitations of evaluating fairness through performance metrics, such as AUC, which are commonly used in the literature.

Sub-Events

SPR-GI-1 **Fully-automated Liver Couinaud Segmentation In Computed Tomography For Diagnosing Advanced Liver Fibrosis And Cirrhosis**

Participants
Sungwon Lee, MD,PhD, Bethesda, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To develop and evaluate a fully-automated algorithm for segmenting the liver Couinaud segments from CT volume to detect left lateral and caudate hypertrophy in advanced liver fibrosis and cirrhosis.*Methods and Materials For this retrospective study, a convolutional neural network based on the 3D U-Net architecture was trained on 644 CT scans to perform Couinaud segmentation. Automated liver segmental volume ratio (LSVR) was defined by dividing the total volume of Couinaud segments I-III by that from segments IV-VIII. The algorithm was tested on two external datasets: "Dataset 1" consisted of 422 patients who received liver biopsy for hepatitis C evaluation from 2000 to 2016 (METAVIR F0-4, each 48, 65, 92, 65, 152). 184 asymptomatic renal donors were added to enrich the F0 class. "Dataset 2" consisted of 215 patients who received liver biopsy for hepatitis B, C, or D from 2001 to 2021 (Ishak stage 0-6, each 62, 33, 25, 29, 22, 10, 34). All biopsies were done within 1 year of a portal phase CT. AUCs for diagnosing advanced fibrosis (= F3/Ishak 4) and cirrhosis (F4/Ishak 6) with the automated LSVR were calculated for both dataset 1 and 2. Dataset 1 also had manual LSVR calculated from manual Couinaud segmentation done by six radiologists. Weighted kappa and linear regression were used to compare the manual and automated LSVR.*Results AUC values in distinguishing advanced fibrosis (= F3/Ishak 4) were 0.78 (95% CI 0.73-0.82) vs. 0.81 (95% CI 0.77-0.85) for the automated vs. manual LSVR in dataset 1, and 0.70 (95% CI 0.62-0.78) for the automated LSVR in dataset 2. In distinguishing cirrhosis (F4/Ishak 6), the AUCs were 0.82 (95% CI 0.78-0.86) vs. 0.84 (95% CI 0.80-0.89) for the automated vs. manual LSVR in dataset 1, and 0.73 (95% CI 0.63-0.83) for the automated LSVR in dataset 2. The weighted kappa between the automated and manual LSVR was 0.60 (95% CI 0.56-0.64, p<0.001) and the linear regression slope was 1.07 (R2=0.96).*Conclusions The fully-automated algorithm performed well in diagnosing histopathologic advanced fibrosis and cirrhosis with LSVR and was comparable to manual measurements.*Clinical Relevance/Application Anatomical liver segment (Couinaud segment) volumes can be obtained fully-automatically from an enhanced abdominal CT scan.

RESULTS

AUC values in distinguishing advanced fibrosis (= F3/Ishak 4) were 0.78 (95% CI 0.73-0.82) vs. 0.81 (95% CI 0.77-0.85) for the automated vs. manual LSVR in dataset 1, and 0.70 (95% CI 0.62-0.78) for the automated LSVR in dataset 2. In distinguishing cirrhosis (F4/Ishak 6), the AUCs were 0.82 (95% CI 0.78-0.86) vs. 0.84 (95% CI 0.80-0.89) for the automated vs. manual LSVR in dataset 1, and 0.73 (95% CI 0.63-0.83) for the automated LSVR in dataset 2. The weighted kappa between the automated and manual LSVR was 0.60 (95% CI 0.56-0.64, p<0.001) and the linear regression slope was 1.07 (R2=0.96).

CLINICAL RELEVANCE/APPLICATION

Anatomical liver segment (Couinaud segment) volumes can be obtained fully-automatically from an enhanced abdominal CT scan.

SPR-GI-10 **Predicting Microsatellite Instability Status In Colorectal Cancer Based On Triphasic Enhanced Computed Tomography Radiomics Signatures: A Multicenter Study**

Participants
Yuntai Cao, MS,MS, Xining, China (*Presenter*) Nothing to Disclose

PURPOSE

Microsatellite instability (MSI) status is a key clinical predictor for evaluating the treatment strategies and prognosis of colorectal cancer (CRC) patients. This study aimed to develop and validate a computed tomography (CT)-based radiomics model to predict microsatellite instability (MSI) status in colorectal cancer patients.*Methods and Materials In total, 502 colorectal cancer patients with preoperative contrast-enhanced CT images and available MSI status (441 in the training cohort and 61 in the external validation cohort) were enrolled from two centers in our retrospective study. Radiomic features of the entire primary tumor were extracted from arterial-, delayed-, and venous-phase CT images. The least absolute shrinkage and selection operator method was used to retain the features closely associated with MSI status. Radiomics, clinical, and combined clinicoradiomics models were built to predict MSI status. Model performance was evaluated by receiver operating characteristic curve analysis.*Results After removed irrelevant features by multiple steps, finally, 6 AP radiomics features, 10 VP radiomics features, and 16 DP radiomics features were retained as the final radiomics signatures for predicting MSI status. Delayed-phase models showed superior predictive performance compared to arterial- or venous-phase models. Additionally, age, location and carcinoembryonic antigen level were considered useful predictors of MSI status. The clinicoradiomics nomogram that incorporated both clinical risk factors and radiomics parameters showed excellent performance, with an AUC, accuracy, and sensitivity of 0.898, 0.837, and 0.821 in the training cohort and 0.964, 0.918, and 1.000 in the validation cohort, respectively.*Conclusions We proposed and validated a CT-based radiomics model, incorporating clinical risk factors and radiomics parameters, which showed a relatively high diagnostic performance for the risk prediction of MSI in patients with CRC.*Clinical Relevance/Application This model may be a potential tool for preoperatively identifying the MSI status and can be used in individualized therapeutic strategy planning and prognostic prediction.

RESULTS

After removed irrelevant features by multiple steps, finally, 6 AP radiomics features, 10 VP radiomics features, and 16 DP radiomics features were retained as the final radiomics signatures for predicting MSI status. Delayed-phase models showed superior predictive performance compared to arterial- or venous-phase models. Additionally, age, location and carcinoembryonic antigen level were considered useful predictors of MSI status. The clinicoradiomics nomogram that incorporated both clinical risk factors and radiomics parameters showed excellent performance, with an AUC, accuracy, and sensitivity of 0.898, 0.837, and 0.821 in the training cohort and 0.964, 0.918, and 1.000 in the validation cohort, respectively.

CLINICAL RELEVANCE/APPLICATION

This model may be a potential tool for preoperatively identifying the MSI status and can be used in individualized therapeutic strategy planning and prognostic prediction.

SPR-GI-11 Estimation Of Tumor Recurrence In Patients With Single Hepatocellular Carcinoma After Curative Resection: Development And Validation Of A Risk Score

Participants
So Hyun Park, MD, Incheon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate a risk scoring system using gadoxetic acid-enhanced liver MRI features and clinical factors that predicts recurrence-free survival (RFS) after surgery for single hepatocellular carcinoma (HCC).*Methods and Materials In this retrospective study, consecutive patients with treatment-naïve single HCC who underwent curative surgery from January 2010 to December 2016 (development set) and from January 2013 to December 2016 (test set for external validation) were enrolled from two centers. In the development set, uni- and multivariable Cox proportional hazard models were used to select MRI features and clinical factors associated with RFS and to develop a risk scoring system that stratified the patients into high-, intermediate-, and low-risk groups. The discriminatory power of the risk scores was assessed and validated using Harrell C-index, AUC, and Kaplan-Meier analysis using log-rank test in the development and test sets.*Results A total of 295 patients were evaluated, including 205 patients (mean age, 57 years ± 10.2; 158 men) in the development set and 90 patients (mean age, 56.7 years ± 9.8; 69 men) in the test set. Five variables predicted risk of recurrence: nonresectable hypointense nodule on hepatobiliary phase (hazard ratio [HR], 4.31; 95% confidence interval [CI]: 2.83-6.59; P < 0.001), tumor size = 5 cm (HR, 2.01; 95% CI: 1.28-3.16; P = 0.002), tumor in vein or suspicious vessel invasion on MRI (HR, 1.86; 95% CI: 1.20-2.88; P = 0.006), targetoid appearance (HR, 1.53; 95% CI: 0.94-2.50; P = 0.09), and microvascular invasion (HR, 1.70; 95% CI: 1.08-2.66; P = 0.02). In the development set, the high-risk group showed shorter RFS than the intermediate- and low-risk groups (all log-rank Ps < 0.001). For each group, 2-year RFS was 88.6%, 73.8%, and 26.3%, respectively. In the test set, the risk score showed high discriminatory power (C-index, 0.81) with AUC for 2-year recurrence of 0.88 (95% CI: 0.80-0.95). The high-risk group likewise showed shorter RFS than the other lower-risk groups (all log-rank Ps < 0.001). Two-year RFS for each group was 86.5%, 71.1%, and 42.9%, respectively, in the test set.*Conclusions The developed and validated risk scoring system can estimate RFS after curative surgery for single HCC.*Clinical Relevance/Application Risk scores for predicting RFS after surgery for HCC have been developed and externally validated to yield high discriminatory ability across stratified groups.

RESULTS

A total of 295 patients were evaluated, including 205 patients (mean age, 57 years ± 10.2; 158 men) in the development set and 90 patients (mean age, 56.7 years ± 9.8; 69 men) in the test set. Five variables predicted risk of recurrence: nonresectable hypointense nodule on hepatobiliary phase (hazard ratio [HR], 4.31; 95% confidence interval [CI]: 2.83-6.59; P < 0.001), tumor size = 5 cm (HR, 2.01; 95% CI: 1.28-3.16; P = 0.002), tumor in vein or suspicious vessel invasion on MRI (HR, 1.86; 95% CI: 1.20-2.88; P = 0.006), targetoid appearance (HR, 1.53; 95% CI: 0.94-2.50; P = 0.09), and microvascular invasion (HR, 1.70; 95% CI: 1.08-2.66; P = 0.02). In the development set, the high-risk group showed shorter RFS than the intermediate- and low-risk groups (all log-rank Ps < 0.001). For each group, 2-year RFS was 88.6%, 73.8%, and 26.3%, respectively. In the test set, the risk score showed high discriminatory power (C-index, 0.81) with AUC for 2-year recurrence of 0.88 (95% CI: 0.80-0.95). The high-risk group likewise showed shorter RFS than the other lower-risk groups (all log-rank Ps < 0.001). Two-year RFS for each group was 86.5%, 71.1%, and 42.9%, respectively, in the test set.

CLINICAL RELEVANCE/APPLICATION

Risk scores for predicting RFS after surgery for HCC have been developed and externally validated to yield high discriminatory ability across stratified groups.

SPR-GI-12 Annual Non-contrast Liver MRI Vs. Biannual Liver Ultrasonography For Surveillance Of HCC In Patients With Liver Cirrhosis: Results Of A Prospective, Multicenter Trial NCT02551250 (MAGNUS-HCC)

Participants
Moon Hyung Choi, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Ultrasonography (US) is recommended as a standard surveillance tool for patients with high risk of hepatocellular carcinoma (HCC). However, the low sensitivity of US for small HCC may lead to surveillance failure. The purpose of this study is to evaluate the feasibility and performance of non-contrast liver MRI as a surveillance tool for HCC in patients with liver cirrhosis, compared with US.*Methods and Materials This study is a prospective, multicenter clinical trial with crossover design in a single arm of patients. We enrolled 218 patients with high-risk for HCC (annual risk > 5%) in six institutes. All patients underwent US every 6 months (6, 12, 18, 24, 30 and 36 months) and non-contrast MRI every 12 months (6, 18 and 30 months) for surveillance of HCC during the follow-up period of 3 years. Non-contrast MRI consists of T2 FSE, T2 SSFSE, in- and opposed-phased T1 GRE, and DWI (b-values of 0, 50 and 500 s/mm2). If a focal liver lesion suspected with HCC was detected, dynamic CT was performed for confirmation of HCC. After the last surveillance round, patients who were not diagnosed with HCC were evaluated with dynamic CT to exclude false negative. We compared the diagnostic performance, including sensitivity, positive predictive value (PPV) and false referral rate (FRR), of annual non-contrast MRI and biannual US.*Results 34 HCCs were developed in 31 patients. Per-patient and per-tumor sensitivity of MRI and US were 71.0% and 45.2% (p=0.0768), 73.5% and 47.1% (p=0.0490), respectively. PPV and FRR of MRI and US were 61.1% and 33.3% (p=0.0223), 2.71% and 2.85% (p=1.000), respectively. All four HCC patients diagnosed by US alone were found in follow-up rounds when US was performed without MRI. When simulating alternative examinations of non-contrast MRI

and US with 6-month interval, per-patient sensitivity was 83.9% and FRR was 2.85%.*Conclusions Annual non-contrast MRI surveillance was marginally superior in sensitivity to biannual US surveillance for HCC detection. PPV of annual non-contrast MRI was better than that of biannual US without significant difference of FRR. Alternating examinations of non-contrast MRI and US with 6-month interval could maximize the performance of HCC surveillance.*Clinical Relevance/Application Non-contrast MRI outperforms US as a HCC surveillance tool. Cheap, fast image acquisition time and no need for repetitive contrast injection are advantages of non-contrast MRI comparing to contrast-enhanced MRI.

RESULTS

34 HCCs were developed in 31 patients. Per-patient and per-tumor sensitivity of MRI and US were 71.0% and 45.2% (p=0.0768), 73.5% and 47.1% (p=0.0490), respectively. PPV and FRR of MRI and US were 61.1% and 33.3% (p=0.0223), 2.71% and 2.85% (p=1.000), respectively. All four HCC patients diagnosed by US alone were found in follow-up rounds when US was performed without MRI. When simulating alternative examinations of non-contrast MRI and US with 6-month interval, per-patient sensitivity was 83.9% and FRR was 2.85%.

CLINICAL RELEVANCE/APPLICATION

Non-contrast MRI outperforms US as a HCC surveillance tool. Cheap, fast image acquisition time and no need for repetitive contrast injection are advantages of non-contrast MRI comparing to contrast-enhanced MRI.

SPR-GI-13 Prognostic Value Of Gadoxetic Acid-enhanced MRI In Patients With Hepatocellular Carcinoma After Hepatectomy

Participants
Hong Wei, MMed, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the prognostic values of preoperative gadoxetic acid-enhanced MRI findings in patients with hepatocellular carcinoma (HCC) after surgical resection.*Methods and Materials This retrospective study included consecutive treatment-naïve patients with surgically proven HCC who underwent preoperative gadoxetic acid-enhanced MRI between August 2015 and September 2020. All MR images were reviewed by two independent radiologists who were blinded to all clinical, pathological and follow-up information with respect to all Liver Imaging Reporting and Data System (LI-RADS) version 2018 imaging features and several non-LI-RADS imaging features in consensus. Uni-variate and multi-variate Cox proportional hazards regression analyses were used to identify significant predictors for recurrence-free survival (RFS) and overall survival (OS) with five-fold cross-validation. Thereafter, regression-based predictive models were constructed for RFS and OS using backward stepwise approach with the Akaike information criterion. Model performances were estimated by the Harrell's concordance index (C index), calibration plots, and Kaplan-Meier curves.*Results Two hundred twenty-five patients (mean age: 52.6 ± 11.7 years, 186 men [82.7%]) were evaluated. The median follow-up period was 16.4 months (range: 3.1-65.8 months). There were 91 (40.4%) recurrences and 27 (12.0%) deaths. Factors significantly predictive of RFS included: age (Hazard Ratio [HR]: 0.978), multiplicity (HR: 1.533), tumor size > 5cm (HR: 1.733), tumor in vein (HR: 1.488), peritumoral hyperintense area on T2WI (HR: 1.712) and Eggel's growth classification (HR: 1.467). Factors significantly predictive of OS were: AFP level > 400 ng/mL (HR: 2.416), bilobar involvement (HR: 2.310), satellite nodule (HR: 2.204), corona enhancement (HR: 3.718), infiltrative appearance (HR: 2.614), non-smooth tumor margin (HR: 4.838) and peritumoral biliary dilatation (HR: 2.448). The C-index for RFS and OS was 0.717 (95% confidence interval [CI]: 0.656-0.778) and 0.878 (95%CI: 0.822-0.935), respectively.*Conclusions Nomograms incorporating preoperative gadoxetic acid-enhanced MRI findings and clinical factors can effectively predict risk of recurrence and survival of HCC patients after hepatectomy.*Clinical Relevance/Application MRI-based nomograms effectively predict postsurgical prognosis of HCC patients, which may contribute to the guidance of pretreatment clinical decision-making and optimization of patient management.

RESULTS

Two hundred twenty-five patients (mean age: 52.6 ± 11.7 years, 186 men [82.7%]) were evaluated. The median follow-up period was 16.4 months (range: 3.1-65.8 months). There were 91 (40.4%) recurrences and 27 (12.0%) deaths. Factors significantly predictive of RFS included: age (Hazard Ratio [HR]: 0.978), multiplicity (HR: 1.533), tumor size > 5cm (HR: 1.733), tumor in vein (HR: 1.488), peritumoral hyperintense area on T2WI (HR: 1.712) and Eggel's growth classification (HR: 1.467). Factors significantly predictive of OS were: AFP level > 400 ng/mL (HR: 2.416), bilobar involvement (HR: 2.310), satellite nodule (HR: 2.204), corona enhancement (HR: 3.718), infiltrative appearance (HR: 2.614), non-smooth tumor margin (HR: 4.838) and peritumoral biliary dilatation (HR: 2.448). The C-index for RFS and OS was 0.717 (95% confidence interval [CI]: 0.656-0.778) and 0.878 (95%CI: 0.822-0.935), respectively.

CLINICAL RELEVANCE/APPLICATION

MRI-based nomograms effectively predict postsurgical prognosis of HCC patients, which may contribute to the guidance of pretreatment clinical decision-making and optimization of patient management.

SPR-GI-14 2019 Korean Society Of Abdominal Radiology Consensus Recommendations For Extrahepatic Bile Duct Cancer: Diagnostic Accuracy And Interreader Agreement In Longitudinal Tumor Extent, Vascular Invasion, And Resectability Evaluation Using Multi-row Detector CT

Participants
Bohyun Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

In extrahepatic bile duct (EHD) cancer, accurate assessment of resectability is essential for curative surgery but pertinent guidelines in the perspectives of radiologists are pending. The Korean Society of Abdominal Radiology (KSAR) has recently announced consensus recommendations for a comprehensive evaluation of EHD cancer on imaging technique, tumor extent, major vessel involvement, and lymph node/distant metastasis outlined in a structured report form to facilitate radiologic prediction of resectability. The purpose of the study was to investigate the diagnostic performance of MDCT according to the recommendations and to evaluate interreader agreement.*Methods and Materials This retrospective study included EHD cancer patients who underwent multiphasic CT scans of = 3 mm slice thickness before surgery from Jan 2016 to Dec 2018. Three abdominal radiologists with 6-10 years of experience evaluated longitudinal extent of the tumor, presence of hepatic artery/portal vein invasion, and resectability per KSAR recommendations. The diagnostic performance was assessed by sensitivity, specificity, and AUC. Interreader agreement was determined using kappa statistics.*Results In total, 112 patients (mean age, 61.3 ± 11.3; 73 men) were evaluated.

Overall longitudinal tumor extent was correctly assessed in 72.3% (81/112) of the patients. In a biliary segment-wise analysis, the sensitivity for detecting 2° confluence involvement (n = 62) was lower than that for the 1° confluence or intrapancreatic duct (n = 115; 50.0-75.0% vs. 82.0-87.0%). For vascular invasion (n = 17), moderate sensitivity (70.0-71.4%) and high specificity (95.1-97.1%) were noted. For predicting R0 resection (n = 85), the sensitivity and specificity ranged 71.8-95.4% and 33.3-66.7%, respectively, with the AUC ranging 0.768 to 0.799. Interreader agreements for tumor extent, vascular invasion, and resectability were 0.649-0892, 0.273-0.643, and 0.465-0.525, respectively.*Conclusions The consensus recommendations provided moderate sensitivity and high specificity for assessing tumor extent and vascular invasion of EHD cancers using MDCT. For tumor resectability, high sensitivity and moderate specificity with moderate interreader agreement were noted.*Clinical Relevance/Application For preoperative evaluation of EHD cancer, the consensus recommendations enabled systemic assessment of the disease status and provided acceptable performance in predicting R0 resection.

RESULTS

In total, 112 patients (mean age, 61.3 ± 11.3; 73 men) were evaluated. Overall longitudinal tumor extent was correctly assessed in 72.3% (81/112) of the patients. In a biliary segment-wise analysis, the sensitivity for detecting 2° confluence involvement (n = 62) was lower than that for the 1° confluence or intrapancreatic duct (n = 115; 50.0-75.0% vs. 82.0-87.0%). For vascular invasion (n = 17), moderate sensitivity (70.0-71.4%) and high specificity (95.1-97.1%) were noted. For predicting R0 resection (n = 85), the sensitivity and specificity ranged 71.8-95.4% and 33.3-66.7%, respectively, with the AUC ranging 0.768 to 0.799. Interreader agreements for tumor extent, vascular invasion, and resectability were 0.649-0892, 0.273-0.643, and 0.465-0.525, respectively.

CLINICAL RELEVANCE/APPLICATION

For preoperative evaluation of EHD cancer, the consensus recommendations enabled systemic assessment of the disease status and provided acceptable performance in predicting R0 resection.

SPR-GI-15   Adrenal Nodules Detected On Staging CT In Patients With Potentially Resectable Gastric Cancer: Is Additional Imaging Necessary Before Surgery?

Participants
Hae Young Kim, MD,MS, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To measure the prevalence of adrenal nodule detected on staging CT in patients with potentially resectable gastric cancer, and the proportion of patients with malignant nodules among them.*Methods and Materials This retrospective study included 10250 consecutive patients who underwent staging CT and had potentially resectable gastric cancer in a high volume center. We measured the prevalence of adrenal nodule (= 10 mm) via retrospective CT image review (patients with CT-detected adrenal nodule out of 10250 patients with potentially resectable gastric cancer). Among the patients with CT-detected adrenal nodules, we measured the per-patient proportions of malignant nodules, adrenal metastasis from gastric cancer, and additional adrenal examination.*Results The prevalence of adrenal nodule was 4.5% (462/10250; 95% CI, 4.1%-4.9%). The proportions of malignant nodule, and the proportion of adrenal metastasis from gastric cancer were 0.4% (2/462; 0.1%-1.6%) and 0.0% (0/462; 0.0%-0.8%), respectively. 26.6% of the patients with CT-detected adrenal nodules (123/462; 22.7%-30.9%) underwent additional adrenal examination.*Conclusions Adrenal nodules detected on staging CTs in patients with otherwise resectable gastric cancer rarely turn out to be malignant. Only two of 10250 patients turned out to have malignant adrenal nodules, neither of whom had adrenal metastasis from gastric cancer.*Clinical Relevance/Application Guidelines recommending additional imaging for adrenal nodules detected on CT lack relevant epidemiology evidence. Our results suggest that current guidelines need a revision toward more selective use of additional imaging for adrenal nodules in patients with otherwise resectable gastric cancer.

RESULTS

The prevalence of adrenal nodule was 4.5% (462/10250; 95% CI, 4.1%-4.9%). The proportions of malignant nodule, and the proportion of adrenal metastasis from gastric cancer were 0.4% (2/462; 0.1%-1.6%) and 0.0% (0/462; 0.0%-0.8%), respectively. 26.6% of the patients with CT-detected adrenal nodules (123/462; 22.7%-30.9%) underwent additional adrenal examination.

CLINICAL RELEVANCE/APPLICATION

Guidelines recommending additional imaging for adrenal nodules detected on CT lack relevant epidemiology evidence. Our results suggest that current guidelines need a revision toward more selective use of additional imaging for adrenal nodules in patients with otherwise resectable gastric cancer.

SPR-GI-16   Deep Learning Image Reconstruction Algorithm For Pancreatic Protocol Dual-energy Computed Tomography: Image Quality And Quantification Of Iodine Concentration

Participants
Yoshihumi Noda, MD,PhD, Gifu, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the image quality and iodine concentration (IC) measurements in pancreatic protocol dual-energy CT (DECT) reconstructed using deep learning image reconstruction (DLIR) and compare them with those of images reconstructed using hybrid iterative reconstruction (IR).*Methods and Materials The local institutional review board approved this prospective study. Written informed consent was obtained from all participants. Thirty consecutive participants with pancreatic cancer (PC) underwent pancreatic protocol DECT for initial evaluation. DECT data were reconstructed at 70 keV using 40% adaptive statistical iterative reconstruction-Veo (hybrid-IR) and DLIR at medium and high levels (DLIR-M and DLIR-H, respectively). The diagnostic acceptability and conspicuity of PC were qualitatively assessed using a five-point scale. IC values of the abdominal aorta, pancreas, PC, liver, and portal vein; standard deviation (SD); and coefficient of variation (CV) were calculated. Qualitative and quantitative parameters were compared between the hybrid-IR, DLIR-M, and DLIR-H groups.*Results The diagnostic acceptability and conspicuity of PC were significantly better in the DLIR-M group compared with those in the other groups (P < .001-.001). The IC values of the anatomical structures were almost comparable between the three groups (P = .001-0.9). The SD of IC values was significantly lower in the DLIR-H group (P < .001) and resulted in the lowest CV (P < .001-.002) compared with those in the hybrid-IR and DLIR-M groups.*Conclusions DLIR could significantly improve image quality and reduce the variability of IC values than could hybrid-IR.*Clinical Relevance/Application DLIR algorithm can markedly reduce the background noise and demonstrate less iodine concentration variability values in pancreatic protocol dual-energy CT.

RESULTS

The diagnostic acceptability and conspicuity of PC were significantly better in the DLIR-M group compared with those in the other groups (P < .001-.001). The IC values of the anatomical structures were almost comparable between the three groups (P = .001-0.9). The SD of IC values was significantly lower in the DLIR-H group (P < .001) and resulted in the lowest CV (P < .001-.002) compared with those in the hybrid-IR and DLIR-M groups.

CLINICAL RELEVANCE/APPLICATION

DLIR algorithm can markedly reduce the background noise and demonstrate less iodine concentration variability values in pancreatic protocol dual-energy CT.

SPR-GI-17   Detection Of Incidental Esophageal Cancers On Chest CT By Deep Learning

Participants
Zhanhao Mo, Changchun, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop a deep learning-based model for improving detection of incidental esophageal cancer in unenhanced chest CT examination.*Methods and Materials We retrospectively collected 141 patients with esophageal cancers (mean age: 57.4, range: 34-87) and 273 non-esophageal cancer subjects (mean age: 41.7, range: 18-73) in unenhanced chest CT images from January 2017 to March 2019 in our hospital. These Data were used to establish a convolutional neural (CNN) network model for diagnosing esophageal cancer. The CNN model is a V-Net segmentation network that can segment the esophagus and localize the thickening positions of esophageal lesions. To validate this model, another 52 missed cases of patients with esophageal cancers (mean age: 58.8, range: 23-85) and 48 normal esophagi (mean age: 42.1, range: 19-62) were collected to evaluate the performance of the deep learning-based model and radiologists with or without assistance of the deep learning-based model respectively.*Results The sensitivity and specificity of the esophageal cancer detection model were 88.8% and 90.9%, respectively. Of the 52 missed esophageal cancer cases and 48 normal cases, the sensitivity, specificity and accuracy of the deep learning esophageal cancer detection model were 69% ,61%,65%, respectively, and the radiologists' independent reading results were sensitivity 25%,31%,27%, specificity 78%,75%,75%, and accuracy 53%,54%,53% in the absence of deep learning-based model assistance. With the aid of the deep learning-based model, the radiologists' reading results were improved to sensitivity 77%, 81%,75%, specificity 75%,74%,74% and accuracy 76%,77%,75% respectively.*Conclusions Deep learning-based model can effectively detect esophageal cancers in unenhanced chest CT scan to help improve incidental detection of esophageal cancer on CT.*Clinical Relevance/Application The Deep learning-based model is highly objective in detecting esophageal cancer and can provide more reliable abnormal reminders,and it also can improve the efficiency of image reading by quickly browsing images and judge abnormal images in a short time.

RESULTS

The sensitivity and specificity of the esophageal cancer detection model were 88.8% and 90.9%, respectively. Of the 52 missed esophageal cancer cases and 48 normal cases, the sensitivity, specificity and accuracy of the deep learning esophageal cancer detection model were 69% ,61%,65%, respectively, and the radiologists' independent reading results were sensitivity 25%,31%,27%, specificity 78%,75%,75%, and accuracy 53%,54%,53% in the absence of deep learning-based model assistance. With the aid of the deep learning-based model, the radiologists' reading results were improved to sensitivity 77%, 81%,75%, specificity 75%,74%,74% and accuracy 76%,77%,75% respectively.

CLINICAL RELEVANCE/APPLICATION

The Deep learning-based model is highly objective in detecting esophageal cancer and can provide more reliable abnormal reminders,and it also can improve the efficiency of image reading by quickly browsing images and judge abnormal images in a short time.

SPR-GI-18   Assessment Of Liver Steatosis By Ultrasound-guided Attenuation Parameter: Prospective Multi-center Study From 6 Japanese Sites

Participants
Katsutoshi Sugimoto, MD, PhD, Tokyo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Ultrasound (US)-based attenuation marker called US-Guided Attenuation Parameter (UGAP) has proven to be efficient for the evaluation of liver steatosis in small-sized clinical trial. The purpose of this study was to investigate the diagnostic performance of UGAP in assessing liver steatosis in patients with chronic liver disease as findings form magnetic resonance imaging (MRI)-based proton density fat fraction (PDFF) were used for reference standard.*Methods and Materials This prospective multi-center study from 6 sites collected data from 1012 adult patients (mean age, 62 years ± 15 [standard deviation]; 561 men) with chronic liver disease who underwent MRI-PDFF and were enrolled February 2020 to February 2021. Most patients had nonalcoholic fatty liver disease (n=515) chronic hepatitis B (n=133), or hepatitis C (n=124). UGAP was measured using a US scanner (LOGIQ E10: GE healthcare). Diagnostic performance of UGAP was assessed using the area under the receiver operating characteristic curve (AUC) for the steatosis grade which was defined by MRI-PDFF. The correlation between UGAP and MRI-PDFF was determined.*Results The diagnostic performance of UGAP for steatosis grades =1, =2, and 3, as determined by MRI-PDFF were AUC of 0.91 (95% confidence interval [CI]: 0.89-0.93) with sensitivity of 87% and specificity of 82% at the threshold of 0.65 (dB/cm/MHz), 0.91 (95% CI: 0.89-0.93) with sensitivity of 78% and specificity of 91% at the threshold of 0.71 (dB/cm/MHz), and 0.89 (95% CI: 0.87-0.92) with sensitivity of 83% and specificity of 81% at the threshold of 0.71 (dB/cm/MHz), respectively. The correlation coefficient between PDFF values and UGAP values were 0.77 (95% CI: 0.74-0.79; P < .001).*Conclusions UGAP had high diagnostic performance for detecting hepatic steatosis in patients with chronic liver disease.*Clinical Relevance/Application US-Guided Attenuation Parameter can assess degree of liver steatosis accurately and easily in daily clinical practice.

RESULTS

The diagnostic performance of UGAP for steatosis grades =1, =2, and 3, as determined by MRI-PDFF were AUC of 0.91 (95% confidence interval [CI]: 0.89-0.93) with sensitivity of 87% and specificity of 82% at the threshold of 0.65 (dB/cm/MHz), 0.91 (95% CI: 0.89-0.93) with sensitivity of 78% and specificity of 91% at the threshold of 0.71 (dB/cm/MHz), and 0.89 (95% CI: 0.87-0.92) with sensitivity of 83% and specificity of 81% at the threshold of 0.71 (dB/cm/MHz), respectively. The correlation coefficient between PDFF values and UGAP values were 0.77 (95% CI: 0.74-0.79; P < .001).

CLINICAL RELEVANCE/APPLICATION

US-Guided Attenuation Parameter can assess degree of liver steatosis accurately and easily in daily clinical practice.

SPR-GI-2   Prediction Of Whole-body 3D Adipose Volume By A Single Axial Abdominal Cross-section 2D Adipose Area: Early Interim Analysis From The Dallas Heart Study Third Examination

Participants
Takeshi Yokoo, MD, PhD, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To assess the feasibility of predicting the whole-body visceral, subcutaneous, and total adipose tissue (VAT, SAT, TAT) compartment volumes from the cross-sectional segmented adipose areas on a single axial magnetic resonance imaging (MRI) section at the L2/L3 intervertebral level.*Methods and Materials This is an interim, cross-sectional analysis of participants from the third examination of the Dallas Heart Study, a longitudinal population-based cohort study in Dallas, TX. Forty-three (43) adult participants underwent whole-body (neck to knee) 3-D axial T1-weighted Dixon gradient echo MRI at 3T. The Dixon image data were analyzed for whole-body VAT, SAT, and TAT volumes (in cm3) using a validated technique by AMRA Medical (Linkoping University, Sweden). On the single cross section Dixon fat image at L2/L3 intervertebral level, the corresponding VAT, SAT, and TAT areas (cm2) were manually segmented. L2/L3 level was previously suggested as the most predictive and reproducible single abdominal axial section for total abdominal adiposity characterization. A linear prediction model was developed with age, sex, height, weight, and the L2/L3 adipose area as potential predictor variables of the whole-body adipose volume for each compartment.*Results For the whole-body VAT volume, only the association of L2/L3 VAT area (p<0.001) was significant. For the whole-body SAT volume, sex (p=0.021), weight (p<0.001), and L2/L3 SAT area (p<0.001) were significant. For the whole-body TAT volume, sex (p<0.001), weight (p=0.002), and L2/L3 TAT area (p<0.001) were significant. Using only these significant variables, the prediction models explained 85%, 88%, and 91% of the whole-body VAT, SAT, and TAT volume variations by regression R2, respectively. Representative subjects with segmented L2/L3 images and regression plots with 95% prediction interval in dotted red for VAT, SAT, and TAT are shown in Figure 1.*Conclusions Prediction of whole-body adipose compartment volumes may be feasible by single-slice abdominal cross-sectional adipose area segmentation.*Clinical Relevance/Application Whole-body adiposity assessment without whole-body imaging may enable large-scale retrospective and opportunistic studies of whole-body adiposity in whom only cross-sectional abdominal images are available.

RESULTS

For the whole-body VAT volume, only the association of L2/L3 VAT area (p<0.001) was significant. For the whole-body SAT volume, sex (p=0.021), weight (p<0.001), and L2/L3 SAT area (p<0.001) were significant. For the whole-body TAT volume, sex (p<0.001), weight (p=0.002), and L2/L3 TAT area (p<0.001) were significant. Using only these significant variables, the prediction models explained 85%, 88%, and 91% of the whole-body VAT, SAT, and TAT volume variations by regression R2, respectively. Representative subjects with segmented L2/L3 images and regression plots with 95% prediction interval in dotted red for VAT, SAT, and TAT are shown in Figure 1.

CLINICAL RELEVANCE/APPLICATION

Whole-body adiposity assessment without whole-body imaging may enable large-scale retrospective and opportunistic studies of whole-body adiposity in whom only cross-sectional abdominal images are available.

SPR-GI-20   Role Of FDG-PET In Re-staging Of Borderline Resectable Pancreatic Cancer After Neo-adjuvant Treatment

Participants
Seungchul Han, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To retrospectively evaluate the clinical significance of PET based systemic surveillance for distant metastasis in borderline resectable pancreatic cancer (BRPC) patients who are undergoing FOLFIRINOX based neoadjuvant chemotherapy (NAC).*Methods and Materials 78 patients who underwent FOLFIRINOX based NAC for BRPC from a single institute during January 2013 to December 2019 were retrospectively reviewed. All of the patients underwent an initial PET scan to confirm local disease. Image review including pre- and post-NAC (CT, MRI and PET) images was done by 2 radiologists in consensus based on the NCCN 2020 guideline. Clinical information including operative findings and pathologic findings were obtained from patients records. Risk factor analysis for disease progression and metastasis development was performed with binary logistic regression and Chi-square analysis.*Results Among the 78 patients who underwent NAC, 15.4% (12/78) of the patients converted to palliative setting due to local progression (7.7%, 6/78) or distant metastasis (7.7%, 6/78). The remaining 84.6% (66/78) of the patients proceeded to preoperative evaluation with (n=52) or without (n=14) PET evaluation. Among the patients with preoperative PET scan, distant metastasis was detected in 7.7% (4/52) of the patients. Among them, one liver metastasis (25%, 1/4) in one patient was only found on PET scan. Overall, 12.8% (10/78) patients developed metastasis during NAC. Among them, 2 cases of metastasis were only detected in the PET scan (2/10, 20%). Regarding the risk factors, the increment of CA 19-9 level during treatment was associated with development of metastasis during NAC (OR 13.1 [2.95-57.85], p=0.001).*Conclusions Considerable proportion of patients undergoing NAC for BRPC develop distant metastasis during treatment, especially for patients with increased CA 19-9 during the NAC, and systemic PET can aid in detection before undergoing curative resection.*Clinical Relevance/Application The results of this study suggests the clinical value of PET based systemic surveillance of de novo distant metastasis in patients with BRPC treated by NAC, and re-staging after NAC including PET may contribute in accurate patient allocation to surgical resection.

RESULTS

Among the 78 patients who underwent NAC, 15.4% (12/78) of the patients converted to palliative setting due to local progression (7.7%, 6/78) or distant metastasis (7.7%, 6/78). The remaining 84.6% (66/78) of the patients proceeded to preoperative evaluation with (n=52) or without (n=14) PET evaluation. Among the patients with preoperative PET scan, distant metastasis was detected in 7.7% (4/52) of the patients. Among them, one liver metastasis (25%, 1/4) in one patient was only found on PET scan. Overall, 12.8% (10/78) patients developed metastasis during NAC. Among them, 2 cases of metastasis were only detected in the PET scan (2/10, 20%). Regarding the risk factors, the increment of CA 19-9 level during treatment was associated with development of metastasis during NAC (OR 13.1 [2.95-57.85], p=0.001).

CLINICAL RELEVANCE/APPLICATION

The results of this study suggests the clinical value of PET based systemic surveillance of de novo distant metastasis in patients

with BRPC treated by NAC, and re-staging after NAC including PET may contribute in accurate patient allocation to surgical resection.

SPR-GI-21 Identification Of Intratumoral Cysts By Magnetic Resonance Imaging To Predict Prognosis In Patients With Pancreatic Ductal Adenocarcinoma After Curative Resection

Participants
Hokun Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Pancreatic ductal adenocarcinoma (PDAC) is often accompanied by intratumoralcysts such as necrosis or neoplastic mucin cysts on preoperative magnetic resonance imaging (MRI). We aimed to compare the prognosis of PDAC after curative resection according to the type of intratumoral cyst identified on MRI.*Methods and Materials This study included 112 consecutive patients who underwent upfront surgery with margin-negative resection between 2012 and 2019. All patients underwent MRI within 1 month before surgery. Three radiologists independently assessed the MRI findings, determined whether intratumoral cysts were present, and classified all intratumoral cysts by type (i.e., necrosis or neoplastic mucin cysts). Interobserver agreement was evaluated using the free-marginal multi-rater ? analysis. Recurrence-free survival (RFS) and overall survival (OS) were evaluated by the Kaplan-Meier method and the Cox proportional hazards model. Histopathological differences according to the type of intratumoral cyst were assessed.*Results Of the 112 patients with PDAC, intratumoral cysts were identified on MRI in 33(29.5%), among which 18 were classified as necrosis and 15 as neoplastic mucin cysts. Interobserver agreement for discriminating the intratumoral cysts was good (?=0.66). PDAC patients with necrosis demonstrated significantly shorter RFS (mean 6.1 months versus 47.3months; P<.001) and OS (18.4 months versus 55.0 months, P=.001) than those with neoplastic mucin cysts. Multivariable analysis showed that only the type of intratumoral cyst was significantly associated with RFS (hazard ratio [HR], 2.51 and 0.37; P=.003 and P=.038 for necrosis and neoplastic mucin cysts, respectively). Tumor size (HR, 1.19; P=.032) and lymph node metastasis (HR, 1.75; P=.032) showed independent associations with OS. PDAC with necrosis had more frequent histological necrosis, more aggressive tumor differentiation, and higher tumor cellularity than PDAC with neoplastic mucin cysts (P=.016).*Conclusions The detection and discrimination of intratumoral cysts on preoperative MRI may be useful in predicting the prognosis of PDAC patients after curative resection.*Clinical Relevance/Application PDAC patients with necrosis on preoperative MRI had a worse postsurgical prognosis than those with ordinary PDAC, while those with neoplastic mucin cysts had a better prognosis.

RESULTS

Of the 112 patients with PDAC, intratumoral cysts were identified on MRI in 33(29.5%), among which 18 were classified as necrosis and 15 as neoplastic mucin cysts. Interobserver agreement for discriminating the intratumoral cysts was good (?=0.66). PDAC patients with necrosis demonstrated significantly shorter RFS (mean 6.1 months versus 47.3months; P<.001) and OS (18.4 months versus 55.0 months, P=.001) than those with neoplastic mucin cysts. Multivariable analysis showed that only the type of intratumoral cyst was significantly associated with RFS (hazard ratio [HR], 2.51 and 0.37; P=.003 and P=.038 for necrosis and neoplastic mucin cysts, respectively). Tumor size (HR, 1.19; P=.032) and lymph node metastasis (HR, 1.75; P=.032) showed independent associations with OS. PDAC with necrosis had more frequent histological necrosis, more aggressive tumor differentiation, and higher tumor cellularity than PDAC with neoplastic mucin cysts (P=.016).

CLINICAL RELEVANCE/APPLICATION

PDAC patients with necrosis on preoperative MRI had a worse postsurgical prognosis than those with ordinary PDAC, while those with neoplastic mucin cysts had a better prognosis.

SPR-GI-22 Assessment Of Image Quality And Diagnostic Performance Of Deep Learning Image Reconstruction (DLIR) Algorithm In Abdominopelvic CT: A Perspective Of Radiation Dose Reduction

Participants
June Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate image quality and diagnostic performance of deep learning image reconstruction (DLIR) algorithm in lower-dose contrast-enhanced abdominopelvic CT (LDCT) images as compared with standard-dose CT (SDCT) images.*Methods and Materials Our retrospective study included 111 patients who undergone LDCT (100 kVp, noise index of 17) between May and November 2020 and also had prior SDCT (100 kVp, noise index of 14) by the same CT machine. LDCT images were reconstructed with ASiR-V 40% (AV-40), TrueFidelity moderate- and high-strength (TF-M and TF-H) while SDCT images were reconstructed with AV-40. A radiologist measured CT values and standard deviation values of ROIs on liver, muscle, aorta, and fat to assess image noise, SNR, and CNR. Overall image quality, image noise, image sharpness, artifactual texture, and lesion conspicuity were graded on the 5-point comparative scale by two radiologists: among LDCT images, the LDCT images which had the most similar quantitative values to SDCT images were compared with SDCT images. Diagnostic performance was also evaluated in 40 cases that had focal liver lesions.*Results In quantitative analysis, the LDCT TF-M was not significantly different from the SDCT with respect to image noise, SNR, and CNR. In qualitative analysis, the LDCT TF-M was equal to the SDCT for all parameters except image noise and overall image quality: the image noise was lesser (for one reader), and the overall image quality was better (for both readers) on the LDCT TF-M. Diagnostic performance was no significant difference between the two groups in per-lesion analysis (SN and PPV) and per-segment analysis (SN, SP, PPV, NPV, and accuracy). Reader-averaged AUC showed no performance difference between LDCT TF-M and SDCT (0.915 vs. 0.908, p = 0.72). An average 35.1% radiation dose reduction was achieved in the LDCT group compared to the SDCT group.*Conclusions With DLIR (TF-M), radiation dose could be reduced by 35.1% without deteriorating image quality and diagnostic performance for focal liver lesions.*Clinical Relevance/Application Implanting DLIR algorithms in abdominopelvic CT scans can reduce radiation exposure without sacrificing diagnostic accuracy.

RESULTS

In quantitative analysis, the LDCT TF-M was not significantly different from the SDCT with respect to image noise, SNR, and CNR. In qualitative analysis, the LDCT TF-M was equal to the SDCT for all parameters except image noise and overall image quality: the image noise was lesser (for one reader), and the overall image quality was better (for both readers) on the LDCT TF-M. Diagnostic performance was no significant difference between the two groups in per-lesion analysis (SN and PPV) and per-segment analysis (SN, SP, PPV, NPV, and accuracy). Reader-averaged AUC showed no performance difference between LDCT TF-M and SDCT (0.915 vs. 0.908, p = 0.72). An average 35.1% radiation dose reduction was achieved in the LDCT group compared to the SDCT group.

CLINICAL RELEVANCE/APPLICATION

Implanting DLIR algorithms in abdominopelvic CT scans can reduce radiation exposure without sacrificing diagnostic accuracy.

SPR-GI-23   Low-contrast Detectability And Radiation Dose Saving Potential Using Deep Learning Image Reconstruction: Phantom Experiment And Clinical Study With Hepatic Metastases

Participants
Peijie Lyu, MD, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the low-contrast detectability of deep learning imaging reconstruction (DLIR) on small hypoattenuating lesions under multiple radiation exposure levels in a contrast-detail phantom and to validate its performance for potential dose reduction in the detection of liver metastases.*Methods and Materials A proprietary low-contrast phantom consisting of low-contrast objects (two sizes [4 and 6 mm] and one contrast level selected) was scanned at five CT dose index levels (1, 2, 3, 6, and 10 mGy) with noise levels comparable to clinical images. A prospective, institutional review board-approved study was performed in 45 patients (mean age, 62 years ± 13; 23 men) who underwent multidetector CT of the hepatic metastasis at four dose levels (automatic exposure control settings: 60, 100, 140, and 200, quality reference mAs). All images were reconstructed using filtered back projection (FBP), hybrid model-based adaptive statistical IR (ASiR-V) 60%, and DLIR at medium strength level (DLIR-M). A generalized linear mixed-effects model was used to compare detection accuracy measured with a two-alternative forced-choice approach by eleven readers in the phantom. Noninferiority analysis was performed to evaluate the image quality, lesion conspicuity, and lesion detectability in the patient study.*Results The phantom data showed that detection accuracy of DLIR-M was not significantly different than ASiR-V 60% but improved by 3.0% compared to FBP on average across all variables (P < .001). In the patient study, 105 hepatic metastases were included (mean size, 1.8 cm; mean size-specific dose estimates for the four radiation dose levels, 4.1, 6.8, 9.5, and 13.6 mGy). For each radiation exposure level, readers' perception of image quality and lesion conspicuity was consistently ranked superior with DLIR-M compared to FBP and ASiR-V 60% (P <.05 for all comparisons) while the lesion detectability was similar among all the algorithms. Reduction of up to 70% in radiation exposure by using DLIR-M yielded similar reader rankings of image quality and lesion conspicuity, and comparable lesion detectability when compared with routine-dose FBP and ASiR-V 60%.*Conclusions For detection of hepatic metastases by using contrast-enhanced CT, DLIR allowed a substantial radiation dose reduction (70%) while preserving low-contrast detectability compared with FBP and ASiR-V 60%.*Clinical Relevance/Application Deep learning image reconstruction showed preferred abdominal CT imaging appearance for radiologists and allowed for substantial radiation dose reduction (70%) while maintaining image quality and preserving low-contrast lesion detectability.

RESULTS

The phantom data showed that detection accuracy of DLIR-M was not significantly different than ASiR-V 60% but improved by 3.0% compared to FBP on average across all variables (P < .001). In the patient study, 105 hepatic metastases were included (mean size, 1.8 cm; mean size-specific dose estimates for the four radiation dose levels, 4.1, 6.8, 9.5, and 13.6 mGy). For each radiation exposure level, readers' perception of image quality and lesion conspicuity was consistently ranked superior with DLIR-M compared to FBP and ASiR-V 60% (P <.05 for all comparisons) while the lesion detectability was similar among all the algorithms. Reduction of up to 70% in radiation exposure by using DLIR-M yielded similar reader rankings of image quality and lesion conspicuity, and comparable lesion detectability when compared with routine-dose FBP and ASiR-V 60%.

CLINICAL RELEVANCE/APPLICATION

Deep learning image reconstruction showed preferred abdominal CT imaging appearance for radiologists and allowed for substantial radiation dose reduction (70%) while maintaining image quality and preserving low-contrast lesion detectability.

SPR-GI-24   Comparison Of Diagnostic Performance Between HASTE T2WI Using Intermediate TE And Conventional T2WI In Liver MRI

Participants
Seungchul Han, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the image quality and the diagnostic performance of single-shot fast spin echo using intermediate TE (HASTE-iTE) using compressed sensing compared to conventional T2 weighted (T2W) sequence in patients with risk factors for developing HCC.*Methods and Materials The images of 231 patients (M: F=173:58) with viral hepatitis or cirrhosis and who underwent gadoxetic acid-enhanced liver MRI at 3T were included. The three sequences (HASTE-iTE with compressed sensing (CS) and deep learning (DL) reconstruction (HASTE-DL), HASTE-iTE with only CS reconstruction (HASTE-CS), and T2W image using BLADE) were provided to the reviewers in random order. Three radiologists independently reviewed the image quality, noise, vessel conspicuity on a four-point scale along with solid lesion detection. 280 solid lesions were designated as reference after reviewing the dynamic sequences and the follow-up images and LI-RADS score was assigned to the lesions. Image quality and lesion detection were compared between the sequences.*Results The acquisition time of HASTE-DL, HASTE-CS and T2W image was 70-, 84-, and 90-seconds, respectively. Both HASTE-DL and HASTE-CS images showed better overall image quality, less noise, and higher vessel conspicuity compared to those of T2W images (p < 0.001 for all). HASTE-DL additionally showed better overall image quality, less noise and higher vessel conspicuity than HASTE-CS images (p < 0.001 for all). In per-lesion analysis, HASTE-DL showed superior performance, calculated as figure of merit, compared to T2W image in all lesions (0.58 vs. 0.54, p=0.02), and LR-4, -5, -M lesions (0.59 vs. 0.53, p<0.001) and in lesions larger than 1cm in size (0.63 vs. 0.57, p=0.02). In per-patient analysis, HASTE-DL showed significantly higher sensitivity than conventional T2W image for lesions = 1cm (63.7% vs. 54.7%, p=0.015), and for LR-4, -5, -M lesions (58.1% vs. 47.6%, p=0.015). HASTE-CS also showed significantly higher sensitivity than T2W image for LR-4, -5, -M lesions (56.7% vs. 47.6%, p=0.01).*Conclusions HASTE-DL and HASTE-CS provided better diagnostic performance and image quality for detecting solid focal liver lesions compared to conventional T2W images.*Clinical Relevance/Application HASTE-iTE with DL and CS based reconstruction can provide images with better quality and superior diagnostic performance than conventional T2 weighted image with shorter acquisition time.

RESULTS

The acquisition time of HASTE-DL, HASTE-CS and T2W image was 70-, 84-, and 90-seconds, respectively. Both HASTE-DL and HASTE-CS images showed better overall image quality, less noise, and higher vessel conspicuity compared to those of T2W images (p < 0.001 for all). HASTE-DL additionally showed better overall image quality, less noise and higher vessel conspicuity than HASTE-CS images (p < 0.001 for all). In per-lesion analysis, HASTE-DL showed superior performance, calculated as figure of merit, compared to T2W image in all lesions (0.58 vs. 0.54, p=0.02), and LR-4, -5, -M lesions (0.59 vs. 0.53, p<0.001) and in lesions

larger than 1cm in size (0.63 vs. 0.57, p=0.02). In per-patient analysis, HASTE-DL showed significantly higher sensitivity than conventional T2W image for lesions = 1cm (63.7% vs. 54.7%, p=0.015), and for LR-4, -5, -M lesions (58.1% vs. 47.6%, p=0.015). HASTE-CS also showed significantly higher sensitivity than T2W image for LR-4, -5, -M lesions (56.7% vs. 47.6%, p=0.01).

CLINICAL RELEVANCE/APPLICATION

HASTE-iTE with DL and CS based reconstruction can provide images with better quality and superior diagnostic performance than conventional T2 weighted image with shorter acquisition time.

SPR-GI-25   Energy Spectral Parameters Of Mesenteric Adipose Tissue Assessed By Dual-energy CT Enterography: Potentially Novel Clinical Application For Quantitatively Evaluate Creeping Fat In Patients With Crohn's Disease

Participants
Xueying Long, MD, Changsha, China (*Presenter*) Nothing to Disclose

PURPOSE

To assess the energy spectral parameters of dual-energy CT enterography (CTE) between the normal mesenteric adipose tissue (MAT) in non-CD control group and the creeping fat in Crohn's disease (CD) group, and to evaluate the correlation of quantitative energy spectral parameters of creeping fat between inactive and active CD patients.*Methods and Materials This prospective study was approved by the Medical Ethics Committee of our hospital and written informed consents were obtained from all participants. In this study, the patients with known or suspected Crohn's disease who underwent the dual-energy CTE (with high-speed switching from 80 kVp to 140 kVp) at the enteric and the delayed phases on a 256-detector row CT scanner (Revolution CT, GE Healthcare) were enrolled. From March 1, 2019 to March 31, 2021, forty patients were selected as the creeping fat CD group according to the presence of creeping fat with surgical and pathologic correlations, and 40 non-CD patients were selected as control group. The quantitative parameters of the normal MAT or the creeping fat were obtained on the AW 4.7 workstation (GE Healthcare) with GSI software, including the slope of Hounsfield unit (HU) curve (?HU), normalized fat-water concentration (NFWC), normalized fat-iodine concentration (NFIC) and normalized fat volume fraction (NFVF) at the enteric and delayed phases. Mann-Whitney U test, Kruskal-Wallis H test and receiver operating characteristic (ROC) curve analysis were applied to compare quantitative parameters among various groups.*Results A significant difference was observed in ?HU, NFIC, NFWC and NFVF between normal MAT and creeping fat with CD both at the enteric and delayed phases (all P < 0.001). All quantitative parameters of creeping fat including ?HU, NFIC, NFWC and NFVF both at the enteric and delayed phases (all P < 0.01) had significant differences between inactive and active CD patients. ROC curve analysis showed that ?HU of creeping fat at the delayed phase had a better capability to distinguish inactive and active CD [AUC= 0.95, P < 0.001].*Conclusions Dual-energy CTE with quantitative parameters is a potentially novel noninvasive tool for evaluating creeping fat in CD.*Clinical Relevance/Application Recent studies have shown that the mesentery interacts closely with the affected bowel and plays a potential role in the development process of CD. Dual-energy CT can distinguish different tissues according to the behaviors of the material at different energy levels and spectral parameters may help quantitatively assessing mesenteric tissues in CD. However, the spectral parameters of creeping fat correlated with the surgical and pathologic findings of CD have not been reported so far.

RESULTS

A significant difference was observed in ?HU, NFIC, NFWC and NFVF between normal MAT and creeping fat with CD both at the enteric and delayed phases (all P < 0.001). All quantitative parameters of creeping fat including ?HU, NFIC, NFWC and NFVF both at the enteric and delayed phases (all P < 0.01) had significant differences between inactive and active CD patients. ROC curve analysis showed that ?HU of creeping fat at the delayed phase had a better capability to distinguish inactive and active CD [AUC= 0.95, P < 0.001].

CLINICAL RELEVANCE/APPLICATION

Recent studies have shown that the mesentery interacts closely with the affected bowel and plays a potential role in the development process of CD. Dual-energy CT can distinguish different tissues according to the behaviors of the material at different energy levels and spectral parameters may help quantitatively assessing mesenteric tissues in CD. However, the spectral parameters of creeping fat correlated with the surgical and pathologic findings of CD have not been reported so far.

SPR-GI-26   Effective Boolean Interpretation Model Using "T1wi Or Dwi Or Mrcp" In Discriminating Small Pancreatic Ductal Adenocarcinoma (pdac) From Control Group

Participants
Hainan Ren, BMedSc, Sendai, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic performance of findings on T1WI, T2WI, DWI, and MRCP separately and to identify an optimal Boolean interpretation model for discriminating patients with small PDAC from control groups in clinical practice.*Methods and Materials During April 2008 and September 2018, 30 patients with surgery confirmed small PDAC (=20 mm) and 302 patients without pancreatic abnormality were enrolled. The presence of masses was evaluated by T1WI, T2WI, and DWI. Abnormality of the main pancreatic duct (MPD) was evaluated by T2WI and MRCP. Multivariate logistic regression analysis was performed to select significant sequences for discriminating the small PDAC and control groups. Boolean operators "OR" or "AND" were used to construct sequence combinations. Diagnostic performances of these sequences and combinations were evaluated by X2 tests.*Results The sensitivity of T2WI was lowest (20%) for detecting masses. For evaluating MPD abnormality, sensitivity was higher for MRCP than for T2WI (86.7% vs. 53.3%). Multivariate logistic regression analysis showed that T1WI and DWI for detecting the presence of masses and MRCP for evaluating MPD abnormality were significantly associated with differentiation between the two groups (p = 0.0002, p = 0.0484 and p < 0.0001, respectively). Seven combinations were constructed with T1WI, DWI, and MRCP using "OR" or "AND". The combination of findings on "T1WI or DWI or MRCP" achieved the highest sensitivity of 96.7% and negative predictive value of 99.6%.*Conclusions The combination of findings on "T1WI or DWI or MRCP" might be an optimal Boolean interpretation model for discriminating small PDAC from control groups in clinical practice.*Clinical Relevance/Application When there is at least one positive finding from the three sequences including T1WI, DWI and MRCP, the presence of small PDAC is suggested, and further clinical examination should be considered.

RESULTS

The sensitivity of T2WI was lowest (20%) for detecting masses. For evaluating MPD abnormality, sensitivity was higher for MRCP

than for T2WI (86.7% vs. 53.3%). Multivariate logistic regression analysis showed that T1WI and DWI for detecting the presence of masses and MRCP for evaluating MPD abnormality were significantly associated with differentiation between the two groups (p = 0.0002, p = 0.0484 and p < 0.0001, respectively). Seven combinations were constructed with T1WI, DWI, and MRCP using "OR" or "AND". The combination of findings on "T1WI or DWI or MRCP" achieved the highest sensitivity of 96.7% and negative predictive value of 99.6%.

CLINICAL RELEVANCE/APPLICATION

When there is at least one positive finding from the three sequences including T1WI, DWI and MRCP, the presence of small PDAC is suggested, and further clinical examination should be considered.

SPR-GI-27   Prognostic Value Of Tumor-parenchymal Enhancement Ratio On Portal Venous Phase CT In Patients With Pancreatic Neuroendocrine Neoplasms: Comparison With Current Staging And Grading Systems

Participants
Hyo Jung Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Due to the diverse spectrum of the disease, the outcome of individual patients with pancreatic neuroendocrine neoplasm (PanNEN) varies after curative-intent resection. The major limitation of current prognostic tools such as AJCC staging system and WHO classification is that they are based on surgical pathology data. The tumor-to-parenchymal enhancement ratio on portal venous phase CT (CT portal enhancement ratio; CT-PER) has the potential for predicting the outcome of PanNENs. We aimed to evaluate its prognostic value in PanNEN, and to compare its prognostic performance to the current staging and grading systems.*Methods and Materials This retrospective study included 465 patients who underwent curative-intent resection for PanNEN with available dynamic CT performed within 30 days before surgery. CT was used to obtain CT-PER and tumor size (CT-Size). Optimal cutoffs of CT-PER and CT-Size were determined using a multi-way partitioning algorithm. Patients were classified according to CT-PER, CT-Size, 2019 WHO classification system (WHO), and the 8th American Joint Committee on Cancer staging system (AJCC). Harrell's C-index was used to assess the prognostic performance of each method.*Results CT-PER (cutoffs, 0.75, 0.95, and 1.25) showed a C-index of 0.78 (95% confidence interval [CI], 0.73-0.83) and 0.79 (95% CI, 0.71-0.87) for predicting recurrence-free survival (RFS) and overall survival (OS), respectively, which were equivalent to WHO (C-index, 0.80 [95% CI, 0.75-0.85] for RFS and 0.80 [95% CI, 0.72-0.88] for OS) and AJCC (C-index, 0.78 [95% CI, 0.74-0.83] for RFS and 0.74 [95% CI, 0.66-0.82] for OS). CT-Size (cutoffs, 2-cm and 4-cm) showed the lowest C-index for RFS (0.69 [95% CI, 0.64-0.74]) and OS (0.65 [95% CI, 0.57-0.72]).*Conclusions CT-PER showed similar ability to AJCC and WHO in predicting RFS and OS, indicating its possible use as a preoperatively available, non-invasive prognostic biomarker in PanNEN.*Clinical Relevance/Application CT-PER may serve as a preoperatively available, non-invasive prognostic tool for patients with resectable PanNEN.

RESULTS

CT-PER (cutoffs, 0.75, 0.95, and 1.25) showed a C-index of 0.78 (95% confidence interval [CI], 0.73-0.83) and 0.79 (95% CI, 0.71-0.87) for predicting recurrence-free survival (RFS) and overall survival (OS), respectively, which were equivalent to WHO (C-index, 0.80 [95% CI, 0.75-0.85] for RFS and 0.80 [95% CI, 0.72-0.88] for OS) and AJCC (C-index, 0.78 [95% CI, 0.74-0.83] for RFS and 0.74 [95% CI, 0.66-0.82] for OS). CT-Size (cutoffs, 2-cm and 4-cm) showed the lowest C-index for RFS (0.69 [95% CI, 0.64-0.74]) and OS (0.65 [95% CI, 0.57-0.72]).

CLINICAL RELEVANCE/APPLICATION

CT-PER may serve as a preoperatively available, non-invasive prognostic tool for patients with resectable PanNEN.

SPR-GI-28   Perfluorobutane-enhanced Ultrasound As A Diagnostic Tool For Hepatocellular Carcinoma In Individuals With High Risk: Intraindividual Comparison With Sulfur Hexafluoride-enhanced Ultrasound

Participants
Hyo-Jin Kang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate which dynamic phase of perfluorobutane-enhanced ultrasound (PFB-US) is most appropriate to assess washout in the noninvasive diagnosis of HCC in participants with high risk by comparing to sulfur hexafluoride-enhanced ultrasound (SHF-US)*Methods and Materials We prospectively recruited participants at risk of HCC with treatment-naïve solid hepatic observations (=1 cm). They underwent same-day PFB-US and SHF-US with at least 30 min intervals. PFB-US imaging diagnosis of HCC was made using criteria of nonrim arterial phase hyperenhancement (APHE) and mild hypoechogenicity relative to the surrounding liver parenchyma, which refers to washout, between (1) 1-2 min and (2) 1-5 min after contrast injection, and (3) 1-min to the Kupffer phase. The Kupffer phase echogenicity for PFB-US was also evaluated. SHF-US imaging diagnosis of HCC was APHE and mild washout 1-min after contrast injection during a 5-min SHF-US examination. The diagnostic performance of SHF-US and PFB-US with different vascular phase were compared.*Results Eighty-nine participants with 89 observations (HCCs [n=61], non-HCC, malignancies [n=18], benign [n=10]) were evaluated. Among 61 HCCs, 54 (88.5%) in PFB-US and 56 (91.8%) in SHF-US showed nonrim APHE (p=0.73). Fifty-three HCCs (86.9%) in PFB-US and 51 (83.6%) in SHF-US showed mild washout (p=0.33). For the noninvasive diagnosis of HCC, PFB-US criterion 1 provided lower sensitivity (18.0%, 95%CI: 9.4-30.0%) than criterion 2 (52.5%, 95%CI: 39.3-65.4%), criterion 3 (52.5%, 95%CI: 39.3-65.4%), or SHF-US (47.5%, 95%CI: 34.6-90.7%). The specificity were 96.4% (95%CI: 81.7-99.9%) by criterion 1, 92.9% (95%CI: 76.5-99.1%) by criterion 2, 89.3% (95%CI: 71.8-97.7%) by criterion 3, and 96.4% (95%CI: 81.7-99.9%) by SHF-US. The Kupffer phase hypoechogenicity was more frequent in HCC (51/61, 83.6%; p=0.04) and non-HCC malignancies (17/18, 94.4%; p=0.02) than or benign lesions (5/10, 50.0%) but was not specific for HCC.*Conclusions To make a specific diagnosis of HCC using PFB-US, washout should be determined before 5-min after contrast injection.*Clinical Relevance/Application Perfluorobutane-enhanced ultrasound has different physiological characteristics from sulfur hexafluoride-enhanced ultrasound, but it is unclear whether HCC show similar wash-in and washout patterns. Our results would provide proper application of PFB-US to diagnose HCC.

RESULTS

Eighty-nine participants with 89 observations (HCCs [n=61], non-HCC, malignancies [n=18], benign [n=10]) were evaluated. Among 61 HCCs, 54 (88.5%) in PFB-US and 56 (91.8%) in SHF-US showed nonrim APHE (p=0.73). Fifty-three HCCs (86.9%) in PFB-US and 51 (83.6%) in SHF-US showed mild washout (p=0.33). For the noninvasive diagnosis of HCC, PFB-US criterion 1 provided lower

sensitivity (18.0%, 95%CI: 9.4-30.0%) than criterion 2 (52.5%, 95%CI: 39.3-65.4%), criterion 3 (52.5%, 95%CI: 39.3-65.4%), or SHF-US (47.5%, 95%CI: 34.6-90.7%). The specificity were 96.4% (95%CI: 81.7-99.9%) by criterion 1, 92.9% (95%CI: 76.5-99.1%) by criterion 2, 89.3% (95%CI: 71.8-97.7%) by criterion 3, and 96.4% (95%CI: 81.7-99.9%) by SHF-US. The Kupffer phase hypoechogenicity was more frequent in HCC (51/61, 83.6%; p=0.04) and non-HCC malignancies (17/18, 94.4%; p=0.02) than or benign lesions (5/10, 50.0%) but was not specific for HCC.

CLINICAL RELEVANCE/APPLICATION

Perfluorobutane-enhanced ultrasound has different physiological characteristics from sulfur hexafluoride-enhanced ultrasound, but it is unclear whether HCC show similar wash-in and washout patterns. Our results would provide proper application of PFB-US to diagnose HCC.

SPR-GI-29   Evaluation Of Intratumoral Vascular Structures Of Focal Liver Lesions Using Contrast-enhanced Ultrasonography And Post-processing Contrast Vector Imaging: A Prospective Study

Participants
Jeongin Yoo, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To demonstrate tumor-specific vascularization pattern of common focal liver lesions on post-processing contrast vector imaging (CVI), and to determine whether the combination of contrast-enhanced US and CVI can improve characterization of focal liver lesions.*Methods and Materials Between July 2019 and October 2020, 65 patients with focal lesions in the liver (HCC [n=18], non-HCC malignancy [n=13], and benign lesions [n=14]) were enrolled in this prospective study. Contrast-enhanced ultrasound (CEUS) using SonoVue® was performed with high frame rate contrast harmonic imaging technique by one of the two radiologists. Post-processing CVI including histogram of velocity was obtained and analyzed by the two radiologists independently and then in consensus.*Results Among 65 patients, post-processing CVI was technically successful in 53 patients (technical success rate, 81.5% [53/65]). There were significant differences in enhancement pattern (p=0.0023) and adjacent vascular structures (p=0.0009) on CVI among HCC (n=18), non-HCC malignancy (n=13), and benign groups (n=21); diffuse staining was frequent in HCC and benign groups, while peripheral rim was predominant in non-HCC malignancy. Regarding histogram pattern of velocity, there were no significant difference among three groups (p=0.315). However, significant difference was found between HCC and non-HCC groups (p=0.033); HCC group predominantly demonstrated variable distribution of velocity, whereas non-HCC group frequently showed low velocity.*Conclusions HCC, non-HCC, and benign groups demonstrated significantly different imaging features on CVI, including arterial enhancement pattern, adjacent vascular structures, and velocity histogram.*Clinical Relevance/Application Differences in imaging features on CVI could aid the diagnoses of focal liver lesions in addition to CEUS.

RESULTS

Among 65 patients, post-processing CVI was technically successful in 53 patients (technical success rate, 81.5% [53/65]). There were significant differences in enhancement pattern (p=0.0023) and adjacent vascular structures (p=0.0009) on CVI among HCC (n=18), non-HCC malignancy (n=13), and benign groups (n=21); diffuse staining was frequent in HCC and benign groups, while peripheral rim was predominant in non-HCC malignancy. Regarding histogram pattern of velocity, there were no significant difference among three groups (p=0.315). However, significant difference was found between HCC and non-HCC groups (p=0.033); HCC group predominantly demonstrated variable distribution of velocity, whereas non-HCC group frequently showed low velocity.

CLINICAL RELEVANCE/APPLICATION

Differences in imaging features on CVI could aid the diagnoses of focal liver lesions in addition to CEUS.

SPR-GI-30   Peritoneal Metastasis Score Based On CT Characteristics In The Prediction Of The Overall Survival Of Gastric Cancer Patients

Participants
Jia-Zheng Li, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop a peritoneal metastasis (PM) score based on CT characteristics (CT-PMS) to hierarchize gastric cancer (GC) patients with PM according to the life expectancy.*Methods and Materials This retrospective study enrolled 66 consecutive patients newly diagnosed as GC with synchronous PM. On CT, the manifestation of PM includes smudged appearance, multiple fibrosis strands, nodules, and omental cake. The following regions were assessed by radiologists: (1) gastrosplenic ligament(GSL); (2) gastrohepatic and hepatoduodenal ligament (GHL and HDL); (3) gastrocolic ligament (GCL); (4) peri-hepatic visceral peritoneum; (5) the mesenteries; (6) greater omentum; (7) superior parietal peritoneum; (8) posterior parietal peritoneum; (9) anterior parietal peritoneum; (10) pelvic parietal peritoneum. Based on the number of regions PM involved, the CT-PMS were acquired ranged from 0 to 10. We also recorded patients' age, gender, histology type of primary tumor, differentiation status of primary tumor, the location of primary tumor, the presence of linitis plastica, and the presence of extraperitoneal metastases.*Results The median OS was 315 days in all patients (range, 40-1440 days). We used X-tile plots to generate the optimal cutoff value of the CT-PMS as 2. CT-PMS >2 had great diagnostic accuracy for recognizing patients with OS < 100 days(sensitivity, 88.9%; specificity, 59.6%; accuracy, 63.6%; AUC, 0.743 [95% CI, 0.590-0.896]). Significant differences in OS were obtained between patients with CT-PMS >2 and patients with CT-PMS = 2 (P=0.006, log-rank test). Univariate analysis showed that CT-PMS >2 and the differentiation status were significant risk factors for reduced OS (P=0.007, P=0.045). Multivariate analysis showed that CT-PMS >2 was an independent risk factor for reduced OS (HR=1.965; 95% CI=1.168-3.306; P=0.011).*Conclusions The prognosis of PM patients depends on the extent of PM dissemination and patients with CT-PMS >2 had a dismal prognosis compared with those with CT-PMS = 2.*Clinical Relevance/Application CT-PMS provides a method for patient selection to identify the most optimal candidate and to avoid futile aggressive treatment including palliative gastrectomy, or treatment combining CRS and HIPEC.

RESULTS

The median OS was 315 days in all patients (range, 40-1440 days). We used X-tile plots to generate the optimal cutoff value of the CT-PMS as 2. CT-PMS >2 had great diagnostic accuracy for recognizing patients with OS < 100 days(sensitivity, 88.9%; specificity, 59.6%; accuracy, 63.6%; AUC, 0.743 [95% CI, 0.590-0.896]). Significant differences in OS were obtained between patients with CT-PMS >2 and patients with CT-PMS = 2 (P=0.006, log-rank test). Univariate analysis showed that CT-PMS >2 and the differentiation status were significant risk factors for reduced OS (P=0.007, P=0.045). Multivariate analysis showed that CT-PMS >2 was an independent risk factor for reduced OS (HR=1.965; 95% CI=1.168-3.306; P=0.011).

SPR-GI-31　A Nomogram Combining Radiomics Signature And Clinical Factors To Preoperatively Predict Histological Grade In Patients With Pancreatic Ductal Adenocarcinoma

Participants
Chunyuan Cen, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

In pancreatic ductal adenocarcinoma (PDAC), the histological grade is one of the most significant independent prognostic indicators of survival. In this study, we aimed to develop a nomogram integrating radiomics signature and clinical factors to preoperatively predict the histological grade of PDAC.*Methods and Materials A total of 182 patients with PDAC who underwent contrast-enhanced computed tomography (CECT) were enrolled, and were randomly divided into a training and validation cohort in an 8:2 ratio. 851 radiomics features were extracted from each arterial phase (AP) and portal venous phase (PVP) images. Maximum relevance minimum redundancy (mRMR) and least absolute shrinkage and selection operator regression (LASSO) were applied for feature selection, and then a radiomics signature was developed. Multivariable logistic regression analysis was used to develop the combined model, combining the radiomics signature and clinical factors. The Kaplan-Meier (KM) method was used for the overall survival (OS) analysis of tumor grades.*Results The radiomics signature showed favorable diagnostic efficacy, with the area under curves (AUCs) of the training and validation cohort of 0.870 and 0.812, respectively. The combined model, incorporating the radiomics signature, smoking status, CA12-5 level, maximum tumor diameter and cTNM, demonstrated better discrimination performance (training cohort: AUC = 0.896; validation cohort: AUC = 0.859) and calibration, outperforming the radiomics signature. The decision curve analysis (DCA) confirmed its clinical utility. KM analysis showed that the actual histological grade was significantly related to survival (P < 0.0001); that is, the higher grade the tumor was, the shorter the survival period. Moreover, the grade of histology predicted by our radiomics signature and combined nomogram were also related to survival (both P < 0.0001), which verified the accuracy of our models in predicting the histological grade.*Conclusions The radiomics signature was significantly associated with the histological grade of PDAC.The combined model integrating radiomics signature and clinical factors have the good diagnostic performance to preoperatively and non-invasively predict tumor grades in PDAC patients.The radiomics signature and the combined model were associated with OS may helpful for clinical decision-making and achieve a good survival outcome.*Clinical Relevance/Application The nomogram can serve as a preoperative, noninvasive, precise evaluation tool for histological grading of PDAC, which can help clinicians better tailor the treatment protocol for each patient and achieve better clinical outcomes.

RESULTS

The radiomics signature showed favorable diagnostic efficacy, with the area under curves (AUCs) of the training and validation cohort of 0.870 and 0.812, respectively. The combined model, incorporating the radiomics signature, smoking status, CA12-5 level, maximum tumor diameter and cTNM, demonstrated better discrimination performance (training cohort: AUC = 0.896; validation cohort: AUC = 0.859) and calibration, outperforming the radiomics signature. The decision curve analysis (DCA) confirmed its clinical utility. KM analysis showed that the actual histological grade was significantly related to survival (P < 0.0001); that is, the higher grade the tumor was, the shorter the survival period. Moreover, the grade of histology predicted by our radiomics signature and combined nomogram were also related to survival (both P < 0.0001), which verified the accuracy of our models in predicting the histological grade.

CLINICAL RELEVANCE/APPLICATION

The nomogram can serve as a preoperative, noninvasive, precise evaluation tool for histological grading of PDAC, which can help clinicians better tailor the treatment protocol for each patient and achieve better clinical outcomes.

SPR-GI-32　Impact Of LR-TR Category As A Predictor Of Recurrence After Curative Surgery For Hepatocellular Carcinoma Previously Treated With Locoregional Therapy: Risk Stratification Using Radiologic And Clinical Factors

Participants
Seo Yeon Youn, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

In HCC, locoregional therapy (LRT) is implemented as a bridging or downstaging treatment before curative surgery, but the impact of radiologic treatment response on the surgical outcome is little known. This study aimed to evaluate radiologic and clinical factors predicting recurrence-free survival (RFS) after curative surgery for LRT-treated HCC.*Methods and Materials This retrospective study included consecutive patients who underwent curative surgery for HCC after LRT from Dec 2010 to Nov 2016 and had baseline and post-LRT follow-up liver CT/MRI up to the point of surgery. Two radiologists assessed sequential treatment response with mRECIST and radiologic viable tumor by Liver Imaging Reporting and Data System treatment response (LR-TR) algorithm before surgery among other features. Clinical factors regarding LRT, laboratory data, and pathologic reports were collected. Uni- and multivariate Cox proportional hazard models determined factors predicting RFS and generated prognostic scores for risk stratification. RFS was analyzed by Kaplan-Meier method with log-rank test.*Results A total of 71 patients (mean age, 56 ± 10 years; 50 men) who received liver transplantation (53.5%; 38/71) or resection (46.5%; 33/71) were evaluated. During the median follow-up period of 64.0 months (range, 1-122 months), 28 (39.4%) recurrences were observed. Multivariate analysis revealed LR-TR viable category (Hazard ratio [HR] = 3.66; 95% confidence interval [CI], 1.02-13.2; P = 0.047) but not the pathologic viable tumor as a significant factor along with pre-operative AFP level > 200 ng/mL (HR = 4.14; 95% CI, 1.83-9.4; P = 0.001), greater number of LRT sessions (HR = 1.23; 95% CI, 1.1-1.39; P = 0.001), and resection compared to liver transplantation (HR = 3.46; 95% CI, 1.42-8.42; P = 0.006). Based on the multivariate analysis, risk scores were assigned as follows: high AFP level and LR-TR viable category, 2 points; resection, 1 point; number of LRT sessions, 1-2 points. The Kaplan-Meier curves for RFS showed significant risk stratification among three groups: = 4 points (high risk, 5-year RFS rate 19.0%), 2-3 points (intermediate risk, 63.6%%) and 0-1 points (low risk, 89.3%) (all log-rank Ps, < 0.025).*Conclusions Risk scoring system based on LR-TR viable category, high pre-operative AFP level, greater number of LRT, surgery type of resection effectively stratified risk of recurrence after curative surgery for LRT-treated HCC.*Clinical Relevance/Application LR-TR viable category on pre-operative image is a significant predictor of recurrence after curative surgery for LRT-treated HCC.

RESULTS

A total of 71 patients (mean age, 56 ± 10 years; 50 men) who received liver transplantation (53.5%; 38/71) or resection (46.5%; 33/71) were evaluated. During the median follow-up period of 64.0 months (range, 1-122 months), 28 (39.4%) recurrences were observed. Multivariate analysis revealed LR-TR viable category (Hazard ratio [HR] = 3.66; 95% confidence interval [CI], 1.02-13.2; P = 0.047) but not the pathologic viable tumor as a significant factor along with pre-operative AFP level > 200 ng/mL (HR = 4.14; 95% CI, 1.83-9.4; P = 0.001), greater number of LRT sessions (HR = 1.23; 95% CI, 1.1-1.39; P = 0.001), and resection compared to liver transplantation (HR = 3.46; 95% CI, 1.42-8.42; P = 0.006). Based on the multivariate analysis, risk scores were assigned as follows: high AFP level and LR-TR viable category, 2 points; resection, 1 point; number of LRT sessions, 1-2 points. The Kaplan-Meier curves for RFS showed significant risk stratification among three groups: = 4 points (high risk, 5-year RFS rate 19.0%), 2-3 points (intermediate risk, 63.6%%) and 0-1 points (low risk, 89.3%) (all log-rank Ps, < 0.025).

CLINICAL RELEVANCE/APPLICATION

LR-TR viable category on pre-operative image is a significant predictor of recurrence after curative surgery for LRT-treated HCC.

SPR-GI-33 Contrast-enhanced Ultrasound Liver Imaging Reporting And Data System V2017:patient Outcomes For Early-stage Hepatocellular Carcinoma Nodules With Category 3-5 And Category M

Participants
Yixin Hu, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate relationship between outcomes in patients with HCC at early-stage after initial therapy and retrospectively-assigned LI-RADS categories (LR 3-5 vs LR-M) at CEUS.*Methods and Materials In this retrospective study, 272 patients with high risks for HCC and solitary clinically or pathologically-confirmed HCC were identified between January 2010 and December 2015. Patients were initially treated by resection or radiofrequency ablation (RFA) according to the Barcelona Clinic Liver Cancer (BCLC) staging system and were follow-up until December 31, 2018. Recurrence-free survival (RFS) and overall survival (OS) were compared between nodules assigned as LR 3-5 or LR M according to CEUS LI-RADS v2017 by using the Kaplan-Meier curve, log-rank test, and Cox proportional hazard model. RFS and OS were also compared across each treatment and three treatments for each category.*Results There was no significantly difference in the liver background, clinically significant portal hypertension (CSPH), differentiation of hepatocytes, nodules sizes as well as treatment procedures and complete treatment reaction between LR-3-5 and LR-M patients (P>0.05). At both univariable and multivariable analysis, treatment procedures and LI-RADS category showed an independent correlation with OS and RFS (P <0.05). LR 3-5 category were more correlated with better OS compared with LR-M (88.6 months and 74.2 months, respectively; P =0.017). Surgical resection demonstrated longer OS and RFS than RFA in LR-M patients and longer OS in LR 3-5 patients (P <0.05). Besides, there was no significantly difference in OS and RFS between LR 3-5 and LR-M patients (P >0.05) in resection, while for patients treated with RFA, LR 3-5 patients showed significant longer OS and RFS than LR-M patients (P <0.05).*Conclusions Patients with HCC assigned as LR-M showed worse RFS and OS and surgical resection tended to be a more effective treatment for these patients.*Clinical Relevance/Application This study was aimed to investigate the feasibility of classification according to CEUS LI-RADS to predict the prognosis of early-stage hepatocellular carcinoma and guide the therapy decision

RESULTS

There was no significantly difference in the liver background, clinically significant portal hypertension (CSPH), differentiation of hepatocytes, nodules sizes as well as treatment procedures and complete treatment reaction between LR-3-5 and LR-M patients (P>0.05). At both univariable and multivariable analysis, treatment procedures and LI-RADS category showed an independent correlation with OS and RFS (P <0.05). LR 3-5 category were more correlated with better OS compared with LR-M (88.6 months and 74.2 months, respectively; P =0.017). Surgical resection demonstrated longer OS and RFS than RFA in LR-M patients and longer OS in LR 3-5 patients (P <0.05). Besides, there was no significantly difference in OS and RFS between LR 3-5 and LR-M patients (P >0.05) in resection, while for patients treated with RFA, LR 3-5 patients showed significant longer OS and RFS than LR-M patients (P <0.05).

CLINICAL RELEVANCE/APPLICATION

This study was aimed to investigate the feasibility of classification according to CEUS LI-RADS to predict the prognosis of early-stage hepatocellular carcinoma and guide the therapy decision

SPR-GI-35 Deep-learning Assisted Ultrasound Of The Gallbladder For Detection Of Malignancy

Participants
Pankaj Gupta, MD, Chandigarh, India (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the performance of deep learning (DL)-assisted ultrasound (US) for detection of gallbladder cancer.*Methods and Materials This IRB-approved prospective study comprised consecutive patients with gallbladder diseases who underwent US of the gallbladder. US evaluation was performed by two reviewers. The US images were anonymized and labeled using a single free-size axis-aligned rectangular box spanning the gallbladder. Another similar axis-aligned box was used for the pathological segments of the gallbladder. Multiple boxes were drawn in a single image if more than one finding was detected. A two-staged DL-model was utilized. In the first stage, gallbladder segmentation was performed using YOLOv4, Faster-RCNN, Reppoints, and CentripetalNet. In stage two, ResNet50 classification architecture was used to classify images into normal, benign, and malignant. Visual acuity (VA)-based curriculum learning was also used. For training in both the stages, data augmentation, and transfer learning techniques were utilized to improve the performance of the networks and prevent overfitting. The performance of the gallbladder detection algorithms was assessed using precision, recall, and mean intersection over union (mIoU). For classification of gallbladder abnormality, sensitivity, specificity, and area under the curve (AUC) were used.*Results Two hundred eighteen patients (1255 images) underwent US evaluation of the gallbladder during the study period. For algorithm training,1134 images were selected randomly. The normal, benign, and malignant classes included 402, 511, and 221 images respectively. For testing the algorithm, the rest of the 121 images were used (30 normal, 47 benign and 44malignant). The Faster-RCNN model had the best performance for the detection of gallbladder (mIoU 0.765, recall 0.994, and precision 0.937). The image classification model had sensitivity, specificity, and AUC of 89%, 86%, and 0.95, respectively. With the addition of VA-based curriculum learning, the performance improved (sensitivity 93%, specificity 97%, and AUC 0.98).*Conclusions The DL-based approach may improve the accuracy of detection of GBC on US. Larger studies with validation across different patient groups and specific gallbladder diseases may allow widespread application of this tool.*Clinical Relevance/Application DL-based US has the potential to improve the performance of radiologist for the characterization of gallbladder abnormalities.

RESULTS

Two hundred eighteen patients (1255 images) underwent US evaluation of the gallbladder during the study period. For algorithm training,1134 images were selected randomly. The normal, benign, and malignant classes included 402, 511, and 221 images respectively. For testing the algorithm, the rest of the 121 images were used (30 normal, 47 benign and 44malignant). The Faster-RCNN model had the best performance for the detection of gallbladder (mIoU 0.765, recall 0.994, and precision 0.937). The image classification model had sensitivity, specificity, and AUC of 89%, 86%, and 0.95, respectively. With the addition of VA-based curriculum learning, the performance improved (sensitivity 93%, specificity 97%, and AUC 0.98).

CLINICAL RELEVANCE/APPLICATION

DL-based US has the potential to improve the performance of radiologist for the characterization of gallbladder abnormalities.

SPR-GI-36 Semi-automated Classification Of Intestinal Fibrosis In Patients With Crohn'S Disease Using Computed Tomography Enterography Based Deep Learning

Participants
Jixin Meng, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Accurate evaluation of bowel fibrosis in Crohn's disease (CD) remains difficult. Computed tomography enterography (CTE) based radiomics reportedly enabled to assess bowel fibrosis, but it still existed deficiencies including significant time consumption. We aimed to develop and validate a CTE based deep learning model (DLM) for characterization of bowel fibrosis more efficiently and precisely.*Methods and Materials 235 patients with 312 resected bowel segments from three tertiary referral hospitals were enrolled in this retrospective and multicenter study. Data of training cohort and test cohort 1 were from center 1, data of test cohort 2 were from center 2 and 3. The transmural fibrosis severity was semi-quantitatively assessed. The interpretation of preoperative CTE was independently performed by two radiologists. Regions of interest (ROI) were annotated by the radiologists on venous phase CTE. A DLM was constructed in the training cohort using a 3D deep convolutional neural network based on ResNet, and an independent external validation was conducted on the multicenter test cohort. The radiomics model (RM) was developed as per the reported approach. The DeLong test and non-inferiority test were used to compare the ROC curves among the DLM, radiologists' interpretation and RM.*Results The DLM distinguished none-mild from moderate-severe bowel fibrosis with an AUC of 0.828 (P<0.001) in the training cohort and also exhibited robust performance in the total test cohort, test cohort 1 and 2 (AUC=0.811, 0.808 and 0.839, respectively; all P<0.001). In the total test cohort, DLM achieved better classification performance than that of two radiologists' interpretation (*1 AUC= 0.579, *2 AUC= 0.646, both P<0.05) and was not inferior to that of RM (AUC= 0.813, Z=3.869 > Z0.05=1.645). The time of feature extraction and selection for DLM (1.26 ± 0.55 s) was shorter than that of RM (811.21±1216.40 s, P<0.001).*Conclusions The performance of CTE based DLM in distinguishing moderate-severe and none-mild intestinal fibrosis in CD patients is better than radiologists' interpretation and not inferior to the RM in a more time-saving approach.*Clinical Relevance/Application In general, this study indicates the wide clinical application potential of a DLM for semi-automated identification and accurate binary classification of intestinal fibrosis in CD patients on CTE.

RESULTS

The DLM distinguished none-mild from moderate-severe bowel fibrosis with an AUC of 0.828 (P<0.001) in the training cohort and also exhibited robust performance in the total test cohort, test cohort 1 and 2 (AUC=0.811, 0.808 and 0.839, respectively; all P<0.001). In the total test cohort, DLM achieved better classification performance than that of two radiologists' interpretation (*1 AUC= 0.579, *2 AUC= 0.646, both P<0.05) and was not inferior to that of RM (AUC= 0.813, Z=3.869 > Z0.05=1.645). The time of feature extraction and selection for DLM (1.26 ± 0.55 s) was shorter than that of RM (811.21±1216.40 s, P<0.001).

CLINICAL RELEVANCE/APPLICATION

In general, this study indicates the wide clinical application potential of a DLM for semi-automated identification and accurate binary classification of intestinal fibrosis in CD patients on CTE.

SPR-GI-37 Spleen Stiffness - A Determinant Of Portal Hypertension With Esophageal Varices

Participants
Rajul Rastogi, MD, Greater Noida, India (*Presenter*) Nothing to Disclose

PURPOSE

Liver & spleen play a vital role in the splanchnic circulation. Variety of etiological agents can cause irreversible injury to hepatic cells leading to fibrosis & ultimately cirrhosis which is manifested in form of clinically significant portal hypertension and its complications including formation of varices at lower end of esophagus. Esophageal varices, an important cause of morbidity & mortality in cirrhotic patients can be diagnosed by upper gastrointestinal endoscopy and are managed according to various parameters. Recently, there is a growing interest in utilizing spleen stiffness by sonoelastography to predict portal hypertension & its complication viz. esophageal varices. Aims & Objectives: Our study aimed to determine the association of splenic stiffness with portal hypertension and esophageal varices.*Methods and Materials Sixty patients of portal hypertension, diagnosed clinically, radiologically & biochemically and those who were candidates for upper gastrointestinal endoscopy were evaluated by sonoelastography using Acoustic Radiation Forced Impulse technique to obtain mean value of spleen stiffness prior to endoscopy following IEC approval & written informed consent. The spleen stiffness measurements were then correlated with findings of endoscopy to calculate the cut-off values and various statistical parameters. In addition, spleen stiffness values were also measured in normal subjects who served as controls.*Results Spleen stiffness is significantly higher in patients of portal hypertension than in normal subjects (3.53+0.40m/s vs 2.24+0.29m/s). Furthermore, it is higher in patients of portal hypertension with esophageal varices than those without them (3.57m/s vs 3.18m/s). Mean SS value of >2.53m/s for predicting portal hypertension yielded the sensitivity, specificity and accuracy, 98.3%, 86.7%, and 92.5% respectively while mean SS value of >3.15m/s for predicting PHTN with EV, yielded the sensitivity, specificity, and accuracy, 87%, 66.7%, and 85% respectively.*Conclusions Mean spleen stiffness values are higher in patients with clinically significant portal hypertension than normal subjects with further higher values seen in patients of portal hypertension with esophageal varices. Hence, spleen stiffness measurement can be used as a non-invasive imaging tool for screening patients with portal hypertension as well as those with portal hypertension & esophageal varices.*Clinical Relevance/Application Utilizing noninvasive sonoelastography in predicting portal hypertension with esophageal varices can help time the invasive upper gastrointestinal endoscopy for appropriate management and not just for diagnosis of esophageal varices.

RESULTS

Spleen stiffness is significantly higher in patients of portal hypertension than in normal subjects (3.53+0.40m/s vs 2.24+0.29m/s). Furthermore, it is higher in patients of portal hypertension with esophageal varices than those without them (3.57m/s vs 3.18m/s). Mean SS value of >2.53m/s for predicting portal hypertension yielded the sensitivity, specificity and accuracy, 98.3%, 86.7%, and 92.5% respectively while mean SS value of >3.15m/s for predicting PHTN with EV, yielded the sensitivity, specificity, and accuracy, 87%, 66.7%, and 85% respectively.

CLINICAL RELEVANCE/APPLICATION

Utilizing noninvasive sonoelastography in predicting portal hypertension with esophageal varices can help time the invasive upper gastrointestinal endoscopy for appropriate management and not just for diagnosis of esophageal varices.

SPR-GI-38 Non-invasive Prediction Of KRAS Mutation In Rectal Cancer From T2-weighted MR Images And Clinical Risk Factors Using Deep Learning

Participants
Huanhuan Liu, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop diagnostic models using deep learning method based on T2-weighted MR images and clinical factors for preoperatively predicting the KRAS mutation of rectal cancer.*Methods and Materials A total of 360 consecutive patients with histopathologically confirmed rectal adenocarcinoma (development cohort, n = 288; independent testing cohort, n = 72) were retrospectively enrolled in this study. All patients underwent preoperative high-resolution MR examinations and the postoperative KRAS mutation status was pathologically diagnosed. Risk factors including clinical characteristics and MR features were extracted from medical reports. A clinical model was constructed on risk factors via multivariable logistic regression analysis, and two deep learning models based on modified MobileNetV2 architecture were proposed for predicting KRAS mutation based on MR images alone (Image model) or both MR images and clinical risk factors (Combined model). The performance of these predictive models was evaluated by receiver operating characteristics curve (ROC) analysis, calibration curve, and decision curve analysis (DCA).*Results Seven MR features and four clinical characteristics were selected as risk factors for model development. The AUCs of the clinical model, image model and combined model were 0.671 (95% CI, 0.614~0.725), 0.791 (95% CI, 0.739~0.836) and 0.850 (95% CI, 0.804~0.889) in the development cohort, respectively. The performance of these models was validated in the testing cohort with good calibration, with AUCs achieving 0.653 (95% CI, 0.532~0.761), 0.760 (95% CI, 0.645~0.853) and 0.815 (95% CI, 0.706~0.897). Delong's test indicated the combined model showed improved performance than the clinical model (p = 0.060) and image model (p = 0.483). DCA confirmed net benefit of the combined model was higher than other models across majority range of threshold probabilities.*Conclusions The proposed deep learning model incorporating T2-weighted MR images and clinical risk factors shows good predictive efficacy and can be served as a non-invasive method for predicting KRAS mutation in rectal cancer.*Clinical Relevance/Application The proposed deep learning model shows favorable performance in preoperatively predicting KRAS mutation via integrating T2-weighted MR images and clinical risk factor in patients with rectal cancer.

RESULTS

Seven MR features and four clinical characteristics were selected as risk factors for model development. The AUCs of the clinical model, image model and combined model were 0.671 (95% CI, 0.614~0.725), 0.791 (95% CI, 0.739~0.836) and 0.850 (95% CI, 0.804~0.889) in the development cohort, respectively. The performance of these models was validated in the testing cohort with good calibration, with AUCs achieving 0.653 (95% CI, 0.532~0.761), 0.760 (95% CI, 0.645~0.853) and 0.815 (95% CI, 0.706~0.897). Delong's test indicated the combined model showed improved performance than the clinical model (p = 0.060) and image model (p = 0.483). DCA confirmed net benefit of the combined model was higher than other models across majority range of threshold probabilities.

CLINICAL RELEVANCE/APPLICATION

The proposed deep learning model shows favorable performance in preoperatively predicting KRAS mutation via integrating T2-weighted MR images and clinical risk factor in patients with rectal cancer.

SPR-GI-39 Esophageal Squamous Cell Carcinoma: Correlation Of Tumor Size On Pre-treatment Mri With Recurrent Free Survival And Overall Survival

Participants
Wang Shaoyu, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To retrospectively investigate the prognostic value of MRI in patients with esophageal squamous cell carcinoma (ESCC).*Methods and Materials A total of 558 patients diagnosed with ESCC and had pre-treatment MRI between October 2014 and May 2017 were included in this retrospective study. Tumor length and thickness were measured on pre-treatment MRI by two readers. Kappa analysis was conducted to evaluate inter-reader agreement. The relationships between MR measurable features and overall survival (OS) as well as recurrent free survival (RFS) were evaluated by Cox regression model adjusting for clinical features. All analysis was conducted in SATA 13.0.*Results The final cohort included 506 ESCC patients (345 men, 68.2%); mean age ± standard deviation, 62.7 years ± 8.3). Mean RFS and OS was 44.0 months (95% CI, 41.6-46.5), and 45.6 months (95% CI, 43.2-48.0), respectively. Inter-reader agreements of MRI Tumor length and thickness were substantial or perfect (Kappa=0.953, 0.929, all P<0.001). At baseline, of the imaging parameters derived from MRI, tumor thickness and tumor length were predictors of RFS and OS. In multivariate analysis, only MRI tumor thickness predicted RFS and OS. MRI tumor thickness of > 12 mm was the only independent variable associated with RFS and OS.*Conclusions MRI tumor thickness > 12 mm was associated with great risk of recurrent free survival (RFS) and overall survival (OS) in patients with esophageal squamous cell carcinoma (ESCC).*Clinical Relevance/Application Tumor thickness > 12 mm at baseline MRI was associated with worse survival in patients with ESCC.

RESULTS

The final cohort included 506 ESCC patients (345 men, 68.2%); mean age ± standard deviation, 62.7 years ± 8.3). Mean RFS and OS was 44.0 months (95% CI, 41.6-46.5), and 45.6 months (95% CI, 43.2-48.0), respectively. Inter-reader agreements of MRI Tumor length and thickness were substantial or perfect (Kappa=0.953, 0.929, all P<0.001). At baseline, of the imaging parameters derived from MRI, tumor thickness and tumor length were predictors of RFS and OS. In multivariate analysis, only MRI tumor thickness predicted RFS and OS. MRI tumor thickness of > 12 mm was the only independent variable associated with RFS and OS.

CLINICAL RELEVANCE/APPLICATION

Tumor thickness > 12 mm at baseline MRI was associated with worse survival in patients with ESCC.

SPR-GI-4 Deep Network Segmentation Of The Normal Pancreas And Abnormal Pancreas With Pancreatic Ductal Adenocarcinoma On CT: Can Deep Network Segmentation Replace Manual Segmentation?

Participants
Satomi Kawamoto, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Accurate segmentation is necessary for AI based volumetric analyses of the pancreas. The purpose of the study is to quantitatively and qualitatively evaluate accuracy of deep network (DN) prediction of the normal and abnormal pancreas with pancreatic ductal adenocarcinoma (PDAC) on CT.*Methods and Materials Fifty-one potential renal donors without pancreatic abnormality (male=22, female=29, average age: 46±11 years) and 51 patients with PDAC (male=24, female=27, average age: 68±10 years) who had dedicated pancreas protocol CT between 2007 and 2018 were retrospectively evaluated. Venous phase CT data reconstructed at 0.75/0.5mm thickness/increment were used for analysis. Among variations of deep networks, the ResDSN (residual deep supervision network) developed for pancreatic tumor segmentation was used. For the training of the deep network, the entire pancreas (including PDAC) was segmented as 3D volumes in both groups by manual segmentation by experienced researchers supervised by radiologists and using the deep network. DICE similarity coefficients were calculated. Two experienced radiologists independently evaluated accuracy of DN prediction assigning score from 10 to 1 by estimated volume of correctly predicted pancreas (10:100%; 9:95-99%; 8:90-94%; 7:85-89%;...; 2:60-65%; 1:<60%), and recorded the areas of discrepancy.*Results DICE similarity coefficients was 87.7±3.2% [95% confidence interval: 78.6-92.4%] for normal pancreas, and 84.9±3.9% [72.8-93.0%] for abnormal pancreas with PDAC. Average score of DN prediction by each radiologist was 9.49±0.54 and 9.69±0.55 for normal pancreas, and 9.04±0.92 and 8.68±1.0 for abnormal pancreas with PDAC. The scores were agreed between the two radiologists in 35 cases (68.6%) and 23 cases (45.1%) for normal and abnormal pancreas, respectively. All normal pancreas were graded higher than score 7, and 61.8% of normal pancreas were graded as score 10 by average. All abnormal pancreas with PDAC were graded higher than score 5, and 30.4% were graded as score 10 by average. Minor discrepancy along the border of the pancreatic head and duodenum was the most common cause of incorrect prediction, with borders of the pancreas (tail, head or uncinate process) or peripancreatic vessels being less common causes in normal pancreas. A part of tumor and/or atrophic upstream pancreas were the additional causes for incorrect prediction in abnormal pancreas with PDAC.*Conclusions DN prediction of pancreas is highly accurate in normal pancreas and moderately accurate with abnormal pancreas with PDAC.*Clinical Relevance/Application DN prediction of pancreas is accurate and can be applied for AI based volumetric analyses in many cases. Minor manual editing may be necessary, more commonly in PDAC cases.

RESULTS

DICE similarity coefficients was 87.7±3.2% [95% confidence interval: 78.6-92.4%] for normal pancreas, and 84.9±3.9% [72.8-93.0%] for abnormal pancreas with PDAC. Average score of DN prediction by each radiologist was 9.49±0.54 and 9.69±0.55 for normal pancreas, and 9.04±0.92 and 8.68±1.0 for abnormal pancreas with PDAC. The scores were agreed between the two radiologists in 35 cases (68.6%) and 23 cases (45.1%) for normal and abnormal pancreas, respectively. All normal pancreas were graded higher than score 7, and 61.8% of normal pancreas were graded as score 10 by average. All abnormal pancreas with PDAC were graded higher than score 5, and 30.4% were graded as score 10 by average. Minor discrepancy along the border of the pancreatic head and duodenum was the most common cause of incorrect prediction, with borders of the pancreas (tail, head or uncinate process) or peripancreatic vessels being less common causes in normal pancreas. A part of tumor and/or atrophic upstream pancreas were the additional causes for incorrect prediction in abnormal pancreas with PDAC.

CLINICAL RELEVANCE/APPLICATION

DN prediction of pancreas is accurate and can be applied for AI based volumetric analyses in many cases. Minor manual editing may be necessary, more commonly in PDAC cases.

SPR-GI-40 Deep Learning Based Image Reconstruction Of 40-keV Virtual Monoenergetic Dual-energy CT For The Assessment Of Hypovascular Hepatic Metastasis: Comparison With Standard Linear Blended Images Regarding Image Quality And Lesion Detection

Participants
Taehee Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To compared the image quality and the diagnostic performance in the detection of hypovascular hepatic metastasis of deep learning model (DLM) reconstructed, low virtual monoenergetic imaging (VMI) from dual energy CT (DECT), compared with standard linear blended images (simulated 100kVp) using advanced modeled iterative reconstruction (ADMIRE).*Methods and Materials The intuitional review board approved this retrospective study and waived informed consent. 131 patients (68 with metastases and 63 without) underwent contrast enhanced DECT (80-and 150-kVp with a tin filter) during the portal venous phase. DECT were reconstructed into a linearly blended image with a blending factor of 0.6 (60% 80kVp and 40% 150kVp), using ADMIRE, representing the standard 100-kVp acquisitions. DECT data were post-processed for 40-keV VMI using an advanced image-based reconstruction algorithm (Mono+), and these data were subsequently reconstructed using DLM (DLM 40keV VMIs). The CT attenuation and the image noise of various sites, including the metastatic lesion and the hepatic parenchyma were measured on three image sets: standard 40keV VMIs, linear blended images, and DLM 40keV VMIs. The contrast-to-noise ratios (CNRs) of the metastatic lesion to the liver were calculated. The edge rise gradient (ERG) was measured as an indicator of image sharpness at the hepatic artery and portal vein. Three abdominal radiologists independently assessed each of the three image sets with regard to image contrast, image noise, image sharpness, lesion conspicuity, diagnostic acceptability, and artificial sensation. They were asked to mark liver lesions and rate the probability of malignancy on a five-point confidence scale. Noninferiority analysis using jackknife alterative free-response ROC (JAFROC) was performed.*Results The DLM 40-keV VMIs showed a higher CNR, SNR, and better image contrast, image quality, lesion conspicuity, and diagnostic acceptability than 40-keV VMI and linear blended images using ADMIRE (p < 0.001). The average ESGs of DLM 40-keV VMIs were significantly higher than those of standard 40-keV VMI and linear blended images (p = 0.002, p < 0.001). In terms of lesion detection, reader-averaged JAFROC figure of merit (FOM) was significantly higher on the DLM 40-keV VMIs than on the 40-keV VMI (p < 0.05). The non-inferiority of the DLM 40-keV VMIs for metastases detection compared with simulated 100kVp using ADMIRE was confirmed.*Conclusions DLM based reconstruction of 40keV VMIs provides better image quality and non-inferior diagnostic performance for the detection of hepatic metastasis compared with standard linear blended images with ADMIRE.*Clinical Relevance/Application DLM based reconstruction of 40keV VMIs improves the depiction of hepatic metastasis.

RESULTS

The DLM 40-keV VMIs showed a higher CNR, SNR, and better image contrast, image quality, lesion conspicuity, and diagnostic acceptability than 40-keV VMI and linear blended images using ADMIRE (p < 0.001). The average ESGs of DLM 40-keV VMIs were significantly higher than those of standard 40-keV VMI and linear blended images (p = 0.002, p < 0.001). In terms of lesion detection, reader-averaged JAFROC figure of merit (FOM) was significantly higher on the DLM 40-keV VMIs than on the 40-keV VMI (p < 0.05). The non-inferiority of the DLM 40-keV VMIs for metastases detection compared with simulated 100kVp using ADMIRE was confirmed.

CLINICAL RELEVANCE/APPLICATION

DLM based reconstruction of 40keV VMIs improves the depiction of hepatic metastasis.

SPR-GI-41 Feasibility Of Contrast-enhanced T1-weighted Magnetic Resonance Enterography Using Compressed Sensing-sensitivity Encoding In Patients With Crohn's Disease

Participants
Jeongyun Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of using contrast enhanced magnetic resonance enterography (CE-MRE) with combined compressed sensing (CS) sensitivity encoding (SENSE) in Crohn's disease (CD).*Methods and Materials This retrospective study included patients with CD who underwent CE-MRE between June 2020 and September 2020. Both coronal T1-weighted enteric and portal phase images were obtained for all patients. Images for either the enteric or portal phase were randomly obtained using SENSE (acceleration factor 3), and images for the other phase were obtained using CS-SENSE (acceleration factor 5). Qualitative parameters evaluated by two radiologists were compared between SENSE and CS-SENSE using the Wilcoxon signed-rank test. The generalized estimating equation was used to compare diagnostic performances for the detection of active CD inflammation in 115 bowel segments.*Results A total of 41 patients (mean age ± standard deviation [SD], 34 ± 12 years; 31 men) were evaluated. The acquisition times of CE-MRE with CS-SENSE (mean ± SD, 11.5 ± 0.8 s) were shorter (33%) than SENSE (17.2 ± 1.1 s, P < .001). Image quality was better for CS-SENSE (4.2 ± 0.7) than SENSE (3.7 ± 1.1, P = .02). Fewer motion artifacts were observed with CS-SENSE than SENSE (4.0 ± 0.8 vs. 3.6 ± 1.2, P = .01). Regarding the diagnostic performance of CE-MRE, sensitivity (92% [67/73] vs. 80% [58/73], P = .01) and accuracy (91% [105/115] vs. 86% [99/115], P = .002) were higher with CS-SENSE compared to SENSE for reader 2. For reader 1, the two techniques were not significantly different (Ps = 0.08).*Conclusions CS-SENSE can improve the image quality of CE-MRE with shorter scan times compared to SENSE, and this may enhance the overall diagnostic performance of CE-MRE for CD.*Clinical Relevance/Application CS-SENSE can improve the image quality of CE-MRE while reducing scan times compared to SENSE, which may enhance the overall diagnostic performance of CE-MRE for CD.

RESULTS

A total of 41 patients (mean age ± standard deviation [SD], 34 ± 12 years; 31 men) were evaluated. The acquisition times of CE-MRE with CS-SENSE (mean ± SD, 11.5 ± 0.8 s) were shorter (33%) than SENSE (17.2 ± 1.1 s, P < .001). Image quality was better for CS-SENSE (4.2 ± 0.7) than SENSE (3.7 ± 1.1, P = .02). Fewer motion artifacts were observed with CS-SENSE than SENSE (4.0 ± 0.8 vs. 3.6 ± 1.2, P = .01). Regarding the diagnostic performance of CE-MRE, sensitivity (92% [67/73] vs. 80% [58/73], P = .01) and accuracy (91% [105/115] vs. 86% [99/115], P = .002) were higher with CS-SENSE compared to SENSE for reader 2. For reader 1, the two techniques were not significantly different (Ps = 0.08).

CLINICAL RELEVANCE/APPLICATION

CS-SENSE can improve the image quality of CE-MRE while reducing scan times compared to SENSE, which may enhance the overall diagnostic performance of CE-MRE for CD.

SPR-GI-42 Role Of Magnetic Resonance Elastography For Risk Stratification In Patients With Decompensated Cirrhosis

Participants
Jie Zhu, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

There is an established need for methods to predict risk of mortality in patients with decompensated cirrhosis. Magnetic resonance elastography (MRE) provides a quantitative biomarker in the form of liver stiffness that spans a large range (~5-10kPa) in patients who all have the same biopsy diagnosis of F4 fibrosis. The goal of this retrospective study was to assess the association between liver shear stiffness (LSS) measured by MRE and different states of decompensated cirrhosis, and to investigate the ability of LSS to predict the risk of transition from the first decompensation to further decompensation.*Methods and Materials In patients with decompensated cirrhosis who received MRE (2015-2019), a baseline cohort and follow-up cohort (patients with a first decompensated event) were established. Multivariate logistic regression analysis was used to analyze the relationship between LSS and the state of further decompensation in the baseline cohort. Cox proportional hazard analysis was used to determine the association between LSS and the development of further decompensation.*Results In the baseline cohort (n = 427), liver shear stiffness was significantly higher in 218 patients with further decompensation (6.77 kPa, IQR 5.25-8.86) than in 209 patients with the first decompensation (5.89, IQR 4.57-7.27). After adjustment for age, gender, etiology, Serum sodium, Model for End Stage Liver Disease score, white blood cell, and platelet count, LSS (odds, OR=1.106, 95%CI 1.005-1.217) was independently associated with further decompensation at baseline. In the follow-up cohort, 39 (23%) of 167 patients with the first decompensation developed further decompensation over a median follow-up of 30 months. The hazard of further decompensation was 1.281 (95% CI 1.111-1.478) per unit increase in LSS value over time. Among the first decompensated patients, the subgroup with LSS = 6.715 kPa has a hazard ratio of 4.030(95% CI 2.092-7.764, p<0.001) to develop further hepatic decompensation compared to subjects with LSS<6.715.*Conclusions Baseline LSS assessed by MRE is independently associated with further decompensated patients. LSS can predict the risk from a low-risk group transition to a high-risk group in patients with decompensated cirrhosis.*Clinical Relevance/Application The prognosis was significantly poor in cirrhotic patients with further decompensation than with the first decompensation. MRE is a non-invasive method reflecting distinct states of decompensated cirrhosis. LSS may be as an effective risk stratification tool in patients with decompensated cirrhosis, identifying a high-risk cohort for intensive management.

RESULTS

In the baseline cohort (n = 427), liver shear stiffness was significantly higher in 218 patients with further decompensation (6.77

kPa, IQR 5.25-8.86) than in 209 patients with the first decompensation (5.89, IQR 4.57-7.27). After adjustment for age, gender, etiology, Serum sodium, Model for End Stage Liver Disease score, white blood cell, and platelet count, LSS (odds, OR=1.106, 95%CI 1.005-1.217) was independently associated with further decompensation at baseline. In the follow-up cohort, 39 (23%) of 167 patients with the first decompensation developed further decompensation over a median follow-up of 30 months. The hazard of further decompensation was 1.281 (95% CI 1.111-1.478) per unit increase in LSS value over time. Among the first decompensated patients, the subgroup with LSS = 6.715 kPa has a hazard ratio of 4.030(95% CI 2.092-7.764, p<0.001) to develop further hepatic decompensation compared to subjects with LSS<6.715.

CLINICAL RELEVANCE/APPLICATION

The prognosis was significantly poor in cirrhotic patients with further decompensation than with the first decompensation. MRE is a non-invasive method reflecting distinct states of decompensated cirrhosis. LSS may be as an effective risk stratification tool in patients with decompensated cirrhosis, identifying a high-risk cohort for intensive management.

SPR-GI-44   Comparison Of Dual-layer Spectral CT And Contrast-enhanced MRI For The Diagnosis Of Focal Liver Lesions Using The Liver Imaging Reporting And Data System(lR-RADS) Version 2018

Participants
Wenqi Shi, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the Liver Imaging Reporting and Data System (LIRADS) version 2018 categorization of focal liver lesions (FLLs) on dual-layer spectral CT (DLSCT) in comparison with contrast-enhanced MRI (CE-MRI)*Methods and Materials 84 high-risk patients with 115 focal liver lesions (FLLs) who underwent both DLSCT and MRI within one month interval were retrospectively studied. The virtual monoenergetic images (VMIs) at 40keV derived from DLSCT in arterial and portal venous phases were reconstructed. The best available reference standard was applied for each FLL. Blinded to the reference standard, two radiologists scored LI-RADS major imaging features retrospectively and assigned each observation a category (LR 1-5, M and TIV) using LI-RADS v2018 on both VMIs at 40keV derived from DLSCT and MR images in consensus. Per-FLL sensitivity and specificity using DLSCT images and MRI images were assessed. Diagnostic performance and inter-modality agreement were calculated and compared among 40keV and MRI LI-RADS categories by McNemar test and Kappa test*Results The inter-modality agreement between VMIs at 40keV DLSCT and MR when categorizing LR-5 or LR-5 &TIV was 0.86 (P<0.05) . Using LI-RADS v2018, sensitivity of LR-5 &TIV category on VMIs at 40keV was higher than on MR, but without significant difference (89.61% vs. 84.42%, P=0.453), and specificity of two exams were the similar (89.74% vs. 89.74%, P= 0.500). When categorizing LR-5 alone, the sensitivity values of two modalities both decreased slightly (72.73% vs. 66.23%, DLSCT vs. MR, P=0.219) with significant difference (P<0.001) and specificity values remained similar (89.74% vs. 92.31%, DLSCT vs. MR, P=0.500) compared with LR-5 &TIV criteria*Conclusions The VMIs at 40keV derived from DLSCT showed comparable sensitivity and specificity for categorizing LR-5/TIV or LR-5 alone in LI-RADS v2018-based classification of liver lesions in comparison with CE-MRI*Clinical Relevance/Application VMIs at 40keV derived from DLSCT have comparable diagnostic performance for HCC by using LI-RADS Version 2018 versus MR. Further comparative studies between DLSCT and MR are needed to validate our preliminary results with a larger sample size in a prospective multi-center setting

RESULTS

The inter-modality agreement between VMIs at 40keV DLSCT and MR when categorizing LR-5 or LR-5 &TIV was 0.86 (P<0.05) . Using LI-RADS v2018, sensitivity of LR-5 &TIV category on VMIs at 40keV was higher than on MR, but without significant difference (89.61% vs. 84.42%, P=0.453), and specificity of two exams were the similar (89.74% vs. 89.74%, P= 0.500). When categorizing LR-5 alone, the sensitivity values of two modalities both decreased slightly (72.73% vs. 66.23%, DLSCT vs. MR, P=0.219) with significant difference (P<0.001) and specificity values remained similar (89.74% vs. 92.31%, DLSCT vs. MR, P=0.500) compared with LR-5 &TIV criteria

CLINICAL RELEVANCE/APPLICATION

VMIs at 40keV derived from DLSCT have comparable diagnostic performance for HCC by using LI-RADS Version 2018 versus MR. Further comparative studies between DLSCT and MR are needed to validate our preliminary results with a larger sample size in a prospective multi-center setting

SPR-GI-45   Subspecialist Radiological TNM Staging In Pancreatic Ductal Adenocarcinoma - Important Implications For Prognosis And Management

Participants
Sam Banks, BMedSc,MD, Melbourne, Australia (*Presenter*) Nothing to Disclose

PURPOSE

To identify the discrepancy in radiological staging between real-world radiological reporting practices and centralised staging according to AJCC guidelines by a blinded subspecialist radiologist.*Methods and Materials Cases were identified from the PURPLE Translational Registry; a prospective, multicentre electronic database which collates comprehensive, standardised data on demographics, diagnosis, clinic-pathological features, surgery, treatments received and disease outcome in consecutive pancreatic cancer patients. Data for patients treated between January 2016 - March 2020 at tertiary treatment centres across Australia were extracted. De-identified index CT staging scans were imported to a centralised database before being re-reported by a blinded subspecialist radiologist according to AJCC guidelines .*Results Findings from our study of 110 patients, revealed a high frequency of discordant T, N, & M scores between initial radiological staging and on centralised review. For T, N & M scores respectively such discrepancy occurred in 47/110 (43%), 40/110 (36%) and 10/110 (10%) of cases. In most instances these discrepancies were up upstaged on centralised review; for T, N & M scores this occurred in 43/47 (91%), 33/40 (83%) and 10/10 (100%) cases respectively. This resulted in an overall staging discrepancy of 63/110 (57%) with 43/63 (68%) of these resulting in overall upstaging. Survival outcomes between real-world CT staging vs. centralised review, were most noticeably different for stage 2 disease with a median overall survival of 17.3 months vs undefined at time of analysis (p=0.05).*Conclusions There is significant discrepancy between subspecialist and non-subspecialist radiological staging of PDAC in real-world CT practice. This likely results in patients with incurable disease undergoing futile interventions with associated morbidity and poorer outcomes.*Clinical Relevance/Application Pancreatic ductal adenocarcinoma (PDAC) is increasing in incidence. Surgical resection for localised PDAC offers the only hope of cure. Accurate CT-radiological staging is pivotal in determining resectability and prognosis.

RESULTS

Findings from our study of 110 patients, revealed a high frequency of discordant T, N, & M scores between initial radiological

staging and on centralised review. For T, N & M scores respectively such discrepancy occurred in 47/110 (43%), 40/110 (36%) and 10/110 (10%) of cases. In most instances these discrepancies were up upstaged on centralised review; for T, N & M scores this occurred in 43/47 (91%), 33/40 (83%) and 10/10 (100%) cases respectively. This resulted in an overall staging discrepancy of 63/110 (57%) with 43/63 (68%) of these resulting in overall upstaging. Survival outcomes between real-world CT staging vs. centralised review, were most noticeably different for stage 2 disease with a median overall survival of 17.3 months vs undefined at time of analysis (p=0.05).

CLINICAL RELEVANCE/APPLICATION

Pancreatic ductal adenocarcinoma (PDAC) is increasing in incidence. Surgical resection for localised PDAC offers the only hope of cure. Accurate CT-radiological staging is pivotal in determining resectability and prognosis.

SPR-GI-49   Clinical Phenotypic Clustering Of Patients With Intrahepatic Cholangiocarcinoma Highlights Important Prognostic Differences

Participants
Qian Li, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To characterise patients with intrahepatic cholangiocarcinoma (ICC) into different clinical phenotypes using multiomics-based clustering analysis, and to further identify the clinical phenotypes associated with the prognostic outcomes.*Methods and Materials In this multiomics-based hierarchical clustering analysis, we included 308 consecutively recruited patients with ICC. Cox regression analysis was conducted to quantify the independent associations of the identified phenotypes with prognostic outcomes. Decision tree analysis was performed to predict cluster assignment.*Results Four clusters of patients with ICC, which had significantly different characteristics associated with prognostic outcomes, were identified. Cluster 1 (n=78, 25.32%) had a biliary dilation and low AFP value phenotype, cluster 2 (n=41, 13.31%) had a large tumour size and tumour in vein phenotype, cluster 3 (n=80, 25.97%) had a satellite nodule and multifocal phenotype, and cluster 4 (n=109, 35.39%) had a small tumour size and low radiomics phenotype. Of these phenotypes, cluster 2 was associated with the poorest median survival time of 12.1 months and lowest 1-year survival rate of 51.21%, while cluster 4 was associated with the longest median survival time of 27.0 months and longest 1-year, 3-year and 5-year survival rates of 91.51%, 39.45%, and 10.09%, respectively.*Conclusions Four clinical phenotypes with differential clinical and imaging features associated with prognostic outcomes were developed. Based on the results, we propose a novel clinical phenotypic classification of ICC that facilitates prognostic prediction and may support decision making with regard to the choice of therapy.*Clinical Relevance/Application Our study developed four clusters in patients with ICC in a real-world setting base on multiomics variables analysis before surgery. The prespecified clusters demonstrated significant prognostic differences after surgery.The developed clusters have important clinical implications for patient management and treatment decisions, which may help clinicians to consider systemic therapy more comprehensively than upfront surgery among high-risk patients with ICC, as well as inform the intensity of surveillance following resection.

RESULTS

Four clusters of patients with ICC, which had significantly different characteristics associated with prognostic outcomes, were identified. Cluster 1 (n=78, 25.32%) had a biliary dilation and low AFP value phenotype, cluster 2 (n=41, 13.31%) had a large tumour size and tumour in vein phenotype, cluster 3 (n=80, 25.97%) had a satellite nodule and multifocal phenotype, and cluster 4 (n=109, 35.39%) had a small tumour size and low radiomics phenotype. Of these phenotypes, cluster 2 was associated with the poorest median survival time of 12.1 months and lowest 1-year survival rate of 51.21%, while cluster 4 was associated with the longest median survival time of 27.0 months and longest 1-year, 3-year and 5-year survival rates of 91.51%, 39.45%, and 10.09%, respectively.

CLINICAL RELEVANCE/APPLICATION

Our study developed four clusters in patients with ICC in a real-world setting base on multiomics variables analysis before surgery. The prespecified clusters demonstrated significant prognostic differences after surgery.The developed clusters have important clinical implications for patient management and treatment decisions, which may help clinicians to consider systemic therapy more comprehensively than upfront surgery among high-risk patients with ICC, as well as inform the intensity of surveillance following resection.

SPR-GI-5   Comparison Of Diagnostic Performance Of Abbreviated Versus Comprehensive MRCP For Pancreatic Cyst Surveillance

Participants
Chenchan Huang, MD, Manhasset, New York (*Presenter*) Nothing to Disclose

PURPOSE

Pancreatic cysts are frequently detected on imaging studies and can progress to cancer or indicate increased risk of pancreatic cancer elsewhere. Multiple societal guidelines recommend long term surveillance with MRCP. We retrospectively compared the diagnostic performance of abbreviated MRCP (aMRCP) with comprehensive MRCP (cMRCP).*Methods and Materials 151 patients undergoing pancreatic cyst surveillance with a baseline contrast enhanced MRCP and follow-up index surveillance MRCP exam were included. Three sequences selected from index MRCP (axial and coronal HASTE, axial T1 fat-saturated pre-contrast, and 3D MRCP) comprised the aMRCP protocol and the entire index MRCP, including post-contrast sequences, was the cMRCP protocol. 3 blinded abdominal radiologists assessed for the presence of worrisome features, high risk stigmata, and signs of concurrent pancreatic adenocarcinoma with both aMRCP and cMRCP protocols, with a 2-week washout period between aMRCP and cMRCP review. Cyst multiplicity, location, morphology and duct communication were also assessed.*Results Overall high intra-reader (88-100%) and inter-reader (93-99%) agreement between aMRCP and cMRCP on key features of cyst characterization and secondary signs of solid pancreatic mass. 6/151 patients had surgically resected malignant IPMN. 2 (33%) were classified as benign on aMRCP by at least 1 reader. 7/151 had concurrent pancreatic adenocarcinomas, 2 of which were missed on aMRCP by at least one reader (29%).*Conclusions aMRCP showed high intra- and inter-reader agreement for pancreatic cyst characterization and secondary signs of solid pancreatic mass, but malignant IPMN and concurrent adenocarcinoma were occasionally missed with aMRCP.*Clinical Relevance/Application While aMRCP can save time, cost and anxiety associated with contrast administration, physicians and patients should understand the possibility of missing the more clinically significant pancreatic cancer.

RESULTS

Overall high intra-reader (88-100%) and inter-reader (93-99%) agreement between aMRCP and cMRCP on key features of cyst

characterization and secondary signs of solid pancreatic mass. 6/151 patients had surgically resected malignant IPMN. 2 (33%) were classified as benign on aMRCP by at least 1 reader. 7/151 had concurrent pancreatic adenocarcinomas, 2 of which were missed on aMRCP by at least one reader (29%).

CLINICAL RELEVANCE/APPLICATION

While aMRCP can save time, cost and anxiety associated with contrast administration, physicians and patients should understand the possibility of missing the more clinically significant pancreatic cancer.

SPR-GI-50   Selecting Candidates For Organ Preserving Strategy Of Rectal Cancer After Neoadjuvant Chemoradiotherapy: Model Development And Validation Integrating Radiomics And Pathomics

Participants
Lijuan Wan, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate a multi-scale model incorporating radiomics and pathomics features for predicting patients with pathological good response (pGR) that down-staging to stage ypT0-1N0 after neoadjuvant chemoradiotherapy (nCRT) in locally advanced rectal cancer (LARC).*Methods and Materials This retrospective study included 153 patients (training group: n = 107; validation group: n = 46) with clinicopathologically confirmed LARC who received nCRT before surgery between January 2015 and March 2018. All patients underwent MRI examination before and after nCRT, as well as endoscopic biopsy before nCRT. Radiomics and pathomics features were extracted from MR images and digital histopathological slides, respectively. Two radiomics signatures, including pretreatment and posttreatment radiomics signature, and one pathomics signature were created by using a dimensionality reduction and feature selection process. Integrating three signatures and related clinicoradiological factors, a multi-scale pGR prediction model was established by multivariable logistic regression analysis. The diagnostic performance of the multi-scale model (calibration, discrimination, and clinical usefulness) was evaluated, and then compared with a model based on clinicoradiological factors alone.*Results A total of 19.6% patients achieved pGR. Pretreatment radiomics signature (odds ratio [OR] = 2.53; 95% CI: 1.58-4.66; p< 0.001), posttreatment radiomics signature (OR = 9.59; 95% CI: 3.04-41.46; p < 0.001), and pathomics signature (OR = 3.14; 95% CI: 1.40-8.31; p = 0.01) were retained in the multi-scale model as independent factors. The multi-scale model presented good calibration, and good discrimination with AUCs of 0.93 (95% CI: 0.88-0.98) and 0.90 (95% CI: 0.78-1.00) in the training and validation group. The diagnostic performance of the multi-scale model was improved than those of clinicoradiological model.*Conclusions The multi-scale model incorporating radiomics and pathomics features can effectively predict patients with pGR after nCRT in LARC.*Clinical Relevance/Application Our multi-scale model may be used for selecting suitable candidates for organ-preserving surgery in clinical practice.

RESULTS

A total of 19.6% patients achieved pGR. Pretreatment radiomics signature (odds ratio [OR] = 2.53; 95% CI: 1.58-4.66; p< 0.001), posttreatment radiomics signature (OR = 9.59; 95% CI: 3.04-41.46; p < 0.001), and pathomics signature (OR = 3.14; 95% CI: 1.40-8.31; p = 0.01) were retained in the multi-scale model as independent factors. The multi-scale model presented good calibration, and good discrimination with AUCs of 0.93 (95% CI: 0.88-0.98) and 0.90 (95% CI: 0.78-1.00) in the training and validation group. The diagnostic performance of the multi-scale model was improved than those of clinicoradiological model.

CLINICAL RELEVANCE/APPLICATION

Our multi-scale model may be used for selecting suitable candidates for organ-preserving surgery in clinical practice.

SPR-GI-51   Clinical-radiological Nomogram For Predicting Early Recurrence Of Early-stage Hepatocellular Carcinomas After Radiofrequency Ablation

Participants
Linqi Zhang, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Early recurrence rate of early-stage hepatocellular carcinoma (eHCC) patients after radiofrequency ablation (RFA) have been reported approximately 30-50%. It is very important to identify patients with eHCC at risk of early recurrence (ER) and then choose optimal treatment strategy. The aim of this study was to develop and validate the clinical-radiological nomogram estimating the probability of ER in patients with eHCC after RFA.*Methods and Materials 480 patients with eHCC who underwent preoperative dynamic contrast-enhanced MRI examinations within 1 month before RFA from 2008 to 2018 in our hospital were collected retrospectively and randomly divided into the derivation cohort (n = 320) and the internal validation cohort (n = 160). Multivariate Cox proportional hazards analysis was used to identify independent risk factors for ER after RFA by using clinical and imaging information of the derivation cohort, then established clinical nomogram and clinical-radiological nomogram, and their prediction values were compared by De-Long test. Performance of nomogram was assessed by concordance index (c-index) and a calibration curve.*Results Within the follow-up period (median 32 months), a total of 130 (40.63%,130/320) and 66 (41.25%, 66/160) patients experienced ER in derivation and validation cohort, respectively. Multiple tumor foci (P <0.001), tumor size=2 cm (P =0.001), AFP=40 ng/ml (P =0.001), irregular tumor margins (P<0.001), and peritumor enhancement (P=0.046) were identified as independent risk factors associated with 2-year recurrence-free survival (2 y-RFS).The clinical-radiological nomogram (AUC: 0.814, 95%CI: 0.767-0.861) outperformed only clinical nomogram (AUC: 0.646, 95%CI: 0.587-0.706) in predicting 2 y-RFS in derivation cohort, and the c-index for clinical-radiological nomogram in the internal validation cohort was 0.771 (95% CI, 0.734-0.843). Calibration curves showed good agreement between actual observation and nomogram prediction both in derivation (P=0.114) and validation (P=0.368)cohort.*Conclusions We developed one non-invasive combined clinical and MRI features-based data nomogram to estimate the probability of ER in patients with eHCC after RFA, with favorable discrimination and calibration values. And this clinical-radiological nomogram was superior to only clinical nomogram to predict ER.*Clinical Relevance/Application Our nomogram may be a useful clinical tool for identifying patients at high-risk for ER of eHCC after RAF, stratifying their treatment strategy and follow-up planning in clinical practice.

RESULTS

Within the follow-up period (median 32 months), a total of 130 (40.63%,130/320) and 66 (41.25%, 66/160) patients experienced ER in derivation and validation cohort, respectively. Multiple tumor foci (P <0.001), tumor size=2 cm (P =0.001), AFP=40 ng/ml (P =0.001), irregular tumor margins (P<0.001), and peritumor enhancement (P=0.046) were identified as independent risk factors associated with 2-year recurrence-free survival (2 y-RFS).The clinical-radiological nomogram (AUC: 0.814, 95%CI: 0.767-0.861) outperformed only clinical nomogram (AUC: 0.646, 95%CI: 0.587-0.706) in predicting 2 y-RFS in derivation cohort, and the c-index

for clinical-radiological nomogram in the internal validation cohort was 0.771 (95% CI, 0.734-0.843). Calibration curves showed good agreement between actual observation and nomogram prediction both in derivation (P=0.114) and validation (P=0.368)cohort.

CLINICAL RELEVANCE/APPLICATION

Our nomogram may be a useful clinical tool for identifying patients at high-risk for ER of eHCC after RAF, stratifying their treatment strategy and follow-up planning in clinical practice.

SPR-GI-52   CT-based Deep Learning Towards Early Detection Of Pancreatic Ductal Adenocarcinoma

Participants
Natália Alves, MSc, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the performance of a 3D nnUnet based algorithm for pancreatic ductal adenocarcinoma (PDAC) detection and assess the potential of the model for early diagnosis by conducting a subgroup analysis on small (size < 2cm) tumors.*Methods and Materials Portal-venous phase contrast-enhanced computed tomography (CE-CT) scans from a cohort of 119 patients with pathology-proven PDAC and 122 consecutive patients with normal pancreas were included in this retrospective study. For the PDAC cohort, expert segmentations of the pancreas and tumor volumes were available, along with the tumor sizes measured on the CT scan. For the non-PDAC cohort, the pancreas segmentations were obtained using a pre-trained deep learning segmentation model. The pancreas segmentation determined a region of interest from the full CE-CT as input to the 3D nnUnet. The network was trained for 1000 epochs with 5-fold cross-validation to differentiate between tumor and normal voxels. The predicted heatmaps were thresholded at 0.1. An image was considered a positive case of PDAC if the predicted tumor volume was greater than 100 mm3.*Results The median tumor size on the PDAC cohort was 2.8 cm (range 1.2 cm - 9.3 cm). The detection task achieved an average sensitivity of 0.93 ± 0.04 (111/119), specificity of 0.98 ± 0.02 (119/122) and area under the receiver operating characteristic curve of 0.96 ± 0.04. The median DICE score between the expert and the network tumor segmentations was 0.68 ± 0.18. In 2 of the 3 false positive cases the network wrongly detected a hypodense region of the normal pancreas, which could be originated by fat accumulation or natural perfusion differences. The mean sensitivity in the sub-group of tumors with size smaller than 2 cm was 0.92 ± 0.1 (21/23), and the median DICE score in this sub-group was 0.56 ± 0.20.*Conclusions These preliminary results indicate that a 3D nnUnet based algorithm can accurately detect small tumors, suggesting that it could be useful at assisting in early PDAC diagnosis.*Clinical Relevance/Application Early diagnosis improves pancreatic cancer prognosis but requires significant expertise. An automatic tool for the detection of early-stage tumors would reduce expertise requirements.

RESULTS

The median tumor size on the PDAC cohort was 2.8 cm (range 1.2 cm - 9.3 cm). The detection task achieved an average sensitivity of 0.93 ± 0.04 (111/119), specificity of 0.98 ± 0.02 (119/122) and area under the receiver operating characteristic curve of 0.96 ± 0.04. The median DICE score between the expert and the network tumor segmentations was 0.68 ± 0.18. In 2 of the 3 false positive cases the network wrongly detected a hypodense region of the normal pancreas, which could be originated by fat accumulation or natural perfusion differences. The mean sensitivity in the sub-group of tumors with size smaller than 2 cm was 0.92 ± 0.1 (21/23), and the median DICE score in this sub-group was 0.56 ± 0.20.

CLINICAL RELEVANCE/APPLICATION

Early diagnosis improves pancreatic cancer prognosis but requires significant expertise. An automatic tool for the detection of early-stage tumors would reduce expertise requirements.

SPR-GI-54   Survival Prediction In Intrahepatic Cholangiocarcinoma: A Proof Of Concept Study Using Artificial Intelligence For Risk Assessment

Participants
Felix Hahn, MD,MSc, Mainz, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Several scoring systems have been devised to objectively predict survival for patients with intrahepatic cholangiocellular carcinoma (ICC) and support treatment stratification, but they have failed external validation. The aim of the present study was to improve prognostication using an artificial intelligence-based approach.*Methods and Materials We retrospectively identified 417 patients with ICC who were referred to our tertiary care center between 1997 and 2018. Of these, 293 met the inclusion criteria. Established risk factors served as input nodes for an artificial neural network (ANN) (Figure A). For an 80:20 split, all patients with an initial diagnosis before the 31st December 2013 (n = 233, 80%) were allocated to the training set. Patients with an initial diagnosis afterwards (n = 60, 20%) formed the holdout validation set. In the training set, a five-fold cross validation approach was used to maximize the training capabilities of the ANN (Figure B). We compared the performance of the trained model to the most widely used conventional scoring system, the Fudan score.*Results Predicting 1-year survival, the ANN reached an area under the ROC curve (AUC) of 0.89 for training and 0.80 for the validation set. The AUC of the Fudan score was significantly lower in the validation set (0.77, p < 0.001). In the training set, the Fudan score yielded a lower AUC (0.74) without reaching significance (p = 0.24).*Conclusions The ANN outperformed conventional risk scoring, leading to the conclusion that especially the inclusion of more risk factors offers a great potential for survival prediction. This study proved the feasibility of this approach for patients with ICC prior to treatment.*Clinical Relevance/Application Artificial intelligence-based approaches have the potential to improve treatment stratification when models trained on large multicenter data are openly available.

RESULTS

Predicting 1-year survival, the ANN reached an area under the ROC curve (AUC) of 0.89 for training and 0.80 for the validation set. The AUC of the Fudan score was significantly lower in the validation set (0.77, p < 0.001). In the training set, the Fudan score yielded a lower AUC (0.74) without reaching significance (p = 0.24).

CLINICAL RELEVANCE/APPLICATION

Artificial intelligence-based approaches have the potential to improve treatment stratification when models trained on large multicenter data are openly available.

SPR-GI-55 Ceus-based Classification Of Liver Tumors With Deep Learning

Participants
Hongyu Zhou, Tianjin, China (*Presenter*) Nothing to Disclose

PURPOSE

Contrast-enhanced ultrasound (CEUS) is considered the most convenient and efficient tool for checking focal liver lesions(FLLs) . However, to accurately diagnose a single case with CEUS, the radiologist should carry out a series of tasks with tedious details. All of the works are time-consuming and also highly experience-dependent. Therefore, the study aims to develop an effective computed-aided diagnosis (CADx) system for classifying the suspected liver lesions between benign and malignant by using a proposed deep learning algorithm for the CEUS sequence.*Methods and Materials A total of 420 focal liver lesions with 136 benign cases and 284 malignant cases were examined through CEUS by a 6-year experienced radiologist . For the data preprocessing, the recorded CEUS video for each case was cropped to a suitable size by bounding box to fit the lesion. A deep learning model based on two dimensional convolution neural network (2D CNN i.e. ResNet-18), a long short-term memory (LSTM) and a Linear classifier (with sigmoid) was developed to analysis the CEUS video from different contrast imaging phases. The 4-fold cross-validation was performed on the proposed algorithm to avoid sampling bias by stratified randomly partitioning the dataset. For comparison, a 3D CNN model and a machine-learning (ML)-based time-intensity curve (TIC) method were also used for the evaluation under the same dataset in the study*Results For evaluating the performance of the purposed algorithm for distinguishing benign and malignancy of liver lesions, the area under the receiver operation characteristic curve (AUC) was adopted as evaluation indices. Results of the 4-fold validation demonstrate the mean AUC is evaluated to 0.91, 0.88 and 0.78 for the purposed CNN-LSTM model, the 3D-CNN model and the ML-based TIC method, respectively. On the other hand, the results of sensitivity increased from 0.83 to 0.95 and the specificity decreased from 0.82 to 0.7 with the threshold of the predicted malignant probabilities by using the purposed CNN-LSTM model. The 3D CNN shows the highest sensitivity of 0.96, but with specificity of 0.55; the ML-based TIC method also shows the lowest specificity of 0.21 when the sensitivity is 0.96*Conclusions In summary, this study demonstrates a complete methodology from data preprocessing to model implementation for the diagnosis of focal liver lesions. The purposed CNN-LSTM model shows its ability to distinguish the benign and malignancy of the lesions with good performance compared to the relevant existing methods.*Clinical Relevance/Application the study aims to develop an effective computed-aided diagnosis (CADx) system for classifying the suspected liver lesions between benign and malignant by using a proposed deep learning algorithm for the CEUS sequence.

RESULTS

For evaluating the performance of the purposed algorithm for distinguishing benign and malignancy of liver lesions, the area under the receiver operation characteristic curve (AUC) was adopted as evaluation indices. Results of the 4-fold validation demonstrate the mean AUC is evaluated to 0.91, 0.88 and 0.78 for the purposed CNN-LSTM model, the 3D-CNN model and the ML-based TIC method, respectively. On the other hand, the results of sensitivity increased from 0.83 to 0.95 and the specificity decreased from 0.82 to 0.7 with the threshold of the predicted malignant probabilities by using the purposed CNN-LSTM model. The 3D CNN shows the highest sensitivity of 0.96, but with specificity of 0.55; the ML-based TIC method also shows the lowest specificity of 0.21 when the sensitivity is 0.96

CLINICAL RELEVANCE/APPLICATION

the study aims to develop an effective computed-aided diagnosis (CADx) system for classifying the suspected liver lesions between benign and malignant by using a proposed deep learning algorithm for the CEUS sequence.

SPR-GI-56 Dual-layer Spectral Detector CT For HCC Diagnosis Using LI-RADS Version 2018: Comparison Of Virtual Monoenergetic Images (VMIs) And Conventional Images (CIs)

Participants
Wu Zhang, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic value of virtual monoenergetic images (VMIs) at 40keV and conventional images(CIs) obtained from Dual-Layer Spectral Detector CT (DLSCT) for characterization of liver observations in patients at high risk for Hepatocellular carcinoma (HCC) by using Liver Imaging Reporting and Data System (LI-RADS) Version 2018.*Methods and Materials 116 liver observations in 84 patients at high risk for HCC who underwent multiphase contrast enhancement (370 mg/ml iodine) scanning by DLSCT were retrospectively enrolled in this study, including 77 HCCs, 8 non-HCCs malignancies, and 31 benign entities with biopsy-proven and/or follow-up confirmation. The CIs and VMIs at 40keV derived from DLCT in arterial and portal venous phases were reconstructed. Two blinded radiologists scored LI-RADS imaging features and assigned each observation a LI-RADS category based on main features using LI-RADS v2018 (including LR1-5, M and TIV) on both CIs and VMIs at 40keV in consensus. For the same patient with multiple liver observations, the LI-RADS category of each observation was adjusted based on spectral attenuation curve. Sensitivity and specificity were calculated and compared among CIs, VMIs at 40keV and adjusted 40keV LI-RADS categories by McNemar test.*Results Using LI-RADS v2018, LR-5&TIV at CIs provided 72.73% sensitivity and 97.44% specificity for HCC. LR-5&TIV criteria at VMIs at 40keV and adjusted 40keV significantly increased sensitivity (89.61%/93.51% vs. 72.73%, both P<0.001) without significantly reducing specificity (89.74%/87.18% vs 97.44%, both P>0.05). LR-5 criteria at CIs provided 54.55% sensitivity and 97.44% specificity for HCC. LR-5 criteria at VMIs at 40keV and adjusted 40keV significantly increased sensitivity (72.73%/76.62% vs. 54.55%, both P<0.001) without significantly reducing specificity (89.74%/87.18% vs 97.44%, both P>0.05). LR-5 criteria at VMIs at CIs, 40keV and adjusted 40keV has lower sensitivity (all P<0.001) while maintaining similar specificity compared with LR-5/TIV criteria (all P>0.05) in this study.*Conclusions VMIs at 40keV derived from DLSCT in combination with spectral attenuation curve significantly increases sensitivity without significantly reducing specificity for the diagnosis of HCC in patients at high risk for HCC. Confirmation is warranted in multi-center prospective studies.*Clinical Relevance/Application VMIs at 40keV obtained from DLSCT has better sensitivity for HCC than at CIs in patients at high risk for HCC by using LI-RADS Version 2018. Further studies with a larger sample size in a prospective multi-center setting are needed to validate our preliminary results.

RESULTS

Using LI-RADS v2018, LR-5&TIV at CIs provided 72.73% sensitivity and 97.44% specificity for HCC. LR-5&TIV criteria at VMIs at 40keV and adjusted 40keV significantly increased sensitivity (89.61%/93.51% vs. 72.73%, both P<0.001) without significantly reducing specificity (89.74%/87.18% vs 97.44%, both P>0.05). LR-5 criteria at CIs provided 54.55% sensitivity and 97.44% specificity for HCC. LR-5 criteria at VMIs at 40keV and adjusted 40keV significantly increased sensitivity (72.73%/76.62% vs. 54.55%, both P<0.001) without significantly reducing specificity (89.74%/87.18% vs 97.44%, both P>0.05). LR-5 criteria at VMIs at CIs, 40keV and adjusted 40keV has lower sensitivity (all P<0.001) while maintaining similar specificity compared with LR-5/TIV

criteria (all P>0.05) in this study.

CLINICAL RELEVANCE/APPLICATION

VMIs at 40keV obtained from DLSCT has better sensitivity for HCC than at CIs in patients at high risk for HCC by using LI-RADS Version 2018. Further studies with a larger sample size in a prospective multi-center setting are needed to validate our preliminary results.

SPR-GI-57   Influence Of Liver Iron Content And Fibrosis In Inter- And Intra-individual Quantification Of Hepatic Steatosis Using Fast-kilovolt-peak-switching Dual Energy Computed Tomography And Material Decomposition Technique: A Prospective Clinical Study.

Participants
Eriko Yoshizawa, Matsumoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To clarify the influence of iron content and fibrosis of the liver in clinical hepatic steatosis quantification using fast-kilovolt-peak-switching dual energy computed tomography (DECT) and material decomposition (MD) technique.*Methods and Materials This study included 88 sets of DECT and MR examinations (1.5T&3.0T) including MR elastography (MRE) performed prospectively on the same day before and after 6 months exercise therapy (interval walking training) in 38 patients with type 2 diabetes. Fat density (FD) derived from DECT, proton density fat fraction (PDFF1.5T, PDFF3.0T) and R2* (R2*1.5T, R2*3.0T) as an alternative indicator for hepatic fat and iron content derived from 6-point Dixon MR imaging by different magnetic field strength, liver stiffness (LS) as an alternative indicator for hepatic fibrosis derived from 1.5T MRE were measured. The difference of FD and PDFF (?FD, ?PDFF1.5T, ? PDFF3.0T), the mean of R2* and LS (mR2*1.5T, mLS) before and after exercise therapy were calculated, respectively. Univariate correlation analysis and multivariate stepwise linear regression analysis (MSLRA) were performed using PDFF and ?PDFF obtained from 1.5T MR imaging as a dependent variable, parameters obtained from DECT and 1.5T MR imaging as independent variables.*Results Correlation coefficient of FD and PDFF3.0T against PDFF1.5T were 0.83(95%CI:0.76,0.88) and 0.93(0.89,0.96), respectively. MSLRA revealed that FD and mR2*1.5T were significant independent variables for PDFF1.5T and there was not significant difference in correlation to PDFF1.5T between derived model (r=0.85;0.78,0.90) and PDFF3.0T. There was no significant difference in correlation coefficient against ?PDFF1.5T between ?FD (r=0.44;0.19,0.65) and ?PDFF3.0T(r=0.57;0.34,0.73). MSLRA revealed that only ?FD was a significant independent variables for ?PDFF1.5T. mLS was not significant independent variables for either PDFF1.5T or ?PDFF1.5T.*Conclusions Hepatic iron content corresponding to R2* significantly influences inter-individual quantification of hepatic steatosis using DECT and MD technique; however ?FD can be used as an alternative to ?PDFF in intra-individual quantification of hepatic steatosis.*Clinical Relevance/Application 1) The influence of hepatic iron content should be considered in inter-individual quantification of hepatic steatosis by current MD technique. 2) If it can be assumed that the interval change in hepatic iron content is small, current MD technique has a feasibility to quantify hepatic steatosis in intra-individual assessment. 3) Current MD technique can be applicable to patients with NAFLD in the early to late stages because liver fibrosis which corresponds to liver stiffness does not affect the quantification of hepatic steatosis.

RESULTS

Correlation coefficient of FD and PDFF3.0T against PDFF1.5T were 0.83(95%CI:0.76,0.88) and 0.93(0.89,0.96), respectively. MSLRA revealed that FD and mR2*1.5T were significant independent variables for PDFF1.5T and there was not significant difference in correlation to PDFF1.5T between derived model (r=0.85;0.78,0.90) and PDFF3.0T. There was no significant difference in correlation coefficient against ?PDFF1.5T between ?FD (r=0.44;0.19,0.65) and ?PDFF3.0T(r=0.57;0.34,0.73). MSLRA revealed that only ?FD was a significant independent variables for ?PDFF1.5T. mLS was not significant independent variables for either PDFF1.5T or ?PDFF1.5T.

CLINICAL RELEVANCE/APPLICATION

1) The influence of hepatic iron content should be considered in inter-individual quantification of hepatic steatosis by current MD technique. 2) If it can be assumed that the interval change in hepatic iron content is small, current MD technique has a feasibility to quantify hepatic steatosis in intra-individual assessment. 3) Current MD technique can be applicable to patients with NAFLD in the early to late stages because liver fibrosis which corresponds to liver stiffness does not affect the quantification of hepatic steatosis.

SPR-GI-59   Machine Learning (ML) Model Based On CT Radiomics Signature For Detection Of Pancreatic Ductal Adenocarcinoma (PDA) On Prediagnostic CT Scans

Participants
SOVANLAL MUKHERJEE, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Early detection of PDA is the key to improve outcomes. However, small PDAs are often missed on CT scans due to their subtle imaging features or inattentional bias. To address this challenge, our purpose was to evaluate a ML model based on CT radiomics features for detection of PDA on prediagnostic CT scans.*Methods and Materials Volumetric pancreas segmentation was performed by radiologists using 3D Slicer® on a highly curated prediagnostic CT dataset (portal-venous phase CTs from 2005-2016; slice thickness=5-mm; mean interval between CT and eventual histopathologic diagnosis of PDA:12 months) of 163 patients (median age:63 years; Male:Female=1.1:1) and an equal number of age- and sex-matched controls with normal pancreas. None of the prediagnostic CTs had focal imaging findings to suggest cancer. Total 78 radiomics features (first order and gray levels) were extracted using Pyradiomics to quantify the imaging phenotype and 24 features were selected through a F-score feature selection method to remove redundant features (figure). The dataset was divided into a training set (273 CTs: 136 prediagnostic plus 137 controls) and a test set (53 CTs: 27 prediagnostic and 26 controls). Four classifiers based on K-Nearest Neighbor (KNN), Support Vector Machine (SVM), Random Forest (RF) and XGBoost were evaluated for classification of CTs from the test set into PDA vs. normal. A leave-one-out cross-validation method was utilized to select the best hyperparameters for each classifier.*Results The respective sensitivity, specificity, accuracy and area under the curve (AUC) of the classifiers [mean (95% confidence intervals)] were as follows: KNN [0.55 (0.26, 0.88); 0.84 (0.56, 0.87); 0.69 (0.57, 0.82)]; 0.70 (0.57, 0.85)], SVM [0.74 (0.52, 0.91); 0.73 (0.58, 0.88); 0.74 (0.62, 0.85); 0.74 (0.58, 0.88)], RF [0.67 (0.43, 0.91); 0.73 (0.58, 0.88); 0.69 (0.58, 0.82); 0.70 (0.57, 0.85)] and XGBoost [0.67 (0.41, 0.92); 0.77 (0.58, 0.87); 0.72 (0.59, 0.84); 0.72 (0.58, 0.87)]. Thus, SVM yielded the highest performance metrics among different classifiers. It correctly classified 73% (19/26) normal CTs and 74% (20/27) pre-diagnostic CTs.*Conclusions A SVM ML classifier shows potential for detection of PDA by quantifying the radiomics-based imaging phenotype of cancer on prediagnostic CTs even in the absence of overt imaging findings.*Clinical Relevance/Application Once fine-tuned on

larger and heterogenous datasets, radiomics-based ML models may augment physician expertise for early PDA detection in high-risk cohorts (e.g. new onset diabetes with weight loss).

RESULTS

The respective sensitivity, specificity, accuracy and area under the curve (AUC) of the classifiers [mean (95% confidence intervals)] were as follows: KNN [0.55 (0.26, 0.88); 0.84 (0.56, 0.87); 0.69 (0.57, 0.82)]; 0.70 (0.57, 0.85)], SVM [0.74 (0.52, 0.91); 0.73 (0.58, 0.88); 0.74 (0.62, 0.85); 0.74 (0.58, 0.88)], RF [0.67 (0.43, 0.91); 0.73 (0.58, 0.88); 0.69 (0.58, 0.82); 0.70 (0.57, 0.85)] and XGBoost [0.67 (0.41, 0.92); 0.77 (0.58, 0.87); 0.72 (0.59, 0.84); 0.72 (0.58, 0.87)]. Thus, SVM yielded the highest performance metrics among different classifiers. It correctly classified 73% (19/26) normal CTs and 74% (20/27) pre-diagnostic CTs.

CLINICAL RELEVANCE/APPLICATION

Once fine-tuned on larger and heterogenous datasets, radiomics-based ML models may augment physician expertise for early PDA detection in high-risk cohorts (e.g. new onset diabetes with weight loss).

SPR-GI-6   VSI Teleultrasound Of The Right Upper Quadrant: A New Horizon In Imaging

Participants
Thomas Marini, MD, Rochester, New York (*Presenter*) Nothing to Disclose

PURPOSE

Although hepatic and biliary diseases are prevalent worldwide, the majority of people lack access to diagnostic medical imaging for their assessment. The liver and gallbladder are readily amenable to sonographic examination which may assist in diagnosis of pathology and alter patient management. However, ultrasound's deployment is limited by the lack of experienced sonographers. In this study, we tested an asynchronous telediagnostic system for right upper quadrant (RUQ) abdominal ultrasound examination operated by individuals without prior ultrasound experience to facilitate deployment of ultrasound to rural and underserved areas.*Methods and Materials The teleultrasound system utilized in this study employs volume sweep imaging (VSI) and a telemedicine app installed on a tablet which connects to an ultrasound machine. VSI is an ultrasound technique in which an individual scans the target region utilizing preset ultrasound sweeps demarcated by easily recognized external body landmarks. The sweeps are saved as video clips for later interpretation by an experienced radiologist. In our study, teleultrasound scans from a Peruvian clinic were sent to the United States for remote interpretation and quality assessment. Standard of care comparison was made to a same-day ultrasound examination performed by a radiologist.*Results 144 subjects were recruited to participate in the study. Among VSI exams of acceptable or excellent image quality (n=91), there was 95% agreement between standard of care and teleultrasound on whether an exam was normal or abnormal, with a Cohen's kappa of 0.84 (95% CI 0.7-0.98, p <0.0001). The liver and gallbladder showed greater than 80% visualization in a majority of the acceptable and excellent image quality cases. Among teleultrasound exams of acceptable or excellent image quality, the sensitivity for an abnormal gallbladder was 94% (95% CI 69.8%-99.8%) and the specificity was 97% (95% CI 89.5%-99.6%).*Conclusions This asynchronous telediagnostic system allows individuals without prior ultrasound experience to effectively scan the liver, gallbladder and right kidney with a high degree of agreement with standard of care ultrasound.*Clinical Relevance/Application VSI teleultrasound can be deployed to improve access to diagnostic imaging in low-resource areas.

RESULTS

144 subjects were recruited to participate in the study. Among VSI exams of acceptable or excellent image quality (n=91), there was 95% agreement between standard of care and teleultrasound on whether an exam was normal or abnormal, with a Cohen's kappa of 0.84 (95% CI 0.7-0.98, p <0.0001). The liver and gallbladder showed greater than 80% visualization in a majority of the acceptable and excellent image quality cases. Among teleultrasound exams of acceptable or excellent image quality, the sensitivity for an abnormal gallbladder was 94% (95% CI 69.8%-99.8%) and the specificity was 97% (95% CI 89.5%-99.6%).

CLINICAL RELEVANCE/APPLICATION

VSI teleultrasound can be deployed to improve access to diagnostic imaging in low-resource areas.

SPR-GI-60   Simultaneous Multislice Diffusion-weighted Imaging Versus Standard Diffusion-weighted Imaging In Whole-body PET/MRI

Participants
Felipe Furtado, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Diffusion-weighted imaging (DWI) is a magnetic resonance imaging (MRI) sequence useful for detecting primary tumors and metastases. However, DWI acquisition in abdominal and whole-body protocols is often lengthy and sensitive to artifacts. Simultaneous Multi-Slice (SMS) DWI is a parallel imaging technique that may address this issue. This study compared standard (STD) DWI and SMS-DWI during whole-body (WB) positron emission tomography (PET)/MRI in regard to acquisition duration and lesion detection sensitivity.*Methods and Materials Adult oncologic patients who underwent whole-body fluorodeoxyglucose positron emission tomography (PET)/MRI between 8/2018 and 3/2020 were prospectively enrolled. All data were acquired on a 3T Biograph mMR (Siemens Healthcare, Erlangen, Germany) using the spine coil and body coil arrays. MRI sequences included Axial T2 HASTE, a prototype Axial SMS-DWI, axial STD-DWI, coronal T2 HASTE, pre- and post-contrast axial T1 VIBE, and post-contrast coronal T1 VIBE. SMS-DWI and its computed ADC map were compared with their STD counterparts regarding acquisition time and lesion detection. The standard of reference for lesion detection included the anatomic MRI sequences and the PET data. Linear and ordinal logistic models were created to quantify the association between acquisition time and lesion detection to imaging modality. All model parameters were estimated using generalized estimating equations and odds ratios were computed.*Results 83 adults were enrolled, 57% (47/83) female, median age 64 years (IQR 52-71 years). The median STD-DWI acquisition time was 14.67 minutes (IQR 14.10-15.76 minutes), compared to 6.95 minutes (IQR 6.70-7.15) for SMS-DWI. Acquisition times using standard DWI were 2.21 (95%: 2.13 - 2.30) times longer than the SMS-DWI (p<0.001). STD-DWI detected 277 of the 356 (78%) lesions while SMS-DWI could locate 297 (83%) of them (odds ratio 1.44, p-value 0.036).*Conclusions SMS-DWI was able to significantly reduce acquisition time while improving the diagnostic yield.*Clinical Relevance/Application DWI is useful for whole-body oncologic imaging, but its acquisition time remains a challenge. SMS-DWI might enable faster acquisition while retaining or even improving diagnostic yield.

RESULTS

83 adults were enrolled, 57% (47/83) female, median age 64 years (IQR 52-71 years). The median STD-DWI acquisition time was 14.67 minutes (IQR 14.10-15.76 minutes), compared to 6.95 minutes (IQR 6.70-7.15) for SMS-DWI. Acquisition times using standard DWI were 2.21 (95%: 2.13 - 2.30) times longer than the SMS-DWI (p<0.001). STD-DWI detected 277 of the 356 (78%) lesions while SMS-DWI could locate 297 (83%) of them (odds ratio 1.44, p-value 0.036).

CLINICAL RELEVANCE/APPLICATION

DWI is useful for whole-body oncologic imaging, but its acquisition time remains a challenge. SMS-DWI might enable faster acquisition while retaining or even improving diagnostic yield.

SPR-GI-61   Meta-analysis And Systematic Review Of Contrast-enhanced Ultrasound In Evaluating The Treatment Response After Locoregional Therapy Of Hepatocellular Carcinoma

Participants
Esika Savsani, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Contrast-enhanced ultrasound (CEUS) is a useful tool to measure treatment response after ablation or transarterial chemoembolization (TACE) of hepatocellular carcinoma (HCC). Several single-site clinical validation studies have been conducted, and a summary of the studies in this field is needed. Here, we performed a systematic review and meta-analysis to evaluate the usefulness of CEUS in evaluation of tumor treatment response after locoregional therapy.*Methods and Materials PubMed, Scopus, and Cochrane library databases were searched from their inception until March 8, 2021, for diagnostic test accuracy studies comparing CEUS to a reference standard for identifying residual tumors after locoregional therapy for hepatocellular carcinoma (HCC). The pooled sensitivity, specificity, accuracy, and diagnostic odds ratio (DOR) were obtained using a bivariate random effects model. Subgroup analyses were performed by stratifying the studies based on study design, type of locoregional therapy, CEUS criteria for residual tumor, timing of CEUS, and type of standard reference to evaluate the influence of these factors on the overall effect.*Results Two reviewers independently evaluated 1479 publications. After full-text review, 142 studies were found to be relevant and 43 publications (50 cohorts) with sufficient study detail were included in the final meta-analysis. The overall sensitivity of CEUS in detection of residual disease estimated from the bivariate random effects model was 0.85 (95% CI 0.80-0.89). Similarly, the overall specificity was estimated to be 0.94 (95% CI 0.91-0.96). The accuracy (fraction of correct tests) was 93.5%. The DOR was 84.1 (95% CI 54.0-131.0), and the AUROC was 0.95. Initial subgroup analysis showed no apparent differences in the diagnostic performance between locoregional therapy (TACE vs. ablation) or criteria used to define residual enhancement (any intratumoral enhancement vs. arterial phase hyper-enhancement), timing for performing CEUS, study design, and type of reference standard.*Conclusions Evidence shows that CEUS is a highly effective method for identifying residual HCC after locoregional therapy.*Clinical Relevance/Application A meta-analysis of 43 studies including 2993 HCC nodules demonstrated that CEUS is an effective imaging modality for diagnosing residual tumor after locoregional therapy.

RESULTS

Two reviewers independently evaluated 1479 publications. After full-text review, 142 studies were found to be relevant and 43 publications (50 cohorts) with sufficient study detail were included in the final meta-analysis. The overall sensitivity of CEUS in detection of residual disease estimated from the bivariate random effects model was 0.85 (95% CI 0.80-0.89). Similarly, the overall specificity was estimated to be 0.94 (95% CI 0.91-0.96). The accuracy (fraction of correct tests) was 93.5%. The DOR was 84.1 (95% CI 54.0-131.0), and the AUROC was 0.95. Initial subgroup analysis showed no apparent differences in the diagnostic performance between locoregional therapy (TACE vs. ablation) or criteria used to define residual enhancement (any intratumoral enhancement vs. arterial phase hyper-enhancement), timing for performing CEUS, study design, and type of reference standard.

CLINICAL RELEVANCE/APPLICATION

A meta-analysis of 43 studies including 2993 HCC nodules demonstrated that CEUS is an effective imaging modality for diagnosing residual tumor after locoregional therapy.

SPR-GI-62   Comparison Between Conventional And Volumetric Response Criteria For Assessment Of Clinical Benefit From Systemic Immunotherapy In HCC

Participants
Azarakhsh Baghdadi, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

RECIST 1.1 is the most widely utilized imaging criteria for clinical trials of systemic therapies in HCC, but imaging assessments with RECIST may not reflect the full spectrum of clinical benefit. Here we compare the performance of RECIST, mRECIST, EASL, and viable tumor volume for imaging assessment with PD(L)1-based therapy in HCC.*Methods and Materials We conducted a retrospective review of patients receiving systemic immunotherapy for intermediate or advanced stage HCC at the Johns Hopkins Hospital from 2019-2020. Patients were eligible for inclusion if they had received immunotherapy as standard of care with at least 6 months of follow up, and paired imaging with contrast CT or MRI at treatment baseline and at the end of treatment. Anatomic (RECIST, mRECIST and EASL) and functional (total and viable tumor volume) imaging assessments were performed on the baseline and follow-up images. Patients who had more than 66% decrease in viable tumor volume and 50% decrease in total tumor volume were deemed responders.*Results Thirty-seven patients met our inclusion criteria and were included in our retrospective imaging review. A higher percentage of baseline and on-treatment lesions were evaluable by volumetric response criteria than by conventional response criteria (37 by viable tumor volume assessment, and 35 by RECIST 1.1). On imaging review, response rates for patients with evaluable lesions were higher with viable tumor volume assessment(35%) than by conventional imaging modalities (2.5% by RECIST, 19% by mRECIST and 19% by EASL).*Conclusions Viable tumor volume captures a higher number of responses with immunotherapy in HCC than conventional imaging modalities, especially in lesions that cannot be measured with conventional response criteria. Further prospective validation of viable tumor volume as a predictor of clinical outcomes is warranted in clinical trials of immunotherapy in HCC.*Clinical Relevance/Application Immunotherapy is a groundbreaking treatment and this study can be the foundation of future prospective studies and also clinical trials to assess response to immunotherapy in HCC.

RESULTS

Thirty-seven patients met our inclusion criteria and were included in our retrospective imaging review. A higher percentage of baseline and on-treatment lesions were evaluable by volumetric response criteria than by conventional response criteria (37 by viable tumor volume assessment, and 35 by RECIST 1.1). On imaging review, response rates for patients with evaluable lesions

were higher with viable tumor volume assessment(35%) than by conventional imaging modalities (2.5% by RECIST, 19% by mRECIST and 19% by EASL).

CLINICAL RELEVANCE/APPLICATION

Immunotherapy is a groundbreaking treatment and this study can be the foundation of future prospective studies and also clinical trials to assess response to immunotherapy in HCC.

SPR-GI-63 PET/MRI Versus PET/CT, MRI, And CT In The Diagnosis Of Peritoneal Carcinomatosis

Participants
Felipe Furtado, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To compare positron emission tomography (PET)/ Magnetic resonance imaging (MRI) to the standard of care imaging (SCI) regarding the diagnosis of peritoneal carcinomatosis (PC) in primary abdominal malignancies. PC has profound negative prognostic significance in several cancers including primary abdominopelvic malignancies. Its presence may preclude surgical cure or definitive cure. Thus, the detection of PC non-invasively by imaging is of compelling clinical interest in cancer staging and restaging.*Methods and Materials Adult patients were prospectively enrolled consecutively from 4/2019 to 3/2021. Inclusion criteria were: (a) acquisition of fluorodeoxyglucose PET/MRI, (b) confirmed primary abdominal neoplasm. Patients were excluded if: (a) the interval between SCI and PET/MRI exceeded 4 weeks, (b) if follow-up pathology, laparoscopy, or imaging results were not available. SCI consisted of whole-body contrast-enhanced (CE) PET/CT with diagnostic-quality (i.e. standard radiation dose) CT, abdominal CE-CT, or abdominal CE-MRI. If available, pathology, and laparoscopy/surgical description, served as the primary standard of reference, otherwise, imaging follow-up, which was acquired in every patient, served as the standard of reference.*Results One hundred sixty-four patients were studied, 85 (52%) were female. The median age was 60 years (IQR 50 - 69). Thirty-one cases ultimately had PC according to the reference standard, 18 females (58%), median age 56 years (IQR 52 - 66). The standard was pathology or laparoscopy for 51% (84/164) and imaging for 49% (80/164). PET/MRI had a sensitivity of 90% (95% CI 74% - 98%), a specificity of 92% (95% CI 86% - 96%), and accuracy of 91% (95% CI 86% - 95%), compared to 58% (95% CI 39% - 75%), 96% (95% CI 91% - 98%), and 89% (95% CI 83% - 93%), respectively, for SCI. When segmenting each individual modality, sensitivity, specificity, and accuracy were, respectively 59%, 96%, and 88% for PET/CT, 50%, 94%, and 88% for CT, and 67%, 100%, and 95% for MRI.*Conclusions PET/MRI provides a substantial increase in sensitivity for peritoneal involvement over SCI.*Clinical Relevance/Application Peritoneal carcinomatosis is not uncommon in gastrointestinal cancers, and its detection is paramount to establish adequate management. PET/MRI presents improved sensitivity for peritoneal carcinomatosis over the currently used modalities.

RESULTS

One hundred sixty-four patients were studied, 85 (52%) were female. The median age was 60 years (IQR 50 - 69). Thirty-one cases ultimately had PC according to the reference standard, 18 females (58%), median age 56 years (IQR 52 - 66). The standard was pathology or laparoscopy for 51% (84/164) and imaging for 49% (80/164). PET/MRI had a sensitivity of 90% (95% CI 74% - 98%), a specificity of 92% (95% CI 86% - 96%), and accuracy of 91% (95% CI 86% - 95%), compared to 58% (95% CI 39% - 75%), 96% (95% CI 91% - 98%), and 89% (95% CI 83% - 93%), respectively, for SCI. When segmenting each individual modality, sensitivity, specificity, and accuracy were, respectively 59%, 96%, and 88% for PET/CT, 50%, 94%, and 88% for CT, and 67%, 100%, and 95% for MRI.

CLINICAL RELEVANCE/APPLICATION

Peritoneal carcinomatosis is not uncommon in gastrointestinal cancers, and its detection is paramount to establish adequate management. PET/MRI presents improved sensitivity for peritoneal carcinomatosis over the currently used modalities.

SPR-GI-64 Sinogram-based Thin Slices Deep Learning Image Reconstruction Technique In Abdominal CT: Image Quantitative And Qualitative Analysis.

Participants
Jinjin Cao, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the image quality and perception of deep-learning image reconstruction (DLIR) for single-energy abdominal CT using 1.25 mm thin slices compared to 5 mm standard-of-care adaptive statistical iterative reconstruction (ASIR-V) images.*Methods and Materials This retrospective study included 52 patients (31 F; 56.9±16.9 years) undergoing portal venous phase abdominal CT. Four reconstructions [5-mm thickness ASIR-V at 40%, and 1.25-mm thickness DLIR at three strengths (low (DLIR-L), medium (DLIR-M) and high (DLIR-H)) were generated. Qualitative assessment was performed for image noise, contrast, visibility of small structures, sharpness and artifact by the two blinded radiologists on a 5-point-scale ranging from 1=excellent to 5=very poor. Radiologists also indicated image preference on a 3-point-scale (1=most preferred; 2=acceptable; 3=least preferred). Quantitative assessment was performed by measuring attenuation, image noise, and contrast-to-noise ratios (CNR).*Results DLIR-M and DLIR-H yielded better image quality scores compared to ASIR-V 40. Mean qualitative scores on DLIR-H for noise (1.77 ± 0.71), contrast (1.6 ± 0.68), small structure visibility (1.42 ± 0.66), sharpness (1.34 ± 0.55) and image preference (1.11 ± 0.34) were the best (p<0.05) followed by DLIR-M (2.66 ± 0.65, 2.12 ± 0.70, 1.97 ± 0.70, 1.78 ± 0.56, 1.30 ± 0.50), DLIR-L (3.22 ± 0.61, 2.41 ± 0.63, 2.32± 0.67, 2.02 ± 0.42, 1.56 ± 0.57) and ASIR-V (3.09 ± 0.64, 2.62 ± 0.60, 2.59 ± 0.73, 2.07 ± 0.42). There were no significant differences in image noise and sharpness scores between DLIR L and ASIR-V 40 (p=0.053 and p=0.275). There is significant difference image contrast and image preference scores between DLIR-L and ASIR-V 40 (p<0.05). Ratings for artifacts were similar for all reconstructions (p>0.05). There is no significant difference attenuation value among all the groups. For quantitative analysis, DLIR-H demonstrated the lowest image noise (9.17 ± 3.11) and the highest CNR (CNRliver = 26.88 ± 6.54 and CNRportal vein = 7.92 ± 3.85).*Conclusions DLIRs were preferred over iterative reconstruction subjectively and DLIR-H yielded better quantitative CNR due to improved image quality and lower noise.*Clinical Relevance/Application DLIR demonstrates potential benefit in clinical practice, allowing for potential radiation dose reduction while preserving good image quality and low image noise.

RESULTS

DLIR-M and DLIR-H yielded better image quality scores compared to ASIR-V 40. Mean qualitative scores on DLIR-H for noise (1.77 ± 0.71), contrast (1.6 ± 0.68), small structure visibility (1.42 ± 0.66), sharpness (1.34 ± 0.55) and image preference (1.11 ± 0.34) were the best (p<0.05) followed by DLIR-M (2.66 ± 0.65, 2.12 ± 0.70, 1.97 ± 0.70, 1.78 ± 0.56, 1.30 ± 0.50), DLIR-L (3.22 ± 0.61, 2.41 ± 0.63, 2.32± 0.67, 2.02 ± 0.42, 1.56 ± 0.57) and ASIR-V (3.09 ± 0.64, 2.62 ± 0.60, 2.59 ± 0.73, 2.07 ± 0.42). There were

no significant differences in image noise and sharpness scores between DLIR L and ASIR-V 40 (p=0.053 and p=0.275). There is significant difference image contrast and image preference scores between DLIR-L and ASIR-V 40 (p<0.05). Ratings for artifacts were similar for all reconstructions (p>0.05). There is no significant difference attenuation value among all the groups. For quantitative analysis, DLIR-H demonstrated the lowest image noise (9.17 ± 3.11) and the highest CNR (CNRliver = 26.88 ± 6.54 and CNRportal vein = 7.92 ± 3.85).

CLINICAL RELEVANCE/APPLICATION

DLIR demonstrates potential benefit in clinical practice, allowing for potential radiation dose reduction while preserving good image quality and low image noise.

SPR-GI-8   Converting Diffusion Weighted Rectal Tumor Imaging Data At Multiple B-values Into MNIST-like Pictures For The Pretreatment Prediction Of Pathological Complete Response To Neoadjuvant Chemoradiotherapy By Deep Learning

Participants
Haitao Zhu, PhD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Several non-Gaussian models have been proposed to predict the pathological results of locally advanced rectal cancers, including IVIM, stretched-exponential model, DKI, etc., but no model has been considered as the gold standard. In fact, all models aim to simplify diffusion physics into an equation with several parameters, but the true biological environment might be far more complicated than the models. It is desirable to skip the parameterizing step and directly utilize the decay curve of diffusion signal. In this study, we propose a method to convert DWI data acquired at multiple b-values into MNIST-like 2D pictures for deep learning. The method is used to predict the status of pathological complete response (pCR) after neoadjuvant chemoradiotherapy (NCRT) by using pretreatment DWI data.*Methods and Materials 472 subjects were enrolled and divided to a train group (n=200), a validation group (n=72) and a test group (n=200). All participants were scanned on a 3.0 Tesla MRI scanner (Discovery MR750) before the initiation of NCRT using an 8-channel phased array body coil in the supine position. DWI data were acquired with TR=2800 ms, TE=66 ms, FOV=340 mm, matrix=256×256, thickness=4 mm and gap=1 mm. The b-values were: 0, 20, 50, 100, 200, 400, 600, 800, 1000, 1200, 1400, and 1600 sec/mm2. ROI of rectal tumor was delineated by two experienced radiologists. DWI data were converted into a MNIST-like picture by: (1) A histogram was calculated from the logarithm format of signals in ROI at each b-value with 35 bins between 3 and 10; (2) the histograms of all b-values were piled to construct a 12×35 picture. It looks like a handwriting signature on a plate with gray level as x-axis, b-value as y-axis and pixel number as intensity. 3 repetitions of a convolutional layer, a pooling layer and a ReLU layer were used to classify the pictures into pCR and non-pCR. Pathological results were used as ground truth. Data augmentation was performed in the train and validation groups by randomly sampling half of the voxels in ROI by 100 times for pCR and 25 times for non-pCR to keep a balance in classes.*Results Validation group was used to optimize hyperparameters into batch=200, epochs=7.2e4 and learning rate=1e-5. Test group was evaluated by the final model determined above. Accuracy and AUC are 0.894 and 0.939 in the train group, 0.861 and 0.924 in the validation group, 0.915 and 0.924 in the test group.*Conclusions This study proposes a deep learning method of analyzing DWI data acquired at multiple b-values without parameterization and shows good prediction of pCR after NCRT by using pre-NCRT DWI data.*Clinical Relevance/Application Prediction of pathological result before NCRT for locally advanced rectal cancer makes it possible to change NCRT or surgery plan before the start of treatment.

RESULTS

Validation group was used to optimize hyperparameters into batch=200, epochs=7.2e4 and learning rate=1e-5. Test group was evaluated by the final model determined above. Accuracy and AUC are 0.894 and 0.939 in the train group, 0.861 and 0.924 in the validation group, 0.915 and 0.924 in the test group.

CLINICAL RELEVANCE/APPLICATION

Prediction of pathological result before NCRT for locally advanced rectal cancer makes it possible to change NCRT or surgery plan before the start of treatment.

SPR-GI-9   Low Volume Reduced Bowel Preparation Regimen For CT Colonography: A Randomized Noninferiority Trial

Participants
Simone Vicini, MD, Latina, Italy (*Presenter*) Nothing to Disclose

PURPOSE

Bowel preparation is the most unpleasant step of CT colonography (CTC) due to high volume of cathartic solution to ingest and gastrointestinal discomfort. The aim of our study was to determine whether the quality of a low-volume reduced bowel preparation (LV-RBP) for CTC is noninferior to standard full-volume reduced bowel preparation (FV-RBP) regimen.*Methods and Materials In this randomized controlled trial, consecutive participants referred for CTC were randomly assigned (1:1 ratio, fixed blocks of 10) to receive LV-RBP (52.5 g of PMF104 in 500 mL of water) or FV-RBP (105 g of PMF104 in 1000 mL of water). Images were independently reviewed by five blinded readers who rated the quality of bowel preparation using a 4-point scale from 0 (best score) to 3 (worst score) on per-colonic segment basis.The primary outcome was the noninferiority of LV-RBP to FV-RBP in the proportion of segments scored 0 for colon cleansing quality, with a noninferiority margin of 10%. Noninferiority in residual fluids and colonic distension, and superiority in lesions and polyps detection rates and patient acceptability were secondary outcomes.*Results From March 2019 to January 2020, a total of 110 participants (mean age 65 years ± 14 [standard deviation]; 74 women) were allocated to LV-RBP (n=55) or FV-RBP (n=55) arms. There were 92% segment with score 0 in colon cleansing quality in LV-RBP and 94% in FV-RBP for prone scans, and 94% vs 92% as for supine scans. Risk difference was - 2.1 (95% CI: -5.9 to 1.7) and 1.5 (95% CI: - 2.4 to 5.4) for prone and supine positions, respectively. Residual fluids and colonic distension were also noninferior in LV-RBP. LV-RBP was associated with a lower number of evacuations during preparation (7±5 vs 10±6, p=0.002).There was almost perfect agreement for overall quality of colon cleansing and volume of residual fluids scoring among all readers (ICC = 0.90 [95% CI 0.88-0.91] and ICC = 0.88 [95% CI 0.87-0.90] in the LV-RBP and in the FV-RBP arm, respectively). Patients discomfort related to the bowel preparation was rated as mild by most participants for both regimens (median VAS score [range]: 2 (0 - 10) vs 2 (0 - 10); p=0.64). The LV-RBP regimen was associated with a lower number of evacuation during the bowel preparation compared.*Conclusions The low-volume bowel preparation for CT colonography demonstrated noninferior quality of colon cleansing with improved gastrointestinal tolerability compared to full-volume regimen.*Clinical Relevance/Application A low-volume reduced bowel preparation for CT colonography improves patients gastrointestinal tolerability while providing noninferior quality of colon

cleansing compared to a full volume regimen.

RESULTS

From March 2019 to January 2020, a total of 110 participants (mean age 65 years ± 14 [standard deviation]; 74 women) were allocated to LV-RBP (n=55) or FV-RBP (n=55) arms. There were 92% segment with score 0 in colon cleansing quality in LV-RBP and 94% in FV-RBP for prone scans, and 94% vs 92% as for supine scans. Risk difference was - 2.1 (95% CI: -5.9 to 1.7) and 1.5 (95% CI: -2.4 to 5.4) for prone and supine positions, respectively. Residual fluids and colonic distension were also noninferior in LV-RBP. LV-RBP was associated with a lower number of evacuations during preparation (7±5 vs 10±6, p=0.002).There was almost perfect agreement for overall quality of colon cleansing and volume of residual fluids scoring among all readers (ICC = 0.90 [95% CI 0.88-0.91] and ICC = 0.88 [95% CI 0.87-0.90] in the LV-RBP and in the FV-RBP arm, respectively). Patients discomfort related to the bowel preparation was rated as mild by most participants for both regimens (median VAS score [range]: 2 (0 - 10) vs 2 (0 - 10); p=0.64). The LV-RBP regimen was associated with a lower number of evacuation during the bowel preparation compared.

CLINICAL RELEVANCE/APPLICATION

A low-volume reduced bowel preparation for CT colonography improves patients gastrointestinal tolerability while providing noninferior quality of colon cleansing compared to a full volume regimen.

Abstract Archives of the RSNA, 2021

Participants
Stephen Hobbs, MD, Lexington, Kentucky (*Moderator*) Author with royalties, Wolters Kluwer nvAuthor with royalties, Reed Elsevier
Chi Wan Koo, MD, Rochester, Minnesota (*Moderator*) Nothing to Disclose

Sub-Events

SSCH03   **Keynote Speaker**

Participants
Chi Wan Koo, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

SSCH03-2   **Deep Learning Chest Age Estimation From Radiographs Improves Prediction Of Survival In Patients With Lung Cancer**

Participants
Jakob Weiss, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

One of the most important risk factors used for prognostication in cancer patients is chronological age. However, as people age at different rates, chronological age is an imperfect measure of aging, but medical imaging may provide quantitative data on biological aging. Here, we developed a deep learning model to estimate a biological chest age from a routine chest radiograph image (CXR Chest-Age), and evaluated its prognostic value in lung cancer screening eligible individuals and patients with confirmed lung cancer.*Methods and Materials The CXR Chest-Age model was developed using 147,497 chest radiographs of 40,643 asymptomatic participants in a prospective cancer screening trial. Subsequently, the model was applied to two independent test-sets without retraining, 1) 5,414 heavy smokers aged 55-74 having a screening chest radiograph in the National Lung Screening Trial (NLST), and 2) 604 patients with histologically confirmed lung cancer enrolled in the Boston Lung Cancer Study (BLCS). The prognostic power of CXR Chest-Age was compared to chronological age using the concordance index and Cox proportional hazards regression.*Results In NLST, 118 (5.0%) lung cancer deaths occurred over a median follow-up of 11.9±3.0 years and the C-index for CXR Chest-Age was 0.66 compared to chronological age 0.58 (p<0.001). A similar pattern was found for the BLCS patients (follow-up 3.3±3.2 years; 36.6% lung cancer deaths; C-index CXR Chest-Age vs. chronological age of 0.61 vs. 0.53; p<0.001). Adding CXR Chest-Age to a multivariate Cox model with demographic (age, race, smoking, BMI) and clinical risk factors (cancer stage, treatment) resulted in a significant improvement in the estimate of lung cancer-specific survival in the BLCS patients (C-index 0.77 vs. 0.76; p<0.001).*Conclusions Deep learning-based assessment of chest age from routine chest radiographs significantly improves prediction of survival in patients with lung cancer independent of baseline risk factors and beyond chronological age.*Clinical Relevance/Application Deep learning can automatically extract prognostic information from a routine chest radiograph and improve prognostication in screening and cancer populations, which may guide decision making, inform risk stratification and personalize patient management.

RESULTS

In NLST, 118 (5.0%) lung cancer deaths occurred over a median follow-up of 11.9±3.0 years and the C-index for CXR Chest-Age was 0.66 compared to chronological age 0.58 (p<0.001). A similar pattern was found for the BLCS patients (follow-up 3.3±3.2 years; 36.6% lung cancer deaths; C-index CXR Chest-Age vs. chronological age of 0.61 vs. 0.53; p<0.001). Adding CXR Chest-Age to a multivariate Cox model with demographic (age, race, smoking, BMI) and clinical risk factors (cancer stage, treatment) resulted in a significant improvement in the estimate of lung cancer-specific survival in the BLCS patients (C-index 0.77 vs. 0.76; p<0.001).

CLINICAL RELEVANCE/APPLICATION

Deep learning can automatically extract prognostic information from a routine chest radiograph and improve prognostication in screening and cancer populations, which may guide decision making, inform risk stratification and personalize patient management.

SSCH03-4   **Deep Learning Quantification Of Hepatic Steatosis And Mortality In The National Lung Screening Trial (NLST)**

Participants
Jakob Weiss, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Early detection of hepatic steatosis is important to initiate preventive measures. Although quantification is possible on non-contrast enhanced CT scans, it is not routinely performed, and its value in heavy smokers remains inconclusive. Here, we used an automatic deep learning algorithm to estimate hepatic steatosis from lung screening chest CTs and investigated its prognostic significance in 14,753 participants of the National Lung Screening Trial (NLST).*Methods and Materials We used a deep learning model to volumetrically segment the liver on chest CTs. Hepatic steatosis was defined as a mean hepatic attenuation <40 Hounsfield Units. Participants with hepatic steatosis were categorized as overweight (BMI=25) and lean (BMI<25). The association between hepatic steatosis and all-cause mortality as well as cardiovascular mortality was investigated in 14,753 NLST participants.*Results Over a

median follow-up of 6.5±1.0 years there were 7.2% (1,066/14,753) all-cause and 1.9% (282/14,753) cardiovascular deaths. The median liver density was not significantly different in lean and overweight participants (33.2 HU vs. 32.4 HU; p=0.63). There was a significant association between hepatic steatosis and all-cause mortality in lean (HR: 2.48 [95% CI 1.37-4.49]; p=0.003) but not in overweight participants (HR: 0.99 [95% CI 0.76-1.29]; p=0.93). This signal remained robust (HR: 2.56 [95% CI 1.41-4.66]; p=0.002) after adjustment for baseline demographic (age, race, gender, BMI) and cardiovascular risk factors (hypertension, diabetes, Agatston score, past MI and stroke). No significant association was found between hepatic steatosis and cardiovascular mortality for lean and overweight participants (HR: 0.84 [95% CI 0.12-5.96; p=0.86; and HR: 1.04 [95% CI 0.63-1.73; p=0.87].*Conclusions Hepatic steatosis shows a strong association with all-cause but not cardiovascular mortality in lean heavy smokers participating in a lung cancer screening trial.*Clinical Relevance/Application Deep learning-based approximation of the presence of hepatic steatosis helps to identify individuals at high risk and may guide preventive measures.

RESULTS

Over a median follow-up of 6.5±1.0 years there were 7.2% (1,066/14,753) all-cause and 1.9% (282/14,753) cardiovascular deaths. The median liver density was not significantly different in lean and overweight participants (33.2 HU vs. 32.4 HU; p=0.63). There was a significant association between hepatic steatosis and all-cause mortality in lean (HR: 2.48 [95% CI 1.37-4.49]; p=0.003) but not in overweight participants (HR: 0.99 [95% CI 0.76-1.29]; p=0.93). This signal remained robust (HR: 2.56 [95% CI 1.41-4.66]; p=0.002) after adjustment for baseline demographic (age, race, gender, BMI) and cardiovascular risk factors (hypertension, diabetes, Agatston score, past MI and stroke). No significant association was found between hepatic steatosis and cardiovascular mortality for lean and overweight participants (HR: 0.84 [95% CI 0.12-5.96; p=0.86; and HR: 1.04 [95% CI 0.63-1.73; p=0.87].

CLINICAL RELEVANCE/APPLICATION

Deep learning-based approximation of the presence of hepatic steatosis helps to identify individuals at high risk and may guide preventive measures.

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Science Session with Keynote: Nuclear Medicine/Molecular Imaging (Technical Advances in Molecular Imaging)

Participants

Michael V. Knopp, MD, PhD, Columbus, Ohio (*Moderator*) Nothing to Disclose

Sub-Events

SSNMMI02 Keynote Speaker

Participants

Michael V. Knopp, MD, PhD, Columbus, Ohio (*Presenter*) Nothing to Disclose

SSNMMI02-2 Ultrafast, Low Dose FDG Oncologic Whole-body PET/CT: Phase III Findings

Participants

Michelle Knopp, Columbus, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

To validate the clinical equivalence of ultrafast (2 min), low dose (5 mCi) FDG oncologic whole body imaging using digital PET/CT and adaptive regularized reconstruction to conventional ~15-20 min acquisition in a prospective Phase III clinical trial.*Methods and Materials 275 whole-body FDG PET/CT in patients with an oncologic disease were prospectively enrolled and digital PET imaging performed 60 - 75 min p.i. using both a conventional 90s per bed position and investigational 9s per be position acquisition. The BMI averaged at 30 and glucose level 104. The target FDG dose was at the lowest FDA labeled at 5.0 mCi. An organ, BMI adaptive regularized reconstruction methodology was consistently used for the ultrafast acquisition while the 90s was performed using current system default settings. A blinded two reader, adjudicator visual and a quantitative assessment was performed.*Results Due to count sparsity, regularized adaptive reconstruction was essential and enabled all cases with a BMI <35 (213/213) to be assessed as diagnostic. In the 62 cases with BMI >=35, 7 were classified as non-diagnostic, 19 limited and 36 as diagnostic. An additional investigation of those cases that were rated limited or non-diagnostic with a simulated extended acquisition time that doubled the count density to 4 min table time demonstrated all to be diagnostic.*Conclusions Ultrafast (2 min) low dose (5 mCi) wholebody FDG PET/CT using regularized adaptive reconstruction was shown to be diagnostic equivalent to conventional PET/CT acquired using 10x longer acquisition times in all patients with BMI <35. In patients with BMI >=35, a 5x shorter acquisition time enabled full diagnostic equivalency.*Clinical Relevance/Application Shorter diagnostic wholebody PET/CT exam times are an important improvement for the patient experience and helpful for efficient patient throughput. This study confirmed diagnostic equivalency even at the lowest FDA allowable dose.

RESULTS

Due to count sparsity, regularized adaptive reconstruction was essential and enabled all cases with a BMI <35 (213/213) to be assessed as diagnostic. In the 62 cases with BMI >=35, 7 were classified as non-diagnostic, 19 limited and 36 as diagnostic. An additional investigation of those cases that were rated limited or non-diagnostic with a simulated extended acquisition time that doubled the count density to 4 min table time demonstrated all to be diagnostic.

CLINICAL RELEVANCE/APPLICATION

Shorter diagnostic wholebody PET/CT exam times are an important improvement for the patient experience and helpful for efficient patient throughput. This study confirmed diagnostic equivalency even at the lowest FDA allowable dose.

SSNMMI02-3 Multiparametric Integrated 18F-FDG PET/MRI Based Radiomics For Breast Cancer Phenotyping And Tumordecoding

Participants

Johannes Grueneisen, Essen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

This study investigated the performance of simultaneous 18F-FDG PET/MRI of the breast as a platform for comprehensive radiomics analysis for breast cancer subtype analysis, hormone receptor status, proliferation rate and lymphonodular and distant metastatic spread.*Methods and Materials 124 patients with 125 breast cancer tumors underwent simultaneous 18F-FDG PET/MRI. Breast tumors were segmented and radiomic features were extracted utilizing CERR software following the IBSI guidelines. LASSO regression was employed to select the most important radiomics features prior to model development. Five-fold cross validation was then utilzied alongside support vector machines, resulting in predictive models for various combinations of imaging data series.*Results Highest AUC and accuracy for differentiation between luminal A and B was achieved by all MR sequences (AUC 0.98; accuracy 97.3). Best results in AUC for prediction of hormone receptor status and proliferation rate were faciliated based on all MR and PET data (ER AUC 0.87, PR AUC 0.88, Ki-67 AUC 0.997). PET provided best determination of grading (AUC 0.71), while all MR and PET analysis yielded best results for lymphonodular and distant metastatic spread (0.81 and 0.99, respectively).*Conclusions 18F-FDG PET/MRI enables comprehensive high-quality radiomics analysis for breast cancer phenotyping and tumor decoding, utilizing the perks of simultaneously acquired morphologic, functional and metabolic data.*Clinical Relevance/Application 18F-FDG

PET/MRI serves as an excellent imaging platform for high quality non-invasive tissue characterization of breast cancer.

RESULTS

Highest AUC and accuracy for differentiation between luminal A and B was achieved by all MR sequences (AUC 0.98; accuracy 97.3). Best results in AUC for prediction of hormone receptor status and proliferation rate were faciliated based on all MR and PET data (ER AUC 0.87, PR AUC 0.88, Ki-67 AUC 0.997). PET provided best determination of grading (AUC 0.71), while all MR and PET analysis yielded best results for lymphonodular and distant metastatic spread (0.81 and 0.99, respectively).

CLINICAL RELEVANCE/APPLICATION

18F-FDG PET/MRI serves as an excellent imaging platform for high quality non-invasive tissue characterization of breast cancer.

SSNMMI02-4 Evaluation Of A High-sensitivity Organ-targeted PET Camera

Participants
Oleksandr Bubon, PhD, Thunder Bay, Ontario (*Presenter*) Shareholder, Radialis Medical;Officer, Radialis Medical

PURPOSE

The Radialis PET camera is an organ-targeted positron emission tomography (PET) system that uses seamless planar arrays of silicon photomultipliers. The aim of this work is to evaluate the image quality of the Radialis PET Camera to inform clinical applications.*Methods and Materials The image quality assessment was conducted according to the National Electrical Manufacturers Association (NEMA) NU-4 standards, with several modifications to accommodate the planar detector design, in terms of spatial resolution, sensitivity, count rate performance, scatter fraction and image quality. Furthermore, a side-by-side comparison of the clinical image quality acquired with the developed camera and a whole body (WB) PET is presented.*Results Micro hotspot phantom sources are visualized down to the 1.35 mm diameter rods. The sensitivity at the peak noise equivalent count rate is 5,400 cps/MBq. The system peak noise equivalent count rate is 17.8 kcps and the peak true count rate is 32.5 kcps. System scatter fraction is 24%. The maximum sensitivity achieved was 3.5%, with a system normalized sensitivity of 2.4%.*Conclusions Given the improved sensitivity compared to whole-body PET and organ-targeted PET systems, the Radialis PET Camera is suited to high-resolution imaging under significantly reduced activity levels.*Clinical Relevance/Application This is of a high significance for applications where the organ of interest is known before imaging and applications where current PET doses are prohibitive (including breast cancer imaging for patients for whom conventional x-ray mammography is suboptimal).

RESULTS

Micro hotspot phantom sources are visualized down to the 1.35 mm diameter rods. The sensitivity at the peak noise equivalent count rate is 5,400 cps/MBq. The system peak noise equivalent count rate is 17.8 kcps and the peak true count rate is 32.5 kcps. System scatter fraction is 24%. The maximum sensitivity achieved was 3.5%, with a system normalized sensitivity of 2.4%.

CLINICAL RELEVANCE/APPLICATION

This is of a high significance for applications where the organ of interest is known before imaging and applications where current PET doses are prohibitive (including breast cancer imaging for patients for whom conventional x-ray mammography is suboptimal).

SSNMMI02-5 Elastic Motion Correction With Deblurring: Quantitative Impacts In Oncologic PET/CT

Participants
Adeel Haq, MBBS, St. Louis, Missouri (*Presenter*) Nothing to Disclose

PURPOSE

Standard free-breathing PET images are often degraded by respiratory motion artifacts near the diaphragm. Conventional respiratory gating reduces motion artifacts but increases image noise, as many counts are discarded. This study assessed the quantitative impact of elastic motion correction with deblurring (EMCD), which generates motion-corrected PET images without discarding counts, in a general oncology population.*Methods and Materials To date, this IRB-approved, HIPAA-compliant prospective study has enrolled 10 patients with active malignancy in the lung bases (n = 7) or liver (n = 3). All subjects provided written informed consent. Imaging occurred on a Biograph Vision PET/CT (Siemens Healthineers). A weight-based FDG dose was given ~60 min before imaging. Using an Anzai system to track respiration, free-breathing PET data were acquired. Four PET reconstructions were performed: (1) without motion correction (uncorrected); (2) using only end-expiratory counts (EE-gate); (3) using EMCD to correct counts to a reference gate, as informed by the Anzai system (Anz-EMCD); and (4) using EMCD to correct counts to a reference gate via a purely data-driven approach (DD-EMCD). For each reconstruction, maximum SUV (SUV-max), metabolic tumor volume (MTV) based on an SUV-max 60% isocontour, and mean SUV (SUV-mean) of the MTV were extracted using MIM software. Statistical comparisons were based on the Wilcoxon signed-rank test (a = 0.05).*Results All data reported are medians [interquartile ranges] for the 10 subjects. SUV-max was significantly lower for uncorrected (5.6 [5.2]) images than for EE-gate (7.2 [6.4]; p = 0.02), Anz-EMCD (6.5 [6.7]; p = 0.01), or DD-EMCD (6.8 [5.8]; p = 0.01) images. MTV was significantly higher for uncorrected (1.3 ml [2.8]) images than for EE-gate (0.6 ml [0.6]; p = 0.01), Anz-EMCD (0.6 ml [0.7]; p = 0.01), or DD-EMCD (0.5 ml [1.0]; p = 0.01) images. SUV-mean of the MTV was significantly lower for uncorrected (4.2 [4.3]) images than for EE-gate (5.0 [4.7]; p = 0.02), Anz-EMCD (5.0 [5.2]; p = 0.01), or DD-EMCD (4.9 [4.5]; p = 0.01) images. There were no significant differences in these metrics among EE-gate, Anz-EMCD, and DD-EMCD images. However, for all subjects, image noise was visually lower for Anz-EMCD and DD-EMCD images relative to EE-gate images (data not shown).*Conclusions EMCD using either Anzai or data-driven respiratory signals results in higher SUV-max, smaller MTV, and higher SUV-mean of the MTV compared with uncorrected PET images, as well as lower image noise than conventional respiratory gating.*Clinical Relevance/Application Even without respiratory tracking, motion-corrected PET images with higher SUVs can be readily achieved in an oncology population, with potential for improved lesion detection and quantification.

RESULTS

All data reported are medians [interquartile ranges] for the 10 subjects. SUV-max was significantly lower for uncorrected (5.6 [5.2]) images than for EE-gate (7.2 [6.4]; p = 0.02), Anz-EMCD (6.5 [6.7]; p = 0.01), or DD-EMCD (6.8 [5.8]; p = 0.01) images. MTV was significantly higher for uncorrected (1.3 ml [2.8]) images than for EE-gate (0.6 ml [0.6]; p = 0.01), Anz-EMCD (0.6 ml [0.7]; p = 0.01), or DD-EMCD (0.5 ml [1.0]; p = 0.01) images. SUV-mean of the MTV was significantly lower for uncorrected (4.2 [4.3]) images than for EE-gate (5.0 [4.7]; p = 0.02), Anz-EMCD (5.0 [5.2]; p = 0.01), or DD-EMCD (4.9 [4.5]; p = 0.01) images. There were no significant differences in these metrics among EE-gate, Anz-EMCD, and DD-EMCD images. However, for all subjects, image noise was visually lower for Anz-EMCD and DD-EMCD images relative to EE-gate images (data not shown).

Even without respiratory tracking, motion-corrected PET images with higher SUVs can be readily achieved in an oncology population, with potential for improved lesion detection and quantification.

SSNMMI02-6 Harmonization Of Multi-centric 18F-FDG-PET/CT And PET/MRI Radiomic Data: Implications For Tissue Classification

Participants
Doris Leithner, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether ComBat harmonization improves radiomics-based tissue discrimination in pooled clinical 18F-FDG-PET data obtained with different PET/CT and PET/MRI scanners; and to determine whether effects of ComBat harmonization differ between radiomic feature classes.*Methods and Materials 18F-FDG-PET datasets of 200 cancer patients who had undergone PET/CT (two scanners from different vendors; 50 patients each) or PET/MRI (two scanners from different vendors; 50 patients each) were retrospectively included. Fixed-size 2.5-cm spherical volumes of interest were placed in the disease-free liver, spleen, and bone marrow, and radiomic features of the following classes were calculated using PyRadiomics: first-order histogram, grey-level co-occurrence matrix (GLCM), run-length matrix (GLRLM), size-zone matrix (GLSZM), and neighborhood grey-tone difference matrix (NGTDM). ComBat harmonization was applied to radiomic features to correct for technical differences between scanners. For each feature class independently, a multi-layer perceptron neural network (MLP-NN) was used for separation of the three tissues (liver, spleen, bone marrow) in the pooled dataset, before and after Combat harmonization. Classification accuracies were the primary outcome measure.*Results ComBat-harmonized PET radiomic features were superior to unharmonized features in terms of separation of liver, spleen and bone marrow, with the following accuracies in training/validation sets: histogram, 70.4/69.7% (harmonized) vs. 60.8/57.9% (unharmonized); GLCM, 82.1/74.2% vs. 52.8/49.7%; GLRLM, 79.9/75.0% vs. 58.8/60.4%; GLSZM, 76.3/78.7% vs. 54.9/54.3%; and NGTDM, 68.5/67.4% vs. 51.2/53.6%.*Conclusions ComBat harmonization markedly improves 18F-FDG-PET radiomics-based tissue classification for all radiomic feature classes, and even when PET data from PET/CT and PET/MRI data are pooled.*Clinical Relevance/Application ComBat harmonization may be useful for multi-centric clinical PET radiomics studies that utilize a mix of different PET/CT and PET/MRI scanners.

RESULTS

ComBat-harmonized PET radiomic features were superior to unharmonized features in terms of separation of liver, spleen and bone marrow, with the following accuracies in training/validation sets: histogram, 70.4/69.7% (harmonized) vs. 60.8/57.9% (unharmonized); GLCM, 82.1/74.2% vs. 52.8/49.7%; GLRLM, 79.9/75.0% vs. 58.8/60.4%; GLSZM, 76.3/78.7% vs. 54.9/54.3%; and NGTDM, 68.5/67.4% vs. 51.2/53.6%.

CLINICAL RELEVANCE/APPLICATION

ComBat harmonization may be useful for multi-centric clinical PET radiomics studies that utilize a mix of different PET/CT and PET/MRI scanners.

Abstract Archives of the RSNA, 2021

Participants

Katja Pinker-Domenig, MD, New York, New York (*Moderator*) Speakers bureaus:European Society of Breast Imaging (active)Siemens Healthineers (ended)IDKD 2019 (ended)Olea Medical (ended) Consulting, AdvisoryConsultantGenentech, Inc.05/19-presentConsultantMerantix Healthcare05/20- presentConsultantAURA Health

Sub-Events

SSBR06-1   A New Horizon For Breast Cancer Imaging: First Results Of Simultaneous FAPi-PET/MRI Targeting The Fibroblast Activation Protein

Participants
Matthias C. Burg, MD, Muenster, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Imaging plays a major role in the management of breast cancer. Different imaging modalities are used for assessing local tumor extent and whole-body staging.Integrated PET/MRI is a technically promising modality for breast assessment. The most frequently used tracer 18F-FDG is applied for whole-body staging in advanced breast cancer but has limited accuracy in evaluation of primary breast lesions. The fibroblast activation protein (FAP) is abundantly expressed in invasive breast cancer and FAP-directed PET tracers have recently become available.The aim of this study was to initially evaluate the potential of FAP-directed breast PET/MRI and consecutive whole-body scanning using the ligand 68Ga-FAPi-46 for staging of local disease extent and metastases in clinical use.*Methods and Materials In 19 female patients with breast cancer, we retrospectively analyzed 68Ga-FAPi-PET/MRI and PET/CT scans; 18 scans were performed to complement initial staging and 1 for re-staging after therapy for distant metastases. 30 min after injection of 149 ± 48 MBq (mean ± SD) 68Ga-FAPi-46 patients underwent a 25-min prone breast PET/MRI and subsequently either received supine whole-body PET/MRI or PET/CT.*Results Strong tracer accumulation was observed in every untreated primary breast malignancy (mean Standardized Uptake Values, SUVmax: 13.9, range: 7.9 - 29.9, median lesion diameter 26 mm, 9 - 155 mm) resulting in clear tumor delineation in every case independent of tumor grading, hormone receptor status and histological type. All preoperatively verified lymph node metastases in 13 patients demonstrated strong tracer accumulation (mean SUVmax 12.2, 3.3 - 22.4, mean diameter 21 mm, 14 - 35 mm). Tracer uptake established or supported extra-axillary lymph node involvement in 7 patients and impacted therapy decisions in 3 patients. In cases with distant metastases, FAPi-PET uncovered additional lesions.*Conclusions Combining 68Ga-FAPi-46 in simultaneous breast PET/MRI demonstrated highly favorable imaging characteristics. Subsequent whole-body scanning added incremental diagnostic information for detection of lymph node and distant metastases.*Clinical Relevance/Application Simultaneous FAPi-PET/MRI for imaging breast cancer is a promising imaging modality to assess the local tumor extent and for whole-body staging. Further prospective studies are needed to evaluate its additional benefit compared to the existing imaging modalities.

RESULTS

Strong tracer accumulation was observed in every untreated primary breast malignancy (mean Standardized Uptake Values, SUVmax: 13.9, range: 7.9 - 29.9, median lesion diameter 26 mm, 9 - 155 mm) resulting in clear tumor delineation in every case independent of tumor grading, hormone receptor status and histological type. All preoperatively verified lymph node metastases in 13 patients demonstrated strong tracer accumulation (mean SUVmax 12.2, 3.3 - 22.4, mean diameter 21 mm, 14 - 35 mm). Tracer uptake established or supported extra-axillary lymph node involvement in 7 patients and impacted therapy decisions in 3 patients. In cases with distant metastases, FAPi-PET uncovered additional lesions.

CLINICAL RELEVANCE/APPLICATION

Simultaneous FAPi-PET/MRI for imaging breast cancer is a promising imaging modality to assess the local tumor extent and for whole-body staging. Further prospective studies are needed to evaluate its additional benefit compared to the existing imaging modalities.

SSBR06-2   Simultaneous PET-MRI Using 18F-Fluoroethylcholine Can Provide Accurate Diagnosis And Characterization Of Breast Cancer

Participants
Paola Clauser, MD, Vienna, Austria (*Presenter*) Speaker, Siemens AG

PURPOSE

The aim of our study was to investigate the use of [18F] fluoroethylcholine (FEC) as a novel radiotracer to distinguish benign from malignant breast lesions and characterize breast cancer aggressiveness in simultaneous PET-MRI of the breast.*Methods and Materials This prospective, monocentric, diagnostic pharmaceutical phase II study was approved by the national authorities and local ethics committee and 101 patients gave their written informed consent. Patients with lesions classified as suspicious on mammography, tomosynthesis and/or ultrasound and no contraindications to contrast enhanced MRI and PET were included. PET-MRI of the breast were performed simultaneously in a prone position with a dedicated 16-channel MRI breast coil. A board certified nuclear medicine physician and an experienced breast radiologist evaluated the images together and measured the maximum standardized uptake value (SUVmax) of the MRI suspicious findings. PET imaging findings were correlated with MRI and with

histopathology. A reference standard by means of histopathology had to be present. Immunohistochemical (IHC) analysis was available for all malignant lesions. Differences in SUVmax between benign and malignant lesions and between malignant lesion IHC characteristics were evaluated with the Mann-Whitney-U-test. To calculate diagnostic performance metrics, the area under the curve (AUC) was used.*Results 101 patients (mean age 52.3 years, standard deviation 12.0) with 117 lesions were included (30 benign, 7 ductal carcinomas in situ (DCIS), 80 invasive carcinomas (IC)). FEC SUVmax was higher in malignant lesions compared to benign lesions (p<0.001), with an AUC for lesion characterization of 0.846. FEC SUVmax was higher in IC compared to DCIS (p<0.001). In the analysis of IC, FEC uptake was higher for lesions with a higher proliferation rate (p=0.011) and HER2 positive (p=0.041).*Conclusions The lesion uptake of FEC was significantly higher in malignant than in benign breast lesions. FEC SUVmax is a promising new PET imaging biomarker and seems to allow cancer subtyping.*Clinical Relevance/Application Our findings indicate the potential of [18F]FEC SUVmax to be used as an imaging biomarker for diagnosis of breast cancer and breast cancer aggressiveness.

RESULTS

101 patients (mean age 52.3 years, standard deviation 12.0) with 117 lesions were included (30 benign, 7 ductal carcinomas in situ (DCIS), 80 invasive carcinomas (IC)). FEC SUVmax was higher in malignant lesions compared to benign lesions (p<0.001), with an AUC for lesion characterization of 0.846. FEC SUVmax was higher in IC compared to DCIS (p<0.001). In the analysis of IC, FEC uptake was higher for lesions with a higher proliferation rate (p=0.011) and HER2 positive (p=0.041).

CLINICAL RELEVANCE/APPLICATION

Our findings indicate the potential of [18F]FEC SUVmax to be used as an imaging biomarker for diagnosis of breast cancer and breast cancer aggressiveness.

SSBR06-3   Prediction Of Pathologic Complete Response To Neoadjuvant Chemotherapy In Breast Cancer Using Bi-rads Mri Features

Participants
Caroline Malhaire, MD, Paris, France (*Presenter*) Research Consultant, AVATAR MEDICAL, LLC;Research Consultant, Therapixel SA

PURPOSE

To evaluate BI-RADS descriptors on pre-therapeutic MRI for the prediction of breast cancer (BC) pathological complete response (pCR) to neoadjuvant chemotherapy (NAC).*Methods and Materials In this retrospective study, we included patients treated for breast cancer by NAC. Estrogen and Progesterone receptor expression, Her2 status, histologic grade , Ki-67 and tumor infiltrating lymphocytes (TILs) levels from initial BC biopsy were collected. MR scans were acquired according to a protocol consisting of T1-WI, T2-WI, dynamic 3D contrast-enhanced sequences, diffusion weighted imaging. BC index lesion was described using descriptors from the Breast Imaging and Reporting Data System (BI-RADS). The presence of intratumoral high signal intensity, peritumoral, prepectoral and subcutaneous edema on T2W images, multifocality, index tumor size were evaluated. Tumor response was evaluated according to the Residual Cancer Burden on post-NAC surgical specimens. Two predictive models of pCR (RCB0) were built after feature selection by Boruta algorithm and evaluated with 5-fold cross-validation. A first model was designed on the total population of the study (Model 1) and a second on TN and Luminal BC subtypes (Model 2).*Results Out of 153 patients with a mean age of 47 years (range: 24-73), 72 achieved pCR (47%). The pCR was significantly different by BC subtype (<0.001, Chi-square test), achieved in 41 TN (59%) and 24 Her2+ (57%) versus 8 in luminal BC (19%). In univariate analysis, MR features associated with pCR were non spiculated margins (OR = 2.57 (1.33, 5.06), p = 0.005), oval or round shape (OR = 2.25 (1.06-4.89, p=0.037), no peripheral non-mass enhancement (OR = 2.98 (1.28, 7.61), p = 0.015), unifocality (OR = 2.36 (1.11-5.28, p=0.030). Multivariate logistic regression showed features independently associated with pCR were non spiculated margins (OR= 2.22 (1.03-4.91), p=0.044)), unifocality (OR = 2.53 (1.04-6.48, p=0.045)), Her2+ BC subtype (OR = 8.43 (2.94-26.92, p<0.001), TN BC subtype (OR = 4.43 (1.74-12.32, p=0.003) and TILs levels (OR = 1.02 (1.00-1.04, p=0.015)). Variables included in Model 1 were tumor margins, unifocality, BC subtype, Ki 67 and TILs. Model 1 achieved a mean AUC of 0.750 +/- 0.094. Variables included in Model 2 were tumor margins, BC subtype and TILs. Model 2 achieved a mean AUC of 0.782 +/- 0.054.*Conclusions Among the set of pre-therapeutic MRI descriptors, tumor margins and unifocality contribute to prediction of breast cancer pCR to NAC in association to histologic parameters such as TILs and molecular subtype.*Clinical Relevance/Application BI-RADS descriptors on pre-therapeutic MRI combined with histologic biomarkers may be valuable for pCR prediction modeling

RESULTS

Out of 153 patients with a mean age of 47 years (range: 24-73), 72 achieved pCR (47%). The pCR was significantly different by BC subtype (<0.001, Chi-square test), achieved in 41 TN (59%) and 24 Her2+ (57%) versus 8 in luminal BC (19%). In univariate analysis, MR features associated with pCR were non spiculated margins (OR = 2.57 (1.33, 5.06), p = 0.005), oval or round shape (OR = 2.25 (1.06-4.89, p=0.037), no peripheral non-mass enhancement (OR = 2.98 (1.28, 7.61), p = 0.015), unifocality (OR = 2.36 (1.11-5.28, p=0.030). Multivariate logistic regression showed features independently associated with pCR were non spiculated margins (OR= 2.22 (1.03-4.91), p=0.044)), unifocality (OR = 2.53 (1.04-6.48, p=0.045)), Her2+ BC subtype (OR = 8.43 (2.94-26.92, p<0.001), TN BC subtype (OR = 4.43 (1.74-12.32, p=0.003) and TILs levels (OR = 1.02 (1.00-1.04, p=0.015)). Variables included in Model 1 were tumor margins, unifocality, BC subtype, Ki 67 and TILs. Model 1 achieved a mean AUC of 0.750 +/- 0.094. Variables included in Model 2 were tumor margins, BC subtype and TILs. Model 2 achieved a mean AUC of 0.782 +/- 0.054.

CLINICAL RELEVANCE/APPLICATION

BI-RADS descriptors on pre-therapeutic MRI combined with histologic biomarkers may be valuable for pCR prediction modeling

SSBR06-4   Value Of 18F-Fluoroethylcholine PET-MRI For Axillary Lymph Node Staging In Breast Cancer Patients

Participants
Paola Clauser, MD, Vienna, Austria (*Presenter*) Speaker, Siemens AG

PURPOSE

The aim of our study was to investigate the usefulness of [18F] fluoroethylcholine (FEC) PET-MRI to diagnose lymph nodes metastases in patients with newly diagnosed breast cancer.*Methods and Materials This IRB-approved prospective, monocentric study investigated breast cancer patients. All were examined by FEC PET-MRI of the breast performed in prone position with a dedicated 16-channel MRI breast coil. The images were evaluated by two breast fellows (R1, R2) using standardized morphological criteria for MRI and a dichotomous evaluation for FEC PET (uptake/no uptake). A standard of reference for lymph node status (image-guided biopsy, sentinel node biopsy or axilla dissection before neoadjuvant treatment) had to be available. Sensitivity and specificity were calculated for MRI and PET alone and metastasis rates were calculated for patients both positive and both

negative in MRI and PET. Inter-reader agreement was calculated.*Results 74 patients (mean age 55.3 years, standard deviation 11.9) with 80 invasive carcinomas were included. A standard of reference was available in 55 cases (27 no lymph node involvement, 28 lymph node metastasis). MRI assessment had a low sensitivity (R1 46.4% and R2 50%) and a high specificity (both readers 96.3%). PET analysis revealed a higher sensitivity (R1 78.6% and R2 67.9%, P=.027 and P=.108, respectively) with a moderate decrease in specificity (R1 81.5% and R2 74.1%, P>.05). Except for one false positive, all cases that were suspicious on both MRI and PET presented with lymph node metastases (R1: 14/15; R2: 13/14). All the metastatic lymph node correctly classified with MRI alone, were also correctly classified with PET. Kappa agreement was substantial for MRI (0.622) and moderate for FEC PET (0.474).*Conclusions Combined simultaneous FEC PET-MRI of the breast can accurately stratify the risk of axillary lymph node metastasis in patients with newly diagnosed breast cancer.*Clinical Relevance/Application Combined simultaneous FEC PET-MRI of the breast is a promising tool for clinical decision making in breast cancer diagnosis and treatment.

RESULTS

74 patients (mean age 55.3 years, standard deviation 11.9) with 80 invasive carcinomas were included. A standard of reference was available in 55 cases (27 no lymph node involvement, 28 lymph node metastasis). MRI assessment had a low sensitivity (R1 46.4% and R2 50%) and a high specificity (both readers 96.3%). PET analysis revealed a higher sensitivity (R1 78.6% and R2 67.9%, P=.027 and P=.108, respectively) with a moderate decrease in specificity (R1 81.5% and R2 74.1%, P>.05). Except for one false positive, all cases that were suspicious on both MRI and PET presented with lymph node metastases (R1: 14/15; R2: 13/14). All the metastatic lymph node correctly classified with MRI alone, were also correctly classified with PET. Kappa agreement was substantial for MRI (0.622) and moderate for FEC PET (0.474).

CLINICAL RELEVANCE/APPLICATION

Combined simultaneous FEC PET-MRI of the breast is a promising tool for clinical decision making in breast cancer diagnosis and treatment.

SSBR06-5   Patients Presenting With Extensive Malignant Microcalcifications; Is Breast Conservation After Neoadjuvant Treatment Feasible?

Participants
Ali Sever, MD, Orpington, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Patients with invasive breast cancer, associated with large area of malignant microcalcifications (MM) are often treated with mastectomy. Response to neoadjuvant chemotherapy (NAC) rarely alters the surgical plan. Whilst monitoring the invasive component during the treatment gives a good idea of response, the in situ component cannot be evaluated securely, as lack of enhancement on MRI would not necessarily indicate complete response. MM would remain on mammograms regardless of the response. Due to the risk of heterogeneous response, surgical approach is to remove the entire MM, and perform mastectomy when conservation is not possible. Also residual MM after lumpectomy may cause delay in the diagnosis of recurrence. This study aims to investigate the response to NAC in patients with biopsy-proven large segmental MM.*Methods and Materials Between 2017 and 2020, patients with invasive breast carcinoma and treated with NAC and subsequent surgery were retrospectively selected. A subgroup of patients who presented with large area of biopsy-proven MM were identified. HER2 status was recorded. Patients with abnormal axillary node(s) were biopsied before commencing chemotherapy. The initial size of MM, pre and post-treatment breast and axillary status were recorded.*Results 255 cases underwent NAC, 27 patients had associating biopsy-proven MM covering an area of 50 to 120 mm. 20/27 patients were node positive at presentation. 19 cases were HER2-positive. All 27 patients were treated with mastectomy. Of the 19 HER2-positive cases, 9 patients (47%) had complete pathological response. 6 of the 9 patients had involved node(s) at presentation, treated with axillary nodal clearance (ANC) (n=4) or with targeted axillary dissection (n=2). All 6 showed complete pathological axillary response. Remaining 3 patients were node negative at sentinel node biopsy. 10 patients had residual disease measuring between 2 - 110 mm. 5 of the 8 node positive cases at presentation revealed involved nodes at ANC. All 8 HER2-negative cases revealed residual disease in mastectomy specimen ranging up to 200 mm. 5 of the 6 node positive patients and 1 of the 2 node negative case showed residual axillary disease.*Conclusions HER2-positive breast tumors with in situ component respond very well to NAC, hence a mastectomy may be overtreatment. In carefully selected cases, patients with MM covering a large area may still be offered conservative surgery. A negative lumpectomy specimen alongside with complete pathological axillary response may be helpful in further planning.*Clinical Relevance/Application Patients with HER2-positive tumors with extensive malignant microcalcifications may respond very well to neoadjuvant chemotherapy. Breast conservation may be feasible in selected cases.

RESULTS

255 cases underwent NAC, 27 patients had associating biopsy-proven MM covering an area of 50 to 120 mm. 20/27 patients were node positive at presentation. 19 cases were HER2-positive. All 27 patients were treated with mastectomy. Of the 19 HER2-positive cases, 9 patients (47%) had complete pathological response. 6 of the 9 patients had involved node(s) at presentation, treated with axillary nodal clearance (ANC) (n=4) or with targeted axillary dissection (n=2). All 6 showed complete pathological axillary response. Remaining 3 patients were node negative at sentinel node biopsy. 10 patients had residual disease measuring between 2 - 110 mm. 5 of the 8 node positive cases at presentation revealed involved nodes at ANC. All 8 HER2-negative cases revealed residual disease in mastectomy specimen ranging up to 200 mm. 5 of the 6 node positive patients and 1 of the 2 node negative case showed residual axillary disease.

CLINICAL RELEVANCE/APPLICATION

Patients with HER2-positive tumors with extensive malignant microcalcifications may respond very well to neoadjuvant chemotherapy. Breast conservation may be feasible in selected cases.

SSBR06-6   Primary Treatment Of Low Risk Breast Cancers Using Image-Guided Cryoablation: A 6 Year Update Of The ICE3 Trial

Participants
Kenneth Tomkovich, MD, Freehold, New Jersey (*Presenter*) Speakers Bureau, IceCure Medical, Inc

PURPOSE

The ICE3 Trial was the first of its kind large scale multi-center trial in the world to evaluate cryoablation using ultrasound guidance as a primary treatment for breast cancer without surgical lumpectomy. We report 6 years follow up results and imaging findings.*Methods and Materials This HIPAA compliant and IRB approved trial enrolled patients for cryoablation of low risk infiltrating

ductal carcinoma of the breast. The study was limited to women ages 50 and over with biopsy proven ultrasound visible unifocal breast cancer measuring 1.5cm or less. Nottingham tumor scores of low grade I or intermediate grade II and tumor prognostic panels ER+/PR+ or ER+/PR- and HER 2- were accepted. Patients were clinically lymph node negative. All patients underwent ultrasound guided cryoablation using the liquid nitrogen based ProSenseTM system (IceCure Medical). Patients underwent a freeze, thaw, freeze cycle of approximately 8 minutes each using cryoablation with the goal of a visible ice ball producing an adequate lethal margin of ice around the tumor. All patients were followed with mammography at 6 and 12 months and then annually up to 60 months post ablation. Imaging with MRI or ultrasound was utilized as needed but was not a requirement. Patients did not undergo surgical lumpectomy. All patients had the option of post cryoablation chemotherapy, hormone therapy and or radiation therapy as clinically indicated. The primary outcome was ipsilateral breast cancer recurrence at the site of ablation at 5 years.*Results Enrollment began in October 2014 at 19 participating centers across the United States. A total of 194 patients ages 55-94 met inclusion criteria and were treated with ultrasound guided cryoablation. Tumor sizes ranged from 3 to 15mm. No major adverse events were reported. There has been 100% procedural success. 107 patients have had at least 36 months follow up. 80 patients have had at least 48 months follow up. 34 patients have completed 60 months follow up. No recurrence has been reported in 190/194 patients (98% success). These results are consistent with expected recurrence rates following surgical lumpectomy. Common mammographic findings following cryoablation include scarring and fat necrosis.*Conclusions Cryoablation of low-grade breast cancer is safe and is well tolerated with a 100% initial procedural success rate. Long term results are promising with an overall clinical success rate of 98% in patients with at least 36 months follow up.*Clinical Relevance/Application Results suggest that cryoablation is a safe and effective primary treatment for women with small low risk breast cancers as an alternative to surgical lumpectomy. This research is ongoing.

RESULTS

Enrollment began in October 2014 at 19 participating centers across the United States. A total of 194 patients ages 55-94 met inclusion criteria and were treated with ultrasound guided cryoablation. Tumor sizes ranged from 3 to 15mm. No major adverse events were reported. There has been 100% procedural success. 107 patients have had at least 36 months follow up. 80 patients have had at least 48 months follow up. 34 patients have completed 60 months follow up. No recurrence has been reported in 190/194 patients (98% success). These results are consistent with expected recurrence rates following surgical lumpectomy. Common mammographic findings following cryoablation include scarring and fat necrosis.

CLINICAL RELEVANCE/APPLICATION

Results suggest that cryoablation is a safe and effective primary treatment for women with small low risk breast cancers as an alternative to surgical lumpectomy. This research is ongoing.

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Participants
Don Yoo, MD, Lexington, Massachusetts (*Moderator*) Consultant, Konica Minolta, Inc
Lisa Bodei, MD, PhD, New York, New York (*Moderator*) Consultant, Novartis AG ;Speaker, Novartis AG;Research Grant, Novartis AG;Consultant, Ipsen SA;Consultant, ITM Isotopen Technologien Muenchen AG;Speaker, ITM Isotopen Technologien Muenchen AG;Consultant, Clovis Oncology, Inc;Consultant, Ion Beam Applications, SA

Sub-Events

SSNMMI05   Keynote Speaker

Participants
Don Yoo, MD, Lexington, Massachusetts (*Presenter*) Consultant, Konica Minolta, Inc

SSNMMI05   Keynote Speaker

Participants
Lisa Bodei, MD, PhD, New York, New York (*Presenter*) Consultant, Novartis AG ;Speaker, Novartis AG;Research Grant, Novartis AG;Consultant, Ipsen SA;Consultant, ITM Isotopen Technologien Muenchen AG;Speaker, ITM Isotopen Technologien Muenchen AG;Consultant, Clovis Oncology, Inc;Consultant, Ion Beam Applications, SA

SSNMMI05-2   Identification And Development Of Radioprotective Agents To Reduce DNA Damage Caused By Ionizing Radiation

Participants
Tyler Smith, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

PURPOSE

Radioprotective agents (RPA) have been shown to reduce DNA damage caused by ionizing radiation and may therefore have a protective effect during medical imaging. Patients with Li-Fraumeni syndrome (LFS) have a mutation in p53, inhibiting normal DNA repair and have an increased susceptibility to radiation induced malignancy. Interventions to reduce the impact of radiation damage in these patients is critical. We aim to assess the potential role of RPAs in LFS cells in vitro to reduce DNA damage caused by ionizing radiation.*Methods and Materials Peripheral blood mononuclear cells (PBMCs) from healthy (WT) and LFS volunteers were cultured with or without an RPA (atorvastatin 0.016 mg/mL, resveratrol 0.2 mg/mL, or N-acetylcysteine (NAC) 3 mg/mL) for 24 hours. Cells were then irradiated with 0.1 Gy or 1 Gy of ionizing radiation. 1 hour after irradiation, cells were assessed for gamma-H2AX (?-H2AX), a marker for double stranded DNA breaks, by confocal microscopy acquired at 63x, and foci per cell were quantified using a semi-automated open source software (image J).*Results WT PMBCs demonstrated a background ?-H2AX foci per cell count of 2.4, which increased to 29.8 with 0.1 Gy of radiation and 30.2 with 1 Gy of radiation. PBMCs isolated from LFS donors had a background ?-H2AX foci count of 2.4 per cell, which increased to 10.4 with 0.1 Gy and 20.7 with 1 Gy. The only agent that consistently showed a reduction in ?-H2AX was NAC, which caused ?-H2AX foci per cell to decrease to near or below background levels following irradiation (WT PBMC 2.3 at 0.1 Gy (P=0.002) and 4.9 at 1 Gy (P<0.001); LFS PMBCs 1.2 at 0.1 Gy (P=0.02) and 1.5 at 1 Gy (P=0.002)).*Conclusions NAC reduces DNA damage caused by ionizing radiation in vitro in WT and LFS human PMBCs. In vivo and clinical studies are needed to assess the potential long-term benefit for patients (i.e. less cancer and improved survival).*Clinical Relevance/Application Reduction of damage due to ionizing radiation in LFS is critical and RPAs may be effective. WT and LFS PBMCs exposed to the RPA NAC in vitro significantly decreased DNA damage from ionizing radiation.

RESULTS

WT PMBCs demonstrated a background ?-H2AX foci per cell count of 2.4, which increased to 29.8 with 0.1 Gy of radiation and 30.2 with 1 Gy of radiation. PBMCs isolated from LFS donors had a background ?-H2AX foci count of 2.4 per cell, which increased to 10.4 with 0.1 Gy and 20.7 with 1 Gy. The only agent that consistently showed a reduction in ?-H2AX was NAC, which caused ?-H2AX foci per cell to decrease to near or below background levels following irradiation (WT PBMC 2.3 at 0.1 Gy (P=0.002) and 4.9 at 1 Gy (P<0.001); LFS PMBCs 1.2 at 0.1 Gy (P=0.02) and 1.5 at 1 Gy (P=0.002)).

CLINICAL RELEVANCE/APPLICATION

Reduction of damage due to ionizing radiation in LFS is critical and RPAs may be effective. WT and LFS PBMCs exposed to the RPA NAC in vitro significantly decreased DNA damage from ionizing radiation.

SSNMMI05-3   Combining Peptide Receptor Radiotherapy With Immune Check Point Inhibition Therapy To Improve The Management Of Neuroendocrine Tumors

Participants
Shadi Abdar Esfahani, MD,MPH, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Neuroendocrine tumors (NET) are known as immune deserts, due to paucity of immune cells in the tumor, which results in very low

response rate to immune check point inhibitors (ICI). Peptide receptor radiotherapy (PRRT) with somatostatin analogs (SSA) can hypothetically results in tumor inflammation and release of tumor antigens and thus increase the response rate to ICIs. Here we discuss the results of combining ICI and PRRT in a humanized mouse model of NET.*Methods and Materials IACUC approval was obtained. Humanized immunocompromised NSG-PBMC mice were implanted with QGP-1 cells in the flank. After the tumor reached 0.5 ml volume mice were treated with saline, pembrolizumab (anti-PD-1), high dose (HD) PRRT only, low-dose (LD), medium dose (MD) or HD PRRT + Pembro. At baseline and 6 days after pembrolizumab we performed 68Ga-NOTA-hGZP PET/MR in all the mice. We extracted the tumors and stained for granzyme B. Tumors were analyzed for immune cell populations using flowcytometry. Growth curves were drown for the tumors. Statistical analysis was performed using PRISM 9. Paired t-test and repeated measures ANOVA were used for comparison.*Results We observed a significant increase in the SUVmax of the tumors treated with pembro + HD PRRT (3.7±0.3) and pembro MD PRRT (3.4±0.3) compared to Pembro + LD PRRT (1.2±0.2), Pembro only (1.4±0.2) and Saline (1.3±0.2) (p<0.001). Also the there was a significant increase in the uptake value of Pembro+ MD PRRT and Pembro + HD PRRT compared to baseline (p<0.001), while there was no significant change in other groups (p > 0.05). We also observed as significant reduction in tumor volumes in the Pembro+ MD PRRT and Pembro + HD PRRT compared to other groups (p<0.001). The growth in the LD PRRT + Pembro and Pembro only groups were significantly less than the control, although tumors kept growing (p<0.01). The tumor volumes in the HD PRRT only group was significantly less than the LD PRRT + Pembro and Pembro only (p<0.01) but more than the HD and MD PRRT + Pembro (p<0.01). Staining of tissue in the Pembro+ MD PRRT and Pembro + HD PRRT showed extensive extracellular granzyme B expression. Flowcytometry data showed that the percentage of CD4+ and CD8+ / CD28-/CD45RA- (Teff) was significantly higher in MD and HD PRRT + Pembro compared other groups (p<0.01) while CD28+/CD45RA+ cells were higher in saline control.*Conclusions We demonstrated that combination pr PRRT and ICI therapy can markedly increase granzyme expression in the tumor and reduce tumor growth compared to other groups.*Clinical Relevance/Application Combination of PRRT and immune checkpoint inhibitors can improve immunotherapy in NETs.

RESULTS

We observed a significant increase in the SUVmax of the tumors treated with pembro + HD PRRT (3.7±0.3) and pembro MD PRRT (3.4±0.3) compared to Pembro + LD PRRT (1.2±0.2), Pembro only (1.4±0.2) and Saline (1.3±0.2) (p<0.001). Also the there was a significant increase in the uptake value of Pembro+ MD PRRT and Pembro + HD PRRT compared to baseline (p<0.001), while there was no significant change in other groups (p > 0.05). We also observed as significant reduction in tumor volumes in the Pembro+ MD PRRT and Pembro + HD PRRT compared to other groups (p<0.001). The growth in the LD PRRT + Pembro and Pembro only groups were significantly less than the control, although tumors kept growing (p<0.01). The tumor volumes in the HD PRRT only group was significantly less than the LD PRRT + Pembro and Pembro only (p<0.01) but more than the HD and MD PRRT + Pembro (p<0.01). Staining of tissue in the Pembro+ MD PRRT and Pembro + HD PRRT showed extensive extracellular granzyme B expression. Flowcytometry data showed that the percentage of CD4+ and CD8+ / CD28-/CD45RA- (Teff) was significantly higher in MD and HD PRRT + Pembro compared other groups (p<0.01) while CD28+/CD45RA+ cells were higher in saline control.

CLINICAL RELEVANCE/APPLICATION

Combination of PRRT and immune checkpoint inhibitors can improve immunotherapy in NETs.

SSNMMI05-4 Simulation Of Radiation Dosimetry Of Intraventricular Injection Of Commercially Available Radiopharmaceuticals For Intrathecal Radionuclide Therapy

Participants
Franklin C. Wong, MD, PhD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Leptomeningeal metastasis (LM) is a fatal cancer complication involving the arachnoids and the subarachnoid space and often treated by intrathecal therapy, either via intraventrical (IVent) route. This study is to simulate radiation dosimetry from IVent injection of 13 radiopharmaceuticals using a common CSF flow model. The effects of CSF ventricular stasis from pathologic obstruction are also simulated. The hypothesis is that simulation of radiation dosimetry on a common kinetic model allows rational choice of radionuclides and radiopharmaceuticals for treating LM.*Methods and Materials Established CSF bulk flow is simulated for the ventricle, C-spine, L-spine and Convexity and integrated with anthropomorphic models of major organs and red marrow. Ventricular stasis assume 90% retention of radionuclide. Monte Carlo simulations were performed with MNCP4b scheme, accounting for all photon emissions to <5% relative errors and betatron emissions to <10% relative errors. Depth doses are derived from concentric shells extending outwards from CSF space. Candidate commercially available radiopharmaceuticals are: Sm-153 EDTMP, Ga-67 citrate, Ga-68 citrate, In-111 DTPA, Tl-201 chloride, I-123 NaI, I-124 NaI, I-125 NaI, I-131 NaI, Y-90 Chloride, Y-90 DTPA, Y-90 Zevalin, and F-18 FDG.*Results Radiation dosimetry on the CSF compartments of ventricle, C-Spine, L-spine and convexity, major organs and red marrow are derived to allow comparison of the radiation absorbed dose in units of cGy/mCi to predict efficacy. The ratios of absorbed doses between the CSF compartment and bone marrow allow estimation of therapeutic windows to predict safety. Depth doses in the ventricle, convexity and spine also allow locoregional evaluation of efficacy and safety. Y-90 compounds provide the highest radiation absorbed dose to CSF space in the ventricle, C-spine, L-spine and the convexity (63, 200, 440 and 67 cGy/mCi, respectively) while the ratios of CSF to marrow predict that Y-90 DTPA has the largest therapeutic window (42, 133, 293 and 45 respectively), better than Y-90 Zevalin which in turn is better than Y-90 chloride (5, 17, 37 and 6, respectively). Stasis indeed delivers markedly higher radiation absorbed dose to the ventricle and also provides higher therapeutic window.*Conclusions Simulated radiation dosimetry using a common biokinetic /anthropomorphic model allows preliminary assessment of efficacy and safety of radiopharmaceuticals for LM therapy.*Clinical Relevance/Application Simulated radiation dosimetry models will enable rational design of radiopharmaceuticals for LM therapy. It also allows preliminary assessment of enhanced radiation delivery by ventricular stasis when obstruction is encountered and when intervention is contemplated.

RESULTS

Radiation dosimetry on the CSF compartments of ventricle, C-Spine, L-spine and convexity, major organs and red marrow are derived to allow comparison of the radiation absorbed dose in units of cGy/mCi to predict efficacy. The ratios of absorbed doses between the CSF compartment and bone marrow allow estimation of therapeutic windows to predict safety. Depth doses in the ventricle, convexity and spine also allow locoregional evaluation of efficacy and safety. Y-90 compounds provide the highest radiation absorbed dose to CSF space in the ventricle, C-spine, L-spine and the convexity (63, 200, 440 and 67 cGy/mCi, respectively) while the ratios of CSF to marrow predict that Y-90 DTPA has the largest therapeutic window (42, 133, 293 and 45 respectively), better than Y-90 Zevalin which in turn is better than Y-90 chloride (5, 17, 37 and 6, respectively). Stasis indeed delivers markedly higher radiation absorbed dose to the ventricle and also provides higher therapeutic window.

CLINICAL RELEVANCE/APPLICATION

Simulated radiation dosimetry models will enable rational design of radiopharmaceuticals for LM therapy. It also allows preliminary

assessment of enhanced radiation delivery by ventricular stasis when obstruction is encountered and when intervention is contemplated.

Abstract Archives of the RSNA, 2021

Participants

Christopher T. Whitlow, MD, PhD, Winston Salem, North Carolina (*Moderator*) Nothing to Disclose

Sub-Events

SSNR10-3   Anterior Pituitary Volume In Patients With Transfusion Dependent Anemias: Volumetric Approaches And Relation To Pituitary R2

Participants
Zhiyue Wang, PhD, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this retrospective study was to determine both the accuracy of different approaches for assessment of anterior pituitary size and the relation between pituitary size and MRI-R2 relaxometry, also with respect to growth impairment and hypogonadism, in patients with transfusion dependent anemia (TDA).*Methods and Materials In 43 patients (21m / 22f; mean age 22 y) and 32 controls (19m / 13f; mean age 38 y) a sagittal T1 GRE 3D sequence at 1.5T was used to assess anterior pituitary gland size by 3D semi-automated threshold volumetry (V3D) (=reference standard), planimetric volumetry (V2D), approximate volumetry based on region of interest (VROI), ellipsoid (VEll), and area-length (VAL), and pituitary height. Pituitary R2 was assessed by fitting proton signal intensities to echo times using a multi-echo SE sequence. Serum ferritin levels, liver iron concentrations, cardiac and pancreatic MRI-R2* rates, and hypogonadic states referred to patient reports. BSA adjusted pituitary 3D volumes (V3Di) as functions of age were expressed as Z-values and growth percentiles were calculated.*Results Compared with reference V3D volumes, V2D volumes revealed the highest agreement (bias -4.8%; 95%CI: -8.8%|-0.7%) and good inter-operator agreement (bias 2.6%, 95%CI: -0.9%|6.1%). Pituitary volume Z-scores and pituitary R2 revealed threshold-derived sensitivity and specificities of 65% and 100% to discriminate patients from controls. In 71% and 75% of patients correctly classified by volume Z-scores and R2 rates, hypogonadism and growth impairment was present, respectively. Liver, cardiac and pancreatic iron accumulation was common in TDA patients, and pancreatic R2* was the strongest predictor for pituitary iron accumulation.*Conclusions Accurate assessment of pituitary size requires 3D or 2D volumetry. Pituitary volume Z-scores and R2 allow to identify TDA patients at risk of pituitary dysfunction.*Clinical Relevance/Application Pituitary R2 and volume assessed by MRI may serve as biomarkers of preclinical pituitary dysfunction.

RESULTS

Compared with reference V3D volumes, V2D volumes revealed the highest agreement (bias -4.8%; 95%CI: -8.8%|-0.7%) and good inter-operator agreement (bias 2.6%, 95%CI: -0.9%|6.1%). Pituitary volume Z-scores and pituitary R2 revealed threshold-derived sensitivity and specificities of 65% and 100% to discriminate patients from controls. In 71% and 75% of patients correctly classified by volume Z-scores and R2 rates, hypogonadism and growth impairment was present, respectively. Liver, cardiac and pancreatic iron accumulation was common in TDA patients, and pancreatic R2* was the strongest predictor for pituitary iron accumulation.

CLINICAL RELEVANCE/APPLICATION

Pituitary R2 and volume assessed by MRI may serve as biomarkers of preclinical pituitary dysfunction.

SSNR10-4   Clinical And MR Imaging Findings In A Large Population Of Autoimmune Encephalitis

Participants
Shivani Gillon, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

To describe the clinical and MRI findings of patients with antibody-proven autoimmune encephalitis (AE).*Methods and Materials We searched our institutional medical record for International Classification of Disease (ICD) code diagnosis of autoimmune encephalitis (2009-2019). Demographics, EEG, CSF, antibody testing and MRI at presentation were reviewed. Clinical features were compared across antibody groups using Chi2. Imaging features were described for each antibody and compared for significance using Fisher's exact test.*Results Of 104 cases of antibody-proven AE, 97 had MRI available for review. The median age at presentation was 35 years (IQR: 24-60, range: 2-75). 29% were male and 68% were female. EEG was abnormal in 71/97 (74%), normal in 8/97 (8%), not performed in 17/96 (18%). CSF showed pleocytosis in 65/97 (67%) and elevated protein in 40/97 (41%). 20 distinct types of AE antibodies were found (Table 1). The most common antibodies included anti-NMDA receptor encephalitis (N=40), anti-Gad antibody (N=8), and VGKC (N=6). 18/97 (19%) were Group 1 (Intracellular Antibodies), 69/97 (71%) were Group 2 (Extracellular Antibodies), and 10/97 (10%) were antibodies associated with demyelination. Thirty patients (30%) had a systemic malignancy that was pre-existing or discovered around time of AE diagnosis. The rates of malignancy did not differ significantly across antibody groups (p=0.27). The median time between diagnosis and MRI was 12 days (IQR: 0-25). MRI was abnormal in 65/97 (67%). The most common areas of signal abnormality in the overall cohort were limbic (30/97, 31%), periventricular white matter (24/97, 25%), and supratentorial cortex (20/97, 21%). Only 1/97 cases (1%, NMDA encephalitis) had susceptibility artifact. Notable imaging findings for each specific antibody are listed in Table 1.*Conclusions Patients with AE were often young and female. Two third of patients had an abnormal MRI at the time of symptom onset, most commonly involving the limbic system. Specific imaging features can help identify patients with suspected AE and direct further laboratory work-up.*Clinical Relevance/Application Diagnosing AE is

clinically and radiographically challenging. Early identification of features suggestive of AE will lead to earlier diagnosis, treatment and potential reversal of symptoms.

RESULTS

Of 104 cases of antibody-proven AE, 97 had MRI available for review. The median age at presentation was 35 years (IQR: 24-60, range: 2-75). 29% were male and 68% were female. EEG was abnormal in 71/97 (74%), normal in 8/97 (8%), not performed in 17/96 (18%). CSF showed pleocytosis in 65/97 (67%) and elevated protein in 40/97 (41%). 20 distinct types of AE antibodies were found (Table 1). The most common antibodies included anti-NMDA receptor encephalitis (N=40), anti-Gad antibody (N=8), and VGKC (N=6). 18/97 (19%) were Group 1 (Intracellular Antibodies), 69/97 (71%) were Group 2 (Extracellular Antibodies), and 10/97 (10%) were antibodies associated with demyelination. Thirty patients (30%) had a systemic malignancy that was pre-existing or discovered around time of AE diagnosis. The rates of malignancy did not differ significantly across antibody groups (p=0.27). The median time between diagnosis and MRI was 12 days (IQR: 0-25). MRI was abnormal in 65/97 (67%). The most common areas of signal abnormality in the overall cohort were limbic (30/97, 31%), periventricular white matter (24/97, 25%), and supratentorial cortex (20/97, 21%). Only 1/97 cases (1%, NMDA encephalitis) had susceptibility artifact. Notable imaging findings for each specific antibody are listed in Table 1.

CLINICAL RELEVANCE/APPLICATION

Diagnosing AE is clinically and radiographically challenging. Early identification of features suggestive of AE will lead to earlier diagnosis, treatment and potential reversal of symptoms.

SSNR10-6   Diagnostic Yield Of Brain Magnetic Resonance Imaging In Patients With Infective Endocarditis

Participants
Seongken Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the diagnostic yield of brain MRI in patients with IE.*Methods and Materials This retrospective, single-institution study included 138 patients who underwent brain MRI between March 2015 and October 2020. Consecutive patients who were diagnosed with definite IE or possible IE according to the modified Duke criteria were recruited. Brain MRI included diffusion-weighted imaging, gradient echo imaging or susceptibility-weighted imaging, contrast-enhanced T1-weighted imaging, time-of-flight and contrast-enhanced MR angiography. Diagnostic yield of brain MRI was defined as the number of patients with positive brain MRI findings divided by the number of patients with definite or possible IE. False referral rate of brain MRI was defined as the number of patients with negative brain MRI findings divided by the number of patients with definite or possible IE. Positive imaging findings included ischemic lesions, cerebral microbleeds, hemorrhagic lesions, mycotic aneurysms, abscesses, meningoencephalitis and ventriculitis.*Results A total 138 patients (mean age, 53 years±18 [standard deviation]; 78 men) were included. The diagnostic yield of brain MRI in patients with IE was 71% (98 of 138; 95% CI: 63%-78%). Ischemic lesion, cerebral microbleed, hemorrhagic lesion and abscess/meningoencephalitis/ventriculitis were detected on MRI in 51% (71 of 138), 51% (70 of 138), 17% (24 of 138), and 6% (8 of 138) of patients, respectively. Mycotic aneurysms were detected on MRI in 5% of patients (7 of 138), however, the mycotic aneurysms were not detected on MRI in 3 patients. Therefore, false referral rate of mycotic aneurysm was 2.2% (3 of 138). Among 10 patients with mycotic aneurysm, aneurysm rupture was occurred in 4 patients and median period of aneurysm rupture was 5 days (range: 4-78).*Conclusions The diagnostic yield of brain MRI in infective endocarditis was high and brain MRI may be considered in patients with infective endocarditis.*Clinical Relevance/Application Further evaluation including CT angiography and transfemoral cerebral angiography should be considered when mycotic aneurysm is suspected because of false referral rate.

RESULTS

A total 138 patients (mean age, 53 years±18 [standard deviation]; 78 men) were included. The diagnostic yield of brain MRI in patients with IE was 71% (98 of 138; 95% CI: 63%-78%). Ischemic lesion, cerebral microbleed, hemorrhagic lesion and abscess/meningoencephalitis/ventriculitis were detected on MRI in 51% (71 of 138), 51% (70 of 138), 17% (24 of 138), and 6% (8 of 138) of patients, respectively. Mycotic aneurysms were detected on MRI in 5% of patients (7 of 138), however, the mycotic aneurysms were not detected on MRI in 3 patients. Therefore, false referral rate of mycotic aneurysm was 2.2% (3 of 138). Among 10 patients with mycotic aneurysm, aneurysm rupture was occurred in 4 patients and median period of aneurysm rupture was 5 days (range: 4-78).

CLINICAL RELEVANCE/APPLICATION

Further evaluation including CT angiography and transfemoral cerebral angiography should be considered when mycotic aneurysm is suspected because of false referral rate.

Abstract Archives of the RSNA, 2021

SSMK02

Musculoskeletal (Muscle, Tendon and Nerve)

Participants
Kambiz Motamedi, MD, Los Angeles, California (*Moderator*) Book loyalties, Elsevier (Publishing Company)
Jenny T. Bencardino, MD, Philadelphia, Pennsylvania (*Moderator*) Nothing to Disclose

Sub-Events

SSMK02-1   Us-guided Fenestration And Surgery For The Treatment Of Chronic Lateral Epicondylosis: Time-dependent Changes In B-Mode US, Power Doppler And Elastography.

Participants
David Tobaly, MD, Montreal, Quebec (*Presenter*) Nothing to Disclose

PURPOSE

To assess and compare the time-dependent changes in B-mode US parameters, Power Doppler and shear wave elastography in the common extensor tendon and radial collateral ligament complex (CET-RCL) following fenestration or surgery in chronic lateral epicondylosis (CLE).*Methods and Materials Patients with clinically diagnosed CLE were prospectively randomized to open-release surgery (Group A) or to US-guided fenestration (Group B). Using an Acuson S3000 US scanner (Siemens Medical Systems, USA) with a standardized imaging protocol, a radiologist with 25-year experience in musculoskeletal US performed a grey-scale US scan and power Doppler evaluation with a 14L5SP MHz probe, and ARFI-mode elastography with a 9L4 MHz probe, at baseline, 6 and 12 months postintervention. The following parameters were assessed in the CET-RCL: maximal thickness, echogenicity, enthesophytes, calcifications, neovascularity, and long-axis mean shear wave velocity (SWV). Repeated-measures analysis of variance derived from linear-mixed or logistic-regression models were used to test the effect of the group, time and the interaction group*time on the parameters.*Results Following one exclusion in each group, 62 patients were equally randomized (Group A: age mean ± standard deviation of 50±7 years, 55% female; Group B: age 47±8 years, 36% female). According to a per-protocol analysis, 23 patients in Group A and 27 patients in Group B completed the 12-month evaluation. A group-by-time interaction effect was found in maximal thickness ($F2$, 100 = 13.43, P < 0.001) and in mean SWV ($F2$, 97 = 5.35, P = 0.006). Maximal tendon thickness was increased in Group A at 6 (P < 0.001) and 12 months (P < 0.035) postintervention, whereas there was no change from baseline to 12 months in Group B (P > 0.05). At 6 months, mean SWV increased in Group B (P = 0.035) and decreased in Group A (P = 0.132). Neovascularity decreased in both groups at 12 months (P < 0.001). Group A had 2.5 times the odds of having decreased echogenicity than Group B, at 6 and 12 months (P = 0.021). In either group, there was no change in the presence of enthesophytes nor calcifications.*Conclusions US-guided fenestration induces minor alterations in tendon structure and appears to promote faster improvement in mechanical properties than open-release surgery.*Clinical Relevance/Application US-guided fenestration is less invasive than open-release surgery and appears to promote more rapid healing of the tendon in chronic lateral epicondylosis.

RESULTS

Following one exclusion in each group, 62 patients were equally randomized (Group A: age mean ± standard deviation of 50±7 years, 55% female; Group B: age 47±8 years, 36% female). According to a per-protocol analysis, 23 patients in Group A and 27 patients in Group B completed the 12-month evaluation. A group-by-time interaction effect was found in maximal thickness ($F2$, 100 = 13.43, P < 0.001) and in mean SWV ($F2$, 97 = 5.35, P = 0.006). Maximal tendon thickness was increased in Group A at 6 (P < 0.001) and 12 months (P < 0.035) postintervention, whereas there was no change from baseline to 12 months in Group B (P > 0.05). At 6 months, mean SWV increased in Group B (P = 0.035) and decreased in Group A (P = 0.132). Neovascularity decreased in both groups at 12 months (P < 0.001). Group A had 2.5 times the odds of having decreased echogenicity than Group B, at 6 and 12 months (P = 0.021). In either group, there was no change in the presence of enthesophytes nor calcifications.

CLINICAL RELEVANCE/APPLICATION

US-guided fenestration is less invasive than open-release surgery and appears to promote more rapid healing of the tendon in chronic lateral epicondylosis.

SSMK02-2   Quantitative Musculoskeletal Imaging Via 3D Ultrasound Tomography

Participants
James Wiskin, PhD, Novato, California (*Presenter*) Employee, QT Imaging, Inc

PURPOSE

We validate here a non-invasive inexpensive and fast method of accurate imaging of the speed of sound (SOS) of muscle tissue, even in the presence of high-speed bone. We distinguish between muscle, cartilage, ligament, tendon and fat tissue based on SOS. This technique does not suffer from signal voids common for MRI, and it may be useful for monitoring of clinical treatment and cartilage/ligament/tendon damage.*Methods and Materials UT creates 3D images slice by slice using 2D algorithms (tomography) in ~20 seconds but has artifacts. 3D algorithms (volography) have required 32 hours using a 128-computer cluster. Our 3D volography algorithm emulates a convolutional neural network (CNN) on NVIDIA GPUs and is 64 times faster. than published results, using 2 NVIDIA cards. We first validated the knee cadaver tissue speed of sound (SOS) compared with SoS in unfixed tissue. We use ROI's (6- and 4-mm radius) in transverse sections and 3D volumetric segmentation of a cadaverous knee scanned in our adapted scanner (QT Imaging®) corresponding to muscle, fat, and cartilage and compare the average values (standard deviation) with the

literature. We validate clinically useful times. A refraction corrected reflection image is also created, using the SOS, in 2 minutes. All UT images were compared with simultaneous MR images*Results Our 3D volography images are available in ~25 minutes or less. We observed an average SoS of 1573 m/s for Vastus medialis muscle. For fat SoS (sd) was 1438.7 (20.5), and for cartilage SoS (sd) =1655.4 (15) - similar values to published literature. We compared ligaments and tendons as well, with good agreement. We show that Formalin fixation changes the SOS values by about 0.1%- 0.4% for fibroglandular tissue, fat and skin. We show regions that have no MR response yet are quantitatively imaged in 3D ultrasound volography. Sub-mm resolution is confirmed.*Conclusions The fast, quantitative high resolution (sub-mm) estimation of tissue characteristics is shown in the presence of bone. We image tissue types (lateral collateral ligaments, periosteum, Biceps Femoris and Patellar tendon where the MR signal is not present. These results indicate the utility of the QTUS images in monitoring DMD/BMD, exercise induced tissue damage, cartilage damage, etc. in the clinic.*Clinical Relevance/Application We have developed specific protocols that allow us to measure quantitatively, SOS in the presence of bone, which can be important clinically for monitoring musculoskeletal injury and muscular diseases such as Muscular Dystrophy (DMD & BMD). The scanner is mobile, self-contained and can be deployed to sports arenas, urban, rural and historically underserved regions. It requires only 2 NVIDIA cards (not 128 computers) and gives images in 10's of minutes not days.

RESULTS

Our 3D volography images are available in ~25 minutes or less. We observed an average SoS of 1573 m/s for Vastus medialis muscle. For fat SoS (sd) was 1438.7 (20.5), and for cartilage SoS (sd) =1655.4 (15) - similar values to published literature. We compared ligaments and tendons as well, with good agreement. We show that Formalin fixation changes the SOS values by about 0.1%- 0.4% for fibroglandular tissue, fat and skin. We show regions that have no MR response yet are quantitatively imaged in 3D ultrasound volography. Sub-mm resolution is confirmed.

CLINICAL RELEVANCE/APPLICATION

We have developed specific protocols that allow us to measure quantitatively, SOS in the presence of bone, which can be important clinically for monitoring musculoskeletal injury and muscular diseases such as Muscular Dystrophy (DMD & BMD). The scanner is mobile, self-contained and can be deployed to sports arenas, urban, rural and historically underserved regions. It requires only 2 NVIDIA cards (not 128 computers) and gives images in 10's of minutes not days.

SSMK02-3   Muscle Injuries And Recovery: Diffusion-tensor-imaging (DTI) And Physical Examination

Participants
Ibrahim Yel, MD, Frankfurt, Germany (*Presenter*) Nothing to Disclose

PURPOSE

MRI is limited to assess muscle morphology and the extent of structural damage. The recovery process and return-to-play decisions are individually determined by sports medicine specialists. We tried to enhance the informative value of MRI by correlating measurable diffusion-tensor parameters with physical/functional parameters.*Methods and Materials 25 male soccer players with a non-contact hamstring injury (10R,15L) were included and 3 consecutive 3-T-MRI- and physical examinations were performed at initial injury, three weeks and six weeks after injury. Freehand ROI-measurements were placed in the injured and contralateral healthy muscle to assess ADC-, fractional anisotropy, and sum of eigenvalues (trace).*Results Overall mean DTI-values for the injured muscle were as following (baseline, first follow-up, second follow-up): ADC (10-6mm2/s) -1882±218.4, 1800±135.5, 1732±82.9; Fractional anisotropy (FA) - 263.1±66.3, 305.1±73.2, 259.3±53.5; Trace - 40.7±10.2, 37.0±8.9, 36.9±9.2. Initial DTI values of the injured muscle were all significantly different compared to the healthy side(p<0.01), consistent with reduced ranges of motion in the functional examinations and the presence of pain(p<0.01). In the healing course, the FA-values (after 3 weeks) started to align with values of the healthy side(p=0.51) followed by the trace-values in the sixth week after injury(p=0.34). ADC showed significantly higher values throughout the recovery process(p<=0.023). Physical and functional parameters were comparable with the healthy side on the first follow-up examination(p=0.82).*Conclusions In the 6-week period after injury the DTI-parameters indicate significant changes for FA-, trace- and ADC-values. FA-values seem to be the fastest indicators of the healing process and show a similar trend to the clinical parameters, but without a statistical prove. All this indicates a complex physiologic healing mechanism (initial edema, fibrosis, development of new muscle tissue, etc) that in its entirety cannot be (linearly) correlated with DTI-values.*Clinical Relevance/Application Muscle injuries cause a significant dynamic in DTI-values, with time-specific assimiliations to the contralateral healthy side, however lagging behind the actual improvements in clinical and functional parameters. DTI could enhance muscle-imaging, if investigated further, leading to an improved informative value regarding recovery and integrity of muscle fibers.

RESULTS

Overall mean DTI-values for the injured muscle were as following (baseline, first follow-up, second follow-up): ADC (10-6mm2/s) - 1882±218.4, 1800±135.5, 1732±82.9; Fractional anisotropy (FA) - 263.1±66.3, 305.1±73.2, 259.3±53.5; Trace - 40.7±10.2, 37.0±8.9, 36.9±9.2. Initial DTI values of the injured muscle were all significantly different compared to the healthy side(p<0.01), consistent with reduced ranges of motion in the functional examinations and the presence of pain(p<0.01). In the healing course, the FA-values (after 3 weeks) started to align with values of the healthy side(p=0.51) followed by the trace-values in the sixth week after injury(p=0.34). ADC showed significantly higher values throughout the recovery process(p<=0.023). Physical and functional parameters were comparable with the healthy side on the first follow-up examination(p=0.82).

CLINICAL RELEVANCE/APPLICATION

Muscle injuries cause a significant dynamic in DTI-values, with time-specific assimiliations to the contralateral healthy side, however lagging behind the actual improvements in clinical and functional parameters. DTI could enhance muscle-imaging, if investigated further, leading to an improved informative value regarding recovery and integrity of muscle fibers.

SSMK02-5   Diagnostic Impact Of MR Neurography Of Lumbosacral Plexus For Failed Back Surgery Syndrome With Outcomes Analysis

Participants
Bayan Mogharrabi, BS, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To determine the value of MR neurography (MRN) of the lumbosacral plexus in clinical management of failed back surgery syndrome (FBSS) with outcomes analysis.*Methods and Materials A cross sectional study of 59 consecutive patients with MRN Lumbar plexus for FBSS and informed consent was waived. All MRN studies were formally read by fellowship trained MSK radiologists. Clinical data and results from other diagnostic tests were recorded from EMR by medical students on scholarly activity. MSK fellow and senior

MSK radiologist re-evaluated all cases and recorded the findings on a 3-point Likert scale for contribution to the final diagnosis as 1-non-contributory, 2- partially contributory, 3- definitely contributory. Impact of both sets of imaging were interpedently recorded- 'clinical data plus other imaging prior to MRN' and 'clinical data plus MRN' using the same scale. Patient charts were further reviewed for change in the clinical diagnosis and management on a 4-point Likert scale (0-no change, 1-minor: change in clinical diagnosis but no change in treatment, 2- moderate: change in clinical diagnosis and change in treatment, 3- major: change in clinical diagnosis, change in treatment, and improved patient outcome). Final patient outcomes were recorded.*Results There were 59 patients ranging from 28-81 years of age. 4/59 had spinal fusion, 10/59 had a decompression lamincectomy,1/59 had a laminotomy ,13/59 had a laminoforaminotomy,9/59 had a discectomy, 6/59 had a lumbar spine fusion, 2/59 had a non-specified back operation, 6/59 had a combination of the aforementioned operations,7/59 did not have surgery prior, and 1/59 could not access surgical history. MRN found nerve lesions in 9/59 cases in L5 nerve root, 5/59 in L4, 2/59 in S1, 2/59 in S2, 2/59 in sciatic, 2/59 in femoral, 26/59 cases had multiple nerve root and downstream femoral and/or sciatic neuropathies, and 11/59 were normal.7/59 MRN were non-contributory, 15/59 were partially contributory, and 37/59 were definitely contributory. Following MRN, 17/59 had surgery, 33/59 had injections or physical therapy, 2/59 had both surgery and injections, 3/59 had a spinal cord stimulator placed, and 4/59 had no treatment. In 9/59 cases, major change occurred due to MRN with improved patient outcomes, 5/59 had a moderate change with no significant change in outcomes, and 6/59 had a minor change with no change in treatment, and 39/59 had no change.*Conclusions MRN of the lumbar plexus was contributory in the clinical diagnosis in a majority of cases of FBSS above the conventional imaging modalities with improved outcomes in 15% of cases.*Clinical Relevance/Application FBSS is a difficult clinical scenario and MRN of lumbosacral plexus can provide diagnostically meaningful information for improved patient outcomes.

RESULTS

There were 59 patients ranging from 28-81 years of age. 4/59 had spinal fusion, 10/59 had a decompression lamincectomy,1/59 had a laminotomy ,13/59 had a laminoforaminotomy,9/59 had a discectomy, 6/59 had a lumbar spine fusion, 2/59 had a non-specified back operation, 6/59 had a combination of the aforementioned operations,7/59 did not have surgery prior, and 1/59 could not access surgical history. MRN found nerve lesions in 9/59 cases in L5 nerve root, 5/59 in L4, 2/59 in S1, 2/59 in S2, 2/59 in sciatic, 2/59 in femoral, 26/59 cases had multiple nerve root and downstream femoral and/or sciatic neuropathies, and 11/59 were normal.7/59 MRN were non-contributory, 15/59 were partially contributory, and 37/59 were definitely contributory. Following MRN, 17/59 had surgery, 33/59 had injections or physical therapy, 2/59 had both surgery and injections, 3/59 had a spinal cord stimulator placed, and 4/59 had no treatment. In 9/59 cases, major change occurred due to MRN with improved patient outcomes, 5/59 had a moderate change with no significant change in outcomes, and 6/59 had a minor change with no change in treatment, and 39/59 had no change.

CLINICAL RELEVANCE/APPLICATION

FBSS is a difficult clinical scenario and MRN of lumbosacral plexus can provide diagnostically meaningful information for improved patient outcomes.

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Participants
Vishal Patel, MD, PhD, Alhambra, California (*Moderator*) Nothing to Disclose
Christopher T. Whitlow, MD, PhD, Winston Salem, North Carolina (*Moderator*) Nothing to Disclose

Sub-Events

SSNR15-1   **An Artificial Intelligence-based Algorithm Can Support Radiologists In Diagnosing Cervical Spine Fractures**

Participants
Sanders Chang, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Artificial intelligence-based algorithms have been developed to assist radiologists in the diagnosis of critical neurologic findings. This project aims to assess the performance of a FDA-approved convolutional neural network model, Aidoc (Tel Aviv, Israel), in detecting cervical spinal fractures within a multi-institutional hospital system.*Methods and Materials Patients who received a cervical CT scan analyzed by Aidoc within a four-month period (August 2020 to November 2020) were included in this retrospective analysis. Scans flagged as positive were evaluated independently by two neuroradiologists with review of the original radiology reports to establish ground truth. Acute and chronic fractures (traumatic and pathologic) were considered true positives. False positives were documented according to their most likely etiology. Scans flagged as negative but had a corresponding radiology report indicating a fracture (i.e. "false negative") were further reviewed independently by two neuroradiologists to establish ground truth. Any discrepancies between the two readers were resolved by a third neuroradiologist.*Results 3165 patients were included in our analysis (mean, 60.6 ± 20.8 years of age; range, 16-103 years of age). 144 cases were flagged as positive by Aidoc, 54 of which were determined to be true positives (positive predictive value of 37.5%). Of note, 4 true positives (7.4%) were fractures not diagnosed in the original radiology report. 90 cases (63.2%) were determined to be false positives, the majority related to degenerative changes (67.8%), nutrient vessels (34.4%), and artifacts (16.7%). 4 false positives had additional fractures not detected by Aidoc and were simultaneously classified as false negatives. In total, 34 cases (1.1%) were determined to be false negatives, consisting of 19 chronic fractures (55.9%), 12 acute fractures (35.3%), and 3 age-indeterminate fractures (8.8%).*Conclusions Artificial intelligence-based algorithms can support radiologists in detecting cervical spine fractures that may be missed in practice. Further refinement of these algorithms will minimize the rate of false positives and false negatives.*Clinical Relevance/Application Artificial intelligence-based algorithms can support radiologists and potentially enhance their accuracy in diagnosing cervical spine fractures.

RESULTS

3165 patients were included in our analysis (mean, 60.6 ± 20.8 years of age; range, 16-103 years of age). 144 cases were flagged as positive by Aidoc, 54 of which were determined to be true positives (positive predictive value of 37.5%). Of note, 4 true positives (7.4%) were fractures not diagnosed in the original radiology report. 90 cases (63.2%) were determined to be false positives, the majority related to degenerative changes (67.8%), nutrient vessels (34.4%), and artifacts (16.7%). 4 false positives had additional fractures not detected by Aidoc and were simultaneously classified as false negatives. In total, 34 cases (1.1%) were determined to be false negatives, consisting of 19 chronic fractures (55.9%), 12 acute fractures (35.3%), and 3 age-indeterminate fractures (8.8%).

CLINICAL RELEVANCE/APPLICATION

Artificial intelligence-based algorithms can support radiologists and potentially enhance their accuracy in diagnosing cervical spine fractures.

SSNR15-2   **Arterial Spin Labeling MRI Can Detect Impaired Cerebrovascular Reactivity In Moyamoya Patients: A Cohort Study Using Simultaneous PET/MRI**

Participants
Yize Zhao, PhD, Palo Alto, California (*Presenter*) Nothing to Disclose

PURPOSE

Cerebrovascular reactivity (CVR) reflects the change in cerebral blood flow (CBF) in response to a vasoactive stimulus. Studies have demonstrated that impaired CVR was associated with a higher risk of stroke 1. PET imaging with 15O-water as the radiotracer has been the standard modality to measure CBF and CVR. However, it is impractical in most hospitals due to the requirement of an on-site cyclotron. Arterial spin labeling is a quantitative MRI technique that enables non-invasive CBF and CVR measurement. In this work, we compare the CVR of Moyamoya patients measured by ASL MRI with the reference-standard 15O-water PET.*Methods and Materials Imaging data were acquired from 26 Moyamoya patients (18-64 years, 16 females) using a simultaneous 3T PET/MRI system (GE SIGNA, Waukesha, WI, USA). All patients had unilateral or bilateral vessel occlusion at the anterior cerebral artery (ACA), middle cerebral artery (MCA), and/or posterior cerebral artery (PCA). The scanning parameters of the single post-labeling delay pseudo-continuous ASL (single-PLD PCASL), delay pseudo-continuous ASL (multi-PLD PCASL, 3 PLDs), and PET were

described in our previous work 2. PET and ASL data were acquired simultaneously at baseline and 15 minutes after the injection of the vasodilator acetazolamide (15 mg/kg with a maximum of 1 g). Each patient received 891±71.8 MBq of 15O-water. CBF of PET was computed using the single-compartment pharmacokinetic model; CBF of ASL was computed using the general kinetic model 3,4. CVR was computed as the percentage of CBF change compared with baseline CBF. Flow territories (right and left ACA, MCA, and PCA) were defined based on the Harvard-Oxford cortical and subcortical structural atlases 5. Mean CVR within the territories affected by occlusion and normal territories was computed for each subject. Paired t-tests were performed to compare the mean CVR between the affected and unaffected territories.*Results Figure 1 shows the mean CVR of the cohort in regions affected by occlusion and normal regions. Overall, the CVR of the affected regions was significantly lower than the normal regions (by 68%, 52%, and 56% for PET, single-PLD PCASL, and multi-PLD PCASL respectively).*Conclusions Both single and multi-delay ASL were effective in detecting impaired CVR in Moyamoya patients.*Clinical Relevance/Application Using 15O-water Pet as the reference, our data showed that the ASL MRI successfully detected impaired CVR in Moyamoya patients, allowing this technique to become a non-invasive modality to identify patients with a high risk of stroke.

RESULTS

Figure 1 shows the mean CVR of the cohort in regions affected by occlusion and normal regions. Overall, the CVR of the affected regions was significantly lower than the normal regions (by 68%, 52%, and 56% for PET, single-PLD PCASL, and multi-PLD PCASL respectively).

CLINICAL RELEVANCE/APPLICATION

Using 15O-water Pet as the reference, our data showed that the ASL MRI successfully detected impaired CVR in Moyamoya patients, allowing this technique to become a non-invasive modality to identify patients with a high risk of stroke.

SSNR15-3 Fully Automated Lumbar Spinal Stenosis (LSS) Grading System In MR Imaging Using 3D Deep Learning Pipeline

Participants
JinHyeong Park, PhD, New York, New York (*Presenter*) Employee, Covera Health

PURPOSE

Lumbar spinal stenosis (LSS) is commonly diagnosed on MR, but there is a high variation in grading severity. We propose a fully automated AI-powered 3D pipeline to detect, localize and grade LSS at each Functional Spinal Units (FSU) level (L1-2 through L5-S1) as grade 1 - none/mild, grade 2 - moderate or grade 3 - severe.*Methods and Materials Sag T1, Sag T2 and Ax T2 sequences from lumbar spine MR at 1.5T (67%) and 3.0T (33%) were collected from 5426 patients. 27,124 FSU were graded based on Stenotic Ratio, 0 - 0.25 (Mild), 0.25 - 0.75 (Moderate), 0.75 - 1, Schizas class C and D (severe). At least 1 of 8 experienced MSK- and neuro-radiologists assigned 22,957 FSU to grade 1 (85%), 1,745 to grade 2 (6%), and 2,422 to grade 3 (9%). The studies were randomly split into train-validation-test sets in a 7:1:2 ratio. A deep reinforcement model was trained to identify the L1-2 through L5-S1 discs. Associated FSUs were cropped (9 x 9 x 4 cm for axial and 8 x 8 x 5 cm for sagittal), then fed to a convolutional neural network. Three independent ResNet50-like encoders, one per each sequence, were trained to grade the stenosis. Derived embeddings were concatenated and normalized using an adaptive dropout to account for missing sequences. A final regression layer predicted a gaussian distribution representing LSS grades with continuous severity scores from 1 to 3. Final grade was set to the closest target grade.*Results Mean absolute error (MAE) between target, discrete grades 1, 2 or 3, and predicted grades, continuous values from 1 to 3, were computed. Overall MAE was 0.27 (std:0.32) and MAE for grades 1, 2, and 3 were 0.26 (std:0.32), 0.33 (std:0.34), and 0.33 (std:0.37). Micro and macro AUC were 0.95, and 0.91. AUC for grade 1, 2 and 3 were 0.94, 0.84, and 0.96. Inter-expert agreement was measured with sensitivity/specificity across 360 randomly selected FSUs. Sensitivity and specificity of grade 1 vs. grades 2 & 3 were 0.91 and 0.92 (0.88 and 0.98 from inter-expert), and grades 1 & 2 vs. grade 3 were 0.88 and 0.98 (0.94 and 0.82 from inter-expert).*Conclusions An AI pipeline is able to accurately detect the presence, location, and grade of lumbar spinal stenosis comparable to experienced, sub-specialized radiologists*Clinical Relevance/Application There is inter-observer variation when radiologists grade LSS, but this can be reduced by an AI pipeline. These research results are not commercially available.

RESULTS

Mean absolute error (MAE) between target, discrete grades 1, 2 or 3, and predicted grades, continuous values from 1 to 3, were computed. Overall MAE was 0.27 (std:0.32) and MAE for grades 1, 2, and 3 were 0.26 (std:0.32), 0.33 (std:0.34), and 0.33 (std:0.37). Micro and macro AUC were 0.95, and 0.91. AUC for grade 1, 2 and 3 were 0.94, 0.84, and 0.96. Inter-expert agreement was measured with sensitivity/specificity across 360 randomly selected FSUs. Sensitivity and specificity of grade 1 vs. grades 2 & 3 were 0.91 and 0.92 (0.88 and 0.98 from inter-expert), and grades 1 & 2 vs. grade 3 were 0.88 and 0.98 (0.94 and 0.82 from inter-expert).

CLINICAL RELEVANCE/APPLICATION

There is inter-observer variation when radiologists grade LSS, but this can be reduced by an AI pipeline. These research results are not commercially available.

SSNR15-4 A Pivotal Randomized Clinical Trial For Brain CT Interpretation Assisted By A Deep Learning-based Automatic Detection Algorithm For Detecting Acute Intracranial Hemorrhage

Participants
Jin Wook Choi, MD, Suwon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To validate the diagnostic performance of brain CT interpretation assisted by a deep learning-based automatic detection algorithm (DLAD) for detecting acute intracranial hemorrhage (AIH).*Methods and Materials A pivotal randomized clinical trial of DLAD (Medical Insight+ Brain Hemorrhage, SK Inc. C&C, Republic of Korea) was performed. AIH was evaluated by nine reviewers belonging to three subgroups (non-radiologist physicians, n=3; board-certified radiologists, n=3; and neuroradiologists, n=3) without or with assistance of the DLAD for a washout period of four weeks using 12,663 slices (2,508 AIH and 10,155 normal) of brain CTs from 296 patients (146 AIH and 150 normal). Our DLAD localized AIH with probability scores for both patients and slices wisely. Its diagnostic performance was evaluated using AUROC. Statistical significance was considered when Bonferroni-corrected P-value was less than 0.05.*Results Brain CT interpretation with the DLAD showed significantly higher AUROC than that without DLAD (0.970 [95% CI: 0.963, 0.976] vs. 0.947 [95% CI: 0.938, 0.955], P < 0.0009). Among three subgroups of reviewers, non-radiologist physicians showed the most improvement in diagnostic accuracy using brain CT interpretation with DLAD than that without DLAD (0.951 [95%

CI: 0.934, 0.964] vs. 0.919 [95% CI: 0.899, 0.936], P = 0.0009). For board-certified radiologists, brain CT interpretation with assistance by DLAD also showed significantly higher AUROC than that without DLAD (0.974 [95% CI: 0.961, 0.983] vs. 0.946 [95% CI: 0.929, 0.960], P = 0.0003). For neuroradiologists, although brain CT interpretation with assistance by DLAD also showed higher diagnostic accuracy than that without DLAD, the difference between the two was not statistically significant (0.987 [95% CI: 0.977, 0.993] vs. 0.976 [95% CI: 0.964, 0.985], P = 0.1776).*Conclusions Brain CT interpretation assisted by DLAD for detecting AIH showed better diagnostic performance than that without assistance by DLAD. The greatest improvement in diagnostic accuracy using brain CT interpretation assisted by DLAD was found for the subgroup of non-radiologist physicians among three subgroups of reviewers.*Clinical Relevance/Application 1. Brain CT interpretation assisted by our deep learning-based automatic detection algorithm showed improvement than that without assistance by deep learning-based automatic detection algorithm for detecting AIH on brain CT.2. When accompanied by our deep learning-based automatic detection algorithm, both non-radiologist physicians and board-certified radiologists improved their performances for detecting AIH, with non-radiologist physicians showing greater improvement in diagnostic accuracy.

RESULTS

Brain CT interpretation with the DLAD showed significantly higher AUROC than that without DLAD (0.970 [95% CI: 0.963, 0.976] vs. 0.947 [95% CI: 0.938, 0.955], P < 0.0009). Among three subgroups of reviewers, non-radiologist physicians showed the most improvement in diagnostic accuracy using brain CT interpretation with DLAD than that without DLAD (0.951 [95% CI: 0.934, 0.964] vs. 0.919 [95% CI: 0.899, 0.936], P = 0.0009). For board-certified radiologists, brain CT interpretation with assistance by DLAD also showed significantly higher AUROC than that without DLAD (0.974 [95% CI: 0.961, 0.983] vs. 0.946 [95% CI: 0.929, 0.960], P = 0.0003). For neuroradiologists, although brain CT interpretation with assistance by DLAD also showed higher diagnostic accuracy than that without DLAD, the difference between the two was not statistically significant (0.987 [95% CI: 0.977, 0.993] vs. 0.976 [95% CI: 0.964, 0.985], P = 0.1776).

CLINICAL RELEVANCE/APPLICATION

1. Brain CT interpretation assisted by our deep learning-based automatic detection algorithm showed improvement than that without assistance by deep learning-based automatic detection algorithm for detecting AIH on brain CT.2. When accompanied by our deep learning-based automatic detection algorithm, both non-radiologist physicians and board-certified radiologists improved their performances for detecting AIH, with non-radiologist physicians showing greater improvement in diagnostic accuracy.

SSNR15-5   Microstructural Alterations Of Major Thalamic Nuclei In The Chronic Pediatric Spinal Cord Injured Population

Participants
Mahdi Alizadeh, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Few studies have investigated microstructural alterations in the thalamus following spinal cord injury (SCI), especially in the pediatric population. In this study, we used diffusion tensor imaging (DTI) derived metrics to characterize microstructural changes in thalamic nuclei in pediatric SCI patients.*Methods and Materials We conducted a retrospective study of 18 subjects aged 8-20 years old with chronic SCIs. Subjects were assigned to three groups after assessing for SCI severity via the American Spinal Injury Association Impairment Scale (AIS). Five subjects were classified as AIS grade A, nine subjects were classified as AIS grade B, and four subjects were classified as AIS grade C and D. DTI scans were acquired in a 3T Siemens Verio MR scanner. Initial raw diffusion data was corrected for motion artifacts and eddy current distortions. Then, diffusion tensor estimates per voxel were fit to generate DTI scalars including FA, MD, AD, and RD, and registered in MNI space. Diffusion values were computed with the AAL3 thalamic atlas for 15 major thalamic nuclei, and a multiple Mann-Whitney U test was applied to identify group differences with significance threshold set at p < 0.05.*Results Significant differences in diffusion scalars were identified between AIS groups A vs CD and B vs CD. Between AIS A and CD, differences in FA in the left reuniens nucleus (p = 0.016) and RD in the parvocellular right mediodorsal lateral nucleus (p = 0.016) were significant. Between AIS B and CD, differences in AD (p = 0.020) and MD (p = 0.0056) in the right medial geniculate nucleus were significant.*Conclusions Our results suggest the presence of microstructural alterations in certain thalamic nuclei following SCI with respect to the severity based on AIS classification. The difference in diffusion metrics in certain nuclei of the thalamus between SCI patients of high grade and low grade severity may reflect neuroplastic changes that develop in chronic SCIs. These microstructural changes may indicate the response of thalamic neuronal cells to injury. While our results only show that differences in diffusion values between AIS groups were significant in just a few thalamic nuclei, these preliminary results are encouraging and warrant further studies with a larger population and with consideration of covariate factors such as age.*Clinical Relevance/Application DTI may provide imaging biomarkers that characterize adaptive neuroplastic changes in the brain after SCI and insight into how they affect the thalamus' role in sensorimotor and cognitive functions.

RESULTS

Significant differences in diffusion scalars were identified between AIS groups A vs CD and B vs CD. Between AIS A and CD, differences in FA in the left reuniens nucleus (p = 0.016) and RD in the parvocellular right mediodorsal lateral nucleus (p = 0.016) were significant. Between AIS B and CD, differences in AD (p = 0.020) and MD (p = 0.0056) in the right medial geniculate nucleus were significant.

CLINICAL RELEVANCE/APPLICATION

DTI may provide imaging biomarkers that characterize adaptive neuroplastic changes in the brain after SCI and insight into how they affect the thalamus' role in sensorimotor and cognitive functions.

SSNR15-6   A Deep Learning Model For Classifying Spontaneous Intracranial Hypotension On Brain MRI

Participants
Walter Wiggins, MD, PhD, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

Spontaneous intracranial hypotension (SIH) is an important, but underrecognized cause of positional headache. SIH is a debilitating but treatable condition. Characteristic brain MRI findings of smooth dural thickening/hyperenhancement, venous distention, and brain sag are key to this diagnosis. Thus, we sought to develop a deep learning model to assist radiologists in identifying potential cases of SIH on brain MRI examinations.*Methods and Materials In total 428 brain MRI examinations from unique subjects were included (155 positive for SIH and 273 normals). Positive cases were selected from an institutional database of confirmed SIH cases. Normal controls were identified by screening consecutive, contemporary brain MRI reports with a natural language

processing tool. Reports flagged as likely normal were manually reviewed and confirmed. Data were split at the subject level into training (45%), validation (30%), and test (25%) sets. Axial and coronal post-contrast, T1-weighted sequences were selected for further analysis. An empirically derived heuristic was applied to select 1 axial image and 2 coronal images from each study most likely to exemplify the characteristic findings of SIH. Transfer learning was employed with ResNet-50 architecture pre-trained on ImageNet, adapted to train 3 separate models for the axial and 2 coronal images. Models were fine-tuned for 50 epochs each. Predictions from the 3 models were ensembled with a logistic regression model to generate a final prediction. Performance was evaluated with receiver operating characteristic (ROC) and precision-recall (PR) curves, including area under the ROC (AUROC).*Results AUROC for axial and coronal models were 0.98, 0.98, and 0.97. Ensemble AUROC was 0.98. Given the surprisingly high accuracy of our results, subsequent testing and experiments were performed for validation. There was no evidence of data leakage. Running model inference on the test data set without fine-tuning the pre-trained model resulted in AUROC 0.55. Fine-tuning of the model on a small subset of the data - 10 positive and 20 negative cases from the training set, 5 positive and 10 negative from the validation set - resulted in a slight improvement with AUROC 0.61. Repeating training with the full dataset reproduced the result of AUROC 0.98.*Conclusions We successfully trained a highly accurate deep learning model capable of classifying SIH on brain MRI examinations from our institutional database.*Clinical Relevance/Application If shown to be generalizable to more challenging cases and/or cases from other institutions, this model could help radiologists identify possible cases of SIH on brain MRI examinations.

RESULTS

AUROC for axial and coronal models were 0.98, 0.98, and 0.97. Ensemble AUROC was 0.98. Given the surprisingly high accuracy of our results, subsequent testing and experiments were performed for validation. There was no evidence of data leakage. Running model inference on the test data set without fine-tuning the pre-trained model resulted in AUROC 0.55. Fine-tuning of the model on a small subset of the data - 10 positive and 20 negative cases from the training set, 5 positive and 10 negative from the validation set - resulted in a slight improvement with AUROC 0.61. Repeating training with the full dataset reproduced the result of AUROC 0.98.

CLINICAL RELEVANCE/APPLICATION

If shown to be generalizable to more challenging cases and/or cases from other institutions, this model could help radiologists identify possible cases of SIH on brain MRI examinations.

Abstract Archives of the RSNA, 2021

SPR-HN

Head and Neck Pre-recorded Scientific Papers

Sub-Events

SPR-HN-1   VSI Teleultrasound Of The Thyroid: A New Horizon In Imaging

Participants
Thomas Marini, MD, Rochester, New York (*Presenter*) Nothing to Disclose

PURPOSE

Thyroid ultrasound is a key tool in the evaluation of the thyroid, but billions of people around the world lack access to ultrasound imaging. In this study, we tested an asynchronous telediagnostic ultrasound system operated by individuals without prior ultrasound training which may be used to effectively evaluate the thyroid and improve access to imaging worldwide.*Methods and Materials The telediagnostic system used in this study utilizes volume sweep imaging (VSI), an imaging technique in which the operator scans the target region with simple sweeps of the ultrasound probe based on external body landmarks. Sweeps are recorded and saved as video clips for later interpretation by an expert. Two operators without prior ultrasound experience underwent 8 hours of training on the thyroid VSI protocol and the operation of the telemedicine platform. After training, the operators scanned patients at a health center in Lima serving a low-income population. Telediagnostic examinations were sent to the United States for remote interpretation. Standard of care thyroid ultrasound was performed by an experienced radiologist at the time of VSI examination to serve as a reference standard.*Results Novice operators scanned 121 subjects with the thyroid VSI protocol. Of these exams, 88% were rated of excellent image quality showing complete or near complete thyroid visualization. There was 98.3% agreement on thyroid nodule presence between VSI and standard of care (Cohen's kappa 0.91, P <0.0001). VSI measured the thyroid size, on average, within 5 mm compared to standard of care. There was fair to moderate agreement on thyroid size measurements with intraclass correlation coefficients varying between 0.37 and 0.58. The Bland-Altman bias varied between 2.84 and 1.07, indicating that VSI tends to result in larger measurements compared to standard of care. The average nodule size in greatest dimension was 9.8 mm +/- 5.2 mm (standard deviation) on VSI and 10.1 mm +/- 8 mm on standard of care. There was no significant difference in measurement of thyroid nodule size (P = 0.74).*Conclusions Thyroid VSI telediagnostic ultrasound demonstrated both excellent visualization of the thyroid gland and agreement with standard of care thyroid ultrasound for nodules and thyroid size evaluation.*Clinical Relevance/Application This system could be deployed for evaluation of palpable thyroid abnormalities, nodule follow-up, and epidemiological studies to promote global health and improve the availability of diagnostic imaging in underserved communities.

RESULTS

Novice operators scanned 121 subjects with the thyroid VSI protocol. Of these exams, 88% were rated of excellent image quality showing complete or near complete thyroid visualization. There was 98.3% agreement on thyroid nodule presence between VSI and standard of care (Cohen's kappa 0.91, P <0.0001). VSI measured the thyroid size, on average, within 5 mm compared to standard of care. There was fair to moderate agreement on thyroid size measurements with intraclass correlation coefficients varying between 0.37 and 0.58. The Bland-Altman bias varied between 2.84 and 1.07, indicating that VSI tends to result in larger measurements compared to standard of care. The average nodule size in greatest dimension was 9.8 mm +/- 5.2 mm (standard deviation) on VSI and 10.1 mm +/- 8 mm on standard of care. There was no significant difference in measurement of thyroid nodule size (P = 0.74).

CLINICAL RELEVANCE/APPLICATION

This system could be deployed for evaluation of palpable thyroid abnormalities, nodule follow-up, and epidemiological studies to promote global health and improve the availability of diagnostic imaging in underserved communities.

SPR-HN-10   Post-COVID Fungal Rhinosinusitis Creating Havoc!!! From Radiologists' Perspective

Participants
Srijit Saha, MBBS, Nagpur, India (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the spectrum of radiological findings that involve orbits and paranasal sinuses using Computed Tomography scans in patients who have recovered from COVID-19 disease.To evaluate the demography, comorbidities and treatment modalities used in these patients which may attribute to development of Fungal Rhinosinusitis after recovery from COVID-19 infection.*Methods and Materials This is a retrospective cohort study of 67 patients who had recovered from COVID-19 pneumonia within 1 month and have been referred to the Radiodiagnosis Department for Contrast Enhanced Computed Tomography (CECT) of Orbit and Paranasal Sinuses with various complaints. Clinical, demographic, comorbidities and COVID-treatment historywere taken.The reports of nasal swabs were collected from Department of Microbiology. *Results Almost all- 66 (99%) had pansinusitis with some degree of nasal obstruction. 31 % patients had orbital cellulitis. 12% had orbital abscess formation. 67% patients had soft tissue density lesion within the paranasal sinuses. 9.5% patients had direct infraorbital extension of the soft tissue, while 17.9 % had direct intracranial extension. 4.5% cases had palatal perforation. Type II Diabetes Mellitus was the most common (79%) comorbid condition. 56% patients needed non-invasive ventilatory support during COVID treatment, 10% cases needed ventilatory support, 17.9% patients were given oxygen support while 14.9% patients did not need any oxygen support at all. 70% patients were treated with oral or injectable steroids during COVID infection, 79% were given broad-spectrum antibiotics while 18% were administered

immunomodulators. The swabs were positive for fungal growths in 62.7 % cases.*Conclusions COVID-19 is associated with a significant incidence of secondary infections, both bacterial and fungal probably due to immune dysregulation. Additionally, the widespread use of steroids/broad-spectrum antibiotics as part of the armamentarium against COVID-19 may lead to the development or exacerbation of preexisting fungal diseases. Patients on ventilatory support or with comorbidities like Diabetes Mellitus have a tendency for secondary fungal infections.*Clinical Relevance/Application Physicians should be aware of the possibility of invasive secondary fungal infections in patients with COVID-19 infection especially in patients with preexisting risk factors and should enable early diagnosis and treatment with the subsequent reduction of mortality and morbidity. The use of therapeutic agents should be monitored to achieve a therapeutic effect at the lowest dose and shortest durations. The use of broad-spectrum antibiotics, especially in the absence of infection, should be re-evaluated.

RESULTS

Almost all- 66 (99%) had pansinusitis with some degree of nasal obstruction. 31 % patients had orbital cellulitis. 12% had orbital abscess formation. 67% patients had soft tissue density lesion within the paranasal sinuses. 9.5% patients had direct infraorbital extension of the soft tissue, while 17.9 % had direct intracranial extension. 4.5% cases had palatal perforation. Type II Diabetes Mellitus was the most common (79%) comorbid condition. 56% patients needed non-invasive ventilatory support during COVID treatment, 10% cases needed ventilatory support, 17.9% patients were given oxygen support while 14.9% patients did not need any oxygen support at all. 70% patients were treated with oral or injectable steroids during COVID infection, 79% were given broad-spectrum antibiotics while 18% were administered immunomodulators. The swabs were positive for fungal growths in 62.7 % cases.

CLINICAL RELEVANCE/APPLICATION

Physicians should be aware of the possibility of invasive secondary fungal infections in patients with COVID-19 infection especially in patients with preexisting risk factors and should enable early diagnosis and treatment with the subsequent reduction of mortality and morbidity. The use of therapeutic agents should be monitored to achieve a therapeutic effect at the lowest dose and shortest durations. The use of broad-spectrum antibiotics, especially in the absence of infection, should be re-evaluated.

SPR-HN-3   Radiomics-based Predictive Analysis Of Lymph Node Metastasis Using Primary Head ; Neck Tumor CT And Fluorescence Lifetime Imaging

Participants
Nimu Yuan, PhD, Davis, California (*Presenter*) Nothing to Disclose

PURPOSE

This study investigates the potential of predicting lymph node metastasis (LNM) using radiomic features derived from pre-operative CT images of primary tumors, while additionally evaluating the benefit of combining the pre-operative CT images with an intra-operative label-free Fluorescence Lifetime Imaging (FLIm).*Methods and Materials Forty-eight patients undergoing oncologic surgical procedures of the oral cavity and oropharynx were investigated in this study following IRB approval. All patients had preoperative CT scans conducted prior to surgery as well as an intraoperative FLIm scan. Primary tumors in CT images were manually segmented by a radiologist to extract radiomic features. In total, 1218 CT features were obtained from each image and 42 FLIm features were extracted based on average lifetime and spectral intensity parameter values from three spectral channels for each point measurement. All 48 subjects were randomly divided into 8 equal subsets. For each subset of data, a classifier was trained using the 7 remaining subsets of data. A nested 7-fold cross-validation (CV) was performed using the 7 subsets to tune the hyper-parameters of the classifier. Before training, features were normalized by removing the mean and variance; dimension reduction was performed using principal component analysis based on the training data only. The Support Vector Machine with radial basis function kernel was selected for classification. Classifiers trained using only CT features were also evaluated for comparison.*Results The accuracies (ACC) of the trained classifiers are listed in Table 1. The classifiers using both features achieved an average testing ACC of 0.67, which outperformed the one using only CT features (testing ACC: 0.63).*Conclusions Herein, we developed a radiomic model that predicts Head & Neck cancer LNM using CT and FLIm-derived parameters of primary tumors. Our current study demonstrates that the combination of pre-operative CT and intra-operative FLIm features can improve the prediction accuracy when compared to using CT features alone. More methods to integrate CT and FLIm information will be investigated in the future.*Clinical Relevance/Application Lymph node metastasis is a significant prognostic factor in patients with Head & Neck cancer, and the ability to predict it accurately is essential to optimizing treatment.

RESULTS

The accuracies (ACC) of the trained classifiers are listed in Table 1. The classifiers using both features achieved an average testing ACC of 0.67, which outperformed the one using only CT features (testing ACC: 0.63).

CLINICAL RELEVANCE/APPLICATION

Lymph node metastasis is a significant prognostic factor in patients with Head & Neck cancer, and the ability to predict it accurately is essential to optimizing treatment.

SPR-HN-4   Comparison Of The Diagnostic Performance Of The Modified 2021 Korean Thyroid Imaging Reporting And Data System For Thyroid Malignancy With Three International Guidelines

Participants
Eun Ju Ha, MD, Suwon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

This study was performed to compare the diagnostic performance of the modified 2021 Korean Thyroid Imaging Reporting and Data System (K-TIRADS) for thyroid malignancy with three international guidelines using Thyroid Imaging Network of Korea registry.*Methods and Materials From June to September 2015, 5,708 thyroid nodules (= 1.0 cm) in 5,081 consecutive patients who underwent thyroid ultrasound (US) from 26 institutions were evaluated. US features of the thyroid nodules were retrospectively reviewed and classified according to the categories defined by each set of guidelines. In the modified 2021 K-TIRADS, the biopsy size threshold was changed to 2.0 cm for K-TIRADS 3 and 1.0 or 1.5 cm for K-TIRADS 4 (K-TIRADS1.0cm and K-TIRADS1.5cm, respectively). We compared diagnostic performance and unnecessary fine-needle aspiration biopsy (FNAB) rates for thyroid malignancy between the modified 2021 K-TIRADS and three international guidelines.*Results Of the 5,708 thyroid nodules, 4,597 (80.5%) were benign and 1,111 (19.5%) were malignant. The overall sensitivity was highest in the modified 2021 K-TIRADS1.0cm (91.0%), followed by the European (EU)-TIRADS (84.6%), American Association of Clinical Endocrinologists/American College of Endocrinology/Associazione Medici Endocrinologi (AACE/ACE/AME) (80.5%), American College of Radiology (ACR)-TIRADS (76.1%),

and modified 2021 K-TIRADS1.5cm (76.1%). For large nodules (> 2.0 cm), the sensitivity increased to 98.0% in both the modified 2021 K-TIRADS1.0cm and K-TIRADS1.5cm. For small nodules (= 2.0 cm), the unnecessary FNAB rate was lowest with the modified 2021 K-TIRADS1.5cm (17.6%), followed by the ACR-TIRADS (18.6%), AACE/ACE/AME (19.3%), EU-TIRADS (28.1%), and modified 2021 K-TIRADS1.0cm (31.2%).*Conclusions The modified 2021 K-TIRADS1.5cm can reduce the unnecessary FNAB rates for small nodules (1.0-2.0 cm), while maintaining high sensitivity for detecting malignancies > 2.0 cm.*Clinical Relevance/Application 1. This study compared the diagnostic performance of the new modified 2021 K-TIRADS with those of ACR-, AACE/ACE/AME-, and EU-TIRADS.2. The modified 2021 K-TIRADS can reduce the unnecessary FNAB rates for small nodules (1.0-2.0 cm), while maintaining high sensitivity for detecting malignancies > 2.0 cm.

RESULTS

Of the 5,708 thyroid nodules, 4,597 (80.5%) were benign and 1,111 (19.5%) were malignant. The overall sensitivity was highest in the modified 2021 K-TIRADS1.0cm (91.0%), followed by the European (EU)-TIRADS (84.6%), American Association of Clinical Endocrinologists/American College of Endocrinology/Associazione Medici Endocrinologi (AACE/ACE/AME) (80.5%), American College of Radiology (ACR)-TIRADS (76.1%), and modified 2021 K-TIRADS1.5cm (76.1%). For large nodules (> 2.0 cm), the sensitivity increased to 98.0% in both the modified 2021 K-TIRADS1.0cm and K-TIRADS1.5cm. For small nodules (= 2.0 cm), the unnecessary FNAB rate was lowest with the modified 2021 K-TIRADS1.5cm (17.6%), followed by the ACR-TIRADS (18.6%), AACE/ACE/AME (19.3%), EU-TIRADS (28.1%), and modified 2021 K-TIRADS1.0cm (31.2%).

CLINICAL RELEVANCE/APPLICATION

1. This study compared the diagnostic performance of the new modified 2021 K-TIRADS with those of ACR-, AACE/ACE/AME-, and EU-TIRADS.2. The modified 2021 K-TIRADS can reduce the unnecessary FNAB rates for small nodules (1.0-2.0 cm), while maintaining high sensitivity for detecting malignancies > 2.0 cm.

SPR-HN-5   A Multi-center Study Based On Artificial Intelligence To Revise ACR TI-RADS Risk Stratification Of Thyroid Nodules: Diagnostic Accuracy And Utility

Participants
Ying Liu, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To determine if artificial intelligence-based modification of Thyroid Imaging Reporting Data System (TI-RADS) would be better than the current American College of Radiology (ACR) TI-RADS for risk stratification of thyroid nodules.*Methods and Materials A total of 2061 thyroid nodules (in 1859 patients) sampled with fine-needle aspiration or operation between January 2017 and July 2020 were retrospectively analyzed. Two radiologists blinded to the pathologic diagnosis evaluated nodule features in five ultrasound categories and assigned TI-RADS scores by both ACR TI-RADS and AI TI-RADS. Inter-rater agreement was assessed by asking another two radiologists to independently score a set of 100 nodules. The reference standard was postoperative pathological or cytopathological diagnosis according to the Bethesda system. Inter-rater agreement was determined using intraclass correlation coefficient (ICC).*Results AI TI-RADS assigned lower TI-RADS risk levels than ACR TI-RADS (P<0.001), and had larger area under receiver operating characteristic curve (0.762 vs. 0.679, P <0.001). The sensitivities of ACR TI-RADS and AI TI-RADS were similar (86.7% vs. 82.2%, P = 0.052), but specificity was higher with AI TI-RADS (70.2% vs. 49.2%, P< 0.001). AI TI-RADS downgraded 743 (48.63%) benign nodules, indicating that 328 (42.3% of 776 biopsied nodules) unnecessary fine-needle aspirations could have been avoided. Inter-rater agreement was better with AI TI-RADS than with ACR TI-RADS (ICC, 0.808 vs. 0.861, P<0.001).*Conclusions AI TI-RADS can achieve meaningful reduction in the number of benign thyroid nodules recommended for biopsy and significantly improve diagnostic accuracy.*Clinical Relevance/Application This study retrospectively compared diagnostic performance between AI TI-RADS and ACR TI-RADS in a large sample and may help avoid unnecessary FNA in a significant proportion of benign thyroid nodules.

RESULTS

AI TI-RADS assigned lower TI-RADS risk levels than ACR TI-RADS (P<0.001), and had larger area under receiver operating characteristic curve (0.762 vs. 0.679, P <0.001). The sensitivities of ACR TI-RADS and AI TI-RADS were similar (86.7% vs. 82.2%, P = 0.052), but specificity was higher with AI TI-RADS (70.2% vs. 49.2%, P< 0.001). AI TI-RADS downgraded 743 (48.63%) benign nodules, indicating that 328 (42.3% of 776 biopsied nodules) unnecessary fine-needle aspirations could have been avoided. Inter-rater agreement was better with AI TI-RADS than with ACR TI-RADS (ICC, 0.808 vs. 0.861, P<0.001).

CLINICAL RELEVANCE/APPLICATION

This study retrospectively compared diagnostic performance between AI TI-RADS and ACR TI-RADS in a large sample and may help avoid unnecessary FNA in a significant proportion of benign thyroid nodules.

SPR-HN-6   Application Of Radiomic Model Based On CT For Distinguishing Adenolymphoma Of Parotid Gland From Pleomorphic Adenoma

Participants
Fei Ji, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the diagnostic value of radiomic analysis in differentiating parotid adenolymphoma from pleomorphic adenoma based on CT plain images.*Methods and Materials A total of 235 patients with pathologically confirmed tumors of parotid gland were retrospectively collected, of whom 89 were adenolymphoma and 146 were pleomorphic adenoma. All cases were randomly divided into the training cohort (n=164) and the testing cohort (n=71) according to the proportion of 70% and 30%. We placed the region of interest (ROIs) at the slice with the maximun diameter of tumors on the CT images using the software of 3D Slicer to extract 145 quantitative parameters, and excluded duplicate features. We applied variance model,correlation coefficient algorithm,lasso model to screen optimal radiomics features and established the predictive model of adenolymphoma and pleomorphic adenoma through logistic regression (LR). The receiver operating characteristic (ROC) curve and area under the curve (AUC) were used to assess the diagnostic efficiency of the model.*Results The LR model combined 10 features: Maximum2DDiameterSlice,Mean,Variance,Idmn ,LargeDependenceLowGrayLevelEmphasis,GrayLevelNonUniformity,LongRunEmphasis,LowGrayLevelZoneEmphasis,ZonePercentage and Strength, among which Mean and LargeDependenceLowGrayLevelEmphasis were significantly different between the adenolymphoma group and the pleomorphic adenoma group(P<0.05). The model showed a desirable AUC of 0.868 , with a sensitivity of 82.3% and a specificity of 74.5% in the training cohort; while in the testing cohort, the AUC value was 0.842 , the sensitivity was 77.8%, and the specificity was 77.3%.*Conclusions It is helpful to distinguish parotid adenolymphoma from pleomorphic

adenoma using the prediction model based on radiomic features.*Clinical Relevance/Application Adenolymphoma and pleomorphic adenoma are the most common two types of parotid tumors, but they have different surgical procedures. It is more likely to recur if pleomorphic adenoma is incompletely removed, and its scope of surgery is required to be larger than that of adenolymphoma. Therefore, a clear preoperative diagnosis is important for the decision of surgical methods.

RESULTS

The LR model combined 10 features: Maximum2DDiameterSlice,Mean,Variance,Idmn ,LargeDependenceLowGrayLevelEmphasis,GrayLevelNonUniformity,LongRunEmphasis,LowGrayLevelZoneEmphasis,ZonePercentage and Strength, among which Mean and LargeDependenceLowGrayLevelEmphasis were significantly different between the adenolymphoma group and the pleomorphic adenoma group(P<0.05). The model showed a desirable AUC of 0.868 , with a sensitivity of 82.3% and a specificity of 74.5% in the training cohort; while in the testing cohort, the AUC value was 0.842 , the sensitivity was 77.8%, and the specificity was 77.3%.

CLINICAL RELEVANCE/APPLICATION

Adenolymphoma and pleomorphic adenoma are the most common two types of parotid tumors, but they have different surgical procedures. It is more likely to recur if pleomorphic adenoma is incompletely removed, and its scope of surgery is required to be larger than that of adenolymphoma. Therefore, a clear preoperative diagnosis is important for the decision of surgical methods.

SPR-HN-8 Application Study Of Pre-setted Adaptive Statistical Iterative Reconstruction VEO Children Low Doses in USCT

Participants
Hong Yin, MD, Qingdao, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the image quality and radiation dose with adaptive statistical iterative reconstruction-V (ASIR-V) technique of GE Revolution-CT at children sinus CT scan.*Methods and Materials 160 patients underwent sinus CT scan were prospectively collected and divided into the control group (group A, n=40) and the study group (group B, n=120) with random number table. According to pre-ASIR-V percentage, the control group 0 was used pre-ASIR-V scan. The study group was assigned into three groups (40 cases in each group). Group B1: 30% pre-ASIR-V scan; group B2: 60%pre-ASIR-V; group B3: 90%pre-ASIR-V. The tube voltage was 100kV, the tube current was automated mAs (Smart mA 10-720) technology, the noise index was six. The dose-length product of each sinus model group and patients group were record, the effective dose (ED) of each group was calculated and compared. Objective evaluation is based on CT axial image of sinus body mode. All the images were blind reading by three junior radiology doctors. The five points method is used to evaluate the image subjectively. Standard for evaluation: five (excellent): four points (good): 3 points (medium): 2 points (poor): the details are fuzzy, difficult to identify, and the noise is obvious, one points (range): Measurements were statistically compared.*Results The average ED value in group A was 0.90±0.19 mSv, and the mean ED value in group B1 was 0.69±0.35 mSv, the mean ED value in group B2 was 0.47±0.57 mSv, and the mean ED value in group B3 was 0.26±0.48 mSv. In the image quality evaluation, the 60%ASIR-V image has better image quality on the soft tissue window and bone window. The SD value of soft tissue in maxillary sinus, sinus muscle and fat (25.06±3.25, 25.06±3.25, 18.17±0.93) of the image was significantly lower than the SD values of 0%, 30%and 90%ASIR-V images (p<0 .05). The SNR (7.89±0.60, 8.40±0.56, 5.89±1.01) was significantly higher than the SNR value (p<0.05) of the 0%, 30%and 90%ASIR-V images. At the same time, the subjective score (3.89±0.55, 4.79±0.60) of the 60%ASIR-V image in the soft tissue window and the bone window was also better than the evaluation score of the 0%, 30%and 90%ASIR-V images (p<0.05).*Conclusions The ASIR-V technique of GE Revolution-CT with 60%pre-ASIR-V technique can reduce radiation dose while maintain good overall image quality.*Clinical Relevance/Application Adaptive statistical iterative reconstruction technology can significantly improve the children'ssinus radiation dose and CT image quality under low voltage scan conditions. The best new multi-model iterative reconstruction algorithm (ASIR-V) obtained in this study has certain guiding significance for low-tube voltage sinusCT scan in children.

RESULTS

The average ED value in group A was 0.90±0.19 mSv, and the mean ED value in group B1 was 0.69±0.35 mSv, the mean ED value in group B2 was 0.47±0.57 mSv, and the mean ED value in group B3 was 0.26±0.48 mSv. In the image quality evaluation, the 60%ASIR-V image has better image quality on the soft tissue window and bone window. The SD value of soft tissue in maxillary sinus, sinus muscle and fat (25.06±3.25, 25.06±3.25, 18.17±0.93) of the image was significantly lower than the SD values of 0%, 30%and 90%ASIR-V images (p<0 .05). The SNR (7.89±0.60, 8.40±0.56, 5.89±1.01) was significantly higher than the SNR value (p<0.05) of the 0%, 30%and 90%ASIR-V images. At the same time, the subjective score (3.89±0.55, 4.79±0.60) of the 60%ASIR-V image in the soft tissue window and the bone window was also better than the evaluation score of the 0%, 30%and 90%ASIR-V images (p<0.05).

CLINICAL RELEVANCE/APPLICATION

Adaptive statistical iterative reconstruction technology can significantly improve the children'ssinus radiation dose and CT image quality under low voltage scan conditions. The best new multi-model iterative reconstruction algorithm (ASIR-V) obtained in this study has certain guiding significance for low-tube voltage sinusCT scan in children.

SPR-HN-9 Establishment And Validation Of Cervical Vertebrae Muscle Wasting As A Marker Of Sarcopenia For Patients With Head And Neck Cancer

Participants
Brennan Olson, BA, Portland, Oregon (*Presenter*) Nothing to Disclose

PURPOSE

Sarcopenia, or excessive skeletal muscle wasting, is a significant predictor of survival and surgical complications for patients with cancers of the head and neck (HNC). However, current skeletal muscle index values for defining sarcopenia are specific to abdominal musculature. Since abdominal imaging is not regularly performed as part of the HNC workup, implementation of this important prognostic factor into clinical decision making remains challenging. Thus, we sought to establish and validate the use of cervical vertebrae skeletal muscle indexing in determining sarcopenia in HNC patients.*Methods and Materials Cross-sectional skeletal muscle area was measured at the third lumbar (L3) and third cervical (C3) vertebral levels in HNC patients with CT imaging. We performed independent correlative and thresholding analyses in these datasets to validate cervical vertebrae skeletal muscle area as a surrogate of lumbar skeletal muscle area for the detection of sarcopenia. We followed these datasets with a large cohort of HNC patients with only neck imaging available, applied our established cervical vertebrae thresholds, and analyzed survival

outcomes.*Results Correlation analyses demonstrated C3-defined sarcopenia thresholds of 14.0 cm2/m2 (men; p<0.001, r = 0.77) and 11.1 cm2/m2 (women; p<0.001, r = 0.80) as the most accurate predictors of L3-defined sarcopenia (defined by 52.4 cm2/m2 and 38.5 cm2/m2 in men and women, respectively). When applying these determined C3 sarcopenia thresholds in an independent HNC cohort with neck imaging alone (N = 536), we observed a significant survival effect of C3-based sarcopenia in both male (HR = 2.67, 95% CI = 1.72-4.15) and female (HR = 1.71, 95% CI = 1.06-2.78) HNC patients on multivariate analysis.*Conclusions Sarcopenia was recently identified as a strong prognostic factor in patients with HNC. However, identification of this high-risk disease feature is challenging in HNC patients due to the lack of standardized head and neck imaging assessments of skeletal muscle wasting. Herein, we identified sex-specific optimal C3 sarcopenia thresholds for predicting overall survival in this population and validated these results in a large cohort of HNC patients with neck imaging alone.*Clinical Relevance/Application This research establishes and validates the use of neck imaging as a useful tool for the identification of sarcopenia in HNC patients and will provide an additional clinical tool in guiding treatment for these high-risk patients.

RESULTS

Correlation analyses demonstrated C3-defined sarcopenia thresholds of 14.0 cm2/m2 (men; p<0.001, r = 0.77) and 11.1 cm2/m2 (women; p<0.001, r = 0.80) as the most accurate predictors of L3-defined sarcopenia (defined by 52.4 cm2/m2 and 38.5 cm2/m2 in men and women, respectively). When applying these determined C3 sarcopenia thresholds in an independent HNC cohort with neck imaging alone (N = 536), we observed a significant survival effect of C3-based sarcopenia in both male (HR = 2.67, 95% CI = 1.72-4.15) and female (HR = 1.71, 95% CI = 1.06-2.78) HNC patients on multivariate analysis.

CLINICAL RELEVANCE/APPLICATION

This research establishes and validates the use of neck imaging as a useful tool for the identification of sarcopenia in HNC patients and will provide an additional clinical tool in guiding treatment for these high-risk patients.

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Participants

Ivan Rosado-Mendez, PhD, MSc, Madison, Wisconsin (*Moderator*) Support, Siemens AG
Zheng Feng Lu, PhD, Chicago, Illinois (*Moderator*) Nothing to Disclose

Sub-Events

SSPH15-2   Use Of Exposure Indices For Gauging The Potential For Pulmonary Injury During Lung Ultrasound

Participants
Douglas L. Miller, PhD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

Lung ultrasound (LUS) has proven to be an exceptionally powerful and readily accessible tool in Covid19 disease, neonatal care and many other patient conditions. However, LUS safety research has identified a risk of lung injury that presents potential safety issues, and sonographers should consider the use of reduced ultrasound output for for some clinical examinations. This study evaluated the bioeffect of pulmonary capillary hemorrhage (PCH) in a rat model of LUS for different image scan rates and associated values of Mechanical Index (MI) and Thermal Index (TI) displayed on-screen to apprise the operator of ultrasound output.*Methods and Materials A Philips iE33 machine with L15-7io probe was used scan anesthetized rats in a warmed water bath with 9 MHz B mode, having ~160 ns pulse durations and ~16 kHz pulse repetition frequencies, for different frames-per-second (fps) settings of 34, 61 and 118 fps. Images were observed for causation of B lines (comet tail artifacts). After 2 min of exposure at a specific output, lung samples were obtained for assessment of any resulting PCH areas measured on the lung surface.*Results Initiation and growth of B line (comet tail) artifacts were observed in the LUS images as a result of ongoing PCH. PCH was zero for shams with only MI= 0.2 (TI=0) aiming exposure. Significant PCH occurred for MI=0.6 at 34 fps and MI=0.8 at 61 and 118 fps, or TI=0.3 at 34 and 61 fps and TI=0.4 at 118 fps. At similar MI, PCH (n=7) decreased with increasing fps, for example for 34 fps (MI=1.0, TI=0.8) 19.5 mm2 ± 9.9 mm2 sd, compared to 61 fps (MI=1.0, TI=0.5) 9.6 mm2 ± 4.3 mm2 sd (P<0.5) and 118 fps (MI=1.1, TI=0.4) 7.5 mm2 ± 2.4 mm2 sd (P<0.01). In contrast, the PCH for similar TI was not significantly different for 34 fps (TI= 0.5, MI=0.8) (10.7 mm2 ± 10.6 mm2 sd), compared to 61 fps and 118 fps, above.*Conclusions The results illustrate the counter-intuitive trends often seen in LUS PCH research: the PCH might have been anticipated to increase with increasing fps values, owing to the increasing number of images (considered as separate increments of exposure) within 2 min. Interestingly, even though the PCH bioeffect is known not to be thermal in origin, the TI was a more predictive indicator of the LUS impact in this study than the MI. The variation in impact may be associated with the slower scan rates for lower fps. The rarefactional pressure amplitudes followed a Gaussian trend at a point during an image scan with full-width-at-half-maxima of 1.46 ms, 0.87 ms, and 0.39 ms for the 34, 61 and 118 fps settings, for which the TIs were 0.8, 0.5 and 0.4, respectively.*Clinical Relevance/Application The TI may useful for LUS PCH exposure characterization and, in the future, the development of a new temporal average index of ultrasound energy exposure specifically for PCH should be of clinical value.

RESULTS

Initiation and growth of B line (comet tail) artifacts were observed in the LUS images as a result of ongoing PCH. PCH was zero for shams with only MI= 0.2 (TI=0) aiming exposure. Significant PCH occurred for MI=0.6 at 34 fps and MI=0.8 at 61 and 118 fps, or TI=0.3 at 34 and 61 fps and TI=0.4 at 118 fps. At similar MI, PCH (n=7) decreased with increasing fps, for example for 34 fps (MI=1.0, TI=0.8) 19.5 mm2 ± 9.9 mm2 sd, compared to 61 fps (MI=1.0, TI=0.5) 9.6 mm2 ± 4.3 mm2 sd (P<0.5) and 118 fps (MI=1.1, TI=0.4) 7.5 mm2 ± 2.4 mm2 sd (P<0.01). In contrast, the PCH for similar TI was not significantly different for 34 fps (TI= 0.5, MI=0.8) (10.7 mm2 ± 10.6 mm2 sd), compared to 61 fps and 118 fps, above.

CLINICAL RELEVANCE/APPLICATION

The TI may useful for LUS PCH exposure characterization and, in the future, the development of a new temporal average index of ultrasound energy exposure specifically for PCH should be of clinical value.

SSPH15-3   Ultrasound Guided Elastography: An Accurate And Reliable Technique For Liver Elasticity

Participants
Margo Gent, MSc, Groningen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Noninvasive assessment of liver fibrosis is important for determining the treatment and prognosis in patients with chronic liver disease. In a preliminary elastography study, we showed that ultrasound guided elastography (Philips Epic7, ElastPQ) showed equal or better clinical results compared to non-ultrasound guided elastography (Fibroscan) (Dam-Vervloet et al., 2018; Warringa et al., 2021). Now, our aim was to evaluate generalizability of this previous outcome to another ultrasound guided elastography system (Acuson Sequoia, Virtual Touch IQ).*Methods and Materials Phantom elasticity was measured to evaluate the performance of ElastPQ on an Epiq 7 (Philips) and Virtual Touch IQ on two Acuson Sequoia (Siemens) systems. Both applications use the point shear wave elastography technique (pSWE). A 5C1 transducer was used. Measurements were performed on a elastography CIRS-phantom (model 040 GSE (Cablon)) with different reference elasticities: 5.7±2, 13.6±3 and 28.3±5 kPa. All measurements were performed in tenfold and median and interquartile range (IQR) elasticity were computed. Accuracy was analyzed by comparing the

median elasticity ±IQR to the reference elasticity. A Wilcoxon test (alpha=0.01) was performed between the Philips system and both separate Siemens systems to test whether the outcomes were equivalent. Reproducibility of the Siemens systems was considered sufficient if IQR/median<0.30 (specifications Siemens).*Results Accuracy of the Siemens systems was high: all median elasticities ±IQR were within the uncertainty boundaries of the reference elasticity. Measured elasticities of neither Siemens system were significantly different from the Philips system (p=0.05 for Philips v.s. Siemens1 and p=0.83 for Philips v.s. Siemens2). Reproducibility of the systems was high with IQR/median ranging from 0.04 to 0.19 (Philips) and from 0.01 to 0.13 (Siemens, complies with specifications).*Conclusions This study shows similar elasticity measurements of three ultrasound systems that are highly reproducible and in accordance with the reference values, which suggests that ultrasound guided elastography systems is an accurate and reliable technique for liver elasticity measurements.*Clinical Relevance/Application pSWE elastography on Siemens ultrasound systems can be an alternative for existing elastography methods in liver fibrosis evaluation.

RESULTS

Accuracy of the Siemens systems was high: all median elasticities ±IQR were within the uncertainty boundaries of the reference elasticity. Measured elasticities of neither Siemens system were significantly different from the Philips system (p=0.05 for Philips v.s. Siemens1 and p=0.83 for Philips v.s. Siemens2). Reproducibility of the systems was high with IQR/median ranging from 0.04 to 0.19 (Philips) and from 0.01 to 0.13 (Siemens, complies with specifications).

CLINICAL RELEVANCE/APPLICATION

pSWE elastography on Siemens ultrasound systems can be an alternative for existing elastography methods in liver fibrosis evaluation.

SSPH15-5   High Resolution XACT Imaging For Radiotherapy

Participants
Kristina Bjegovic, BS, Irvine, California (*Presenter*) Nothing to Disclose

PURPOSE

X-ray induced Acoustic Computed Tomography (XACT) is a developing imaging modality with the capability to change the standard of care for cancer patients undergoing radiation therapy by introducing real time radiation dosimetry and allowing for image-guided dose and beam path adjustments during irradiation. Due to the energy and pulse width limitations of current clinical linear particle accelerators (LINACs), XACT results in images of low resolution (~5 mm) and low sensitivity. We propose to use a LINAC with higher energy and a pulse width as low as sub-microseconds, compared to a pulse width of 4-5us; XACT imaging can thus be performed at higher resolutions (sub-millimeter) and real time dosimetry for clinical translation can be realized.*Methods and Materials In MATLAB, the relationship between pulse width and signal generation efficiency was explored. Theoretical calculations determined ideal pulse width and target thickness for each transducer used. For the first step, a prototypical LINAC with a pulse width of 2us and a 500kHz transducer were used to acquire promising signals of a lead plate. Further experiments with a 0.2us pulse width and a 5MHz transducer will be used to demonstrate an increase in the resolution and sensitivity. Signal processing was done in MATLAB.*Results The MATLAB simulation depicted that a decrease in pulse width while maintaining delivered dose resulted in higher initial pressure X-ray acoustic waves and signal generation efficacy. This increase in acoustic signal generation efficacy will lead to an improvement in the imaging sensitivity for in vivo dosimetry during radiotherapy. Experimental testing with the sub-microsecond LINAC showed a proportional relationship between the energy of the LINAC and the SNR of the transducer output when imaging a lead plate target with a 500kHz transducer. Using averaging, background noise subtraction, and filtering (Savitsky-Golay, Butterworth), a good SNR was achieved; further tests with a shorter pulse width are expected to show better SNR, experimentally showing the increase in resolution seen in simulation.*Conclusions The resolution of XACT imaging can be increased by shortening the pulse duration of X-Ray delivery, generating higher frequency acoustic signal. Furthermore, the dose sensitivity of XACT for in vivo radiation dosimetry will be improved with the shorter pulsed X-ray beam. By increasing the resolution and sensitivity of XACT imaging, the need for real time dosimetry during radiotherapy can be addressed.*Clinical Relevance/Application Our ultimate goal is to apply X-ray induced Acoustic Computed Tomography (XACT) to in vivo dosimetry during clinical radiation therapy. This application will improve the resolution and sensitivity of XACT for precision radiotherapy.

RESULTS

The MATLAB simulation depicted that a decrease in pulse width while maintaining delivered dose resulted in higher initial pressure X-ray acoustic waves and signal generation efficacy. This increase in acoustic signal generation efficacy will lead to an improvement in the imaging sensitivity for in vivo dosimetry during radiotherapy. Experimental testing with the sub-microsecond LINAC showed a proportional relationship between the energy of the LINAC and the SNR of the transducer output when imaging a lead plate target with a 500kHz transducer. Using averaging, background noise subtraction, and filtering (Savitsky-Golay, Butterworth), a good SNR was achieved; further tests with a shorter pulse width are expected to show better SNR, experimentally showing the increase in resolution seen in simulation.

CLINICAL RELEVANCE/APPLICATION

Our ultimate goal is to apply X-ray induced Acoustic Computed Tomography (XACT) to in vivo dosimetry during clinical radiation therapy. This application will improve the resolution and sensitivity of XACT for precision radiotherapy.

SSPH15-6   Real-time Intrafraction Prostate Motion During Dose-escalated Linac-based SBRT

Participants
Denis Panizza, Monza, Italy (*Presenter*) Nothing to Disclose

PURPOSE

An electromagnetic (EM) transmitter-based tracking device for prostate and urethra localization and monitoring during prostate cancer SBRT was implemented. The aim of this study was to evaluate the intra-fraction prostate motion in the very first clinical use worldwide.*Methods and Materials Ten patients with organ-confined prostate cancer underwent dose-escalated SBRT in 4 or 5 fractions (BED1.5=279Gy and 253Gy, respectively), using Volumetric Modulated Arc Therapy (VMAT) techniques with flattening filter free (FFF) beams on VersaHD linac. The EM tracking device consisted in an integrated Foley catheter with a transmitter in a dedicated lumen. Signals sent by the transmitter were detected by antennas in a specific receiver placed on the linac couch. The system was calibrated to the treatment room isocenter and it allowed treatment localization in addition to motion tracking. Starting from the daily CBCT and during the delivery, the prostate motion was tracked with the EM system and SBRT was interrupted when a 2-mm threshold was trespassed and corrected by a new CBCT, unless the offset was transient. Real-time measurement of prostate displacement was recorded for each treatment fraction. These measurements were used to determine the duration and

magnitude of displacement along the three directional axes.*Results Total treatment time lasted on average 9.3 minutes [range 6-14], 5.8 minutes [range 3-9] for setup and 3.5 minutes [range 2-5] for beam delivery. In 41% of the monitored fractions, a new CBCT was mandated. The CBCT was repeated during the initial setup phase in 10 out of 44 fractions, while the beam delivery was interrupted only in 8. The transmitter shifts along x, y, and z axes for every treated patient during each phase of setup and beam delivery are reported in table 1. The majority of intra-fractional motion measured by the system occurred in the anteroposterior direction. The mean value of the target average deviation was -0.3 mm, -0.2 mm, and 0.0 mm in vertical, lateral, and longitudinal direction, respectively. The prostate was found within 1 mm from its initial position in 83.9% of the treatment time, between 1 and 2 mm in 13.0%, and exceeds 2 mm only in 3.1%.*Conclusions Our findings show that EM tracking is a reliable technique for real-time non-ionizing prostate monitoring during dose-escalated SBRT, allowing to keep the average target motion within 2 mm. Using FFF VMAT beams shortened the treatment time and significantly contributed to reduce intra-fractional motion.*Clinical Relevance/Application Linac-based SBRT by means of VMAT-FFF technique coupled with daily image guidance including real-time EM tracking allowed dose-escalated treatment with negligible early side effects.

RESULTS

Total treatment time lasted on average 9.3 minutes [range 6-14], 5.8 minutes [range 3-9] for setup and 3.5 minutes [range 2-5] for beam delivery. In 41% of the monitored fractions, a new CBCT was mandated. The CBCT was repeated during the initial setup phase in 10 out of 44 fractions, while the beam delivery was interrupted only in 8. The transmitter shifts along x, y, and z axes for every treated patient during each phase of setup and beam delivery are reported in table 1. The majority of intra-fractional motion measured by the system occurred in the anteroposterior direction. The mean value of the target average deviation was -0.3 mm, -0.2 mm, and 0.0 mm in vertical, lateral, and longitudinal direction, respectively. The prostate was found within 1 mm from its initial position in 83.9% of the treatment time, between 1 and 2 mm in 13.0%, and exceeds 2 mm only in 3.1%.

CLINICAL RELEVANCE/APPLICATION

Linac-based SBRT by means of VMAT-FFF technique coupled with daily image guidance including real-time EM tracking allowed dose-escalated treatment with negligible early side effects.

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Participants
Rupa Radhakrishnan, MS,MBBS, Indianapolis, Indiana (*Moderator*) Nothing to Disclose

Sub-Events

SSNR02-1   Profiles Of Resting State Functional Connectivity In Temporal Lobe Epilepsy Associated With Post-Laser Interstitial Thermal Therapy Seizure Outcomes

Participants
Mashaal Syed, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

This work seeks to evaluate whether patients with Temporal Lobe Epilepsy (TLE) with Mesial Temporal Sclerosis (MTS) who underwent Laser Interstitial Thermal Therapy (LiTT) display unique functional connectivity patterns; specifically in regards to those who experienced post-operative seizure freedom (SF) and those who did not experience post-operative seizure freedom (nSF) as determined by a 12 month follow up.*Methods and Materials The resting state functional MRIs of 17 controls (NC) (aged 21 - 35 years), 16 left-sided TLE-MTS SF (aged 31 - 66 years), and 16 left-sided TLE-MTS nSF (aged 23 - 69 years) were compared to determine the unique functional connectivity patterns with respect to seizure outcomes. This regions of interest (ROI)-to-ROI connectivity analysis encompassed a total of 171 ROIs, and accounted for age and duration of epileptic activity. Significant correlations were determined via two-sample t-tests and bonferroni correction with an alpha value of 0.05.*Results Comparing NC with the SF group depicted significant correlation between the contralateral (CL) superior frontal gyrus and the ipsilateral (IL) cerebellar hemisphere, lobule IX (p-value= 1.14e-4, mean z-score = -0.11 (SD 0.21), T = 4.46). Comparison of NC with the nSF group revealed significant correlation between the CL amgydala and the CL precuneus (p-value = 1.1e-5, mean z-score = -0.11 (SD 0.19), T= 5.29), as well as between the CL locus coreuleus and the CL anterior pulvinar (p-value = 5.7e-5, mean z-score = 0.09 (SD 0.17), T = -4.71). Between the SF and nSF groups, significant correlation was observed between the CL amgydala and the CL precuneus (p-value= 2.9e-5, mean z-score = -0.12 (SD 0.19), T = 4.98), as well as between the CL locus coreuleus and the IL intralaminar nucleus (p-value= 1.37e-4, mean z-score = 0.06 (SD 0.17), T = -4.41).*Conclusions Disruption in widespread network function - such as within the cerebellar, limbic, and thalamo-arousal networks - is more observed in nSF, as they exhibit bilateral alterations; in contrast, solely unilateral changes were observed in SF. Overall, with respect to post-surgical outcomes, we have demonstrated hyperactivity in the thalamo-arousal network of nSF in comparison to SF and NC.*Clinical Relevance/Application These very different activity patterns associated with post-operative outcomes may help explain why TLE often disrupts widespread network function, and thus, may provide insights to guide future treatment modalities.

RESULTS

Comparing NC with the SF group depicted significant correlation between the contralateral (CL) superior frontal gyrus and the ipsilateral (IL) cerebellar hemisphere, lobule IX (p-value= 1.14e-4, mean z-score = -0.11 (SD 0.21), T = 4.46). Comparison of NC with the nSF group revealed significant correlation between the CL amgydala and the CL precuneus (p-value = 1.1e-5, mean z-score = -0.11 (SD 0.19), T= 5.29), as well as between the CL locus coreuleus and the CL anterior pulvinar (p-value = 5.7e-5, mean z-score = 0.09 (SD 0.17), T = -4.71). Between the SF and nSF groups, significant correlation was observed between the CL amgydala and the CL precuneus (p-value= 2.9e-5, mean z-score = -0.12 (SD 0.19), T = 4.98), as well as between the CL locus coreuleus and the IL intralaminar nucleus (p-value= 1.37e-4, mean z-score = 0.06 (SD 0.17), T = -4.41).

CLINICAL RELEVANCE/APPLICATION

These very different activity patterns associated with post-operative outcomes may help explain why TLE often disrupts widespread network function, and thus, may provide insights to guide future treatment modalities.

SSNR02-2   Interaction Of The Salience Network, Ventral Attention Network, Dorsal Attention Network And Default Mode Network In Neonates And Early Development Of The Bottom-up Attention System

Participants
Valeria Onofri, Rome, Italy (*Presenter*) Nothing to Disclose

PURPOSE

The Salience Network (SN), Ventral Attention Network (VAN), Dorsal Attention Network (DAN) and Default Mode Network (DMN) have shown significant interactions and overlapping functions in bottom-up and top-down mechanisms of attention. In the present study we tested if the SN, VAN, DAN and DMN connectivity can infer the gestational age (GA) at birth. We also ascertained whether the connectivity of SN, VAN, DAN and DMN are able to infer the average functional connectivity of each other network.*Methods and Materials A total of 88 healthy neonates with a gestational age (GA) at birth from 28 weeks to 40 weeks were studied with resting state fMRI on a 3T scanner. The ability to infer GA at birth or another network's connectivity was evaluated using a multi-variate data-driven framework. A mediation analysis was also performed to determine whether the cross-validated inference on GA at birth using VAN acted as a mediator on the cross-validated inference on GA at birth using DMN and DAN.*Results The VAN, DAN and the DMN infer the GA at birth (p<0.05). The SN connectivity was found unable to infer the GA at birth (p>0.05). The SN, DMN and VAN were able to infer the average connectivity over the other networks (p<0.05). Mediation

analysis between VAN's and DAN's inference on GA found reciprocal transmittance of change of VAN's and DAN's connectivity (p<0.05).*Conclusions Our findings suggest that the VAN has a prominent role in the bottom-up salience detection in early infancy and that the VAN and the SN may overlap in their roles of bottom-up control of attention.The SN was the only network in our analysis unable to infer the gestational age at birth. This finding may indicate that the stage of maturation of the SN at birth might be too advanced to infer the GA.*Clinical Relevance/Application This is the first study performed with a on a cohort oh neonates with a multi-variate data-driven framework (i.e. Machine Learning framework) to suggest a prominent role of the VAN in the bottom-up salience detection in early infancy and that the VAN and the SN may overlap in their roles of bottom-up control of attention. We also found reciprocal influence of VAN and DAN on the development of each other network.

RESULTS

The VAN, DAN and the DMN infer the GA at birth (p<0.05). The SN connectivity was found unable to infer the GA at birth (p>0.05). The SN, DMN and VAN were able to infer the average connectivity over the other networks (p<0.05). Mediation analysis between VAN's and DAN's inference on GA found reciprocal transmittance of change of VAN's and DAN's connectivity (p<0.05).

CLINICAL RELEVANCE/APPLICATION

This is the first study performed with a on a cohort oh neonates with a multi-variate data-driven framework (i.e. Machine Learning framework) to suggest a prominent role of the VAN in the bottom-up salience detection in early infancy and that the VAN and the SN may overlap in their roles of bottom-up control of attention. We also found reciprocal influence of VAN and DAN on the development of each other network.

SSNR02-3 Diffusion Microstructure Imaging In Progressive Supranuclear Palsy: Reduced Axonal Volumes In The Superior Cerebellar Peduncles, Dentato-rubro-thalamic Tract, Ventromedial Thalami And Fronto-mesial White Matter

Participants
Alexander Rau, MD, Freiburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The differentiation between Parkinson´s disease (PD) and atypical Parkinson syndromes such as progressive supranuclear palsy (PSP), multiple system atrophy (MSA) and corticobasal degeneration is challenging in clinical practice. We evaluated whether diffusion microstructure imaging (DMI; calculation of diffusivities and volume fractions of intra- and extra-axonal and csf-compartments based on multishell-DWI) enables the identification of PSP patients within a cohort of suspected atypical parkinsonism.*Methods and Materials In a retrospective study, DMI parameters were analyzed in patients with clinically suspected atypical parkinsonism syndromes and healthy controls (HC). Between 2018 and 2020, an exploration cohort was used to identify Voxel- and Region-based differences and to calculate cut-off values in a receiver operating characteristic analysis. Afterwards, the accuracy was tested on a single subject level.*Results In the exploration cohort, 52 PSP patients were compared to 20 PD, 26 MSA, and 7 corticobasal syndrome patients, as well as 25 HC. PSP patients showed widespread intraaxonal volume loss in the superior cerebellar peduncles, the dentato-rubro-thalamic tracts, the ventromedial thalami and the frontal white matter (each p<0.001). Especially the ventromedial thalami showed a high area under the curve of 0.899 between PSP and others. The validation cohort (n=25) consisted of 12 PSP patients, eight with PD, four with MSA, while one patient had no final diagnosis of parkinsonism. The accuracy of the DMI approach in identifying PSP patients was confirmed in the thalamus and the frontal white matter (accuracy 0.96 each).*Conclusions DMI reveals a characteristic regional pattern of axonal degeneration in PSP patients. This fits well with published regions of specific changes in PSP in terms of atrophy and alterations in diffusion weighted imaging.*Clinical Relevance/Application DMI might be used to identify PSP patients on an individual level in a collective with suspected atypical Parkinson syndromes.

RESULTS

In the exploration cohort, 52 PSP patients were compared to 20 PD, 26 MSA, and 7 corticobasal syndrome patients, as well as 25 HC. PSP patients showed widespread intraaxonal volume loss in the superior cerebellar peduncles, the dentato-rubro-thalamic tracts, the ventromedial thalami and the frontal white matter (each p<0.001). Especially the ventromedial thalami showed a high area under the curve of 0.899 between PSP and others. The validation cohort (n=25) consisted of 12 PSP patients, eight with PD, four with MSA, while one patient had no final diagnosis of parkinsonism. The accuracy of the DMI approach in identifying PSP patients was confirmed in the thalamus and the frontal white matter (accuracy 0.96 each).

CLINICAL RELEVANCE/APPLICATION

DMI might be used to identify PSP patients on an individual level in a collective with suspected atypical Parkinson syndromes.

SSNR02-4 Role Of Shear Wave Elastography In Assessment Of Hypoxic Ischemic Injury (HII) In Preterm Neonates

Participants
Anjuna Reghunath, MD,MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the utility of ultrasound shear wave elastography (SWE) in determining the difference in brain stiffness in preterm neonates who had a history of asphyxia at birth as compared to preterm neonates who cried at birth (no history of asphyxia).*Methods and Materials A pilot study using shear wave elastography of the neonatal brain was performed in 40 preterm neonates (range of gestational age 28-37 weeks), of which 20 had clinically diagnosed hypoxic ischemic injury (HII), while the remaining 20 had no history of asphyxia. Stiffness was measured as Young's modulus (KPa) at 4 points: right and left ganglio-capsulo-thalamic region (deep gray nuclei) and the right and left periventricular parieto-occipital white matter (POWM). Mean and standard deviation was calculated at each of the 4 points for cases and controls respectively.*Results Mean (KPa) with standard deviation at each of the 4 points was as follows in the preliminary evaluation of data in the study: right deep gray nuclei (4.4295 ±2.36), left deep gray nuclei (4.65 ±2.42), right POWM (4.9865 ±3.3), and left POWM (5.272 ±2.7) for preterm neonates with asphyxia. Mean with standard deviation for preterm neonates without asphyxia was: right deep gray nuclei (4.7455±2.12), left deep gray nuclei (4.7305±2.26), right POWM (5.9045±2.23), and left POWM (6.0205±2.34).*Conclusions The stiffness in bilateral periventricular white matter as well as in deep gray nuclei was found to be slightly lower in preterm neonates with a clinical history of birth asphyxia as compared to preterm neonates without similar history, suggesting that the areas with brain injury are softer.*Clinical Relevance/Application Cranial ultrasound is commonly used to evaluate the neonatal brain in HII. However, it may be

limited by its lack of sensitivity and specificity. SWE might provide additional information to conventional gray-scale imaging and improve its specificity.

RESULTS

Mean (KPa) with standard deviation at each of the 4 points was as follows in the preliminary evaluation of data in the study: right deep gray nuclei (4.4295 ±2.36), left deep gray nuclei (4.65 ±2.42), right POWM (4.9865 ±3.3), and left POWM (5.272 ±2.7) for preterm neonates with asphyxia. Mean with standard deviation for preterm neonates without asphyxia was: right deep gray nuclei (4.7455±2.12), left deep gray nuclei (4.7305±2.26), right POWM (5.9045±2.23), and left POWM (6.0205±2.34).

CLINICAL RELEVANCE/APPLICATION

Cranial ultrasound is commonly used to evaluate the neonatal brain in HII. However, it may be limited by its lack of sensitivity and specificity. SWE might provide additional information to conventional gray-scale imaging and improve its specificity.

SSNR02-5 High-resolution MR Microscopy Of Hippocampus WITH SUBFIELD MAPPING In Patients With Mesial Temporal Sclerosis And Temporal Lobe Epilepsy For Prediction Of Post Operative Outcomes - A Multiparametric In-vivo And Histopathological Correlation Study

Participants
Rammohan Vadapalli, MD, Hyderabad, India (*Presenter*) Research Consultant, General Electric Company

PURPOSE

To correlate the Findings of in vivo MR microscopy of hippocampi and their subfields to Histopathology in patients with hippocampal sclerosis and its Surgical outcomes. *Methods and MaterialsStudy design: Prospective observational cohort study12 age and sex-matched normal controls and 125 patients with refractory temporal lobe epilepsy with definitive exclusion and inclusion criteria with IRB approval were Imaged on High field 3T MR system (Ingenia Philips Health care, Netherlands) using MR Microscopy sequences with a sub-mm resolution with 3D T1 .T2, FLAIR and Dual inversion recovery sequences. Hippocampal Subfield Mapping performed using ITK snap manual segmentation method and correlated with Histopathology and post-surgical outcomes*Results The present study results indicate a high correlation between MR microscopy and pathology to detect the abnormalities in the various segments of the Hippocampus and the temporal lobe. The sensitivities and specificities for HS detection, lateralization, and dual pathologies appear optimal with a strong correlation between MRI subfield mapping and Histopathology.*Conclusions The Pre surgical evaluation of HS using High-resolution Microscopy and subfield mapping of the Hippocampus enables the visualization of its internal architecture, region-specific epileptogenic substrates with the prediction of surgical outcomes.*Clinical Relevance/Application Clinical dilemmas and challenges exist in managing drug-resistant temporal lobe epilepsies due to the most common principal epileptogenic substrate, "Hippocampal sclerosis with sub-optimal long-term outcome of surgery despite the best surgical resection. This was the primary motivation for this study. histopathology.This study will impact the present TLE protocols for evidence-based Prognostic classification of patients with TLE and HS and has a future potential to bridge the gaps in the management of TLE -by offering preoperative intelligent predictive outcome analysis to improve patient selection for surgery by in Vivo Imaging -Increase the Sensitivity and specificity of HS detection and accurate lateralization even in the absence of atrophy or volume loss including MR negative occult coexisting dual pathologies in mesial temporal lobe structures (uncus, amygdala, parahippocampal gyrus)

RESULTS

The present study results indicate a high correlation between MR microscopy and pathology to detect the abnormalities in the various segments of the Hippocampus and the temporal lobe. The sensitivities and specificities for HS detection, lateralization, and dual pathologies appear optimal with a strong correlation between MRI subfield mapping and Histopathology.

CLINICAL RELEVANCE/APPLICATION

Clinical dilemmas and challenges exist in managing drug-resistant temporal lobe epilepsies due to the most common principal epileptogenic substrate, "Hippocampal sclerosis with sub-optimal long-term outcome of surgery despite the best surgical resection. This was the primary motivation for this study. histopathology.This study will impact the present TLE protocols for evidence-based Prognostic classification of patients with TLE and HS and has a future potential to bridge the gaps in the management of TLE -by offering preoperative intelligent predictive outcome analysis to improve patient selection for surgery by in Vivo Imaging -Increase the Sensitivity and specificity of HS detection and accurate lateralization even in the absence of atrophy or volume loss including MR negative occult coexisting dual pathologies in mesial temporal lobe structures (uncus, amygdala, parahippocampal gyrus)

SSNR02-6 Age-related Changes Of White Matter (WM) Microstructure In Autism Spectrum Disorder (ASD)

Participants
Clara Weber, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Previous studies of WM microstructure in children with ASD were limited by relatively small cohort size. We analyzed diffusion metrics of WM microstructure in 583 subjects from four different cohorts in the National Database of Autism Research.*Methods and Materials All imaging and clinical data of study cohorts with T1-weighted and diffusion tensor imaging (DTI) scans were retrieved. Using FSL, we generated Fractional Anisotropy (FA), Mean Diffusivity (MD), and Radial Diffusivity (RD) maps. Tract-based spatial statistics and a voxel-wise analysis were performed to compare ASD and typically developing individuals; using general linear models, we assessed the influences of age and ASD diagnosis. We also analyzed cortical thickness using voxel-based morphometry (VBM). Age is reported as median (interquartile) months.*Results Subjects from 4 study cohorts were included: (1) Infants ("A Longitudinal MRI Study of Infants at Risk for Autism"; age: 7(1) m, 34/121 ASD/control, 12% female); (2) toddlers ("Biomarkers of Autism at 12 months"; age: 33(12) m, 57/45 ASD/control, 16% female); (3) adolescents ("Multimodal Developmental Neurogenetics of Females with ASD" age: 158(51.5) m, 106/124 ASD/control, 48% female); and (4) young adults ("Atypical Late Neurodevelopment in Autism" age: 242(128.5) m, 67/29 ASD/control, 1.5% female). We find a pervasive age-related increase in FA across majority of WM tracts in all age-groups. In voxel-wise analysis, we find reduced FA among ASD subjects compared to controls within anterior/middle commissural tracts of corpus callosum only in adolescents (p=0.014) and young adults (p=0.007), but not infants (p=0.451) and toddlers (p=0.440). Corresponding increases in ASD-related MD and RD were found in young adults (p=0.003). Tract-based analysis also showed reduced ASD-related FA in the corpus callosum, after adjusting for age as covariate, among adolescents (p=0.026) and young adults (p=0.012), but not younger children (infants: p=0.316, toddlers: p= 0.861). In tract-based analysis, RD was increased in the corpus callosum of young adults after controlling for age (p=0.023). In VBM analysis, we found age-related decrease in cortical thickness of young adults, but without any significant differences related to ASD.*Conclusions In a large dataset with an age range of 1 to 50 years, we showed an age-related impairment of microstructural

integrity in anterior/middle corpus callosum commissural tracts among ASD patients compared to controls, starting in adolescence, and becoming more pronounced among young adults.*Clinical Relevance/Application Age-adjusted microstructural correlates of ASD can improve diagnostic algorithms and provide potential objective biomarkers to monitor treatment response.

RESULTS

Subjects from 4 study cohorts were included: (1) Infants ("A Longitudinal MRI Study of Infants at Risk for Autism"; age: 7(1) m, 34/121 ASD/control, 12% female); (2) toddlers ("Biomarkers of Autism at 12 months"; age: 33(12) m, 57/45 ASD/control, 16% female); (3) adolescents ("Multimodal Developmental Neurogenetics of Females with ASD" age: 158(51.5) m, 106/124 ASD/control, 48% female); and (4) young adults ("Atypical Late Neurodevelopment in Autism" age: 242(128.5) m, 67/29 ASD/control, 1.5% female). We find a pervasive age-related increase in FA across majority of WM tracts in all age-groups. In voxel-wise analysis, we find reduced FA among ASD subjects compared to controls within anterior/middle commissural tracts of corpus callosum only in adolescents (p=0.014) and young adults (p=0.007), but not infants (p=0.451) and toddlers (p=0.440). Corresponding increases in ASD-related MD and RD were found in young adults (p=0.003). Tract-based analysis also showed reduced ASD-related FA in the corpus callosum, after adjusting for age as covariate, among adolescents (p=0.026) and young adults (p=0.012), but not younger children (infants: p=0.316, toddlers: p= 0.861). In tract-based analysis, RD was increased in the corpus callosum of young adults after controlling for age (p=0.023). In VBM analysis, we found age-related decrease in cortical thickness of young adults, but without any significant differences related to ASD.

CLINICAL RELEVANCE/APPLICATION

Age-adjusted microstructural correlates of ASD can improve diagnostic algorithms and provide potential objective biomarkers to monitor treatment response.

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Participants

Judy Gichoya, MBChB,MS, Atlanta, Georgia (*Moderator*) Consultant, Cook Group Incorporated;Advisor, Boston Scientific Corporation

Morgan McBee, MD, Charleston, South Carolina (*Moderator*) Nothing to Disclose

Sub-Events

SSIN06-1 Detection Of Racial/Ethnic Health Disparities In COVID-19 Patients Using A Deep Learning Chest Radiography Classifier

Participants

Ayis T. Pyrros, MD, Hinsdale, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

To detect health disparities among patients with coronavirus disease 2019 (COVID-19) by using a multitask neural network deep learning (DL) model, predicting comorbidities from frontal chest radiographs (CXRs) and associate them to self-reported race/ethnicity, relative to electronic health records (EHR).*Methods and Materials A multitask DL model was trained and tested on 14,121 ambulatory frontal CXRs from 2010 to 2019 at a single institution, modeling select comorbidities using the Medicare Advantage Hierarchical Condition Category (HCC) Risk Adjustment Model from electronic health records (EHRs) with PyTorch (version 1.7.1). Sex, age, and select HCC codes were then predicted on CXRs from ambulatory patients with COVID-19 (3/17/2020 to 10/24/2020) with CXRs dating back to 2018. The discriminatory ability of the DL model was assessed using area under receiver operating characteristic curve (AUC) compared to the HCC data from the EHR. Binominal logistical regression was then used to evaluate the relationship between the DL model predictions as independent variables and non-white/white as the dependent variable in R (version 4.0.3). CXR saliency maps and odds ratio plots were generated.*Results Among the 986 patients included, mean age was 50.3 years (median = 52, range = 15-97, IQR = 38); 656 were White (66%), 70 were Asian (7%), 130 were Hispanic (13%), 75 were African American (8%), and 55 were other or unknown (6%). AUC results with 95% confidence intervals for the DL model relative to EHR data were: diabetes with chronic complications 0.80 (0.76-0.85), morbid obesity 0.91 (0.88-0.94), congestive heart failure 0.88 (0.83-0.93), cardiac arrhythmias 0.81 (0.75-0.88), vascular disease 0.87 (0.84-0.90), chronic obstructive pulmonary disease 0.86 (0.80-0.91), and sex 0.99 (0.99-0.99). AUC for the DL comorbidity model in the prediction of self-reported race was 0.65 (0.62-0.69) versus the EHR 0.61 (0.55-0.62). DL predictions for COPD (OR = 0.01) and cardiac arrhythmias (OR= 0.004) were significant predictors for non-white race/ethnicity (P<.05), whereas for the EHR model only age (OR=0.01) was significantly associated.*Conclusions A multitask DL algorithm, using only frontal CXRs, was predictive of select comorbidities, and the comorbidity scores when modeled with logistic regression, were predictive of self-reported race/ethnicity with significant differences from the EHR.*Clinical Relevance/Application Unequal burden of comorbidities is a primary contributor to health disparities. Radiographic DL modeling can predict relevant comorbidities among COVID-19 patients, identifying those with health disparities who may benefit from mitigation.

RESULTS

Among the 986 patients included, mean age was 50.3 years (median = 52, range = 15-97, IQR = 38); 656 were White (66%), 70 were Asian (7%), 130 were Hispanic (13%), 75 were African American (8%), and 55 were other or unknown (6%). AUC results with 95% confidence intervals for the DL model relative to EHR data were: diabetes with chronic complications 0.80 (0.76-0.85), morbid obesity 0.91 (0.88-0.94), congestive heart failure 0.88 (0.83-0.93), cardiac arrhythmias 0.81 (0.75-0.88), vascular disease 0.87 (0.84-0.90), chronic obstructive pulmonary disease 0.86 (0.80-0.91), and sex 0.99 (0.99-0.99). AUC for the DL comorbidity model in the prediction of self-reported race was 0.65 (0.62-0.69) versus the EHR 0.61 (0.55-0.62). DL predictions for COPD (OR = 0.01) and cardiac arrhythmias (OR= 0.004) were significant predictors for non-white race/ethnicity (P<.05), whereas for the EHR model only age (OR=0.01) was significantly associated.

CLINICAL RELEVANCE/APPLICATION

Unequal burden of comorbidities is a primary contributor to health disparities. Radiographic DL modeling can predict relevant comorbidities among COVID-19 patients, identifying those with health disparities who may benefit from mitigation.

SSIN06-2 Deep Learning-based Natural Language Processing In Automating Imaging Protocol Selection

Participants

Jonathan Chung, MD, Chicago, Illinois (*Presenter*) Speaker, Veracyte, Inc;Consultant, Veracyte, Inc;Consultant, Boehringer Ingelheim GmbH;Speaker, Boehringer Ingelheim GmbH;Consultant, F. Hoffmann-La Roche Ltd;Speaker, F. Hoffmann-La Roche Ltd

PURPOSE

Mitigating the time-consuming protocol selection process by training state of the art deep learning-based natural language processing (NLP) systems. The proposed system is aimed to take as input free-form (unstructured) "Reason of Study" (RS) and/or "Study Description" (SD) texts posed by the examination orders and predict the protocol labels (PL) and/or body part labels (BL) as its output.*Methods and Materials The NLP-based protopcol selection models were developed using about 250,000 clinical orders along with corresponding protocol labels (PL) and body part labels (BL). Four state state of the art transformer-based deep learning systems, BERT-base, BioClinical BERT, DistilBERT, and RoBERTa, were fine-tuned with multi-label (linear/MLP) classifier at the

output. Each proposed system were trained and evaluated on a separate test set for the following cases of (input->output) pairs: Case1 (RS->PL), Case2 (RS->PL+BL), Case3 (RS+SD->PL), and Case4 (RS+SD->PL+BL). The number of unique protocol labels were 100 and the number of body parts were 12. Macro average F1 scores were calculated for each system and and each case scenario over the test of 50,000 reports.*Results Out of the four systems developed, the BERT-base yielded the best beformance. By fine-tuning and optimizing the hyperparameters of the learning the macro average F1 scores improved from 0.39, 0.27, 0.75, and 0.57 to of 0.45, 0.39, 0.79, and 0.66 for cases 1, 2, 3 and 4 respectively. And testing accuracy with inclusion of additional features went up from 0.75 to 0.93.*Conclusions The proposed system yields a protocol label prediction as well as a confidence score for this prediction, which in turn can be used by radiologists to amend their own or NLP-based system's protocol label proposals. Since significant increase in performance was seen when incorporating additional feature, we are in the process of adding lab values, allergies, renal function, and problem list data into our feature set and provide additional results.*Clinical Relevance/Application An NLP based automated protocoling algorithm could lead to substantial time savings for radiologist and cost savings to the hospital. This would allow centers to then allocate more resources to other tasks and clinical missions including direct patient care, education, and research.

RESULTS

Out of the four systems developed, the BERT-base yielded the best beformance. By fine-tuning and optimizing the hyperparameters of the learning the macro average F1 scores improved from 0.39, 0.27, 0.75, and 0.57 to of 0.45, 0.39, 0.79, and 0.66 for cases 1, 2, 3 and 4 respectively. And testing accuracy with inclusion of additional features went up from 0.75 to 0.93.

CLINICAL RELEVANCE/APPLICATION

An NLP based automated protocoling algorithm could lead to substantial time savings for radiologist and cost savings to the hospital. This would allow centers to then allocate more resources to other tasks and clinical missions including direct patient care, education, and research.

SSIN06-3   Visual Chest CT Score versus Artificial Intelligence For The Assessment Of COVID-19 Pneumonia Extension

Participants
Ignacio Soriano, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility and reliability of a visual semi-quantitative CT score for the assessment of disease burden in COVID-19 pneumonia compared to an automatic lung evaluation system.*Methods and Materials This retrospective study included 199 consecutive patients with COVID-19 pneumonia undergoing non-contrast chest CT, from 10th of March to 31st of July 2020. A chest radiologist with 16 years of experience calculated the CT extension score by visually estimating the degree of disease burden in each pulmonary lobe (from 0-4; 0=0%, 1 = 1-25%, 2 = 26-50%, 3 = 51-75% and 4>75%). The total CT score was obtained by summing the score of each lobe (from 0 to 20). Chest CT images were also analyzed by an automatic lung evaluation system (AI-Rad Companion Research CT Pneumonia Analysis v2.0; Siemens Healthineers), which automatically identifies the volume and percentage of the hyperdense pulmonary areas (both opacities and consolidations) corresponding to pneumonia. Degree of correlation between the visual score and the automatic detection system was assessed by the Spearman rank correlation coefficient.*Results A strong and statistically significant correlation was found between the total visual score given by the thoracic radiologist and the total percentage of lung opacities given by the AI (Rho = 0.817; p<0.001). Similar results were found for degree of involvement in each lobe (Rho RUL = 0.818; Rho RML = 0.774; Rho RLL = 0.796; Rho LUL = 0.803; Rho LLL = 0.804; p<0.001).*Conclusions The visual semi-quantitative score is an easy and widely available tool which provides a feasible and reliable assessment of the extension of COVID-19 pneumonia. The automatic lung evaluation system provides a more detailed analysis with accurate determination of the volume and percentage of lung involvement.*Clinical Relevance/Application Visual semi-quantitative chest CT score provides a prompt and objective degree of lung burden in patients with COVID-19 pneumonia, which could be of great value for its diagnosis and prognosis.

RESULTS

A strong and statistically significant correlation was found between the total visual score given by the thoracic radiologist and the total percentage of lung opacities given by the AI (Rho = 0.817; p<0.001). Similar results were found for degree of involvement in each lobe (Rho RUL = 0.818; Rho RML = 0.774; Rho RLL = 0.796; Rho LUL = 0.803; Rho LLL = 0.804; p<0.001).

CLINICAL RELEVANCE/APPLICATION

Visual semi-quantitative chest CT score provides a prompt and objective degree of lung burden in patients with COVID-19 pneumonia, which could be of great value for its diagnosis and prognosis.

SSIN06-6   Partially Automating The Workflow To Decrease Cherry Picking In An Academic Radiology Department

Participants
Andrew Sher, MD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

An auto-assignment tool was deployed in our academic neuroradiology section to address their concern of uneven workloads which was primary attributed to cherry picking, but also decreased contribution by some. Using the partially automated workflow, non-stat MR and CT's were auto-assigned to individual radiologists 7a-5p weekdays, at 3 minute intervals. Stat studies remained unassigned, with the intent that higher capacity readers could preferentially interpret in a timely manner. Metrics to evaluate success were radiologists' compliance in interpreting assigned studies (a surrogate for improvement in cherry-picking) and change in workload variability using auto assignment. Error rates in peer learning and TATs for stat and non-stat were also compared before and following change to the new workflow.*Methods and Materials Study was HIPAA compliant and exempt from IRB approval. Data was retrieved from the radiology analytics platform, scheduling software, and peer learning database. Metrics (mean of assigned studies interpreted per radiologist, average wRVU/hr/radiologist, wRVU variability between radiologists, TAT's of stat and non-stat exams, and frequency of errors) were compared over 3 month time periods Jan-March 2020 and Jan-March 2021 (after changing to new workflow Dec 1, 2020), 7a-5p weekdays. Levene's and Fisher's exact tests were used for analysis.*Results Pre-intervention, there were 3430 exams, 650 stat (mean TAT 83 min) and 2780 non-stat (mean TAT 142 min) compared to 3536 in the post-intervention period (2021), 629 stat (mean TAT 59 min), and 2907 non-stat (mean TAT 144 min), with a significant decrease in stat TAT (p<0.0001), and no change in non-stat (p=0.61). Of assigned studies, 2535/2772 (91%) were read by the assigned

radiologist (range 48%-99%, mean 90%, median 96%). Using the new workflow, range of average hourly wRVU/radiologist decreased by 17.8% wRVU and standard deviation by 26.2%. There was no statistically significant difference in rates of errors submitted to the peer learning database with 9 errors/511 submissions (1.76%) before and 11/575 (1.91%) after (p=1).*Conclusions Using an auto-assignment workflow for non-stat daytime studies successfully addressed cherry picking and improved variability in productivity. Furthermore, TATs for stat studies was improved. Finally, the auto-assignment was not shown to effect error rates.*Clinical Relevance/Application By combining an auto-assignment managed workflow for non-stat studies and self-triage for stat exams, groups may be able to better meet demand by allowing the higher capacity readers to complete stat exams in a timely manner, while also decreasing cherry picking.

RESULTS

Pre-intervention, there were 3430 exams, 650 stat (mean TAT 83 min) and 2780 non-stat (mean TAT 142 min) compared to 3536 in the post-intervention period (2021), 629 stat (mean TAT 59 min), and 2907 non-stat (mean TAT 144 min), with a significant decrease in stat TAT (p<0.0001), and no change in non-stat (p=0.61). Of assigned studies, 2535/2772 (91%) were read by the assigned radiologist (range 48%-99%, mean 90%, median 96%). Using the new workflow, range of average hourly wRVU/radiologist decreased by 17.8% wRVU and standard deviation by 26.2%. There was no statistically significant difference in rates of errors submitted to the peer learning database with 9 errors/511 submissions (1.76%) before and 11/575 (1.91%) after (p=1).

CLINICAL RELEVANCE/APPLICATION

By combining an auto-assignment managed workflow for non-stat studies and self-triage for stat exams, groups may be able to better meet demand by allowing the higher capacity readers to complete stat exams in a timely manner, while also decreasing cherry picking.

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Participants
Yuliya Lakhman, MD, New York, New York (*Moderator*) Stockholder, Y-mAbs Therapeutics, Inc
Evis Sala, MD, PhD, Cambridge, United Kingdom (*Moderator*) Co-founder, Lucida Medical Ltd

Sub-Events

SSMS01-2 Whole Body Low Dose Computed Tomography (WBLDCT) In Comparison With Whole Body Magnetic Resonance Imaging (WBMRI) In The Assessment Of Multiple Myeloma

Participants
Cammillo Talei Franzesi, Milan, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To compare the agreement between whole-body low-dose computed tomography (WBLDCT) and magnetic resonance imaging (WBMRI) in the evaluation of bone marrow involvement in patients with multiple myeloma (MM).*Methods and Materials Fifty-eight patients with biopsy-proven MM who underwent both WBLDCT (performed on a 256-slice scanner - iCT, Philips) and WBMRI (performed on a 1.5 T magnet -Ingenia, Philips, The Netherlands) were retrospectively enrolled. After identifying the infiltration pattern (focal, diffuse and combined), the whole skeleton was divided into five anatomic districts (skull, spine, sternum, and ribs, pelvis, limbs) and patients were grouped according to number and location of the lytic lesions (< 5, 5-20, and > 20), also according to Durie and Salmon PLUS system.*Results The agreement between CT and MRI regarding pattern, staging, lesion number and distribution was assessed using the Cohen Kappa statistics. According to both the diagnostic techniques, CT and MRI, the majority of patients showed a focal involvement, followed by diffuse and combined one. According to distribution and Durie Salmon staging, the agreement between CT and MRI was substantial or almost perfect for all patterns (all ? >0.60). The agreement increased proportionally with the number of lesions in the pelvis and spine (?=0.373 to ?=0.564, and ?=0.469 to ?=0.624), while for the skull the agreement proportionally decreased without reaching a statistically significant difference. WBLDCT showed an almost perfect agreement in the evaluation of pattern, staging, lesion number and distribution of bone involvement in comparison with WBMRI.*Conclusions WBLDCT is an effective imaging modality, useful to diagnose and stage MM patients, detecting even small osteolytic lesions. WBMRI should be considered to clarify inconclusive CT findings and those cases of MM-related osteopenia.*Clinical Relevance/Application WBLDCT should be considered a useful diagnostic tool in the evaluation of MM because it is cheaper, faster and less cumbersome if compared to WBMRI, maintaining a good overall diagnostic accuracy.

RESULTS

The agreement between CT and MRI regarding pattern, staging, lesion number and distribution was assessed using the Cohen Kappa statistics. According to both the diagnostic techniques, CT and MRI, the majority of patients showed a focal involvement, followed by diffuse and combined one. According to distribution and Durie Salmon staging, the agreement between CT and MRI was substantial or almost perfect for all patterns (all ? >0.60). The agreement increased proportionally with the number of lesions in the pelvis and spine (?=0.373 to ?=0.564, and ?=0.469 to ?=0.624), while for the skull the agreement proportionally decreased without reaching a statistically significant difference. WBLDCT showed an almost perfect agreement in the evaluation of pattern, staging, lesion number and distribution of bone involvement in comparison with WBMRI.

CLINICAL RELEVANCE/APPLICATION

WBLDCT should be considered a useful diagnostic tool in the evaluation of MM because it is cheaper, faster and less cumbersome if compared to WBMRI, maintaining a good overall diagnostic accuracy.

SSMS01-4 Trends In Cancer Imaging By Indication, Care Setting, And Hospital Type During The COVID-19 Pandemic And Recovery

Participants
Ottavia Zattra, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

The delivery of cancer care has been greatly affected by the COVID pandemic. We aim to investigate the effect of the pandemic on computed tomography (CT) imaging of cancer.*Methods and Materials Cancer-related CT exams were retrospectively analyzed during three periods of 2020: pre-COVID (1/5/20-3/14/20), COVID peak (3/15/20-5/2/20) and post-COVID peak (5/3/20-11/14/20). Volumes were assessed by 1) Imaging indication: cancer screening, initial workup, active cancer, surveillance; 2) Care setting: outpatient, inpatient, ED; 3) Hospital type: quaternary academic center (QAC), university-affiliated community hospital (UACH), sole community hospitals (SCHs).*Results During the COVID peak, a significant drop in CT volumes was observed (-42·2%, p<0·0001), with cancer screening, initial workup, active cancer and cancer surveillance experiencing declines by 81·7%, 54·8%, 30·7% and 44·7% respectively (p<0·0001). The emergency department (ED) was the only setting with stable cancer-related CT volumes. In the post-COVID peak period, CT volumes for cancer screening and for initial workup did not recover (-11·7%, p=0·037; -20·0%, p=0·031), with the outpatient setting particularly affected. CT volumes for active cancer recovered post-peak, but inconsistently across hospital types with the QAC experiencing a 9·4% decline (p=0·022) and the UACH a 41·5% increase (p<0·001). Outpatient CTs recovered during the post-peak period, but a shift in utilization away from the QAC (-8·7%, p=0·020)

toward the UACH (+13·3%, p=0·013) was observed. Inpatient and ED-based cancer-related CTs increased post-peak (+20·0%, p=0·004 and +33·2%, p=0·009, respectively).*Conclusions COVID severely impacted cancer imaging care. CTs for cancer screening and initial workup did not recover to pre-COVID levels well into 2020, a finding that suggests higher numbers of patients with advanced cancers may present in the future. A redistribution of imaging utilization away from the QAC and outpatient settings, toward the community hospitals and inpatient setting/ED was observed. The ED has remained a dependable healthcare delivery setting for patients with cancer throughout the pandemic.*Clinical Relevance/Application COVID has severely impacted cancer care, but few studies have explored its effects on cancer imaging in the late months of 2020. This study examines cancer imaging utilization during the COVID pandemic through November 2020.

RESULTS

During the COVID peak, a significant drop in CT volumes was observed (-42·2%, p<0·0001), with cancer screening, initial workup, active cancer and cancer surveillance experiencing declines by 81·7%, 54·8%, 30·7% and 44·7% respectively (p<0·0001). The emergency department (ED) was the only setting with stable cancer-related CT volumes. In the post-COVID peak period, CT volumes for cancer screening and for initial workup did not recover (-11·7%, p=0·037; -20·0%, p=0·031), with the outpatient setting particularly affected. CT volumes for active cancer recovered post-peak, but inconsistently across hospital types with the QAC experiencing a 9·4% decline (p=0·022) and the UACH a 41·5% increase (p<0·001). Outpatient CTs recovered during the post-peak period, but a shift in utilization away from the QAC (-8·7%, p=0·020) toward the UACH (+13·3%, p=0·013) was observed. Inpatient and ED-based cancer-related CTs increased post-peak (+20·0%, p=0·004 and +33·2%, p=0·009, respectively).

CLINICAL RELEVANCE/APPLICATION

COVID has severely impacted cancer care, but few studies have explored its effects on cancer imaging in the late months of 2020. This study examines cancer imaging utilization during the COVID pandemic through November 2020.

SSMS01-5 Improved Response Prediction Based On Dual Energy CT Radiomics In Patients With Stage IV Melanoma Before Immunotherapy

Participants
Andreas Brendlin, Tuebingen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To assess the additive value of dual energy CT (DECT) over single energy CT (SECT) to radiomics based response prediction in patients with metastatic melanoma undergoing immunotherapy.*Methods and Materials A total of 140 consecutive patients with melanoma (58 female, 63±16 years) for whom baseline DECT tumor load assessment revealed stage IV and who were subsequently treated with immunotherapy were included. Best response was determined using the clinical reports (81 responders: 27 complete response, 45 partial response, 9 stable disease). Individual lesion response was classified manually in the style of RECIST 1.1 through 1291 follow-up examinations on a total of 776 lesions (6.7±7.2 per patient). The patients were sorted chronologically into a study and a validation cohort (each n = 70). The baseline DECT was examined using specialized tumor segmentation software, and radiomic features were analyzed for response predictors. Significant features were selected using univariate statistics with Bonferroni correction and multiple logistic regression. The area under the curve of the best subset was computed (AUROC). A random forest classifier with 10-fold internal cross-validation was trained on the study cohort and tested on the validation cohort to confirm the predictive performance.*Results A total of 4074 timepoint evaluations were performed. Multivariate statistics selected significant features for patient response in SECT (min. brightness, AUROC = 0.67, MI = 0.077 R^2 = 0.112, padj. = 0.001) and DECT (textural coarseness, AUROC = 0.71, MI = 0.064, R^2 = 0.121, padj. = 0.001), as well as lesion response in SECT (mean absolute voxel intensity deviation, AUROC = 0.67, MI = 0.088 R^2 = 0.115, padj. = 0.001) and DECT (iodine uptake metrics, (AUROC = 0.88, MI = 0.1 R^2 = 0.12, padj. = 0.001) Machine-learning application validated the additive predictive power of DECT (patient response AUROC SECT = 0.5, DECT = 0.75; lesion response AUROC SECT = 0.61, DECT = 0.85; p < 0.001).*Conclusions The new method of DECT-specific radiomic analysis provides a significant additive value over SECT radiomics approaches for response prediction in patients with metastatic melanoma preceding immunotherapy, especially on a lesion-based level. As mixed tumor response is not uncommon in metastatic melanoma, this lends a powerful tool for clinical decision-making and may potentially be an essential step towards individualized medicine.*Clinical Relevance/Application Considering mixed responses under immunotherapy, this approach can be a powerful additional tool for oncological decision-making.

RESULTS

A total of 4074 timepoint evaluations were performed. Multivariate statistics selected significant features for patient response in SECT (min. brightness, AUROC = 0.67, MI = 0.077 R^2 = 0.112, padj. = 0.001) and DECT (textural coarseness, AUROC = 0.71, MI = 0.064, R^2 = 0.121, padj. = 0.001), as well as lesion response in SECT (mean absolute voxel intensity deviation, AUROC = 0.67, MI = 0.088 R^2 = 0.115, padj. = 0.001) and DECT (iodine uptake metrics, (AUROC = 0.88, MI = 0.1 R^2 = 0.12, padj. = 0.001) Machine-learning application validated the additive predictive power of DECT (patient response AUROC SECT = 0.5, DECT = 0.75; lesion response AUROC SECT = 0.61, DECT = 0.85; p < 0.001).

CLINICAL RELEVANCE/APPLICATION

Considering mixed responses under immunotherapy, this approach can be a powerful additional tool for oncological decision-making.

SSMS01-6 Prognostic Value Of Whole-body Low-dose CT (WBLDCT) In The Staging Of Patients With Multiple Myeloma (MM): A Long Term Follow-up

Participants
Davide Ippolito, MD, Monza, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the prognostic features of bone marrow involvement and behavior in patients with MM during a long period follow-up according to the dimensional parameter and infiltration pattern, using whole-body low-dose computed tomography (WBLDCT).*Methods and Materials 103 patients with a newly diagnosed MM who underwent WBLDCT (using a 256-slice scanner - iCT, Philips), every year during follow-up (minimum of three years) ,were retrospectively enrolled. The whole skeleton was divided into 5 anatomic districts and evaluated in terms of infiltration pattern. The evolution of osteolytic lesions over time was performed measuring the maximum axial diameter at the baseline (T0) and at the end of follow-up (Te). By using a cut-off value of 10 mm, we divided all lesions into "big lesions" (>10 mm) and "small lesions" (=10 mm). For each patient, location and dimension of up to 3 lesions were registered. Only a lytic lesion's dimensional increase or decrease of at least 2 mm was considered. The time-to-fracture (TTF), expressed in months, was recorded for each patient.*Results 63% of patients presented a focal pattern,22% a

diffuse pattern and 15% a combined one. The dimensional evolution of the small lesions demonstrated that 72% of patients presented stability, 1% showed a decrease and 27% an increase.Patients with big lesions showed a statistically significant difference regarding the mean difference of axial diameter between T0 and Te (p=0.015). During the whole follow-up period, 30 patients (29%) reported at least one bone fracture, most frequently in the pelvis (33%) and spine (66%), while patients with diffuse pattern didn't show any fracture (p<0.0001). Patients with big lesions showed an OR of 29.8 to develop at least one fracture during the follow-up period. Mean TTF was significantly lower in patients with big lesion in comparison with small ones (p=0.011).*Conclusions WBLDCT represents a reliable imaging-based tool for proper management of MM patients, useful to define the behavior of different bone involvement, showing that diffuse pattern or small lytic lesions may deserve a less frequent follow-up.*Clinical Relevance/Application WBLDCT represents a useful imaging based tool to correctly define management of MM patients along the course of follow-up.

RESULTS

63% of patients presented a focal pattern,22% a diffuse pattern and 15% a combined one. The dimensional evolution of the small lesions demonstrated that 72% of patients presented stability, 1% showed a decrease and 27% an increase.Patients with big lesions showed a statistically significant difference regarding the mean difference of axial diameter between T0 and Te (p=0.015). During the whole follow-up period, 30 patients (29%) reported at least one bone fracture, most frequently in the pelvis (33%) and spine (66%), while patients with diffuse pattern didn't show any fracture (p<0.0001). Patients with big lesions showed an OR of 29.8 to develop at least one fracture during the follow-up period. Mean TTF was significantly lower in patients with big lesion in comparison with small ones (p=0.011).

CLINICAL RELEVANCE/APPLICATION

WBLDCT represents a useful imaging based tool to correctly define management of MM patients along the course of follow-up.

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Abstract Archives of the RSNA, 2021

SSIN02

Science Session with Keynote: Informatics (Natural Language Processing and Reporting)

Participants
Bhavik Patel, MD, Paradise Valley, Arizona (*Moderator*) Nothing to Disclose

Sub-Events

SSIN02   Keynote Speaker

Participants
Marta Heilbrun, MD,MS, Atlanta, Georgia (*Presenter*) Nothing to Disclose

SSIN02-2   Quantifying The Impact Of Structured Reporting On The Report Review Process And Turnaround Times Of Resident Reports In Neuroradiology

Participants
Jan Vosshenrich, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To assess the effects of a change from free-text reporting to structured reporting on the report review process and turnaround times of resident reports over a 15-months period in the neuroradiology daily routine.*Methods and Materials Our neuroradiology section introduced in-house developed structured reporting templates for CT examinations in July 2019. Each report follows the same evolution in our RIS and passes through several states (i.e. draft, preliminary and final report). Residents predictate all studies without exception as "draft reports". Following joint read-out with an attending, residents sent corrected "preliminary reports" for final review and sign-off by the respective staff radiologist as "final reports". Reports dictated by residents during dayshifts from January 2019 to March 2020 were retrospectively assessed using quantitative parameters from report comparison. Through automatic analysis of text-string differences between report states, Jaccard similarities and edit distances between report states were calculated overall and for distinct reporting templates. Furthermore, turnaround times until preliminary and final report availability to clinicians were investigated. Parameters were visualized as trending line graphs and statistically compared between reporting standards using an independent Student's t-test or Mann-Whitney U test (significance level p<0.05).*Results 3,538 reports were included into analysis. Mean Jaccard similarity of resident drafts and staff-reviewed final reports increased from 0.53±0.37 to 0.79±0.22 after the introduction of structured reporting (p<.001). Both mean overall edits on draft reports by residents following read-out sessions (0.30±0.45 vs. 0.09±0.29; p<.001) and by staff radiologists during report sign-off (0.17±0.28 vs. 0.12±0.23, p=.001) decreased. Similar results were seen for most distinct reporting templates. With structured reporting, mean turnaround time until preliminary report availability to clinicians decreased by 20.7 minutes (246.9±207.0 vs. 226.2±224.9; p<.001). Similarly, final reports were available 35.0 minutes faster on average (558.0±515.1 vs. 523.0±497.3; p=.002).*Conclusions With structured reporting, resident draft reports require fewer edits during the report review process. This reduction in proofreading workload is likely responsible for substantially lower report turnaround times.*Clinical Relevance/Application Structured reporting is beneficial for residents and staff radiologists in the neuroradiology daily routine, as it facilitates and accelerates the report review process through higher overall report correctness / completeness compared to traditional free-text reports.

RESULTS

3,538 reports were included into analysis. Mean Jaccard similarity of resident drafts and staff-reviewed final reports increased from 0.53±0.37 to 0.79±0.22 after the introduction of structured reporting (p<.001). Both mean overall edits on draft reports by residents following read-out sessions (0.30±0.45 vs. 0.09±0.29; p<.001) and by staff radiologists during report sign-off (0.17±0.28 vs. 0.12±0.23, p=.001) decreased. Similar results were seen for most distinct reporting templates. With structured reporting, mean turnaround time until preliminary report availability to clinicians decreased by 20.7 minutes (246.9±207.0 vs. 226.2±224.9; p<.001). Similarly, final reports were available 35.0 minutes faster on average (558.0±515.1 vs. 523.0±497.3; p=.002).

CLINICAL RELEVANCE/APPLICATION

Structured reporting is beneficial for residents and staff radiologists in the neuroradiology daily routine, as it facilitates and accelerates the report review process through higher overall report correctness / completeness compared to traditional free-text reports.

SSIN02-3   Using Natural Language Processing To Derive A Structured Classification Of Lumbar Spine Pathologies From Unstructured MR Reports

Participants
JinHyeong Park, PhD, New York, New York (*Presenter*) Employee, Covera Health

PURPOSE

Create a robust automated pipeline that transforms freeform lumbar spine MR report text into a structured grid of pathologies with severity for each lumbar disc level.*Methods and Materials The dataset includes 1,223 expert-labeled lumbar MR reports with 5,431 distinct motion segment-specific findings (MS). This dataset was split into 531 studies for training (2,479 MS), 303 studies for validation (1,353 MS) and 389 studies for testing (1,599 MS). Additionally, weakly-supervised learning added an additional 7,032 MS

text segments to the training dataset to enhance generalizability. The NLP pipeline for structured report classification consists of three models for information extraction and segmentation. First, a custom named entity recognition model based on an Ordered Neuron LSTM was used to classify motion segment token spans. Next, we concatenated text and findings associated to motion segments, using a heuristic based on sentence boundaries and proximity to motion segment text spans. Finally, we trained a BERT-based architecture with our own radiology-specific language model on three relevant lumbar spine pathologies: central canal stenosis (CCS), disc herniation (DH) and nerve root impingement (NR). Pathologies were classified categorically, CCS into "None/Mild", "Moderate" or "Severe"; DH into "None", "Small", or "Moderate/Large"; and NR into "None" or "Present".*Results Across CCS, DH and NR, the unweighted average (macro) sensitivity was 0.93 and specificity was 0.96. CCS had an unweighted average (macro) sensitivity of 0.96 and specificity of 0.98. DH had an unweighted average (macro) sensitivity of 0.91 and specificity of 0.96. NR had an unweighted average (macro) sensitivity of 0.93 and specificity of 0.93.*Conclusions A deep learning pipeline is able to compress the diversity of language expressions present in lumbar spine MR reports into a predefined, structured format with a high accuracy and may be suitable for use in standardizing radiology study reporting and data mining.*Clinical Relevance/Application Transforming freeform MR reports into tabular lists of findings yields source data for quality and outcome metrics including accuracy, cohort selection, response to therapy, and correlation analysis. The information presented in this paper is based on research results that are not commercially available.

RESULTS

Across CCS, DH and NR, the unweighted average (macro) sensitivity was 0.93 and specificity was 0.96. CCS had an unweighted average (macro) sensitivity of 0.96 and specificity of 0.98. DH had an unweighted average (macro) sensitivity of 0.91 and specificity of 0.96. NR had an unweighted average (macro) sensitivity of 0.93 and specificity of 0.93.

CLINICAL RELEVANCE/APPLICATION

Transforming freeform MR reports into tabular lists of findings yields source data for quality and outcome metrics including accuracy, cohort selection, response to therapy, and correlation analysis. The information presented in this paper is based on research results that are not commercially available.

SSIN02-4 Automated De-identification Pipeline For Radiology Reports Combining Transformer And "Hide In Plain Sight" Rule-based Model

Participants
Pierre Chambon, BS, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

Develop a de-identification pipeline to localize and classify personal health information (PHI) in radiology reports, replacing it with similar but fake information.*Methods and Materials The developed pipeline uses a transformer trained to classify radiology report tokens into PHI classes. The model was trained on a multi-institutional cohort (14 million unlabeled X-ray and CT reports containing PHI) and fine-tuned on 1000 labeled reports. We compared several pre-training approaches and fine-tuning methods, selected using Bayesian optimization with a tree-structured Parzen estimator. Then, a rule-based algorithm replaced annotated PHI with fake PHI (i.e., "hide in plain sight"). The replacement algorithm mimicked the format and content of the input data, and integrated a two-speed memory and document-level constraints to maintain the coherence of the fake PHI within and among reports. In addition, it could be used as a generator to perform data augmentation for the transformer. The algorithm was evaluated on a separate test set of 220 CT and X-ray reports.*Results Six classes of PHI were present in the training data: vendor, date, healthcare worker, hospital, and identifier. The optimal transformer model achieved a macro-averaged F1-score of 96.0 (95.6 recall, 96.5 precision). For the two most frequent PHI classes in the reports, date and healthcare worker, the model achieved F1 scores of 99.8 (99.9 recall, 99.5 precision) and 98.3 (99.3 recall, 97.3 precision) respectively. Lower performance was achieved for the remaining classes due to their scarcity in the training set. In a head-to-head comparison, our transformer had higher precision and similar recall to other publicly available de-identification algorithms. It enabled a large statistical study of PHI distribution in radiology reports.*Conclusions A transformer pipeline provides highly accurate de-identification of radiology reports. A "hide in plain sight" de-identification step helps prevent discovery of any remaining PHI.*Clinical Relevance/Application A de-identification model designed specifically for radiology reports ensured successful removal of almost all commonly occurring PHI classes, enabling wider distribution of radiology reports for research purposes.

RESULTS

Six classes of PHI were present in the training data: vendor, date, healthcare worker, hospital, and identifier. The optimal transformer model achieved a macro-averaged F1-score of 96.0 (95.6 recall, 96.5 precision). For the two most frequent PHI classes in the reports, date and healthcare worker, the model achieved F1 scores of 99.8 (99.9 recall, 99.5 precision) and 98.3 (99.3 recall, 97.3 precision) respectively. Lower performance was achieved for the remaining classes due to their scarcity in the training set. In a head-to-head comparison, our transformer had higher precision and similar recall to other publicly available de-identification algorithms. It enabled a large statistical study of PHI distribution in radiology reports.

CLINICAL RELEVANCE/APPLICATION

A de-identification model designed specifically for radiology reports ensured successful removal of almost all commonly occurring PHI classes, enabling wider distribution of radiology reports for research purposes.

SSIN02-5 Transformer Versus Traditional Natural Language Processing: How Much Data Is Enough For Automated Radiology Report Classification?

Participants
Eric Yang, BS, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Current state-of-the-art natural language processing (NLP) techniques use transformer deep learning architectures but depend on large datasets for training. We hypothesized that traditional NLP techniques may offer superior performance over transformers for smaller radiology report datasets.*Methods and Materials We compared the performance of different NLP models for the classification of medial (MM) or lateral (LM) meniscus tears on free-text knee MRI radiology reports from a single institution obtained from January 1, 2018 to December 31, 2018 (training set N=2861, test set N=726). The models trained included: (1) gradient boosted tree (XGBoost) model with features engineered using bag-of-words, (2) XGBoost model using medical entities extracted from the Clinspacy library, (3) XGBoost model using text embeddings from Clinspacy, and (4) BioBERT, a deep learning-based transformer model pre-trained on biomedical text. The NLP models were trained on the full training set and 2.5%, 10%, 25%, 50%

and 75% random subsets of the original training data. All models were evaluated on the test set.*Results Using all training data, BioBERT achieved the highest classification performance for MM and LM tear detection on knee MRI reports (MM F1 score 0.98, LM F1 score 0.96), followed by XGBoost with bag-of-words features (MM F1 score 0.94, LM F1 score 0.88), XGBoost with clinspacy medical entities features (MM F1 score 0.86, LM F1 score 0.75), and XGBoost with clinspacy embeddings (MM F1 score 0.84, LM F1 score 0.69). The performance for all models decreased as the training sample size decreased. This effect was most prominent for the BioBERT model, where at 2.5% of the training data, its performance (MM F1 score 0.44, LM F1 score 0.39) was lower than that of the XGBoost with bag-of-words features (MM F1 score 0.89, LM F1 score 0.74).*Conclusions With larger sample sizes, a deep learning-based transformer NLP model (BioBERT) achieved superior performance in radiology report classification; however, with smaller sample sizes (<1000), a traditional NLP technique (XGBoost with bag-of-words) may perform better.*Clinical Relevance/Application NLP is being increasingly used to automate analysis of radiology reports (e.g. clinical research, quality improvement). The best NLP method for a task may depend on the training dataset size.

RESULTS

Using all training data, BioBERT achieved the highest classification performance for MM and LM tear detection on knee MRI reports (MM F1 score 0.98, LM F1 score 0.96), followed by XGBoost with bag-of-words features (MM F1 score 0.94, LM F1 score 0.88), XGBoost with clinspacy medical entities features (MM F1 score 0.86, LM F1 score 0.75), and XGBoost with clinspacy embeddings (MM F1 score 0.84, LM F1 score 0.69). The performance for all models decreased as the training sample size decreased. This effect was most prominent for the BioBERT model, where at 2.5% of the training data, its performance (MM F1 score 0.44, LM F1 score 0.39) was lower than that of the XGBoost with bag-of-words features (MM F1 score 0.89, LM F1 score 0.74).

CLINICAL RELEVANCE/APPLICATION

NLP is being increasingly used to automate analysis of radiology reports (e.g. clinical research, quality improvement). The best NLP method for a task may depend on the training dataset size.

SSIN02-6 Automated Detection Of Adrenal Nodules In Radiology Reports: Proof Of Concept For Using Recurrent Neural Networks For Cohort Creating Using Radiology Reports.

Participants
Jayashree Kalpathy-Cramer, MS, PhD, Charlestown, Massachusetts (*Presenter*) Institutional Research Grant, General Electric Company;Institutional Research Grant, F. Hoffmann-La Roche Ltd

PURPOSE

Inferring the presence of distinct types of conditions from free-text reports is an important and common task in radiology, including the development of cohorts for machine learning (ML). We develop and test a two-step architecture - Long Short-Term Memory (LSTM) + Support Vector Machine, to automatically detect and classify the presence of adrenal nodules in radiology reports.*Methods and Materials The data cohort consists of 16,372 non-annotated reports and 1060 annotated reports (class balance: normal - 994 (93.77%), mass - 65 (6.23%). The annotated set is randomly partitioned at the report level with 70, 15, and 15% of reports used for algorithm training, validation, and testing, respectively. The text pertaining to the adrenal glands is filtered and embedded using the ClinicalBERT model. A bidirectional LSTM cell extracts features from these embeddings which are then processed by densely connected layers to produce logits; a binary cross-entropy loss function and an argmax function determine the final class predicted by the model. The model was further tested on the non-annotated data, and samples that were predicted as positive by this model (1015 in number) are subsequently labeled by a radiologist into six adrenal gland classes (surgically absent, mass, metastasis (>1cm and <1cm), normal, thickening, and unknown) on which a linear support vector classifier (SVC) is trained to perform multiclass classification.*Results The algorithm achieved an AUROC of 95%, an accuracy of 99%, and an F1 score of 95% with respect to the positive class when evaluated on the test set for binary classification. The false-positive rate was 10% while the false-negative rate was 0%. The accuracy of the subsequent SVC was 88% with the mass, surgically absent, and normal classes having F1 scores > 80%. The most frequently confused classes were found to be mass and thickening.*Conclusions By using context-specific embeddings from ClinicalBERT, an LSTM-based architecture, and an SVC, the presence of medical conditions in free-text medical reports can be inferred with high accuracy as demonstrated through the inference of the presence of adrenal nodules in radiology reports.*Clinical Relevance/Application The model is most useful for ML cohort creation using radiology reports and can be expanded to other use-cases, body parts, and modalities. Retrospective review for quality improvement purposes and epidemiological studies would also be greatly facilitated.

RESULTS

The algorithm achieved an AUROC of 95%, an accuracy of 99%, and an F1 score of 95% with respect to the positive class when evaluated on the test set for binary classification. The false-positive rate was 10% while the false-negative rate was 0%. The accuracy of the subsequent SVC was 88% with the mass, surgically absent, and normal classes having F1 scores > 80%. The most frequently confused classes were found to be mass and thickening.

CLINICAL RELEVANCE/APPLICATION

The model is most useful for ML cohort creation using radiology reports and can be expanded to other use-cases, body parts, and modalities. Retrospective review for quality improvement purposes and epidemiological studies would also be greatly facilitated.

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SSGI05

Gastrointestinal (Artificial Intelligence - Techniques)

Participants
Marc Kohli, MD, San Francisco, California (*Moderator*) Founder, Alara ImagingStockholder, Alara Imaging
George L. Shih, MD, New York, New York (*Moderator*) Consultant, MD.ai, Inc;Shareholder, MD.ai, Inc;

Sub-Events

SSGI05-2   Federated Versus Centralized Deep-learning Models For Liver And Tumor Segmentation In Multi-center Hepatic CT Datasets

Participants
Guibo Luo, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

This study was to develop and evaluate a reliable federated deep-learning for liver and tumor segmentation in multi-center hepatic CT datasets with different distributions.*Methods and Materials We retrospectively collected 667 contrast-enhanced venous phase abdominal CT scans, including 131 scans from LiTS (siteA), 405 scans from China (siteB), and 131 scans from US (siteC). These datasets were acquired by different scanners and protocols from different clinical sites, with a largely varying in-plane resolution from 0.55 mm to 1.0 mm and slice thickness from 0.45 mm to 6.0 mm. SiteA mainly contains small, metastatic tumors, siteB contains multiple types of tumors, and siteC mainly contains large, malignant tumors. All CT scans were randomly divided into 550 scans (82%) for training, and 117 scans (18%) for testing.For preprocessing, the 12-bit CT images were mapped to 8-bit images via a liver CT window-level setting, and each slice was concatenated with its two adjacent slices to utilize spatial and temporal information. Then, we trained five 2.5D UNet models for segmentation of liver and tumor, including three standard single-site models trained on each of local datasets, a single centralized model trained on a dataset consisting of the three local datasets, and a federated model with local batch normalization (BN). Specifically, the proposed federated learning model kept the BN layers updated locally without aggregating scheme. The Dice coefficient (Dice) was used as the evaluation metric.*Results For liver segmentation in testing data, the Dice of single model, centralized model, and federated model with localBN were 0.958, 0.959, 0.962 at siteA, and 0.979, 0.966, 0.969 at siteB, and 0.939, 0.937, 0.942 at siteC, respectively. Whereas for tumor segmentation in testing data, the Dice of single model, centralized model, and federated model with localBN were 0.509, 0.524, 0.524 at siteA, and 0.719, 0.707, 0.721 at siteB, and 0.563, 0.589, 0.581 at siteC, respectively.*Conclusions This study has demonstrated that our proposed federated deep-learning with local BN approach provided a comparable performance with centralized deep-learning for liver and tumor segmentation in multi-center datasets while has the potential of preserving data privacy. As a result, local BN can successfully solve the non-iid medical imaging data training in federal learning.*Clinical Relevance/Application Reliable federated learning may provide an effective solution for multi-center collaboratively training a deep learning model without data sharing.

RESULTS

For liver segmentation in testing data, the Dice of single model, centralized model, and federated model with localBN were 0.958, 0.959, 0.962 at siteA, and 0.979, 0.966, 0.969 at siteB, and 0.939, 0.937, 0.942 at siteC, respectively. Whereas for tumor segmentation in testing data, the Dice of single model, centralized model, and federated model with localBN were 0.509, 0.524, 0.524 at siteA, and 0.719, 0.707, 0.721 at siteB, and 0.563, 0.589, 0.581 at siteC, respectively.

CLINICAL RELEVANCE/APPLICATION

Reliable federated learning may provide an effective solution for multi-center collaboratively training a deep learning model without data sharing.

SSGI05-3   Accelerated T2-weighted MRI Of The Liver At 3T Using Single-Shot Technique With Deep Learning Based Image Reconstruction: Impact On The Image Quality And Lesion Detection

Participants
Luke Ginocchio, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Fat-suppressed T2-weighted imaging (T2-FS) is a critical component of clinical liver MRI, but often requires a long scan time and can be wrought with motion artifacts, urging a need for the development of a shorter and more motion robust sequence. We aim to compare the image quality of a single-shot T2-weighted MRI prototype with deep learning based image reconstruction (DL HASTE-FS) with a standard T2-FS sequence for routine clinical liver MRI at 3T.*Methods and Materials 41 consecutive patients who underwent abdominal MRI examinations at 3T including standard T2-FS and DL HASTE-FS, between 5/6/2020 and 11/23/2020, comprised the study cohort. Images were reviewed independently by two radiologists who used a 5-point Likert scale for a number of measures regarding artifacts and image quality, in addition to assessing for the presence of liver lesions and, if present, assessing lesion contrast and lesion image quality.*Results Acquisition time for DL HASTE-FS was 54.93 +/- 16.69 seconds, significantly (p <0.001) shorter than that for standard T2-FS (114.00 +/- 32.98 seconds). DL HASTE-FS received significantly higher scores than standard T2-FS for sharpness of liver margin (mean 4.2 vs 3.3; p<0.001), hepatic vessel margin (4.0 vs 3.2; p<0.001), pancreatic duct margin (4.0 vs 1.6; p<0.001); in-plane (4.1 vs 3.1; p<0.001) and through plane (4.1 vs 3.0; p<0.001) motion artifacts; other ghosting artifacts (4.3 vs 2.9; p<0.001); and overall image quality (3.8 vs 2.8; p<0.001), in addition to

receiving a higher score for sharpness of lesion margin (4.4 vs 3.8; p<0.025), without receiving significant difference in scores for homogeneity/strength of fat suppression or liver-fat/lesion contrast (p>0.05).*Conclusions Single-shot T2-weighted MRI with deep learning based image reconstruction demonstrated superior image quality compared with the standard T2-FS sequence for routine clinical liver MRI at 3T, while being acquired in less than half the time.*Clinical Relevance/Application Novel single-shot T2-weighted MRI with deep learning based image reconstruction technique offers superior image quality and decreased acquisition time compared with standard T2-FS technique at 3T.

RESULTS

Acquisition time for DL HASTE-FS was 54.93 +/- 16.69 seconds, significantly (p <0.001) shorter than that for standard T2-FS (114.00 +/- 32.98 seconds). DL HASTE-FS received significantly higher scores than standard T2-FS for sharpness of liver margin (mean 4.2 vs 3.3; p<0.001), hepatic vessel margin (4.0 vs 3.2; p<0.001), pancreatic duct margin (4.0 vs 1.6; p<0.001); in-plane (4.1 vs 3.1; p<0.001) and through plane (4.1 vs 3.0; p<0.001) motion artifacts; other ghosting artifacts (4.3 vs 2.9; p<0.001); and overall image quality (3.8 vs 2.8; p<0.001), in addition to receiving a higher score for sharpness of lesion margin (4.4 vs 3.8; p<0.025), without receiving significant difference in scores for homogeneity/strength of fat suppression or liver-fat/lesion contrast (p>0.05).

CLINICAL RELEVANCE/APPLICATION

Novel single-shot T2-weighted MRI with deep learning based image reconstruction technique offers superior image quality and decreased acquisition time compared with standard T2-FS technique at 3T.

SSGI05-5   Deep-cleansing: Deep-learning Based Electronic Cleansing In Dual-energy CT Colonography

Participants
Guibo Luo, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

This study was to develop and evaluate a deep-learning based electronic cleansing (EC) method for subtraction of tagged fecal regions in the colon in dual-energy CTC (DE-CTC).*Methods and Materials We retrospectively collected 139 DE-CTC cases with an isotropic resolution of 0.6×0.6×0.6 mm. Each patient underwent a 24-hour low-fiber, low-residue dietary bowel preparation with oral administration of 150 ml of iodinated contrast agent Gastrografin (Bayer Schering Pharma). The regions of interest (ROIs) of the colon lumen and tagged regions were interactively segmented on the fused CT images on our in-house CTC platform by two image analysts. All DE-CTC scans (approximately 80K images) were randomly divided into 76 scans (55%) for training, 28 scans (20%) for validation, and 35 scans (25%) for testing. First, we calculated the "effective" anatomic number (EAN) by fractions of atomic mass number using the low- and high-energy images in DE-CTC. Then we trained and evaluated our Deep-Cleansing on the DE-CTC scans with two different backbone networks (VGG16 and EfficientNet) in U-Net architecture. Specifically, multiple types of combinations of input channels were investigated for the optimal performance of EC, including the combinations of the high-energy, low-energy, fused-energy CT images, and EAN maps. The Dice coefficient (Dice), cleansing ratio (Rec) and soft-tissue preservation ratio (Rst) were used as the evaluation metrics.*Results Our Deep-Cleansing U-Net scheme with EAN maps achieved the Dice, Rec, Rst of 0.953, 94.18%, 98.55% in validation datasets, and 0.956, 96.14%, 97.74% in testing datasets, respectively. Whereas that U-Net model without EAN maps had the Dice, Rec, Rst of 0.948, 93.65%, 98.48% in validation datasets, and 0.955, 95.74%, 97.86% in testing datasets, respectively. In comparison, the conventional method like mosaic decomposition for differentiation of tagged fecal residuals achieved Rec of 90.6% and Rst of 97.8%.*Conclusions This study demonstrated that EAN provides an effective solution to identify tagged fecal materials and U-Net can significantly improve the segmentation of tagged fecal regions in DE-CTC images.*Clinical Relevance/Application Electronic cleansing may "virtually cleanse" tagged fecal materials and preserve the soft-tissue structures in the colon for visualization of the entire colonic surface in CTC.

RESULTS

Our Deep-Cleansing U-Net scheme with EAN maps achieved the Dice, Rec, Rst of 0.953, 94.18%, 98.55% in validation datasets, and 0.956, 96.14%, 97.74% in testing datasets, respectively. Whereas that U-Net model without EAN maps had the Dice, Rec, Rst of 0.948, 93.65%, 98.48% in validation datasets, and 0.955, 95.74%, 97.86% in testing datasets, respectively. In comparison, the conventional method like mosaic decomposition for differentiation of tagged fecal residuals achieved Rec of 90.6% and Rst of 97.8%.

CLINICAL RELEVANCE/APPLICATION

Electronic cleansing may "virtually cleanse" tagged fecal materials and preserve the soft-tissue structures in the colon for visualization of the entire colonic surface in CTC.

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Participants
Hina Saeed, MD, Milwaukee, Wisconsin (*Moderator*) Nothing to Disclose
Suresh K. Mukherji, MD, Carmel, Indiana (*Moderator*) Nothing to Disclose

Sub-Events

SSRO01-1 Price Comparison For Stereotactic Brain Radiation Therapy Using Chargemaster Data From National Cancer Institute-Designated Centers

Participants
Rahul Prasad, MD, Columbus, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Financial toxicity is a highly prevalent and damaging consequence of oncologic therapy potentially addressable through improved price transparency. Recently, the Centers for Medicare & Medicaid Services required all US hospitals to publish a "chargemaster" documenting non-negotiated list charges for all services. Patients often travel to tertiary centers for intracranial stereotactic radiotherapy (SRT), but cost comparison is complicated by multiple delivery systems and fractionation schemes. We hypothesized that listed prices for intracranial SRT vary by delivery system, fractionation scheme, and institution.*Methods and Materials We obtained online available chargemasters for the 63 US clinical National Cancer Institute (NCI)-designated centers. Listed technical charges for Gamma Knife (GK), single fraction linear-accelerator stereotactic radiosurgery (SRS), and 3-fraction fractionated stereotactic radiation therapy (FSRT) were obtained by searching for Current Procedural Terminology (CPT) billing codes first and then keywords. Institutional cost data was adjusted by the Medicare geographic cost price index (GPCI) to control for cost-of-living associated reimbursement differences. Pairwise comparisons were conducted to compare prices across modalities and geographic regions. Price association between modalities and relationships with cost index were examined using Spearman correlations.*Results 62 chargemasters were obtained, and 58 listed intracranial SRT prices. Median listed prices varied widely with large interquartile ranges (GK \$49,529; FSRT \$31,834; SRS \$22,915). After adjusting for GPCI, GK (p = .0003) and FSRT (p = .001) were significantly more expensive than SRS, and no difference in price was noted between regions. FSRT price was positively correlated with GPCI (p = .033) but other modalities were not. All modality prices were positively correlated (all p <.001).*Conclusions The listed price for intracranial stereotactic radiotherapy varies greatly by delivery system, fractionation scheme, and even between institutions. Price differences are not well explained by variability in cost of living. These inefficiencies expose patients already at high risk for financial toxicity to unnecessary costs.*Clinical Relevance/Application The listed price for brain stereotactic radiotherapy varies by delivery system, fractionation scheme, and even between institutions. These inefficiencies expose patients already at high risk for financial toxicity to unnecessary costs.

RESULTS

62 chargemasters were obtained, and 58 listed intracranial SRT prices. Median listed prices varied widely with large interquartile ranges (GK \$49,529; FSRT \$31,834; SRS \$22,915). After adjusting for GPCI, GK (p = .0003) and FSRT (p = .001) were significantly more expensive than SRS, and no difference in price was noted between regions. FSRT price was positively correlated with GPCI (p = .033) but other modalities were not. All modality prices were positively correlated (all p <.001).

CLINICAL RELEVANCE/APPLICATION

The listed price for brain stereotactic radiotherapy varies by delivery system, fractionation scheme, and even between institutions. These inefficiencies expose patients already at high risk for financial toxicity to unnecessary costs.

SSRO01-3 Availability Of Insurer-Negotiated Price Estimates For Radiotherapy And Systemic Therapy At National Cancer Institute-Designated Centers

Participants
Rahul Prasad, MD, Columbus, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Financial toxicity is highly prevalent in oncology and linked to inferior health and quality of life outcomes. Starting January 2021, all US hospitals were required by the federal government to publish online, "shoppable," payer-negotiated prices for at least 300 services of which 70 (including specialty care such as joint and cataract surgery) were specified, but oncology price inclusion was optional. National Cancer Institute (NCI)-designated centers are referral sites for cancer care, but the rate at which they choose to report prices for radiation therapy (RT) or systemic therapy is unknown. We predicted that the proportion of NCI-designated cancer centers reporting RT and infusion prices would lag behind their general rate of compliance with publication of shoppable prices.*Methods and Materials In February 2021 (1 month after regulations took effect), through online query, shoppable price lists were identified for NCI-designated centers and queried for the charge per fraction for simple intensity modulated radiation therapy (IMRT) and the first hour of infusion of systemic therapy using the Current Procedural Terminology codes 77385 and 96413, respectively. Manual search terms such as "radiation," "radiotherapy," "IMRT", "chemotherapy," and "infusion" were also used. Primary endpoints were the rate of reporting of shoppable prices for IMRT and infusion. Secondary endpoints were the rate of publication of shoppable prices and the rate of reporting cost for any RT service. Descriptive statistics including proportions and

frequency counts were performed.*Results Although price transparency webpages for all 63 NCI-designated centers were identified, only 52 (83%) published shoppable prices in any format. 49 of these (78%) were user-friendly web-based tools and 3 were downloadable documents. Overall, 9 (17%) and 8 (15%) centers listed prices for IMRT and infusion, respectively, in their shoppable tools. 20 (38%) listed at least one RT price (such as cost of brachytherapy or CT simulation).*Conclusions Almost 1 in 5 NCI-designated centers are not fully complaint with federal mandates to publish shoppable price tools. Less than 20% report negotiated RT or systemic therapy prices in shoppable tools. Policy changes such as mandatory RT and infusion price reporting should be considered to mitigate financial burden by improving patient access to reliable cost estimates.*Clinical Relevance/Application Less than 20% of NCI-designated centers report insurer-negotiated prices for radiotherapy or systemic therapy complicating price comparison for patients at high risk of treatment-related financial toxicity. Policy changes such as mandatory price reporting might address financial burden by improving patient access to reliable cost estimates.

RESULTS

Although price transparency webpages for all 63 NCI-designated centers were identified, only 52 (83%) published shoppable prices in any format. 49 of these (78%) were user-friendly web-based tools and 3 were downloadable documents. Overall, 9 (17%) and 8 (15%) centers listed prices for IMRT and infusion, respectively, in their shoppable tools. 20 (38%) listed at least one RT price (such as cost of brachytherapy or CT simulation).

CLINICAL RELEVANCE/APPLICATION

Less than 20% of NCI-designated centers report insurer-negotiated prices for radiotherapy or systemic therapy complicating price comparison for patients at high risk of treatment-related financial toxicity. Policy changes such as mandatory price reporting might address financial burden by improving patient access to reliable cost estimates.

SSRO01-4 Time To Proton Therapy For Pediatric Ependymoma Patients: A Report Of The Pediatric Proton/Photon Consortium Registry (PPCR) Study

Participants
Molly Blau, MD,MS, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

For pediatric patients with localized grade II or grade III ependymoma, adjuvant radiation therapy (RT) reduces the risk of local recurrence of disease. Proton RT provides equivalent efficacy while reducing radiation exposure to critical organs at risk in the developing brain. However, children and their families often need to travel for this treatment because proton centers are not as common as photon centers in the US or internationally. On the most recent Children's Oncology Group trial, patients were to start RT within 56 days of diagnosis. Delays in starting radiation raise concerns about impacts on efficacy. In this study, we used a large multi-institution cohort to determine factors associated with increased time to proton RT.*Methods and Materials Using the Pediatric Proton Consortium Registry of US proton centers, we identified patients with localized grades II and III intracranial ependymoma who did not receive chemotherapy prior to RT, were referred for adjuvant radiation rather than observation, and started RT within 150 days of diagnosis. For all patients, we evaluated for association between time to starting proton RT with international vs domestic residency and age. For patients residing in the United States (US), time to start was assessed based on Medicaid vs. private/employer-provided insurance, age less than 5 years, patient living in the same state as the proton center, race and ethnicity.*Results 197 patients (age 1-21 yo) met the inclusion criteria, 143 (73%) of whom started radiation within 56 days of diagnosis. The median days from diagnosis to RT start was 45 days (range 12-135 days). Compared to international patients, US patients were more likely to start radiation within 56 days (82% vs 39%, p <0.01), and had fewer average days to start (46.5 days vs 68.6 days, p<0.01). US patients with private/employer insurance were also more likely to start radiation before day 57 (87% vs 68%, p=0.02) and had shorter average intervals to starting RT (45.1 vs 54.8 days, p<0.01). Other factors, including race and ethnicity among US patients, did not affect time to RT start.*Conclusions International residence was the most important predictor of longer intervals to RT start, but type of insurance among US patients also affected time to begin RT. Delays were not associated with race, ethnicity, or distance from the treatment center for domestic patients. Subsequent analysis can determine if longer interval to starting RT was associated with inferior outcomes.*Clinical Relevance/Application In this study, we use a large multi-institution cohort to evaluate factors associated with increased time to proton RT for pediatric ependymoma patients, which may impact treatment efficacy.

RESULTS

197 patients (age 1-21 yo) met the inclusion criteria, 143 (73%) of whom started radiation within 56 days of diagnosis. The median days from diagnosis to RT start was 45 days (range 12-135 days). Compared to international patients, US patients were more likely to start radiation within 56 days (82% vs 39%, p <0.01), and had fewer average days to start (46.5 days vs 68.6 days, p<0.01). US patients with private/employer insurance were also more likely to start radiation before day 57 (87% vs 68%, p=0.02) and had shorter average intervals to starting RT (45.1 vs 54.8 days, p<0.01). Other factors, including race and ethnicity among US patients, did not affect time to RT start.

CLINICAL RELEVANCE/APPLICATION

In this study, we use a large multi-institution cohort to evaluate factors associated with increased time to proton RT for pediatric ependymoma patients, which may impact treatment efficacy.

SSRO01-5 Analysis Of Virtual Versus In-Person Prospective Peer Review Workflow In A Multisite Academic Radiation Oncology Department

Participants
Shearwood McClelland III, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

In Radiation Oncology, peer review (also known as chart rounds) is a process where subjective treatment planning decisions are assessed by those independent of the prescribing physician. Similar to the function of morbidity and mortality in many medical disciplines, peer review plays a key role in quality management and improvement and is attended by all physicians and representatives of medical dosimetry and physics. Performed retrospectively at most institutions, in 2018 we presented our experience with prospective daily peer review demonstrating improved plan quality without delaying patient care. Prior to March 2020, all peer review sessions occurred in person; however due to the COVID-19 pandemic, the peer-review workflow was transitioned from in-person to virtual. We sought to assess the plan quality and patient care timeliness achieved by virtual versus in-person prospective peer review.*Methods and Materials Patients scheduled to receive non-emergent non-procedural radiation

therapy (RT) were presented daily (Monday-Friday) at prospective peer-review prior to the start of RT administration. Planning software was used, with critical evaluation of treatment intent, radiation dose fractionation, radiation treatment modality, contour definition, treatment target coverage, and risk to critical structures. A deviation was defined as any suggested plan revision; minor deviations were not required for treatment, while major deviations were strongly recommended prior to administration of the next treatment fraction. Statistical analysis involved Fisher's exact test (p=0.05 for significance).*Results 274 treatment plans evaluated in-person were compared with 195 plans evaluated virtually. There were significant differences in palliative intent (36% vs. 22%; p=0.002), but not in total time between simulation and the start of treatment (9.2 vs. 10.0 days; p=0.10), or in minor deviations (4.0% of in-person vs. 1.5% of virtual plans; p=0.17). Major deviations (4.4% vs. 1.0%; p=0.051) trended towards significance. Overall deviations (8.4% in-person vs. 2.6% virtual; p=0.009) were significantly reduced in virtual peer review.*Conclusions Prospective daily peer review of Radiation Oncology treatment plans can be performed virtually with similar efficacy of plan quality and timeliness of patient care compared with in-person peer review. The reduced deviations observed in virtual peer review may be due to the documented inverse relationship between deviation frequency and duration of prospective peer review initiation (Ballo et al., 2014) and deserve further investigation.*Clinical Relevance/Application These findings indicate that virtual workflow does not compromise patient care, and should be considered as standard-of-care.

RESULTS

274 treatment plans evaluated in-person were compared with 195 plans evaluated virtually. There were significant differences in palliative intent (36% vs. 22%; p=0.002), but not in total time between simulation and the start of treatment (9.2 vs. 10.0 days; p=0.10), or in minor deviations (4.0% of in-person vs. 1.5% of virtual plans; p=0.17). Major deviations (4.4% vs. 1.0%; p=0.051) trended towards significance. Overall deviations (8.4% in-person vs. 2.6% virtual; p=0.009) were significantly reduced in virtual peer review.

CLINICAL RELEVANCE/APPLICATION

These findings indicate that virtual workflow does not compromise patient care, and should be considered as standard-of-care.

Abstract Archives of the RSNA, 2021

Participants
Atif Zaheer, MD, Baltimore, Maryland (*Moderator*) Nothing to Disclose
Hina Arif Tiwari, MD, Tucson, Arizona (*Moderator*) Nothing to Disclose
Amir Borhani, MD, CHICAGO, Illinois (*Moderator*) Institutional research agreement, Siemens AG

Sub-Events

SSGI09-1 Influence Of Positive, Neutral And Dark CT Oral Contrast On CT Radiation Dose When Using Automatic Exposure Control In A Phantom Model

Participants
Yuxin Sun, BS,MSc, San Francisco, California (*Presenter*) Stockholder, Nextrast, Inc

PURPOSE

To assess relative CT radiation dose associated with automated exposure control in the setting of enteric positive, neutral, and experimental dark borosilicate contrast material (DBCM, which now has FDA IND) in an adult and small adult phantom model*Methods and Materials An adult (27 x 32 cm diameter) and a small adult (21 x 27 cm diameter) anthropomorphic CT phantom, 30 cm in z-axis, were constructed of polyurethane to simulate soft tissue density, and included 2 cm diameter polyethylene corrugated tubing to simulate bowel, and bone meal urethane cast to simulate the spine. The phantom bowel was serially filled with 1000 mL of three types of oral contrast: positive (barium sulfate 2% w/w, Readi-Cat 2TM, Bracco), neutral (barium sulfate 0.1% w/w, VoLumenTM, Bracco), and dark (experimental DBCM, Nextrast, Inc) and scanned 10 times each on three different CT platforms (750 HD and Revolution, General Electric Healthcare, Waukesha, WI, Noise Index 20; IQon, Philips Healthcare, Cleveland, OH, DoseRight Index 18) at 120 kVp and 2.5 or 2 mm slice thickness using automatic exposure control. The CTDIvol was recorded for each scan and compared between contrast agents by Wilcoxon Signed Rank tests.*Results The mean CT attenuation for the positive, neutral, and dark oral contrast agents were 307, 26, and -118 for the 750 HD, 316, 25, and -137 for the Revolution, and 332, 25, and -131 for the IQon, respectively. For the 750 HD, Revolution, and the IQon scanners, the mean CTDIvol for the adult phantom scans was lower for the dark oral contrast (10.0, 8.6 and 7.9 mGy, respectively) than for the neutral (10.3, 9.0 and 8.1 mGy, p<0.05 each) and the positive (10.6, 9.6 and 8.2 mGy, p<0.05 each) contrast agents. The mean CTDIvol for the small sized phantom scans was lower for the dark oral contrast (3.4, 3.8 and 4.9 mGy, respectively) than for the neutral (3.5, 3.9 and 4.9 mGy, p<0.05 for 750 HD and Revolution, p=0.45 for IQon) and the positive (3.7, 4.0 and 5.1 mGy, p<0.05 each) contrast agents.*Conclusions Use of dark oral contrast may reduce the required radiation dose at abdominal CT imaging compared to positive and neutral oral agents when using automated exposure control.*Clinical Relevance/Application The use of dark oral contrast agents in place of positive or neutral oral agents at abdominal CT should allow for lower radiation doses. Further clinical studies are warranted to assess diagnostic impact.

RESULTS

The mean CT attenuation for the positive, neutral, and dark oral contrast agents were 307, 26, and -118 for the 750 HD, 316, 25, and -137 for the Revolution, and 332, 25, and -131 for the IQon, respectively. For the 750 HD, Revolution, and the IQon scanners, the mean CTDIvol for the adult phantom scans was lower for the dark oral contrast (10.0, 8.6 and 7.9 mGy, respectively) than for the neutral (10.3, 9.0 and 8.1 mGy, p<0.05 each) and the positive (10.6, 9.6 and 8.2 mGy, p<0.05 each) contrast agents. The mean CTDIvol for the small sized phantom scans was lower for the dark oral contrast (3.4, 3.8 and 4.9 mGy, respectively) than for the neutral (3.5, 3.9 and 4.9 mGy, p<0.05 for 750 HD and Revolution, p=0.45 for IQon) and the positive (3.7, 4.0 and 5.1 mGy, p<0.05 each) contrast agents.

CLINICAL RELEVANCE/APPLICATION

The use of dark oral contrast agents in place of positive or neutral oral agents at abdominal CT should allow for lower radiation doses. Further clinical studies are warranted to assess diagnostic impact.

SSGI09-2 Incidentally Detected Pancreatic Duct Dilation On Abdominal Ultrasound: Assessment Of Yield Of Subsequent MRCP

Participants
Abraham Fourie Bezuidenhout, MBChB,MMed, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

The clinical significance and current management of patients with an incidentally detected dilated pancreatic duct (PD) on abdominal ultrasound with no visualized underlying cause are not clear. Our purpose was to assess the diagnostic yield of subsequent MRCP and to identify additional predictors that may be associated with underlying pancreaticobiliary malignancy.*Methods and Materials We included consecutive patients in whom MRCP was performed for further evaluation of an incidentally detected dilated PD on abdominal ultrasound from 2011-2017. We reviewed MRCP scans and retrieved clinical data retrospectively from our hospital information system. Histology or clinical follow-up was used as reference standard. Chi-square test was performed to determine the association between categorical variables.*Results 58 patients were identified with mean age of 65 years, 35 (60%) being female. 36/58 (62%) had PD dilation on MRCP, the others did not. In 17/36 (47%) patients a specific

pancreaticobiliary cause for PD dilation was identified on MRCP [7 (19%) malignant and 10 (28%) benign]. In the remaining 19/36 (53%) patients, no cause was identified. On bivariate analysis, patients with associated common bile duct (CBD) dilation were more likely to have underlying pancreaticobiliary malignancy (p = .002). No patient with initial negative MRCP had pancreaticobiliary malignancy on subsequent work-up.*Conclusions Incidentally detected PD dilation on ultrasound should prompt referral to MRCP. MRCP is an accurate non-invasive method for identifying the underlying cause in these patients and in detecting life threatening pancreaticobiliary malignancy. Patients with associated CBD dilation are more likely to have underlying pancreaticobiliary malignancy.*Clinical Relevance/Application Incidentally detected PD dilatation at US with no sonographically evident cause should not be considered an insignificant finding, as a substantial number of our patients had underlying pancreaticobiliary malignancy.MRCP offers a non-invasive and accurate means to identify the underlying cause of PD dilatation in the majority of these patients and can exclude the presence of pancreaticobiliary malignancy.

RESULTS

58 patients were identified with mean age of 65 years, 35 (60%) being female. 36/58 (62%) had PD dilation on MRCP, the others did not. In 17/36 (47%) patients a specific pancreaticobiliary cause for PD dilation was identified on MRCP [7 (19%) malignant and 10 (28%) benign]. In the remaining 19/36 (53%) patients, no cause was identified. On bivariate analysis, patients with associated common bile duct (CBD) dilation were more likely to have underlying pancreaticobiliary malignancy (p = .002). No patient with initial negative MRCP had pancreaticobiliary malignancy on subsequent work-up.

CLINICAL RELEVANCE/APPLICATION

Incidentally detected PD dilatation at US with no sonographically evident cause should not be considered an insignificant finding, as a substantial number of our patients had underlying pancreaticobiliary malignancy.MRCP offers a non-invasive and accurate means to identify the underlying cause of PD dilatation in the majority of these patients and can exclude the presence of pancreaticobiliary malignancy.

SSGI09-3 Ultrasound Elastography In Pancreatic Transplantation: Normal Values And Its Application In Evaluating Rejection.

Participants
Clara Bassaganyas-Vancells, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

PURPOSE

Rejection is the second cause of pancreatic graft loss after technical complications. Conventional imaging techniques lack sensitivity and specificity to assess rejection. Elastography by Acoustic Radiation Force Impulse (ARFI) quantification is a non-invasive ultrasonographic technique that allows quantification of tissue elasticity. It has been proposed as a complementary tool to detect rejection in liver and kidney transplantation. Unfortunately, there is no data on pancreas transplantation.*Methods and Materials Prospective study including all pancreas transplantations in our center from October 2016 to January 2020. All allografts were evaluated by ARFI (m/s) at 1 week after surgery. Posteriorly, an ARFI evaluation and a protocolized biopsy were performed at 3 weeks and 12 months post-transplantation, and whenever a graft dysfunction was suspected. Allografts with postoperative surgical complications were excluded from the analysis. Grafts were classified according to the biopsy result into two groups (rejection/no rejection). Those cases without biopsy or with an inconclusive biopsy result were classified according to the clinical management. ARFI values were analyzed in each group and compared between them.*Results During this period, 124 ARFI evaluations and 78 biopsies were performed in 54 patients. Three patients were excluded because of postoperative complications (5 evaluations). Both groups showed a high dispersion of the ARFI median values during the first three months: non-rejection group (n=88, 1.52±0.68 m/s) and rejection group (n=31, 1.55±0.46 m/s). These values were attributed to postoperative factors and therefore excluded from the analysis. After the first 3 months, the median ARFI values in the non-rejection group decreased to 0.98±0.32 m/s (n=55), which is similar to values reported in the native pancreas, whereas the rejection group reached a value of 1.45±0.31 m/s (n=16). This difference was found out to be statistically significant (p-value 0.0001). A cut-off value of 1.24 cm/s demonstrated a sensitivity and a specificity of 0.94 and 0.73 respectively (AUC 0.83), for the diagnosis of rejection in grafts older than 3 months.*Conclusions Ultrasound elastography of the pancreatic graft presents high values and dispersion during the first 3 months, probably due to postsurgical factors, making them less reliable. After this period, ARFI may be a useful non-invasive complementary tool to detect pancreatic graft rejection.*Clinical Relevance/Application There are no specific markers to early diagnose pancreatic allograft rejection. ARFI could be a non-invasive tool to detect those cases that may benefit from an early biopsy or an early treatment.

RESULTS

During this period, 124 ARFI evaluations and 78 biopsies were performed in 54 patients. Three patients were excluded because of postoperative complications (5 evaluations). Both groups showed a high dispersion of the ARFI median values during the first three months: non-rejection group (n=88, 1.52±0.68 m/s) and rejection group (n=31, 1.55±0.46 m/s). These values were attributed to postoperative factors and therefore excluded from the analysis. After the first 3 months, the median ARFI values in the non-rejection group decreased to 0.98±0.32 m/s (n=55), which is similar to values reported in the native pancreas, whereas the rejection group reached a value of 1.45±0.31 m/s (n=16). This difference was found out to be statistically significant (p-value 0.0001). A cut-off value of 1.24 cm/s demonstrated a sensitivity and a specificity of 0.94 and 0.73 respectively (AUC 0.83), for the diagnosis of rejection in grafts older than 3 months.

CLINICAL RELEVANCE/APPLICATION

There are no specific markers to early diagnose pancreatic allograft rejection. ARFI could be a non-invasive tool to detect those cases that may benefit from an early biopsy or an early treatment.

SSGI09-4 Personalized Iodine Contrast Algorithm Enabling Optimal And Reproduceable Liver Enhancement: A Prospective Multicenter Study

Participants
Hugues G. Brat, MD, Sion, Switzerland (*Presenter*) Speaker, General Electric Company

PURPOSE

To determine the ability of an iodine contrast optimization algorithm to predict image quality for contrast-enhanced liver CT.*Methods and Materials 254 prospective patients (mean FFM 46.5kg (23.0-66.9), mean age 60.9years (18.3-94.5years)) underwent a standardized multi-phase liver CT examination (kVp range 80-120) in a multicenter imaging network. A patient-specific algorithm based on impedencemetric-determined Fat Free Mass (FFM), tube voltage and contrast media concentration calculated

the appropriate amount of i.v. contrast volume and flow to predict an optimal liver parenchymal enhancement of 40-60 Hounsfield Units (HUtarget). Level of enhancement was determined by attenuation difference between portal and unenhanced parenchyma (HUliver). HUliver histograms were compared to HUtarget through mean and standard deviation (SD). Total amount of iodine dose was estimated by median and interquartile range (IQR) and stratified per contrast media concentration (350_AccupaqueTM/370_IopamirolTM mgI/ml), kVp and gender. Upper and lower limit were set in the algorithm to avoid off label usage of the contrast media (minimal CM dose for AccupaqueTM : 30gI)*Results Mean HUliver was 55.4HU+/-9.7, with 70.4% between 40-60HU and 89.8% between 40-70HU. Median iodine dose was 27.8gI (IQR=6.4gI). Per contrast media type, median iodine dose was 30.2gI/26.4gI for 350/370 iodine concentration (p<0.001). Per kVp, median iodine dose significantly (p<0.01) increased from 18.6/27.8/36.3gI for 80/100/120 kVp. Per gender, women needed significantly lower (p<0.01) dose than men (25.2vs30.2gI).*Conclusions The developed algorithm enabled a diagnostically appropriate and reproduceable mean liver enhancement of 55.4HU, independently of patient habitus, contrast concentration or tube voltage. Lower limit iodine dose due to off label use caused a higher than needed contrast dose for the 350mgI/ml contrast media concentration.*Clinical Relevance/Application Clinical relevance of this patient-to-patient uniformity of liver enhancement translates in significant improvement of liver lesion assessment and reporting accuracy in diagnostic and follow-up CT examinations.

RESULTS

Mean HUliver was 55.4HU+/-9.7, with 70.4% between 40-60HU and 89.8% between 40-70HU. Median iodine dose was 27.8gI (IQR=6.4gI). Per contrast media type, median iodine dose was 30.2gI/26.4gI for 350/370 iodine concentration (p<0.001). Per kVp, median iodine dose significantly (p<0.01) increased from 18.6/27.8/36.3gI for 80/100/120 kVp. Per gender, women needed significantly lower (p<0.01) dose than men (25.2vs30.2gI).

CLINICAL RELEVANCE/APPLICATION

Clinical relevance of this patient-to-patient uniformity of liver enhancement translates in significant improvement of liver lesion assessment and reporting accuracy in diagnostic and follow-up CT examinations.

SSGI09-5 Systematic Review And Meta-analysis Of Diagnostic Performance Of CT For Assessing Resectability Of Pancreatic Ductal Adenocarcinoma After Neoadjuvant Therapy: Importance Of CT Criteria

Participants
Hyun Kyung Yang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To assess the CT diagnostic performance for evaluating resectability of pancreatic ductal adenocarcinoma (PDAC) after neoadjuvant therapy and identify the factor(s) that affect(s) diagnostic performance.*Methods and Materials Databases were searched to identify studies published from January 1, 2000, to November 5, 2019, that evaluated the CT diagnostic performance for assessing resectability of post-neoadjuvant PDAC. Two reviewers independently extracted data and assessed the study quality. A meta-analysis was performed to obtain summary sensitivity and specificity values using a bivariate random-effects model, and heterogeneity across studies was assessed. Univariable meta-regression analysis was performed with eight variables, including the different CT criteria for resectability, conventional National Comprehensive Cancer Network (NCCN) criteria for upfront surgery, and modified criteria for post-neoadjuvant surgery.*Results Ten studies with 311 patients were included and analyzed. The summary sensitivity and specificity for resectability were 78% (95% CI, 68%-86%) and 60% (95% CI, 44%-74%), respectively. No significant heterogeneity was identified (bivariate correlation coefficient ? = -1, p-value for hierarchical summary receiver operating characteristics model ß = 0.667). The two different CT criteria showed different diagnostic performance (p < 0.01), with higher sensitivity (81% [95% CI, 73%-90%] vs. 28% [95% CI, 15%-42%], p < 0.01) and lower specificity (57% [95% CI, 41%-73%] vs. 90% [95% CI, 80%-100%], p < 0.01) for the modified criteria. No other variables affected the diagnostic performance.*Conclusions CT criteria was the only factor that affected the diagnostic performance. Modification of the conventional criteria improved sensitivity but lowered specificity. Further modifications are required to improve specificity and uniformity.*Clinical Relevance/Application When conventional CT criteria for upfront surgery was used to assess resectability of post-neoadjuvant pancreatic ductal adenocarcinoma, sensitivity was low, and specificity was high. When modified CT criteria, considering treatment-related changes, was used to assess resectability of post-neoadjuvant pancreatic ductal adenocarcinoma, sensitivity for identifying R0 resection increased, at the expense of higher likelihood of R1 resection.

RESULTS

Ten studies with 311 patients were included and analyzed. The summary sensitivity and specificity for resectability were 78% (95% CI, 68%-86%) and 60% (95% CI, 44%-74%), respectively. No significant heterogeneity was identified (bivariate correlation coefficient ? = -1, p-value for hierarchical summary receiver operating characteristics model ß = 0.667). The two different CT criteria showed different diagnostic performance (p < 0.01), with higher sensitivity (81% [95% CI, 73%-90%] vs. 28% [95% CI, 15%-42%], p < 0.01) and lower specificity (57% [95% CI, 41%-73%] vs. 90% [95% CI, 80%-100%], p < 0.01) for the modified criteria. No other variables affected the diagnostic performance.

CLINICAL RELEVANCE/APPLICATION

When conventional CT criteria for upfront surgery was used to assess resectability of post-neoadjuvant pancreatic ductal adenocarcinoma, sensitivity was low, and specificity was high. When modified CT criteria, considering treatment-related changes, was used to assess resectability of post-neoadjuvant pancreatic ductal adenocarcinoma, sensitivity for identifying R0 resection increased, at the expense of higher likelihood of R1 resection.

SSGI09-6 Radiomic Features Of Entropy And Uniformity On CT Imaging Correlate With Pancreatic Fibrosis In Patients With Recurrent Acute And Chronic Pancreatitis

Participants
Farhad Pishgar, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To study the association between different radiomic features on CT imaging and pancreatic fibrosis in adult patients with recurrent acute pancreatitis (RAP) or chronic pancreatitis (CP) who underwent total pancreatectomy with islet autotransplantation (TPIAT).*Methods and Materials There were 45 patients with RAP or CP who underwent a contrast-enhanced abdominal CT (CECT) scan prior to TPIAT between 2010 and 2018. The extent and distribution of fibrosis were evaluated using excisional biopsies obtained from the pancreatic head as well as the body/tail at the time of TPIAT, using the Ammann Fibrosis (overall, perilobular, and intralobular) and Japanese Fibrosis (overall, perilobular, interlobular fibrosis, collagen content, sublobular atrophy, and lobular

atrophy) scoring systems. On the contrast-enhanced CT (CECT) before TPIAT, the pancreas was outlined by drawing region of interest (ROI) and 52 radiomic features were extracted from each ROI. Using the correlation matrix followed by hierarchical clustering (5 clusters with =5 features in each cluster), 5 radiomic features showing maximum variability within each cluster were selected. Associations between radiomic features and fibrosis scores were studied using multiple linear regression adjusted for age, sex, and body mass index. Multiple comparisons of the p-values were corrected using the Benjamini-Hochberg method.*Results The mean age of the patients was 37.0±13.4 and 26[57.8%] were women. The degree of fibrosis was the highest in CP (n = 19) followed by ARP (n = 14) followed by suspected CP (n = 12). Of the 52 radiomic features, 5 features (1st order energy, entropy, mean, uniformity, and GLCM autocorrelation) were selected based on maximum variability within each cluster. Entropy and uniformity were associated with overall (ß: 7.1 [2.5 - 11.7] and -7.1 [-11.6 - -2.6], respectively), perilobular, and intralobular fibrosis score. Using the Japanese Fibrosis score, entropy and uniformity were associated with overall (ß: 7.9 [2.4 - 13.4] and -8.2 [-13.6 - -2.9]), perilobular, interlobular fibrosis, collagen content, and lobular atrophy scores.*Conclusions CECT-derived radiomic features of entropy and uniformity are associated with the extent of pancreatic fibrosis in patients with recurrent acute pancreatitis or chronic pancreatitis, showing promise for identifying quantitative biomarkers for pancreatic fibrosis.*Clinical Relevance/Application Radiomic features derived from CECT scans before the TPIAT are associated with the extent of pancreatic fibrosis in patients with pancreatitis. The noninvasive diagnosis of fibrosis could have a myriad of clinical applications.

RESULTS

The mean age of the patients was 37.0±13.4 and 26[57.8%] were women. The degree of fibrosis was the highest in CP (n = 19) followed by ARP (n = 14) followed by suspected CP (n = 12). Of the 52 radiomic features, 5 features (1st order energy, entropy, mean, uniformity, and GLCM autocorrelation) were selected based on maximum variability within each cluster. Entropy and uniformity were associated with overall (ß: 7.1 [2.5 - 11.7] and -7.1 [-11.6 - -2.6], respectively), perilobular, and intralobular fibrosis score. Using the Japanese Fibrosis score, entropy and uniformity were associated with overall (ß: 7.9 [2.4 - 13.4] and -8.2 [-13.6 - -2.9]), perilobular, interlobular fibrosis, collagen content, and lobular atrophy scores.

CLINICAL RELEVANCE/APPLICATION

Radiomic features derived from CECT scans before the TPIAT are associated with the extent of pancreatic fibrosis in patients with pancreatitis. The noninvasive diagnosis of fibrosis could have a myriad of clinical applications.

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Participants

Xin Wu, MD, Atlanta, Georgia (*Moderator*) Nothing to Disclose

Sub-Events

SSHN02   Keynote Speaker

Participants

Ashley H. Aiken, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

SSHN02-2   Dose-efficient Temporal Bone Imaging Using High-resolution Photon-counting Detector (PCD) CT

Participants

John I. Lane, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate improved spatial resolution/critical structure visualization for temporal bone imaging using a photon-counting-detector (PCD) CT system.*Methods and Materials Patients referred for clinically indicated temporal bone CT were scanned on a conventional energy-integrating detector (EID) CT using our routine clinical protocol (120 kV, comb-based ultra-high-resolution (ultra-HR), CTDIvol = 55 mGy) and an investigational PCD-CT system (SOMATOM Count Plus, Siemens Healthineers, 120 kV, non-comb-based HR, CTDIvol = 35.7 mGy). CT images were reconstructed in axial, coronal and Poschl planes using the smallest available slice thickness (0.4 mm for EID-CT, 0.2 mm for PCD-CT). Images were reconstructed using Ur77 (EID-CT) and Hr84 (PCD-CT) kernels to maximize spatial resolution at acceptable noise levels. Two radiologists blindly evaluated randomized and paired EID-CT and PCD-CT images, and scored PCD-CT against EID-CT. Critical structures (round window, incudomallear joint, modiolus, oval window, scutum and incudostapedial joint, as well as ossicular prosthesis when present) were individually scored for spatial resolution/visualization, and a final overall score given for statistical evaluation. Image scoring was performed using a 5-point Likert scale (1 = inferior resolution with degraded visualization, 2 = slightly inferior resolution without affecting visualization, 3 = equivalent resolution and visualization, 4 = slightly superior resolution without affecting visualization, 5 = superior spatial resolution with improved visualization). Wilcoxon rank-sum test was used for statistical analysis, and descriptive analyses (mean and median scores) were performed for individual critical structures.*Results A total of 13 patients were enrolled. CT images were reconstructed separately for left and right sides, yielding 26 image sets for evaluation. Despite a 35% decrease in the CT dose, HR images from PCD-CT were significantly preferred over EID-CT (p < 0.0001) with a mean overall score of 4.62 (individual median score of 5 for PCD-CT from both readers).*Conclusions Reduced dose PCD-CT demonstrated significantly better spatial resolution/visualization for temporal bone structures compared to conventional EID-CT.*Clinical Relevance/Application Substantially better visualization of critical structures within the temporal bone from PCD-CT may yield superior diagnostic capabilities in evaluation of the inner ear.

RESULTS

A total of 13 patients were enrolled. CT images were reconstructed separately for left and right sides, yielding 26 image sets for evaluation. Despite a 35% decrease in the CT dose, HR images from PCD-CT were significantly preferred over EID-CT (p < 0.0001) with a mean overall score of 4.62 (individual median score of 5 for PCD-CT from both readers).

CLINICAL RELEVANCE/APPLICATION

Substantially better visualization of critical structures within the temporal bone from PCD-CT may yield superior diagnostic capabilities in evaluation of the inner ear.

SSHN02-3   Combining CT Radiomic And Pathomic Features From H;E Tissue Images For Prognosticating Outcome In P16+ Oropharyngeal Squamous Cell Carcinoma

Participants

Bolin Song, MS, Cleveland, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

The current paradigm for low-risk patients with p16+ oropharyngeal squamous cell carcinoma (OPSCC) is to reduce the dosage of radio-chemo therapy (treatment de-intensification). The purpose of this study was to combine the pathomic features from digitized H&E images with CT radiomic features to create a prognostic classifier that could enable accurate risk stratification of p16+ OPSCC patients.*Methods and Materials 304 p16+ OPSCC cases from three institutions (N1=100, N2=94, and validation cohort N3=110) were included in this study. The radiomic signature capturing tumor CT textural heterogeneity was trained on pre-treatment CT scans from N1. The tumor infiltrating lymphocytes (TILs)-related features (pathomic) were trained on N2, which quantifies the spatial arrangement of the TILs proximity using network graph metrics. Next, 3 radiomic and 5 pathomic features most associated with disease-free survival (DFS) were identified from N1 and N2, respectively, and used to train Cox regression models. Median of the radiomic and pathomic signatures from N1, N2 were used as cut-off for defining high vs low-risk groups. We then applied the consensus clustering on isomap embedding of the rad-pathomic features on N3, from which two patient clusters were generated.

Kaplan-Meier survival analysis was used to quantify the DFS difference between risk groups or clusters (Figure 1).*Results Hazard ratios (HR) for comparing DFS of high vs low-risk groups for the radiomic and the pathomic signatures in validation cohort N3 are 1.99 (95% CI, 0.896-4.42, p=0.0912) and 2.37 (95% CI, 1.09-5.16, p=0.0302). The two clusters from isomap of rad-pathomic resulted in an improved HR of 3.36 (95% CI, 1.52-7.39, p=0.00264). The rad-pathomic consensus matrix approach yielded higher sensitivity (0.88) in detecting recurrence than either individual radiomic (0.76) or pathomic signatures (0.76).*Conclusions Combing CT radiomic features with pathomic features from H&E slides enabled improved prognosis prediction for p16+ OPSCC.*Clinical Relevance/Application With additional validation, the fused rad-pathomic signature could allow for identifying p16+ OPSCC patients who will benefit from treatment de-intensification.

RESULTS

Hazard ratios (HR) for comparing DFS of high vs low-risk groups for the radiomic and the pathomic signatures in validation cohort N3 are 1.99 (95% CI, 0.896-4.42, p=0.0912) and 2.37 (95% CI, 1.09-5.16, p=0.0302). The two clusters from isomap of rad-pathomic resulted in an improved HR of 3.36 (95% CI, 1.52-7.39, p=0.00264). The rad-pathomic consensus matrix approach yielded higher sensitivity (0.88) in detecting recurrence than either individual radiomic (0.76) or pathomic signatures (0.76).

CLINICAL RELEVANCE/APPLICATION

With additional validation, the fused rad-pathomic signature could allow for identifying p16+ OPSCC patients who will benefit from treatment de-intensification.

SSHN02-4   Impact Of Acceleration On Bone Depiction Quality By Ultrashort Echo Time Magnetic Resonance Bone Imaging Sequences In Medication-related Osteonecrosis Of The Jaw

Participants
Jonas Getzmann, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To assess the impact on bone depiction quality by decreasing number of radial acquisitions (RA) of an ultrashort echo time (UTE) magnetic resonance (MR) bone imaging sequence in medication-related osteonecrosis of the jaw (MRONJ).*Methods and Materials UTE MR bone imaging sequences using pointwise encoding time reduction with RA (PETRA) with 60'000, 30'000 and 10'000 RA were prospectively acquired in 16 patients with clinically confirmed MRONJ and in a control group of 16 healthy volunteers. Blinded readout sessions were performed by two radiologists. Qualitative analysis of the different image series was performed by comparing the detection of osteolytic lesions and productive bony changes (medullary osteosclerosis or periosteal thickening) in the different PETRA sequences of the patients with MRONJ. Quantitative analysis was performed by comparing the different sequences in the control group with regard to differences in image artifacts, contrast-to-noise ratio (CNR) and image noise. Cohen's kappa (?) was used to assess interreader agreement. Standard statistical tests were used for sequence comparison.*Results Acquisition times were reduced from 315 to 165 and 65 seconds (60'000, 30'000, 10'000 RA, respectively), resulting in a fewer number of severe motion artifacts. Bone delineation was significantly different among PETRA sequences (P < 0.05) with increasingly blurred appearance when reducing the number of RA but without any trade-off in terms of diagnostic performance. Interreader agreement for the detection of pathognomonic osteolysis was moderate (? = 0.538) for 60'000 RA and decreased to fair (? = 0.227 and ? = 0.390) when comparing 30'000 and 10'000 RA, respectively. Image quality between sequences was comparable regarding CNR, image noise and artifact dimensions without significant differences (all P > 0.05).*Conclusions UTE MR bone imaging sequences with a lower number of RA provide sufficient image quality for detecting osteolytic lesions and productive bony changes in MRONJ subjects at faster acquisition times compared to the respective standard UTE MR bone imaging sequence.*Clinical Relevance/Application UTE MR bone imaging sequences with a lower number of radial acquisitions allow for shorter image acquisitions with fewer motion artifacts which can be essential in the older MRONJ patient population.

RESULTS

Acquisition times were reduced from 315 to 165 and 65 seconds (60'000, 30'000, 10'000 RA, respectively), resulting in a fewer number of severe motion artifacts. Bone delineation was significantly different among PETRA sequences (P < 0.05) with increasingly blurred appearance when reducing the number of RA but without any trade-off in terms of diagnostic performance. Interreader agreement for the detection of pathognomonic osteolysis was moderate (? = 0.538) for 60'000 RA and decreased to fair (? = 0.227 and ? = 0.390) when comparing 30'000 and 10'000 RA, respectively. Image quality between sequences was comparable regarding CNR, image noise and artifact dimensions without significant differences (all P > 0.05).

CLINICAL RELEVANCE/APPLICATION

UTE MR bone imaging sequences with a lower number of radial acquisitions allow for shorter image acquisitions with fewer motion artifacts which can be essential in the older MRONJ patient population.

SSHN02-5   The Impact Of Surveillance Imaging On Mortality For Head And Neck Squamous Cell Carcinoma (hnscc): The Analysis Of The State Cancer Registry And All-payer Claims Data

Participants
Yoshimi Anzai, MD,MPH, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

PURPOSE

The goal of surveillance cancer imaging is to detect early recurrence before clinical symptoms. Following treatment, anatomical distortion or inflammatory changes make clinical evaluation challenging. Currently, there is no high level of evidence to support clinical guideline on whether surveillance imaging improves mortality among HNC patients. Single-institution studies are often biased due to regional practice patterns and physicians' preferences for imaging use. The purpose of this study is to investigate whether surveillance imaging improves mortality for head and neck squamous cell carcinoma (HNSCC) using the statewide cancer registry data, All-Payer Claims data, statewide healthcare facility data, and electronic health records.*Methods and Materials We identified a cohort of 902 HNSCC patients diagnosed between 2012-2017 in the Utah Cancer Registry. We used CPT codes to identify surveillance imaging procedures, including CT, MRI, and PET/CT. Cox proportional hazards models were used to estimate hazard ratios (HR) and 95% confidence intervals (CI) for the risk of death with adjustment for potential confounders, including sex, race/ethnicity, age at cancer diagnosis, rural residence, health insurance, diagnosis year, cancer sequence number, cancer stage, and cancer subsite.*Results HNSCC patients who had surveillance imaging codes did not have overall lower mortality compared to patients who did not have surveillance imaging codes after the end of cancer treatment (Fig 1) (HR: 0.78, 95%CI: 0.58, 1.05). In the stratified analyses by cancer stage, the risk of death was lower among patients with surveillance imaging for regionalized cancer stage (HR: 0.61, 95%CI: 0.40, 0.94), and distant cancer stage (HR: 0.33, 95%CI: 0.16, 0.67). The protective association

was observed in the first two years and the first 5 years from the end of cancer treatment.*Conclusions The State Cancer Registry and population data analysis demonstrates the protective effects of the surveillance imaging among HNSCC patients with the regionalized or distant disease by SEER staging. The protective association was observed up to 5 years after the completion of treatment.SEER cancer staginghttps://training.seer.cancer.gov/staging/systems/summary/*Clinical Relevance/Application This state cancer registry study suggests that surveillance imaging reduces the mortality of patients with HNSCC with regionalized and distance cancer stages, adjusted for confounding variables.

RESULTS

HNSCC patients who had surveillance imaging codes did not have overall lower mortality compared to patients who did not have surveillance imaging codes after the end of cancer treatment (Fig 1) (HR: 0.78, 95%CI: 0.58, 1.05). In the stratified analyses by cancer stage, the risk of death was lower among patients with surveillance imaging for regionalized cancer stage (HR: 0.61, 95%CI: 0.40, 0.94), and distant cancer stage (HR: 0.33, 95%CI: 0.16, 0.67). The protective association was observed in the first two years and the first 5 years from the end of cancer treatment.

CLINICAL RELEVANCE/APPLICATION

This state cancer registry study suggests that surveillance imaging reduces the mortality of patients with HNSCC with regionalized and distance cancer stages, adjusted for confounding variables.

SSIN03

Informatics (Machine Learning (Clinical Applications and Collaborative Initiatives))

Participants

Mariam Aboian, MD, PhD, New Haven, Connecticut (*Moderator*) Nothing to Disclose

Sub-Events

SSIN03-2   The Federated Tumor Segmentation Initiative: The First Real-world Large-scale Federation Focusing On Neurooncology

Participants

Sarthak Pati, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Towards ensuring robustness and generalizability of artificial intelligent (AI) methods, ample and diverse multi-site patient datasets are desired. However, various factors hinder access to such data in the current paradigm of multi-site collaborations, such as data ownership & legal considerations. To address these, we introduce the Federated Tumor Segmentation (FeTS) Initiative, which includes an open-source package for collaborative learning of AI methods across multiple international sites using federated learning (FL). FL is a novel paradigm for data-private multi-site collaborations, where AI models leverage available data at participating sites, without sharing data between them. As an initial use-case, FeTS focused on the quantification and detection of brain tumor boundaries in MRI scans.*Methods and Materials We designed the FeTS tool with 4 modes of operation: 1) MRI data pre-processing, including co-registration to an anatomical atlas & brain extraction, 2) delineation of brain tumor sub-regions by label fusion of a library of top-performing pretrained models in the BraTS challenge, 3) drawing tools to manually refine the delineations, and 4) federated model training using the OpenFL library. 60 international collaborating sites identified local retrospective data of glioblastoma patients and after using the first 3 modes of operation of FeTS they generated the ground truth labels for the apparent tumor sub-regions. They then trained the same AI model architecture on their local data, and share the model weight updates to an aggregator, which combines the updates from all collaborators to generate a consensus model and shares it back.*Results For the initial training of the FeTS consensus model, 23 institutions participated with data of 2200 glioblastoma patients. We observe an improvement of 11.1% in the accuracy of the model on each collaborator's validation data when compared to a model trained on the publicly available BraTS data.*Conclusions There is no data sharing across participating sites and the final consensus FeTS model will be made publicly available for further research and analyses. From the initial training phase, the model performance is expected to improve further when trained with all 60 institutions, as supported by our preliminary findings. FeTS enables training an AI model with knowledge from data of geographically distinct collaborators, without ever having to share the data, overcoming hurdles relating to legal, ownership, and technical concerns.*Clinical Relevance/Application Federated Learning allows training of AI models using diverse datasets without sharing the data. This would result in more robust models without stepping on ethical dilemmas.

RESULTS

For the initial training of the FeTS consensus model, 23 institutions participated with data of 2200 glioblastoma patients. We observe an improvement of 11.1% in the accuracy of the model on each collaborator's validation data when compared to a model trained on the publicly available BraTS data.

CLINICAL RELEVANCE/APPLICATION

Federated Learning allows training of AI models using diverse datasets without sharing the data. This would result in more robust models without stepping on ethical dilemmas.

SSIN03-4   Analysis Of Changes In Follow-up Liver Metastases In Cect By Automatic Volumetric Simultaneous Deep Learning Classification

Participants

Leo Joskowicz, Jerusalem, Israel (*Presenter*) Officer, HighRAD Ltd

PURPOSE

To evaluate the performance of a novel method that identifies and analyzes the changes of the volume of liver metastasis in contrast enhanced abdominal CT (CECT) between the current and the prior scans by deep learning classification performed simultaneously.*Methods and Materials We developed a novel end-to-end method for the automatic identification and comprehensive quantification of volumetric changes in liver metastases between current and prior CECT scans by simultaneous (analysis of both scans concurrently) deep learning volumetric lesion changes classification. The method consist of five steps: 1) liver region of interest (ROI) segmentation in each scan; 2) pairwise liver ROI deformable registration; 3) simultaneous liver metastases detection and segmentation in the liver ROIs with a new simultaneous 3D U-Net classifier; 4) liver metastases changes detection by bipartite lesions matching; 5) liver metastases changes analysis by computation of volumetric changes of each metastasis between the prior and the current scans.We evaluated our method with 68 pairs of retrospective clinical CECT scans (50 used for training and validation, 18 used for testing) of patients with metastatic (breast, colon, pancreas) disease with a total of 2,042 liver metastases manually delineated by an expert radiologist. We quantified the performance on the test set by comparing it to a standalone method (separate analysis of each scan) with a standard 3D U-Net trained on 102 CECT other scans with a total

of 1,739 liver metastases manually delineated by an expert radiologist. We reported the liver metastasis Precision/Recall detection and the segmentation Dice coefficient.*Results The simultaneous method Precision/Recall outperforms the standalone method by 5.5/24.1% and 20.5/2.2% for liver metastases of diameter > 5mm and > 10mm, respectively: simultaneous Precision/Recall of 0.76/0.75 (std=0.28/0.24) and 0.94/0.93 (std=0.13/0.16) vs standalone Precision/Recall of 0.72/0.72 (std=0.26/0.19) and 0.78/0.91 (std=0.23/0.15) respectively. The simultaneous segmentation Dice coefficient also outperforms the standalone one by 5.1% and 7.3% for liver metastases of diameter > 5mm and > 10mm, respectively: simultaneous 0.81 (std=0.2) and 0.88 (0.08) vs standalone 0.78 (std=0.1) and 0.82 (0.09) respectively.*Conclusions Simultaneous deep learning based detection and quantitative analysis of liver metastases follow-up changes analysis in CECT outperforms standard standalone detection.*Clinical Relevance/Application Computer-aided liver metastases volume change analysis by simultaneous analysis of the current and prior CECT scans may improve the estimation of changes in neoplastic involvement of the liver and the accuracy of disease status evaluation.

RESULTS

The simultaneous method Precision/Recall outperforms the standalone method by 5.5/24.1% and 20.5/2.2% for liver metastases of diameter > 5mm and > 10mm, respectively: simultaneous Precision/Recall of 0.76/0.75 (std=0.28/0.24) and 0.94/0.93 (std=0.13/0.16) vs standalone Precision/Recall of 0.72/0.72 (std=0.26/0.19) and 0.78/0.91 (std=0.23/0.15) respectively. The simultaneous segmentation Dice coefficient also outperforms the standalone one by 5.1% and 7.3% for liver metastases of diameter > 5mm and > 10mm, respectively: simultaneous 0.81 (std=0.2) and 0.88 (0.08) vs standalone 0.78 (std=0.1) and 0.82 (0.09) respectively.

CLINICAL RELEVANCE/APPLICATION

Computer-aided liver metastases volume change analysis by simultaneous analysis of the current and prior CECT scans may improve the estimation of changes in neoplastic involvement of the liver and the accuracy of disease status evaluation.

SSIN03-6   Deep Learning DXA-age From Whole-body Dual-energy Absorptiometry (DEXA) Images: Prediction Of Incident Morbidity And Mortality Versus Chronological Age In The UK Biobank

Participants
Vineet Raghu, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Chronological age is an imperfect measure of biologic processes underlying aging-related diseases. Image-based estimates of age may more accurately assess underlying aging processes and improve risk assessment. We tested whether deep learning could use a whole-body dual energy absorptiometry (DXA) image to estimate a DXA-Age in years, and whether this DXA-Age was associated with incident morbidity and mortality beyond prevalent risk factors.*Methods and Materials We developed an ensemble convolutional neural network model to estimate DXA-Age using baseline whole body DXA images from 7,582 individuals in the UK Biobank, an observational study of healthy volunteers in the UK. Labels for model training were based on age-at-death for those who died during follow-up and estimated age-at-death using an externally derived survival model for those who survived. 31,948 additional UK Biobank participants were reserved as an independent testing dataset. Continuous DXA-Age estimates in years were converted into three risk groups (Low: DXA-Age more than 3 years younger than chronological age, Medium: DXA-Age within 3 years, and High: DXA-Age more than 3 years older). Cox proportional hazards regression was used to test the association between ordinal risk groups and incident morbidity and mortality adjusted for chronological age, sex, smoking, Charlson co-morbidity index, prevalent diabetes, prevalent hypertension, and body composition indices (height, weight, waist circumference, and BMI). Results are provided for the testing dataset only.*Results In the testing dataset (N = 31,948; mean age 64.6±7.5; 51.7% female;mean follow-up time 2.5±1.2 years), individuals in the high-risk groupaccording to DXA-Age were at higher risk than the low-risk group for all-cause mortality(aHR 2.99 95% CI [1.5,5.9]; p < 0.001), incident cardiovascular disease (aHR1.35 [0.9,2.0], p = 0.12), incident type 2 diabetes (aHR 2.76 [1.6,4.6], p <0.001) and incident cancer (aHR 2.11 [1.4,3.1], p < 0.001) after adjustment.*Conclusions Based on a whole-body DXA image, a deep learning model can estimate a DXA-Age that predicts incident morbidity and mortality beyond chronological age, body composition, and risk factors, suggesting it might be capturing an element of biological aging.*Clinical Relevance/Application DXA-Age may help direct prevention and screening interventions to those at high-risk for chronic disease.

RESULTS

In the testing dataset (N = 31,948; mean age 64.6±7.5; 51.7% female;mean follow-up time 2.5±1.2 years), individuals in the high-risk groupaccording to DXA-Age were at higher risk than the low-risk group for all-cause mortality(aHR 2.99 95% CI [1.5,5.9]; p < 0.001), incident cardiovascular disease (aHR1.35 [0.9,2.0], p = 0.12), incident type 2 diabetes (aHR 2.76 [1.6,4.6], p <0.001) and incident cancer (aHR 2.11 [1.4,3.1], p < 0.001) after adjustment.

CLINICAL RELEVANCE/APPLICATION

DXA-Age may help direct prevention and screening interventions to those at high-risk for chronic disease.

Printed on: 06/28/22

Participants

Michelle Williams, MBCHB, BSC, Kelso, United Kingdom (*Moderator*) Speaker bureau for Canon Medical Systems and Siemens Healthineers.
Jill Jacobs, MD, New York, New York (*Moderator*) Nothing to Disclose

Sub-Events

SSCA09-1 Diagnostic Accuracy And Prognostic Significance Of Coronary Artery Calcification On Contrast-enhanced Versus Non-contrast Chest CT In Relation To Agatston Calcium Scores

Participants

Camila Urzua Fresno, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the diagnostic accuracy and prognostic value of coronary artery calcification (CAC) on contrast enhanced (CE) and non-contrast (NC) non-gated chest CT in comparison to Agatston CAC scores.*Methods and Materials Consecutive patients who underwent non-gated chest CT and cardiac CT within a 6-month interval between 2010-2014 were included. A blinded observer scored CAC visually on chest CT using an ordinal scale (absent, mild, moderate or severe). Agatston calcium scores were evaluated on cardiac CT using dedicated post-processing software according to established guidelines. Major adverse cardiac events (MACE) were assessed as a composite of cardiovascular death and myocardial infarction. Statistical analysis included Spearman correlation and Cox proportional hazards models.*Results 260 patients were included (60±11 years, 61% male, 45% CE chest CT) with median follow-up of 5.5 years. Agatston CAC scores correlated strongly with ordinal visual CAC scores on both CE (r=0.94, p<0.001) and NC chest CT (r=0.93, p<0.001). CE and NC chest CT both had high sensitivity (83% [62/75] and 90% [85/95], respectively) and specificity (100% [41/41] and 100% [49/49], respectively) for presence of CAC on cardiac CT. Diagnostic accuracy did not differ significantly between CE and NC chest CT (p=0.21). CAC was misclassified as absent on 13 CE and 10 NC chest CTs; in all cases the Agatston score was very low (<30) and none of these patients experienced MACE. CAC was strongly associated with MACE on both cardiac CT (HR 1.04, 95%CI 1.01-1.06, p=0.010) and chest CT (HR 2.7, 95%CI 1.5-4.8, p=0.001). Severe CAC on chest CT was associated with 12 times higher risk of MACE compared to no CAC (HR 12.5, 95%CI 2.5-63, p=0.002).*Conclusions Simple ordinal visual assessment of CAC on contrast-enhanced and non-contrast chest CT has high diagnostic accuracy and is strongly associated with adverse outcomes, comparable to Agatston calcium scoring. Assessment and reporting of CAC on all chest CT studies could identify a large number of patients who might not otherwise have been considered candidates for preventative medical therapy, but who may receive a benefit from treatment.*Clinical Relevance/Application Current guidelines recommend evaluation of CAC on non-contrast chest CT only. This data suggests that assessment of CAC using a simple visual ordinal scale should be recommended on all chest CT studies.

RESULTS

260 patients were included (60±11 years, 61% male, 45% CE chest CT) with median follow-up of 5.5 years. Agatston CAC scores correlated strongly with ordinal visual CAC scores on both CE (r=0.94, p<0.001) and NC chest CT (r=0.93, p<0.001). CE and NC chest CT both had high sensitivity (83% [62/75] and 90% [85/95], respectively) and specificity (100% [41/41] and 100% [49/49], respectively) for presence of CAC on cardiac CT. Diagnostic accuracy did not differ significantly between CE and NC chest CT (p=0.21). CAC was misclassified as absent on 13 CE and 10 NC chest CTs; in all cases the Agatston score was very low (<30) and none of these patients experienced MACE. CAC was strongly associated with MACE on both cardiac CT (HR 1.04, 95%CI 1.01-1.06, p=0.010) and chest CT (HR 2.7, 95%CI 1.5-4.8, p=0.001). Severe CAC on chest CT was associated with 12 times higher risk of MACE compared to no CAC (HR 12.5, 95%CI 2.5-63, p=0.002).

CLINICAL RELEVANCE/APPLICATION

Current guidelines recommend evaluation of CAC on non-contrast chest CT only. This data suggests that assessment of CAC using a simple visual ordinal scale should be recommended on all chest CT studies.

SSCA09-3 Machine Learning For Time-to-Event Analysis In Patients With Suspected Coronary Artery Disease: Increased Long-term Prognostic Value Of Coronary CT Angiography-derived Measures And Clinical Parameters

Participants

Maximilian Bauer, MEd, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To assess the long-term prognostic value of machine learning (ML) in time-to-event analyses on coronary CT angiography (CCTA)-derived measures and clinical parameters.*Methods and Materials Datasets of 5457 patients (61.1 ± 11.1 years, 66.8% male) with suspected coronary artery disease who underwent CCTA were retrospectively analyzed. Major adverse cardiovascular events (MACE) were defined as composite of all-cause death, myocardial infarction, instable angina, or late revascularization (>90 days after index scan). Demographic parameters, clinical cardiovascular risk factors, CCTA-derived plaque features, and established CCTA-derived risk scores were assessed as predictors of MACE and incorporated into two models: a) A Cox proportional hazards

(CPH) model with recursive feature elimination as reference. b) A ML model based on random survival forests with log-rank as splitting rule. Both models were trained and validated employing repeated nested cross-validation. Harrell's concordance index (C-index) was used to assess the predictive power.*Results During the median follow-up of 7.3 years (IQR: 4.5 - 9.8 years), MACE was observed in 304 patients (5.6 %). The predictive power of the ML model (C-index 0.74 [95%CI 0.71-0.76]) was significantly higher compared to the CPH model (C-index 0.71 [95%CI 0.68-0.74], p=0.02). The ML model also outperformed single CCTA-derived parameters (C-indices 0.44-0.69, all p<0.001) including the segment stenosis score (C-index 0.69 [95%CI 0.66-0.72], p<0.001) and the number of segments with spotty calcifications (C-index 0.66 [95%CI 0.63-0.69], p<0.001). Similar results were observed compared to the clinical predictors (C-indices 0.48-0.66, all p<0.001) including patients' age (C-index 0.66 [95%CI 0.63-0.69], p<0.001) and the Framingham risk score (C-index 0.65 [95%CI 0.62-0.69], p<0.001).*Conclusions ML-based time-to-event analysis was found to predict MACE more accurately than existing clinical or CCTA-derived metrics and a conventional Cox-based model integrating these features.*Clinical Relevance/Application ML may improve risk stratification by enhanced integration of clinical and CCTA-derived risk predictors. Despite efforts to incorporate plaque analysis into the evaluation of CCTA data, the clinical relevance of CCTA-based risk stratification so far has been limited. By introducing time-to-event analysis to machine learning models that integrate clinical and CCTA-derived predictors, our approach has the potential to increase the precision of personalized risk predictions.

RESULTS

During the median follow-up of 7.3 years (IQR: 4.5 - 9.8 years), MACE was observed in 304 patients (5.6 %). The predictive power of the ML model (C-index 0.74 [95%CI 0.71-0.76]) was significantly higher compared to the CPH model (C-index 0.71 [95%CI 0.68-0.74], p=0.02). The ML model also outperformed single CCTA-derived parameters (C-indices 0.44-0.69, all p<0.001) including the segment stenosis score (C-index 0.69 [95%CI 0.66-0.72], p<0.001) and the number of segments with spotty calcifications (C-index 0.66 [95%CI 0.63-0.69], p<0.001). Similar results were observed compared to the clinical predictors (C-indices 0.48-0.66, all p<0.001) including patients' age (C-index 0.66 [95%CI 0.63-0.69], p<0.001) and the Framingham risk score (C-index 0.65 [95%CI 0.62-0.69], p<0.001).

CLINICAL RELEVANCE/APPLICATION

ML may improve risk stratification by enhanced integration of clinical and CCTA-derived risk predictors. Despite efforts to incorporate plaque analysis into the evaluation of CCTA data, the clinical relevance of CCTA-based risk stratification so far has been limited. By introducing time-to-event analysis to machine learning models that integrate clinical and CCTA-derived predictors, our approach has the potential to increase the precision of personalized risk predictions.

SSCA09-6   Using Machine-learning Based CAD-RADS From Radiological Reports And Non-curated Electronic Medical Records Data For Adverse Cardiac Events Prediction

Participants
Marly van Assen, MSc, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this retrospective study is to evaluate whether integration of standard Coronary Artery Disease Reporting & Data System score (CADRADs) extracted from radiology reports and non-curated data from the electronic medical records (EMR) can be used as a predictor for forecasting 5-year risk of adverse cardiac events (ACE) using a machine learning (ML) approach.*Methods and Materials This study included CCTA images of 2407 patients (55% male, mean age 57 years). Two groups of ACE, ischemic ACE (ICD-10:I20-25) and other ACE (ICD-10:I30-39) within 5 years of CCTA were considered as targeted outcome. A Natural Language Processing model which achieved high precision for the same task against expert evaluation, was used to extract CADRADs from structured (formatted using CADRADs) and unstructured (historical) radiology reports. We designed a multimodal ML model that used EMR data such as demographics, co-morbidities (based on ICD and CTP codes), medications, and laboratory test results; all recorded before the day of CCTA exam. Two type of fusion models were evaluated, an early fusion model where features from all EMR modalities were concatenated, normalized, and processed through a predictor; and a late fusion model where cardiac event probabilities, estimated using individual predictors for each EMR modality, were concatenated and passed through a meta-learner for prediction. An XGBoost was used for early fusion and as meta-learner for late fusion. We fine-tuned hyper-parameters using grid-search. The models were evaluated using standard statistical metrics - accuracy and F1 scores.*Results A total of 331(14%) and 400(17%) patients had ischemic ACE or other ACE, respectively. Using CADRADs for the prediction of outcome resulted in an accuracy of 0.68 and 0.74 for ischemic ACE and other ACE. F1-scores for no events were 0.79 and 0.84 for both outcome classes and F1-scores for events were 0.32 and 0.19, respectively. The early/late fusion models resulted in a similar accuracy of 0.68/0.62 and 0.75/0.72 for ischemic ACE, and other ACE, respectively. F1-scores for no events were 0.79/0.75 and 0.84/0.82 for both outcome classes and F1-scores for events were 0.38/0.27 and 0.43/0.3, respectively.*Conclusions ML-CADRADS and non-curated EMR data could predict adverse cardiac events with moderate accuracy. EMR model shows better performance for event prediction, since a large amount of clinical data are included in comparison with report-derived CADRADs. The early/late fusion models resulted in a similar prediction accuracy.*Clinical Relevance/Application Using ML on multi-modal non-curated data is a time-efficient way to assess cardiac event risk. This approach uses a wide variety of clinical, lab and imaging variables without requiring human labor.

RESULTS

A total of 331(14%) and 400(17%) patients had ischemic ACE or other ACE, respectively. Using CADRADs for the prediction of outcome resulted in an accuracy of 0.68 and 0.74 for ischemic ACE and other ACE. F1-scores for no events were 0.79 and 0.84 for both outcome classes and F1-scores for events were 0.32 and 0.19, respectively. The early/late fusion models resulted in a similar accuracy of 0.68/0.62 and 0.75/0.72 for ischemic ACE, and other ACE, respectively. F1-scores for no events were 0.79/0.75 and 0.84/0.82 for both outcome classes and F1-scores for events were 0.38/0.27 and 0.43/0.3, respectively.

CLINICAL RELEVANCE/APPLICATION

Using ML on multi-modal non-curated data is a time-efficient way to assess cardiac event risk. This approach uses a wide variety of clinical, lab and imaging variables without requiring human labor.

Abstract Archives of the RSNA, 2021

Participants
Edward Y. Kim, MD, Seattle, Washington (*Moderator*) Nothing to Disclose
Anna Shapiro, MD, Syracuse, New York (*Moderator*) Nothing to Disclose

Sub-Events

SSRO03-1   Follow-up Imaging In Patients Operated For Ovarian Cancer; Is It Really Necessary When Ca 125 Levels Are Normal? A Preliminary Study

Participants
Riccardo Valletta, MD, Verona, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To correlate follow-up CT and PET-CT imaging findings in patients who underwent surgery for malignant ovarian neoplasms with CA 125 serum levels at the moment of examination.*Methods and Materials We included in our IRB-approved retrospective study 33 consecutive patients (mean age 58 ± 14 years) with histologically proven malignant ovarian neoplasms (21 serous carcinomas, 7 endometrioid carcinomas and 4 mucinous carcinomas) who underwent oncologic surgery and follow-up in our institution. Pre- and post-operative CA 125 serum levels were retrieved from institutional database. Two radiologists, unaware of clinical and laboratory data, independently analyzed CT and PET-CT examinations performed during follow-up. Every examination was classified as negative or positive for the presence of disease; moreover, the disease trend was classified as complete response (CR), partial response (PR), stable disease (SD) or progressive disease (PD). Discrepancies were solved by consensus. Imaging findings were finally compared with serum CA 125 levels at the moment of examination (±15 days) and with their trend (stable/decrease/increase).*Results We examined 83 CTs (0,83 CT per patient per year) and 60 PET-CTs (0,49 PET-CT per patient per year). At the moment of examination, serum CA 125 levels were normal (<35 U/mL) in 97/143 cases (68%) and above the limit (=35 U/m) in 46/143 cases (32%). When serum CA 125 levels were normal we observed 96/97 cases of CR (96%) and 4/97 cases of PD (4%). When a PD was observed with normal serum CA 125 levels in 1 case it resulted to be a false positive whereas in the remaining 3 cases the marker serum levels showed a significant increase in comparison to the previous levels. When serum CA 125 levels were above the limit we observed 29/46 cases of PD (63%), 7/46 cases of SD (15%), 4/46 cases of PR (9%) and 6/46 cases of CR (13%). In 38 cases the serum CA 125 levels rised above the limit in comparison to the prior serum levels and imaging showed a PD in 32 cases (84%); in the remaining 6 cases a PD was found in the subsequent radiological examination.*Conclusions In no patient with normal serum CA 125 serum levels at the moment of imaging CT/PET-CT showed the presence of disease. Therefore, imaging is not indicated in the follow-up of patients treated for malignant ovarian cancer if CA 125 serum levels are normal.*Clinical Relevance/Application CT/PET-CTs examinations should be avoided in the follow up of patients treated for malignant ovarian neoplasms until CA 125 serum values are normal, reducing both radiation exposure and costs.

RESULTS

We examined 83 CTs (0,83 CT per patient per year) and 60 PET-CTs (0,49 PET-CT per patient per year). At the moment of examination, serum CA 125 levels were normal (<35 U/mL) in 97/143 cases (68%) and above the limit (=35 U/m) in 46/143 cases (32%). When serum CA 125 levels were normal we observed 96/97 cases of CR (96%) and 4/97 cases of PD (4%). When a PD was observed with normal serum CA 125 levels in 1 case it resulted to be a false positive whereas in the remaining 3 cases the marker serum levels showed a significant increase in comparison to the previous levels. When serum CA 125 levels were above the limit we observed 29/46 cases of PD (63%), 7/46 cases of SD (15%), 4/46 cases of PR (9%) and 6/46 cases of CR (13%). In 38 cases the serum CA 125 levels rised above the limit in comparison to the prior serum levels and imaging showed a PD in 32 cases (84%); in the remaining 6 cases a PD was found in the subsequent radiological examination.

CLINICAL RELEVANCE/APPLICATION

CT/PET-CTs examinations should be avoided in the follow up of patients treated for malignant ovarian neoplasms until CA 125 serum values are normal, reducing both radiation exposure and costs.

SSRO03-2   Hypofractionated Radiation Leads To More Rapid Bleeding Cessation In Women With Vaginal Bleeding Secondary To Gynecologic Malignancy

Participants
Luke Moradi, Birmingham, Alabama (*Presenter*) Nothing to Disclose

PURPOSE

Vaginal bleeding is a common complication in women with gynecologic (GYN) malignancies and in some cases may be severe, resulting in anemia, need for transfusion, hospitalization and in rare cases may even be life-threatening. Radiation therapy (RT) is commonly used both in the definitive treatment of GYN cancers and for palliation of bleeding. The historical dogma is that high dose per fraction radiation (i.e. hypofractionation) leads to more rapid cessation of bleeding, yet there is scant data to actually support this claim. Therefore, we sought to examine the effect of RT fraction size on bleeding via retrospective analysis of patients receiving hypofractionated radiation therapy (HFRT) compared to conventionally fractionated radiation therapy (CFRT) for control of bleeding secondary to GYN malignancies.*Methods and Materials We identified patients receiving external beam radiation therapy

for continuous vaginal bleeding related to underlying GYN malignancy that were treated in our department from 2010-2020. Radiation was classified as HFRT (>2.4 Gy/fx) or CFRT (1.8 - 2.0 Gy/fx). Demographic information, disease characteristics, and treatment details were collected. The primary endpoint was days from RT initiation until complete bleeding resolution. Baseline characteristics between groups were compared via the Chi-square test. Time to bleeding cessation was assessed via Kaplan-Meier and log-rank test. Univariate Cox-proportional hazards was used to identify factors associated with bleeding cessation.*Results We identified 44 patients meeting inclusion criteria with 26 patients receiving CFRT and 18 patients receiving HFRT. The only identified statistically significant differences in baseline characteristics between the CFRT and HFRT groups included age (p<0.001), menopausal status (p<0.001), and receipt of concurrent chemotherapy (p<0.001). Time to bleeding cessation was significantly shorter for patients receiving HFRT on log-rank testing (p=0.042) with median time to bleeding cessations of 5 days (HFRT) vs. 16 days (CFRT). Cox univariate regression revealed RT fractionation was the only statistically significant indicator of bleeding cessation with a hazard ratio of 1.92 (p=0.040).*Conclusions Patients with continuous vaginal bleeding from GYN tumors receiving HFRT experienced more rapid bleeding cessation than those receiving CFRT. For patients with significant vaginal bleeding, initiation of HFRT to control malignancy related bleeding quickly may be warranted.*Clinical Relevance/Application Vaginal bleeding is a common complication of GYN malignancies but data regarding optimal radiation dosing for cessation of bleeding is scant. Our data suggests that hypofractionated RT resolves bleeding more rapidly.

RESULTS

We identified 44 patients meeting inclusion criteria with 26 patients receiving CFRT and 18 patients receiving HFRT. The only identified statistically significant differences in baseline characteristics between the CFRT and HFRT groups included age (p<0.001), menopausal status (p<0.001), and receipt of concurrent chemotherapy (p<0.001). Time to bleeding cessation was significantly shorter for patients receiving HFRT on log-rank testing (p=0.042) with median time to bleeding cessations of 5 days (HFRT) vs. 16 days (CFRT). Cox univariate regression revealed RT fractionation was the only statistically significant indicator of bleeding cessation with a hazard ratio of 1.92 (p=0.040).

CLINICAL RELEVANCE/APPLICATION

Vaginal bleeding is a common complication of GYN malignancies but data regarding optimal radiation dosing for cessation of bleeding is scant. Our data suggests that hypofractionated RT resolves bleeding more rapidly.

SSRO03-3   Multi-modal Deep-learning Based Prediction Of Stereotactic Body Radiotherapy Induced Vertebral Compression Fracture

Participants
Seoyoung Lee, MS, Daejeon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The spine is one of the most common sites of malignant tumor metastasis. Stereotactic body radiotherapy therapy (SBRT) has been widely used to treat spinal bone metastases (SBM). However, it has been reported that patients may later suffer from an SBRT-induced vertebral compression fracture (VCF). VCF can degrade a patient's quality of life by causing severe pain and also disrupt future surgical plans. Therefore, it is necessary to identify the potential risk groups and inform them of VCF prevention prior to performing SBRT. The purpose of the proposed research is to develop a prediction model that can produce a quantitative probability of occurrence of VCF in metastatic spine tumor patients who received SBRT.*Methods and Materials The cohort of 131 patients received SBRT for SBM at Samsung Medical Center (SMC), South Korea. Prognostic factors of SBRT-induced VCF can be divided into three categories: clinical factors, anatomical image factors, and radiotherapy factors. We developed a deep-learning-based multi-modal network that effectively combines those different types of information. A combined model of the multi-layer perceptron and convolutional neural network was selected as our model. Based on the registered dose map information, relevant tomographic image region-of-interests (ROIs) were selected and fed forward to the network. Appropriate data augmentation was performed in CT image data.*Results The network yielded a prediction accuracy of higher than 90% in the validation study. Other metrics such as high average precision (AP = 0.722) and high area-under-curve (AUC = 0.992) suggest that our multi-modal network can successfully predict the VCF probability after the SBRT. The proposed network showed the best result among other single-modal networks.*Conclusions We developed a multi-modal network-based SBRT-induced VCF prediction model. The network successfully integrated clinical factors, anatomical image factors, and radiotherapy factors, and produced a meaningful quantitative prediction. The prediction model would play a valuable role not only in the treated patients' welfare but also in the treatment planning for those patients.*Clinical Relevance/Application We propose a method of directly estimating the probability of occurrence of SBRT-induced VCF for SBM patients by use of clinical records, anatomical images, and radiotherapy factors in a deep-neural-network framework.

RESULTS

The network yielded a prediction accuracy of higher than 90% in the validation study. Other metrics such as high average precision (AP = 0.722) and high area-under-curve (AUC = 0.992) suggest that our multi-modal network can successfully predict the VCF probability after the SBRT. The proposed network showed the best result among other single-modal networks.

CLINICAL RELEVANCE/APPLICATION

We propose a method of directly estimating the probability of occurrence of SBRT-induced VCF for SBM patients by use of clinical records, anatomical images, and radiotherapy factors in a deep-neural-network framework.

SSRO03-6   Computational Models Forecasting Response Of High-grade Glioma During Adaptive Radiation Therapy

Participants
Maguy Farhat, MD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To determine if multi-parametric magnetic resonance imaging (mpMRI) collected during adaptive radiation therapy (RT) can personalize a mechanism-based model to spatially forecast response in patients with high-grade glioma (HGG) prior to the completion of therapy.*Methods and Materials Following maximal safe resection, patients with pathologically confirmed HGG planned for 6 weeks of concurrent RT and chemotherapy were enrolled into a prospective single-arm adaptive RT trial (target n=80). Patients were imaged weekly with mpMRI over 6 weeks and with contrast at baseline and at week 3 of RT. Extent of tumor burden was defined on post contrast T1 weighted MRI and on T2 FLAIR images; as well as tumor cellularity evaluated by the apparent diffusion coefficient on diffusion imaging. Each patient's MRI data was used to initialize and calibrate a 3D two-species

mathematical model describing the enhancing and non-enhancing tumor volume during RT. We investigated the ability of this model calibrated with different subsets of imaging data to predict the size and distribution of the tumor during the final week of RT (week 6). The predictive accuracy was assessed using model parameters calibrated with different imaging time points. The error in predictions was evaluated at the global level by using percent error in the total number of estimated tumor cells, the percent error in tumor volume, and the Dice correlation value; as well as the local voxel levels by assessing spatial agreement via the Pearson correlation coefficient (PCC), and the concordance correlation coefficient (CCC).*Results We present the preliminary results for two patients using baseline and weekly (during RT) mpMRI data to predict tumor extent at week 6 of RT. The global percent error in total cell count and tumor volume decrease with increasing weeks of data used to calibrate the model. At week 3 (contrast mpMRI), we observed a dramatic improvement in prediction with 11.4% and 12.1% error in tumor volume in these two cases with Dice of values 0.87 and 0.82 respectively, and greater than 0.82 PCC and 0.73 CCC at the local level.*Conclusions Using our two species mathematical model for tumor growth, we demonstrated the ability to forecast the tumors' extent during the final week of RT using the baseline and weekly mpMRI data during RT with particular improvement with repeated enhanced mpMRI data at Week 3.*Clinical Relevance/Application Currently the entire course of RT for HGG is based on a treatment plan using baseline MRI. Adaptive RT is technically feasible but is adapted in reaction to anatomical tumor changes. This study demonstrates the potential to use mathematical models to forecast tumor progression during therapy enabling anticipatory adaptive radiotherapy to improve outcomes for patients with HGG.

RESULTS

We present the preliminary results for two patients using baseline and weekly (during RT) mpMRI data to predict tumor extent at week 6 of RT. The global percent error in total cell count and tumor volume decrease with increasing weeks of data used to calibrate the model. At week 3 (contrast mpMRI), we observed a dramatic improvement in prediction with 11.4% and 12.1% error in tumor volume in these two cases with Dice of values 0.87 and 0.82 respectively, and greater than 0.82 PCC and 0.73 CCC at the local level.

CLINICAL RELEVANCE/APPLICATION

Currently the entire course of RT for HGG is based on a treatment plan using baseline MRI. Adaptive RT is technically feasible but is adapted in reaction to anatomical tumor changes. This study demonstrates the potential to use mathematical models to forecast tumor progression during therapy enabling anticipatory adaptive radiotherapy to improve outcomes for patients with HGG.

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Participants
Michael F. Morris, MD, Paradise Valley, Arizona (*Moderator*) Educator, Medtronic plc;

Sub-Events

SSCA06-1 Left Atrial Strain Correlates With Severity Of Cardiac Involvement In Fabry's Disease

Participants
Tilman Emrich, MD, Charleston, South Carolina (*Presenter*) Speaker, Siemens AG;Travel support, Siemens AG

PURPOSE

Fabry's disease (FD) is characterized by sphingolipid accumulation, leading to increased myocardial mass and shortened myocardial T1, resulting in the pathological alteration of myocardial geometry and function, which correlates with adverse events. Treatment with enzyme replacement therapy (ERT) is restricted to patients with evidence of organ involvement in FD. However, inefficient ERT has been demonstrated in later stages of cardiac involvement. Therefore, it is crucial to detect early stages of cardiac involvement in FD. The aim of this study was to evaluate the changes in LA strain in correlation to FD severity and demonstrate the improvement in diagnostic performance by combining functional LA parameters and conventional markers for myocardial involvement assessment.*Methods and Materials Fifty-seven FD patients (including 17 patients in the per-hypertrophic stage, and 40 patients with cardiac involvement) and 50 healthy volunteers who had previously undergone cardiac MRI at 3T were included in this retrospective study. Myocardial T1 maps and cine images were analyzed. Global longitudinal strain of the LA was calculated from 2-, 3-, and 4-chamber cine acquisitions using the feature-tracking technique.*Results There were significant differences between healthy volunteers and FD patients in T1 (1175 ± 50 ms vs 1124 ± 65 ms, $p<0.001$), myocardial mass (54.6 ± 9.8 g/m2 vs 75.2 ± 24.7 g/m2, $p<0.001$), and LA reservoir strain (41.6 ± 7.8 % vs 32.8 ± 10.2 %, $p<0.001$). LA reservoir strain correlated with T1 ($r=0.421$, $p=0.023$) and inversely correlated with left ventricular myocardial mass ($r=-0.489$, $p<0.001$). Combining LA function parameters with myocardial mass and T1 improved the diagnostic performance to detect FD in every disease stage and provided an excellent diagnostic performance (AUC = 0.93, sensitivity 91.8%, specificity 86.1%), outperforming conventional parameters used to assess myocardial involvement (e.g. LV Mass: AUC=0.80; T1: AUC= 0.62; all $p<0.01$).*Conclusions LA strain parameters have the potential to complement current multiparametric approaches to diagnose myocardial involvement in FD, especially in the early pre-hypertrophic phase of disease.*Clinical Relevance/Application Atrial strain parameters could complement existing multiparametric approaches in order to evaluate disease severity and progression in FD, guide initiation of medical therapy and monitor treatment success.

RESULTS

There were significant differences between healthy volunteers and FD patients in T1 (1175 ± 50 ms vs 1124 ± 65 ms, $p<0.001$), myocardial mass (54.6 ± 9.8 g/m2 vs 75.2 ± 24.7 g/m2, $p<0.001$), and LA reservoir strain (41.6 ± 7.8 % vs 32.8 ± 10.2 %, $p<0.001$). LA reservoir strain correlated with T1 ($r=0.421$, $p=0.023$) and inversely correlated with left ventricular myocardial mass ($r=-0.489$, $p<0.001$). Combining LA function parameters with myocardial mass and T1 improved the diagnostic performance to detect FD in every disease stage and provided an excellent diagnostic performance (AUC = 0.93, sensitivity 91.8%, specificity 86.1%), outperforming conventional parameters used to assess myocardial involvement (e.g. LV Mass: AUC=0.80; T1: AUC= 0.62; all $p<0.01$).

CLINICAL RELEVANCE/APPLICATION

Atrial strain parameters could complement existing multiparametric approaches in order to evaluate disease severity and progression in FD, guide initiation of medical therapy and monitor treatment success.

SSCA06-2 Right Ventricular Involvement Precedes Left Ventricular Phenotypic Changes In Fabry's Disease

Participants
Tilman Emrich, MD, Charleston, South Carolina (*Presenter*) Speaker, Siemens AG;Travel support, Siemens AG

PURPOSE

The accumulation of sphingolipids in Fabry's disease (FD) leads to increased left ventricular hypertrophy (LVH) and shortened myocardial T1. Previous studies have shown a diagnostic gap between the onset of accumulation and detectable myocardial changes. However, early detection of myocardial involvement is essential for the timely initiation and efficacy of enzyme replacement therapy (ERT). The aim of this study was to investigate early changes in right ventricular (RV) mass and feature-tracking-based strains in FD patients and evaluate their diagnostic accuracy.*Methods and Materials Sixty-two genetically proven FD patients and a control group of 62 healthy volunteers (HV) underwent cardiac MR (CMR) imaging at 3T including T1 mapping and cine acquisitions. FD patients were stratified based on findings suggested by existing literature (I: phenotypically healthy, normal or low myocardial T1, no LVH; II: low myocardial T1, moderate LVH, no late gadolinium enhancement (LGE); III: low myocardial T1, positive LGE, severe LVH). RV strains and myocardial mass were evaluated using commercially available CMR software (cvi42 Circle).*Results Left ventricular (LV) CMR volumetric parameters (ejection fraction, indexed myocardial mass (LVMi)) and T1 mapping showed no significant difference between HV and group I FD patients (P>0.05 for all). Indexed right ventricular myocardial mass (RVMi) was significantly increased and RV global longitudinal strain (RV-GLS) was significantly impaired in group I FD patients

compared to HV (p< 0.05). RV-GLS was able to increase diagnostic accuracy in FD compared to LVMi and myocardial T1 (RV GLS: AUC 0.81 vs. LVMi and T1 mapping: AUC 0.65).*Conclusions Morphological and functional changes in the RV precede phenotypic changes in the LV in FD. RVMi and RV-GLS can help detect altered myocardial deformation patterns in previously assumed phenotypically negative FD patients.*Clinical Relevance/Application These findings may lead to an earlier initiation of ERT, which in turn can slow or even prevent LVH and the associated long-term risks. The addition of RVMi and RV-GLS improved diagnostic accuracies, which is necessary in order to confidently rule out cardiac involvement in young patients or initiate a life-long treatment like ERT.

RESULTS

Left ventricular (LV) CMR volumetric parameters (ejection fraction, indexed myocardial mass (LVMi)) and T1 mapping showed no significant difference between HV and group I FD patients (P>0.05 for all). Indexed right ventricular myocardial mass (RVMi) was significantly increased and RV global longitudinal strain (RV-GLS) was significantly impaired in group I FD patients compared to HV (p< 0.05). RV-GLS was able to increase diagnostic accuracy in FD compared to LVMi and myocardial T1 (RV GLS: AUC 0.81 vs. LVMi and T1 mapping: AUC 0.65).

CLINICAL RELEVANCE/APPLICATION

These findings may lead to an earlier initiation of ERT, which in turn can slow or even prevent LVH and the associated long-term risks. The addition of RVMi and RV-GLS improved diagnostic accuracies, which is necessary in order to confidently rule out cardiac involvement in young patients or initiate a life-long treatment like ERT.

SSCA06-3   T1 And T1-RHO Mapping For Early Detection Of Chemotherapy-related Subclinical Cardiac Injury In Patients With Breast Cancer

Participants
Satoshi Higuchi, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Chemotherapy-related cardiac dysfunction is a serious adverse effect of chemotherapy that worsens patients' prognosis. Cardiac magnetic resonance (CMR) has the potential to detect early changes in myocardial tissue characteristics and cardiac function. The purpose of this prospective study was to evaluate whether T1 and T1-rho mapping serve as imaging biomarkers for the early detection of chemotherapy-related cardiac injury in patients with breast cancer.*Methods and Materials Thirty-two chemotherapy-native female patients with breast cancer (56 ± 13 years) scheduled for preoperative chemotherapy were prospectively enrolled. The regimen included anthracyclines for all patients. All patients underwent serial CMR examinations with a 3T whole-body MR scanner at baseline and six months after chemotherapy. Cine MR images, native T1-rho maps, native T1 maps, and extracellular volume (ECV) maps were acquired. Native T1-rho weighted images were acquired using a spin-lock preparation pulse with durations of 0ms and 20ms. Pre- and post-contrast T1 maps were generated using modified Look-Locker inversion recovery methods. Left ventricular ejection fraction (EF), end-systolic volume index, end-diastolic volume index, and mass index (ESVI, ESVI, and MI) were obtained based on short-axis stacks of cine images. Native T1-rho, native T1, and ECV values were measured by placing the regions of interests on the mid-wall of the interventricular septum in the mid-segment. Serial changes of MR parameters were evaluated using paired student's t-tests. P < 0.05 indicated statistical significance.*Results Left ventricular EDVI and ESVI were significantly increased after chemotherapy (EDVI: 63.4 ± 12.2 vs. 68.8 ± 15.9 ml/m2, p < 0.01; ESVI: 21.6 ± 8.9 vs. 26.7 ± 11.3 ml/m2, p < 0.01, respectively), and EF was significantly reduced (65.8 ± 8.7 vs. 62.2 ± 7.8 %, p = 0.02). MI showed no significant difference after chemotherapy. Native T1 and T1 rho values significantly elevated after chemotherapy (native T1: 1268 ± 38 vs. 1298 ± 47 ms, p < 0.01; T1 rho: 56.6 ± 4.0 vs. 59.0 ± 5.3 ms, p = 0.02, respectively), although ECV showed no significant difference.*Conclusions Native T1-rho and T1 values were elevated along with reduced cardiac function after anthracycline chemotherapy in patients with breast cancer. Non-invasive CMR may play a role in the early detection of chemotherapy-related cardiac injury.*Clinical Relevance/Application Native T1-rho and T1 values in CMR may become an emerging non-invasive biomarker for the early detection of cancer therapeutics-related cardiac injury in patients with breast cancer.

RESULTS

Left ventricular EDVI and ESVI were significantly increased after chemotherapy (EDVI: 63.4 ± 12.2 vs. 68.8 ± 15.9 ml/m2, p < 0.01; ESVI: 21.6 ± 8.9 vs. 26.7 ± 11.3 ml/m2, p < 0.01, respectively), and EF was significantly reduced (65.8 ± 8.7 vs. 62.2 ± 7.8 %, p = 0.02). MI showed no significant difference after chemotherapy. Native T1 and T1 rho values significantly elevated after chemotherapy (native T1: 1268 ± 38 vs. 1298 ± 47 ms, p < 0.01; T1 rho: 56.6 ± 4.0 vs. 59.0 ± 5.3 ms, p = 0.02, respectively), although ECV showed no significant difference.

CLINICAL RELEVANCE/APPLICATION

Native T1-rho and T1 values in CMR may become an emerging non-invasive biomarker for the early detection of cancer therapeutics-related cardiac injury in patients with breast cancer.

SSCA06-5   Untilization And Prognostic Value Of Cardiac Magnetic Resonance In Patients With Peripartum Cardiomyopathy

Participants
Huayan Xu, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To detect the heterogeneity of myocardial injury with Cardiac magnetic resonance (CMR) late gadolinium enhancement (LGE) in peripartum cardiomyopathy (PPCM), and further create a predictive model to investigate the role of LGE in long-term prognosis for poor outcomes.*Methods and Materials This study collected data from 106 patients with PPCM at four high-ranking Chinese medical centres from January, 2010, to December, 2019. All patients underwent CMR after PPCM was diagnosed. Moreover, clinical characteristics, laboratory results, echocardiographic and electrocardiographic findings at diagnosis, as well as main clinical outcomes, including major adverse cardiac events (MACEs), non-recovered left ventricular ejection fraction (LVEF) and recovered LVEF, were recorded and compared.*Results Among the 106 women with PPCM (mean age, 29.93±5.34 years) who were studied, LGE was detected on the CMR images of 47 (44.34%) patients, indicating myocardial damages. Patients with diffuse LGE were more likely to experience MACEs [4 (17.39%) deaths, 4 (17.39%) heart transplantations and 4 (17.39%) readmissions to the hospital due to heart failure] than those with focal LGE (OR: 8.229; 95% CI: 1.144 to 59.167, p=0.003) and no LGE (OR: 20.229; 95% CI: 2.747 to 148.974, p=0.000). The event-free rates for MACEs (Log-rank ?2=12, p=0.002) and non-recovered LVEF (Log-rank ?2=18.4, p<0.001) of PPCM patients with diffuse LGE and focal LGE were significantly lower than those without LGE. The multivariate model

demonstrated that LGE (hazard ratio (HR), 2.431; 95% CI, 1.453-4.067; P=0.001) was an independent prognostic factor for MACEs and non-recovered LVEF. The predictive nomogram of LGE showed good discrimination for MACEs and non-recovered LVEF (C index=0.78; 95% CI, 0.61-0.95).*Conclusions LGE is an incremental, independent predictor of MACEs and non-recovered LVEF in PPCM. Cardiovascular magnetic resonance assessments of LGE should be recommended for the risk stratification and clinical management of PPCM patients.*Clinical Relevance/Application In summary, CMR LGE is clinically and prognostically relevant for PPCM. Although almost all PPCM patients without LGE had a good prognosis, significant numbers of such women still had a high risk of myocardial tissue injury, potentially leading to increased deterioration during follow-up. The available information also suggests that LGE could be an important prognostic factor for poor outcomes such as MACEs or non-recovered LVEF and provide risk stratification for PPCM. Therefore, monitoring myocardial involvement with CMR LGE is therefore recommended for the long-term management of PPCM and prevention of detrimental consequences.

RESULTS

Among the 106 women with PPCM (mean age, 29.93±5.34 years) who were studied, LGE was detected on the CMR images of 47 (44.34%) patients, indicating myocardial damages. Patients with diffuse LGE were more likely to experience MACEs [4 (17.39%) deaths, 4 (17.39%) heart transplantations and 4 (17.39%) readmissions to the hospital due to heart failure] than those with focal LGE (OR: 8.229; 95% CI: 1.144 to 59.167, p=0.003) and no LGE (OR: 20.229; 95% CI: 2.747 to 148.974, p=0.000). The event-free rates for MACEs (Log-rank ?2=12, p=0.002) and non-recovered LVEF (Log-rank ?2=18.4, p<0.001) of PPCM patients with diffuse LGE and focal LGE were significantly lower than those without LGE. The multivariate model demonstrated that LGE (hazard ratio (HR), 2.431; 95% CI, 1.453-4.067; P=0.001) was an independent prognostic factor for MACEs and non-recovered LVEF. The predictive nomogram of LGE showed good discrimination for MACEs and non-recovered LVEF (C index=0.78; 95% CI, 0.61-0.95).

CLINICAL RELEVANCE/APPLICATION

In summary, CMR LGE is clinically and prognostically relevant for PPCM. Although almost all PPCM patients without LGE had a good prognosis, significant numbers of such women still had a high risk of myocardial tissue injury, potentially leading to increased deterioration during follow-up. The available information also suggests that LGE could be an important prognostic factor for poor outcomes such as MACEs or non-recovered LVEF and provide risk stratification for PPCM. Therefore, monitoring myocardial involvement with CMR LGE is therefore recommended for the long-term management of PPCM and prevention of detrimental consequences.

SSCA06-6   Cardiac MRI Versus FDG-PET For The Detection Of Cardiac Sarcoidosis: A Comparative Diagnostic Test Accuracy Systematic Review And Meta-analysis

Participants
Matthew Aitken, MBChB, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

Detection of cardiac sarcoidosis (CS) is important given poor prognosis if it is untreated. The optimal cardiac imaging modality for assessment has not been established. The purpose of this study was to perform a comparative diagnostic test accuracy systematic review and meta-analysis comparing cardiac MRI and 18F-FDG PET for detection of CS.*Methods and Materials Ovid MEDLINE, Ovid Epub, Cochrane CENTRAL, EMBASE, Ovid EMCARE, and Scopus were searched from inception until December 2020. Inclusion criteria included studies that evaluated the diagnostic accuracy of cardiac MRI with late gadolinium enhancement (LGE) and/or 18F-FDG PET in adult patients with suspected CS and included sufficient data for compilation of 2x2 tables. Demographic, methodologic, and diagnostic test accuracy data were independently extracted by two investigators and differences were resolved by consensus. Accuracy metrics were obtained using bivariate random-effects meta-analysis. The impact of different covariates on accuracy estimates was assessed using a meta-regression model. Risk of bias was assessed using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS)-2 tool. PROSPERO: CRD42021214776*Results Thirty-two studies including 1875 patients with suspected CS were included (623 with CS), 25 studies evaluated PET (1241 patients) and 15 evaluated MRI (920 patients). Only 4 studies directly compared PET and MRI in the same patients. Sensitivity for PET and MRI was 85% (95%CI 76-91%) and 95% (95%CI 87-98%), respectively. Specificity for PET and MRI was 83% (95%CI 76-88%) and 85% (95%CI 69-94%), respectively. The greater observed sensitivity of MRI was preserved in the meta-regression model (p=0.030), while no difference in specificity was detected (p=0.97). Covariate analysis demonstrated that diagnostic accuracy was significantly lower in studies with direct vs. indirect comparison (p=0.044). Many studies were at high risk of bias.*Conclusions MRI has higher sensitivity than PET and therefore may be advantageous for ruling out CS. However, limitations in the literature, including risk of bias and only a few studies with direct comparison, necessitate additional methodologically rigorous study.*Clinical Relevance/Application This is the first meta-analysis comparing the diagnostic performance of PET and MRI in CS. These results suggest that cardiac MRI may be an appropriate first imaging test although further study is needed.

RESULTS

Thirty-two studies including 1875 patients with suspected CS were included (623 with CS), 25 studies evaluated PET (1241 patients) and 15 evaluated MRI (920 patients). Only 4 studies directly compared PET and MRI in the same patients. Sensitivity for PET and MRI was 85% (95%CI 76-91%) and 95% (95%CI 87-98%), respectively. Specificity for PET and MRI was 83% (95%CI 76-88%) and 85% (95%CI 69-94%), respectively. The greater observed sensitivity of MRI was preserved in the meta-regression model (p=0.030), while no difference in specificity was detected (p=0.97). Covariate analysis demonstrated that diagnostic accuracy was significantly lower in studies with direct vs. indirect comparison (p=0.044). Many studies were at high risk of bias.

CLINICAL RELEVANCE/APPLICATION

This is the first meta-analysis comparing the diagnostic performance of PET and MRI in CS. These results suggest that cardiac MRI may be an appropriate first imaging test although further study is needed.

Abstract Archives of the RSNA, 2021

Participants
Sarah Moum, MD, MSc, Chicago, Illinois (*Moderator*) Nothing to Disclose
Carolina V. Guimaraes, MD, Woodside, California (*Moderator*) Nothing to Disclose

Sub-Events

SSPD01-2 Recovery Of Compression Fracture Of The Vertebral Bodies In Patients With Chronic Nonbacterial Osteomyelitis (CNO)

Participants
Mikhael Sebaaly, MD, Iowa City, Iowa (*Presenter*) Nothing to Disclose

PURPOSE

Vertebral body compression fractures are the most common fractures seen in patients with CNO, and in our experience seen in up to 16% of patients with long term follow up. In this presentation we will review the course and potential recovery in patients with pathologic vertebral loss of height secondary to CNO.*Methods and Materials A retrospective review of patients with CNO and pathologic compression deformities of the vertebral bodies was performed at our institution. A PACS review was done for reports that had CNO and vertebral compression fractures. A total of 60 exams that were performed between June 2006 and August 2020 were identified. To be included, patients had to have at least 2 CT or MRI exams. Vertebral body loss of height was measured in relation to the average of the height of the 2 adjacent vertebral bodies if there is involvement of the posterior wall or to the vertebral body posterior wall if only anterior wedging using Carestream PACS measurement tools. We gathered data on medications, demographics, trauma, back pain and bone marrow edema.*Results 42 vertebral bodies with loss of height in 18 patients with CNO were identified, 41 in thoracic spine,1 in cervical spine. Age ranged between 5 and 22 yr, 28% males and 72% females, 62% of fractures had bone marrow edema and 56% had back pain. There was recovery of vertebral body height in 16 vertebral bodies. 7 out of 18 patients had recovery of vertebral body height of one or more levels. The recovery of vertebral body height was partial at 9 levels and complete at 7 levels. One level had worsening of the vertebral body height loss on follow up. 6 of 7 patients with vertebral body height recovery were on NSAIDS, vs 7 of 11 patients with no vertebral body height recovery. 3 of 7 patients with vertebral body height recovery were on bisphosphonates vs 3 out of 11 in patients that did not have height recovery. The age of patients with recovery of height was between 6 and 11 years (average:7.4yr) at diagnosis vs 5 to 22 years (average:12.7yr).*Conclusions Patient with CNO pathologic vertebral height loss can partially or completely recover vertebral body height. This is why early, accurate diagnosis and appropriate treatment are important to avoiding potential long term consequences. Favorable factors for vertebral body height recovery include age at development of compression deformity (between 6 and 11 yr), bisphosphonate and NSAIDS therapy, female gender and loss of height less than 70%.*Clinical Relevance/Application Compression fractures are the most common pathologic fractures seen in patients with CNO. It is important for radiologists to know that there is potential for vertebral body height recovery. Making a timely diagnosis of CNO and starting appropriate treatment early are important factors in avoiding long term sequelae.

RESULTS

42 vertebral bodies with loss of height in 18 patients with CNO were identified, 41 in thoracic spine,1 in cervical spine. Age ranged between 5 and 22 yr, 28% males and 72% females, 62% of fractures had bone marrow edema and 56% had back pain. There was recovery of vertebral body height in 16 vertebral bodies. 7 out of 18 patients had recovery of vertebral body height of one or more levels. The recovery of vertebral body height was partial at 9 levels and complete at 7 levels. One level had worsening of the vertebral body height loss on follow up. 6 of 7 patients with vertebral body height recovery were on NSAIDS, vs 7 of 11 patients with no vertebral body height recovery. 3 of 7 patients with vertebral body height recovery were on bisphosphonates vs 3 out of 11 in patients that did not have height recovery. The age of patients with recovery of height was between 6 and 11 years (average:7.4yr) at diagnosis vs 5 to 22 years (average:12.7yr).

CLINICAL RELEVANCE/APPLICATION

Compression fractures are the most common pathologic fractures seen in patients with CNO. It is important for radiologists to know that there is potential for vertebral body height recovery. Making a timely diagnosis of CNO and starting appropriate treatment early are important factors in avoiding long term sequelae.

SSPD01-4 Contrast-enhanced Subharmonic Aided Pressure Estimation (SHAPE) For Assessment Of Intracranial Pressure In Vivo

Participants
Ryne Didier, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Intracranial pressure (ICP) measurements in children require invasive techniques. We investigated subharmonic aided pressure estimation (SHAPE) as a noninvasive contrast-enhanced ultrasound (CEUS) tool for assessing ICP in fetal lambs.*Methods and Materials After induction of maternal anesthesia and hysterotomy, 17 fetal lambs (107-138 days gestational age; term = 145 days) underwent externalization and placement of a subdural pressure catheter to measure ICP as part of an IACUC approved protocol. A

modified Logiq E10 ultrasound (US) system (GE Healthcare, Waukesha, WI) optimized with SHAPE software and a curvi-linear C2-9 transducer were used to image the brain in the coronal plane. Definity (Lantheus Medical Imaging, N Billerica, MA) US contrast was administered as an infusion at 120 mL/min via a uterine choroidal vessel which drained into the umbilical vein and fetal circulation. After SHAPE calibration was performed to determine optimal US mechanical index, saline was infused via the subdural catheter to transiently increase ICP from baseline (7-10 mmHg) to approximately 40 mmHg. Multiple five-second SHAPE cine clips of the brain were obtained at various pressures. Experiments were repeated in triplicate for each lamb. Data points were excluded if ICP instability was observed; defined as standard deviation = 3 mmHg. CEUS subharmonic intensity values of the whole brain and thalami were determined and correlated with ICP values using mixed effects linear regression analyses and the strength of the relationship was evaluated by Spearman's rank-order correlation.*Results 47 experiments resulted in 696 datapoints including SHAPE intensity values as well as mean ICP measurements. There was a statistically significant inverse relationship between SHAPE intensity values and ICP measurements in the whole brain and thalami (chi-squared = 1301.7 and 1336.9, respectively; p<0.001; Spearman's rho = -0.21; p<0.001).*Conclusions SHAPE intensity values of the brain demonstrate an inverse and statistically significant correlation with in vivo ICP measurements obtained in an animal model.*Clinical Relevance/Application SHAPE can be used for noninvasive estimation of ICP which has potential for broader applications and may aid clinical evaluations of neurological injury.

RESULTS

47 experiments resulted in 696 datapoints including SHAPE intensity values as well as mean ICP measurements. There was a statistically significant inverse relationship between SHAPE intensity values and ICP measurements in the whole brain and thalami (chi-squared = 1301.7 and 1336.9, respectively; p<0.001; Spearman's rho = -0.21; p<0.001).

CLINICAL RELEVANCE/APPLICATION

SHAPE can be used for noninvasive estimation of ICP which has potential for broader applications and may aid clinical evaluations of neurological injury.

SSPD01-5   Brain Resting State Functional Networks In Infants With Prenatal Opioid And Substance Exposure

Participants
Rupa Radhakrishnan, MS,MBBS, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

Infants of mothers with prenatal opioid and substance use can present with early withdrawal symptoms and are at risk of poor neurodevelopmental outcomes in later childhood. Early brain imaging in infancy has the potential to identify early brain developmental alterations that could help prognosticate neurodevelopmental outcomes in these children and provide opportunities for early intervention. In this study, we aim to identify differences in global brain network connectivity in infants with prenatal opioid and drug exposure compared to healthy control infants, using resting-state functional MRI performed at less than 2 months completed gestational age.*Methods and Materials In this prospective IRB-approved study, we recruited 20 infants (14 female) with prenatal opioid exposure and their mothers and 20 healthy opioid naïve infants (11 female) and their mothers. Anatomic imaging and resting-state functional MRI was performed at less than 48 weeks corrected gestational age. After appropriate preprocessing, rs-fMRI images were coregistered to the UNC neonate brain template and 90 anatomic atlas labeled regions. Covariate Assisted Principal (CAP) regression was performed to identify brain networks within which functional connectivity is associated with opioid exposure adjusting for sex and gestational age. A corrected p-value of less than .05 was considered statistically significant.*Results Group functional connectivity matrices for the opioid exposed infants and non-opioid exposed infants were obtained. There were five CAP components that were significantly different in the opioid exposed versus control infants. The component most distinct between the two groups (CAP5, p= 3.86 x 10-6) included the right inferior temporal gyrus, bilateral hesch's gyrus, left thalamus, left suprmarginal gyrus, left inferior parietal lobule, left superior parietal gyrus, right anterior cingulate gyrus, right gyrus rectus left supplementary motor area and left pars triangularis. Functional connectivity in this network was lower in the infants with prenatal opioid exposure compared to non-opioid exposed infants.*Conclusions In this study we show global network alterations in infants with prenatal opioid exposure compared to non-opioid exposed infants. Future studies should be aimed at identifying clinical significance of this altered connectivity.*Clinical Relevance/Application Opioid and substance use in pregnancy is a huge public health problem and identification of methods to identify early, the consequences of substance exposure on the developing brain can help to initiate early therapies to improve outcomes in prenatal opioid and substance exposure.

RESULTS

Group functional connectivity matrices for the opioid exposed infants and non-opioid exposed infants were obtained. There were five CAP components that were significantly different in the opioid exposed versus control infants. The component most distinct between the two groups (CAP5, p= 3.86 x 10-6) included the right inferior temporal gyrus, bilateral hesch's gyrus, left thalamus, left suprmarginal gyrus, left inferior parietal lobule, left superior parietal gyrus, right anterior cingulate gyrus, right gyrus rectus left supplementary motor area and left pars triangularis. Functional connectivity in this network was lower in the infants with prenatal opioid exposure compared to non-opioid exposed infants.

CLINICAL RELEVANCE/APPLICATION

Opioid and substance use in pregnancy is a huge public health problem and identification of methods to identify early, the consequences of substance exposure on the developing brain can help to initiate early therapies to improve outcomes in prenatal opioid and substance exposure.

Abstract Archives of the RSNA, 2021

SSNMMI03

Science Session with Keynote: Nuclear Medicine/Molecular Imaging (Molecular Imaging of Covid-19)

Participants

Lisa Bodei, MD, PhD, New York, New York (*Moderator*) Consultant, Novartis AG ;Speaker, Novartis AG;Research Grant, Novartis AG;Consultant, Ipsen SA;Consultant, ITM Isotopen Technologien Muenchen AG;Speaker, ITM Isotopen Technologien Muenchen AG;Consultant, Clovis Oncology, Inc;Consultant, Ion Beam Applications, SA

Sub-Events

SSNMMI03   Keynote Speaker

Participants

Lisa Bodei, MD, PhD, New York, New York (*Presenter*) Consultant, Novartis AG ;Speaker, Novartis AG;Research Grant, Novartis AG;Consultant, Ipsen SA;Consultant, ITM Isotopen Technologien Muenchen AG;Speaker, ITM Isotopen Technologien Muenchen AG;Consultant, Clovis Oncology, Inc;Consultant, Ion Beam Applications, SA

SSNMMI03-2   Time-dependent Severity Of FDG Brain Hypometabolism In Post-SARS-CoV-2 Infection With Neurological Involvement

Participants
Anna Lisa Martini, Bologna, Italy (*Presenter*) Nothing to Disclose

PURPOSE

Clinical reports indicate that coronaviruses can have a neuro-invasive potential. Aim of this study was to characterize time-dependent brain functional impairment in SARS-CoV-2 patients with newly originated neurological symptoms and to suggest physiopathology mechanisms underlying central nervous system involvement.*Methods and Materials We included 9 patients with past SARS-CoV-2 acute infection and associated newly originated neurological symptoms and 5 patients with neurological symptoms and ongoing acute SARS-CoV-2 infection. The patients with past infection underwent baseline FDG-PET scan, together with neurological and cognitive assessment, at different time-points from the acute phase. The patients in acute SARS-CoV-2 infection underwent FDG-PET scan, but the cognitive assessment was not possible. One patient was evaluated with a follow-up FDG-PET scan after a significant remission of clinical symptoms. Brain metabolism was analysed using optimised and validated voxel-based SPM method at the single-subject level (p = 0.01), based on comparisons with large and well-selected healthy control dataset.*Results The 5 patients with ongoing acute SARS-CoV-2 infection featured widespread hypometabolism affecting almost all brain cortices. Among the cases with past SARS-CoV-2 acute infection, 5 patients with FDG-PET scan within 2 months from the infection showed extended orbital-, prefrontal and temporal-parietal cortex hypometabolism, and pathological MMSE values. 3 patients with FDG-PET scans 5 months after SARS-CoV-2 acute phase showed normal brain metabolism and normal cognitive scores. The patient evaluated twice showed at baseline, close to the acute phase, an extended, severe hypometabolism affecting almost all brain cortices and only slight hypometabolism in orbitofrontal and medial frontal cortices at follow up.*Conclusions The present results demonstrated that 1. patients with ongoing SARS-CoV-2 infection featured widespread hypometabolism affecting almost all brain cortices, while 2. patients evaluated in post SARS-CoV-2 infection phase, presented with a rather extended cortical hypometabolism only close to the acute phase and 3. along with remission of clinical and cognitive symptoms, the brain hypometabolism reduces progressively as function of time from acute phase. The cortical functional impairment observed in neuro-SARS-CoV-2 patients is likely to be transient and almost reversible, and possibly due to synergistic effects of systemic virus-mediated inflammation sustained by systemic cytokine release and transient hypoxia inducing neuronal dysfunction and local microglial activation.*Clinical Relevance/Application none

RESULTS

The 5 patients with ongoing acute SARS-CoV-2 infection featured widespread hypometabolism affecting almost all brain cortices. Among the cases with past SARS-CoV-2 acute infection, 5 patients with FDG-PET scan within 2 months from the infection showed extended orbital-, prefrontal and temporal-parietal cortex hypometabolism, and pathological MMSE values. 3 patients with FDG-PET scans 5 months after SARS-CoV-2 acute phase showed normal brain metabolism and normal cognitive scores. The patient evaluated twice showed at baseline, close to the acute phase, an extended, severe hypometabolism affecting almost all brain cortices and only slight hypometabolism in orbitofrontal and medial frontal cortices at follow up.

CLINICAL RELEVANCE/APPLICATION

SSNMMI03-3   99mTc-vitamin C SPECT/CT Imaging In Patients With SARS-COV-2 Associated Pneumonia

Participants
Haluk Sayman, MD, Istanbul, Turkey (*Presenter*) Nothing to Disclose

PURPOSE

High-dose intravenous vitamin C has been shown to reduce systemic inflammation by reducing the cytokine storm. In patients with severe sepsis and acute respiratory distress syndrome in particular, it can prevent lung injury. Additionally, it may be beneficial in

patients with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. Therefore, we sought to determine if intravenous vitamin C labeled with 99mTc can be used to assess the utility of Vitamin C in typical lung lesions in patients who are being treated for SARS-CoV-2-associated pneumonia.*Methods and Materials In this small series of patients, four patients with SARS-CoV-2 infection underwent 99mTc-Vitamin C single photon emission computed tomography/computed tomography (SPECT/CT) imaging.*Results Baseline CT images of all patients showed mostly peripheral patchy and ground glass opacities in both lungs, consistent with SARS-CoV-2-associated pneumonia. Active lung lesions were characterized by high 99mTc-Vitamin C uptake on SPECT images. At day 5 of hospitalization, following standard anti-viral and anti-inflammatory treatment, 99mTc-Vitamin C SPECT images showed no abnormal uptake corresponding to lung CT findings. Follow-up SPECT/CT at 3 months after the diagnosis of SARS-CoV-2-associated pneumonia showed that all previous lung findings were resolved for all patients; no 99mTc-Vitamin C uptake was demonstrated on SPECT images.*Conclusions Multifocal pulmonary uptake of 99mTc-Vitamin C could be considered as a feature of active pulmonary involvement with SARS-CoV-2 infection in the regions with expansive spread of the disease.*Clinical Relevance/Application While 99mTc-Vitamin C SPECT/CT imaging cannot be routinely used in the emergency setting and is generally not recommended for the imaging of infectious/inflammatory diseases, this small case series nevertheless suggests that 99m Tc-Vitamin C SPECT/CT imaging could be a promising non-invasive approach to identify the presence and potentially monitor the persistence and progression of Vitamin C lung action.

RESULTS

Baseline CT images of all patients showed mostly peripheral patchy and ground glass opacities in both lungs, consistent with SARS-CoV-2-associated pneumonia. Active lung lesions were characterized by high 99mTc-Vitamin C uptake on SPECT images. At day 5 of hospitalization, following standard anti-viral and anti-inflammatory treatment, 99mTc-Vitamin C SPECT images showed no abnormal uptake corresponding to lung CT findings. Follow-up SPECT/CT at 3 months after the diagnosis of SARS-CoV-2-associated pneumonia showed that all previous lung findings were resolved for all patients; no 99mTc-Vitamin C uptake was demonstrated on SPECT images.

CLINICAL RELEVANCE/APPLICATION

While 99mTc-Vitamin C SPECT/CT imaging cannot be routinely used in the emergency setting and is generally not recommended for the imaging of infectious/inflammatory diseases, this small case series nevertheless suggests that 99m Tc-Vitamin C SPECT/CT imaging could be a promising non-invasive approach to identify the presence and potentially monitor the persistence and progression of Vitamin C lung action.

SSNMMI03-4 Imaging Features And Detection Of COVID-19 Using FDG PET/CT During The Peak Of The New York City Pandemic

Participants
Rick Wray, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To determine the imaging findings and potential clinical utility of FDG PET/CT in patients with laboratory-confirmed COVID-19.*Methods and Materials We performed a single-institution retrospective review of patients diagnosed with COVID-19 using real-time reverse transcription-polymerase chain reaction (RT-PCR) and who underwent FDG PET/CT for routine cancer care between March 1, 2020, and April 30, 2020, during the height of the pandemic in New York City, United States. PET/CT scans were retrospectively reviewed for imaging findings suspicious for COVID-19. For positive imaging findings, the location, FDG-avidity (SUVmax), and CT findings were recorded. Patient demographics and COVID-19 specific clinical data, including symptoms and hospitalizations, were collected and analyzed for FDG PET/CT data.*Results Thirty-one patients (21 males and 10 females, mean age 57 years ± 16) were evaluated. Thirteen patients (41.9%) had positive PET/CT scans, and eighteen patients (58.1%) had negative scans. Patients with positive scans had significantly higher rates of symptomatic COVID-19 infection (77% vs 28%, p=0.01) and hospitalizations (46% vs. 0%, p=0.002) compared to patients with negative scans. Eleven of 13 patients (84.6%) with positive scans had FDG-avid lung findings, with mean lung SUVmax of 5.36 + 3.36. Six of 13 patients (46.2%) had extrapulmonary findings of FDG-avid thoracic lymph nodes. No patients had findings outside of the thorax. Sensitivity of FDG PET/CT for detecting COVID-19 was 41.9%; it was significantly lower when the PET scan was performed before RT-PCR versus after RT-PCR (18.8% (n = 3/16) vs. 66.7% (n=10/15), p=0.009). Lung SUVmax was not associated with COVID-19 symptoms, severity, or disease course.*Conclusions FDG PET/CT has limited sensitivity for detecting COVID-19 infection. However, a positive PET scan is associated with a higher risk of symptomatic infection and hospitalizations, which may help predict disease severity.*Clinical Relevance/Application PET/CT imaging is used frequently in Oncology and can add additional prognostic information for patients with COVID-19 infection. Oncology patients tend to be immunocompromised and with the difficulty in treating COVID-19 additional information such as severity and symptomaticity can benefit these at-risk patients.

RESULTS

Thirty-one patients (21 males and 10 females, mean age 57 years ± 16) were evaluated. Thirteen patients (41.9%) had positive PET/CT scans, and eighteen patients (58.1%) had negative scans. Patients with positive scans had significantly higher rates of symptomatic COVID-19 infection (77% vs 28%, p=0.01) and hospitalizations (46% vs. 0%, p=0.002) compared to patients with negative scans. Eleven of 13 patients (84.6%) with positive scans had FDG-avid lung findings, with mean lung SUVmax of 5.36 + 3.36. Six of 13 patients (46.2%) had extrapulmonary findings of FDG-avid thoracic lymph nodes. No patients had findings outside of the thorax. Sensitivity of FDG PET/CT for detecting COVID-19 was 41.9%; it was significantly lower when the PET scan was performed before RT-PCR versus after RT-PCR (18.8% (n = 3/16) vs. 66.7% (n=10/15), p=0.009). Lung SUVmax was not associated with COVID-19 symptoms, severity, or disease course.

CLINICAL RELEVANCE/APPLICATION

PET/CT imaging is used frequently in Oncology and can add additional prognostic information for patients with COVID-19 infection. Oncology patients tend to be immunocompromised and with the difficulty in treating COVID-19 additional information such as severity and symptomaticity can benefit these at-risk patients.

SSNMMI03-5 F18-FDG Uptake After COVID-19 Vaccination In Oncological PET/CT: Frequency, Intensity And Potential Clinical Impact

Participants
Stephan Skawran, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To assess the frequency, intensity and clinical impact of F18-FDG-avidity of axillary lymph nodes after vaccination with COVID-19 vaccines BNT162b2 (Pfizer-BioNTech) and mRNA-1273 (Moderna) in patients referred for oncological FDG PET/CT.*Methods and Materials One hundred forty patients referred for FDG PET/CT during February and March 2021 after first or second vaccination with Pfizer-BioNTech or Moderna were retrospectively included. FDG-avidity of ipsilateral axillary lymph nodes was measured and compared. Metastatic risk was analyzed by two readers and clinical impact was evaluated.*Results FDG PET/CT showed FDG-avid lymph nodes ipsilateral to the vaccine injection in 75/140 (54%) patients with a mean SUVmax of 5.1 (range 2.0 - 17.3). FDG-avid lymph nodes were more frequent in patients vaccinated with Moderna than Pfizer-BioNTech (36/50 [72%] vs. 39/90 [43%] cases, p<0.001). Metastatic risk of unilateral FDG-avid axillary lymph nodes was rated unlikely in 52/75 (37%), potential in 15/75 (11%) and likely in 8/75 (6%) cases. Clinical management was affected in 17/140 (12%) cases.*Conclusions FDG-avid axillary lymph nodes are common after COVID-19 vaccination. The avidity of lymph nodes is more frequent in Moderna compared to Pfizer-BioNTech vaccines.*Clinical Relevance/Application To avoid relatively frequent clinical dilemmas, we recommend carefully taking the history for prior vaccination in patients undergoing FDG PET/CT and administering the vaccine contralateral to the primary cancer.

RESULTS

FDG PET/CT showed FDG-avid lymph nodes ipsilateral to the vaccine injection in 75/140 (54%) patients with a mean SUVmax of 5.1 (range 2.0 - 17.3). FDG-avid lymph nodes were more frequent in patients vaccinated with Moderna than Pfizer-BioNTech (36/50 [72%] vs. 39/90 [43%] cases, p<0.001). Metastatic risk of unilateral FDG-avid axillary lymph nodes was rated unlikely in 52/75 (37%), potential in 15/75 (11%) and likely in 8/75 (6%) cases. Clinical management was affected in 17/140 (12%) cases.

CLINICAL RELEVANCE/APPLICATION

To avoid relatively frequent clinical dilemmas, we recommend carefully taking the history for prior vaccination in patients undergoing FDG PET/CT and administering the vaccine contralateral to the primary cancer.

SSNMMI03-6 Axillary Lymph Node FDG PET/CT Uptake Post Covid-19 Mrna Vaccination And Its Association With Age And Immune Status

Participants
Michal Eifer, MD, Ramat Gan, Israel (*Presenter*) Nothing to Disclose

PURPOSE

With hundreds of millions of coronavirus disease 2019 (COVID-19) mRNA-based vaccine doses planned to be delivered worldwide in the upcoming months, little is known about positron emission tomography with computed tomography (PET/CT) findings in recently vaccinated immunocompetent or immunocompromised patients. We aimed to assess PET/CT uptake in the deltoid muscle and axillary lymph nodes of patients that received a COVID-19 mRNA-based vaccine, and to evaluate its association with patients' age and immune status.*Methods and Materials All consecutive adult subjects undergoing PET/CT scans at our center during the first month of a national COVID-19 vaccination rollout (between 23 December 2020 and January 27, 2021) were included. Data regarding clinical status, laterality and time interval from recent COVID-19 mRNA was prospectively collected and retrospectively analyzed, and correlated with deltoid muscle and axillary lymph nodes uptake.*Results Of 426 eligible, recently vaccinated, subjects (median age, 67±12 years; 49% female), 377 (88%) underwent PET/CT with 18F-fluorodeoxyglucose (FDG) and positive axillary lymph node uptake was seen in 45% of them. Multivariate logistic regression analysis revealed a strong inverse association between positive FDG uptake in ipsilateral lymph nodes and patients' age (Odds Ratio [OR]=0.57, 95% CI, 0.45-0.72; p<.001), immunosuppressive treatment (OR=0.37, 95% CI, 0.20-0.64; p=0.003) and presence of hematological disease (OR=0.44, 95% CI, 0.24-0.8; p=0.021). No such association was found for deltoid muscle uptake. The number of days from the last vaccination and the number of vaccination doses were also significantly associated with increased odds of positive lymph nodes uptake.*Conclusions In about half of the patients receiving the novel mRNA-based COVID-19 vaccine, PET/CT showed avid ipsilateral lymphadenopathy, which was significantly less common in immunocompromised and elderly patients.*Clinical Relevance/Application Recognition of axillary lymph node FDG uptake post COVID 19 vaccination may reduce misinterpretation thus avoiding unnecessary workup and may hint to the patient's immune response to the vaccine.

RESULTS

Of 426 eligible, recently vaccinated, subjects (median age, 67±12 years; 49% female), 377 (88%) underwent PET/CT with 18F-fluorodeoxyglucose (FDG) and positive axillary lymph node uptake was seen in 45% of them. Multivariate logistic regression analysis revealed a strong inverse association between positive FDG uptake in ipsilateral lymph nodes and patients' age (Odds Ratio [OR]=0.57, 95% CI, 0.45-0.72; p<.001), immunosuppressive treatment (OR=0.37, 95% CI, 0.20-0.64; p=0.003) and presence of hematological disease (OR=0.44, 95% CI, 0.24-0.8; p=0.021). No such association was found for deltoid muscle uptake. The number of days from the last vaccination and the number of vaccination doses were also significantly associated with increased odds of positive lymph nodes uptake.

CLINICAL RELEVANCE/APPLICATION

Recognition of axillary lymph node FDG uptake post COVID 19 vaccination may reduce misinterpretation thus avoiding unnecessary workup and may hint to the patient's immune response to the vaccine.

SPR-CH

Chest Pre-recorded Scientific Papers

Sub-Events

SPR-CH-10 Integration Of A Deep Learning Algorithm Into The Clinically Established PanCan Model For Malignancy Risk Estimation Of Screen-detected Pulmonary Nodules In First Screening CT

Participants
Kiran Vaidhya Venkadesh, MSc, Nijmegen, Netherlands (*Presenter*) Employee, Predible Health;Stockholder, Predible Health

PURPOSE

To quantify the added value of integrating a deep learning algorithm (DLA)'s output to the existing Pan-Canadian Early Detection of Lung Cancer Study (PanCan) models for estimating malignancy risk of screen-detected pulmonary nodules.*Methods and Materials Our DLA was trained on a cohort of 14,828 benign and 1,249 malignant nodules from the National Lung Screening Trial. In the present study, we derived a new multivariable logistic regression model on the PanCan data that included the DLA risk score and the original variables from the PanCan model 2b except for "nodule type" and "spiculation" as these are already encoded in the DLA risk score. The new model was externally validated on baseline nodules from the Danish Lung Cancer Screening Trial (DLCST). For comparison, the performances of the existing PanCan model 2b and of our DLA stand-alone were also calculated.*Results 6024 benign and 86 malignant nodules from the PanCan data were included as the development set, and 818 benign and 34 malignant nodules from the Danish Lung Cancer Screening Trial (DLCST) were included as the validation set. The area under the receiver operating characteristic curve (AUC) for the DLA, PanCan model 2b, and the new model in the PanCan cohort were 0.944 (95% confidence interval = 0.917 - 0.968), 0.941 (0.908 - 0.969), and 0.944 (0.909 - 0.975), respectively. In the DLCST cohort, the AUCs were 0.917 (0.851 - 0.968), 0.896 (0.841 - 0.944), and 0.927 (0.878 - 0.969), respectively.*Conclusions Using our DLA risk score to derive a new multivariable logistic regression model on the PanCan data does not appear to significantly improve the predictive performance in high-risk screening participants, but may serve as a replacement for the "nodule type" and "spiculation" parameters that are known to have substantial interobserver variability.*Clinical Relevance/Application Our DLA has a comparable nodule malignancy risk estimation performance to the PanCan models. This may help to make the computation of nodule risk scores easier and less subjective.

RESULTS

6024 benign and 86 malignant nodules from the PanCan data were included as the development set, and 818 benign and 34 malignant nodules from the Danish Lung Cancer Screening Trial (DLCST) were included as the validation set. The area under the receiver operating characteristic curve (AUC) for the DLA, PanCan model 2b, and the new model in the PanCan cohort were 0.944 (95% confidence interval = 0.917 - 0.968), 0.941 (0.908 - 0.969), and 0.944 (0.909 - 0.975), respectively. In the DLCST cohort, the AUCs were 0.917 (0.851 - 0.968), 0.896 (0.841 - 0.944), and 0.927 (0.878 - 0.969), respectively.

CLINICAL RELEVANCE/APPLICATION

Our DLA has a comparable nodule malignancy risk estimation performance to the PanCan models. This may help to make the computation of nodule risk scores easier and less subjective.

SPR-CH-11 Low-dose CT Characteristics Of Lung Nodules In A Middle-aged Population Of Never-smokers Versus Smokers: The Imalife Study

Participants
Rozemarijn Vliegenthart, MD, PhD, Groningen, Netherlands (*Presenter*) Institutional Research Grant, Siemens AG

PURPOSE

To compare computed tomography (CT) features of lung nodules between never smokers and smokers (former and current) in a Western middle-aged general population.*Methods and Materials We included 1,788 individuals aged 45-60 years from the Dutch Lifelines cohort who had undergone low-dose chest CT as part of the ImaLife study, with at least one lung nodule (=30 mm3) on CT. Smoking variables were collected. CT scans were evaluated for qualitative (count, shape, edge, location, density) and quantitative (diameter and volume) nodule characteristics. Differences in nodule characteristics between never-, former and current smoker groups were examined by Pearson's chi-square testing.*Results Overall, 41.8% were never smokers, 35.9% former smokers and 22.3% current smokers. The median age was 53 years (IQR 48-58), similar across smoking categories; 48.6% were men, with higher prevalence of current smoking among men and higher prevalence of former and never smoking among women. In total, 3,343 nodules were registered. The prevalence of multiple (>1) nodules was higher in current smokers (45%) than in former (39%) and never smokers (36%) (p=0.045, p=0.002). Larger sized nodules were more prevalent in current and former smokers than in never smokers (volume >300mm3: 2.1% and 3.0% vs 1.8%, p=0.028, p=0.013). The percentage of lung nodules categorized as non-solid was higher in former smokers (8.1%) than in current (5.2%) and never smokers (5.8%) (p=0.023, p=0.013). Irregular-shaped and non-smooth nodules were more often identified in current smokers than in former and never smokers (p=0.035, p=0.031), whereas calcified nodules were more often present in never smokers (6.5%) than in former (4.2%) and current smokers (5.0%) (p=0.032).*Conclusions Significant differences in nodule imaging features were found by smoking status: compared to smokers, never smokers with nodules more likely had smaller nodule size, lower proportion of non-solid nodules and of irregular or non-smooth nodules, and higher proportion of calcified nodules.*Clinical Relevance/Application Most evidence for lung nodule imaging features related to probability for lung cancer is based on high-risk (smoking) populations. This study adds evidence in

never smokers, which may help in the future to optimize nodule management of incidentally detected lung nodules in the general population as nodule features seem generally more benign in never smokers.

RESULTS

Overall, 41.8% were never smokers, 35.9% former smokers and 22.3% current smokers. The median age was 53 years (IQR 48-58), similar across smoking categories; 48.6% were men, with higher prevalence of current smoking among men and higher prevalence of former and never smoking among women. In total, 3,343 nodules were registered. The prevalence of multiple (>1) nodules was higher in current smokers (45%) than in former (39%) and never smokers (36%) (p=0.045, p=0.002). Larger sized nodules were more prevalent in current and former smokers than in never smokers (volume >300mm3: 2.1% and 3.0% vs 1.8%, p=0.028, p=0.013). The percentage of lung nodules categorized as non-solid was higher in former smokers (8.1%) than in current (5.2%) and never smokers (5.8%) (p=0.023, p=0.013). Irregular-shaped and non-smooth nodules were more often identified in current smokers than in former and never smokers (p=0.035, p=0.031), whereas calcified nodules were more often present in never smokers (6.5%) than in former (4.2%) and current smokers (5.0%) (p=0.032).

CLINICAL RELEVANCE/APPLICATION

Most evidence for lung nodule imaging features related to probability for lung cancer is based on high-risk (smoking) populations. This study adds evidence in never smokers, which may help in the future to optimize nodule management of incidentally detected lung nodules in the general population as nodule features seem generally more benign in never smokers.

SPR-CH-13   Psoas Muscle Density Evaluated By Chest CT And Long-term Mortality In COPD Patients

Participants
Ana Ezponda, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose

PURPOSE

Poor muscle quality in COPD patients relates to exercise intolerance and mortality. Muscle quality can be estimated on computed tomography (CT) by estimating psoas density (PsD). We tested the hypothesis that PsD is lower in COPD patients than in controls and relates to allcause mortality.*Methods and Materials At baseline, PsD was measured using axial low-dose chest CT images in 220 COPD patients, 80% men, who were 65±8 years old with mild to severe airflow limitation and in a control group of 58 subjects matched by age, sex , body mass index (BMI) and body surface area (BSA). COPD patients were prospectively followed for 76.5 (48-119) months. Anthropometrics, smoking history, BMI, dyspnoea, lung function, exercise capacity, BODE index and exacerbations history were recorded. Cox proportional risk analysis determined the factors more strongly associated with long-term mortality.*Results PsD was lower in COPD patients than in controls (40.5 vs 42.5, p=0.045). During the follow-up, 54 (24.5%) deaths occurred in the COPD group. PsD as well as age, sex, pack-year history, FEV1%, 6MWD, mMRC, BODE index, were independently associated with mortality. Multivariate analysis showed that age (HR 1.06; 95% CI 1.02-1.12, p=0.006) and CT-assessed PsD (HR 0.97; 95%CI 0.94-0.99, p = 0.023) were the variables independently associated with all-cause mortality.*Conclusions In COPD patients with mild to severe airflow limitation, chest CT-assessed psoas muscle density was lower than in matched controls and independently associated with long-term mortality. Muscle quality using the easy to evaluate psoas muscle density from chest CT may provide clinicians with important prognostic information in COPD.*Clinical Relevance/Application Chest-CT assessed PsD is an independent predictor of all-cause mortality in patients with mild to severe COPD.if our findingsare confirmed in other studies, an effort may be made to guarantee that CT's include the psoasas a target to measure in routine CT scans of the chest. Furthermore, new algorithms wouldallow automatic detection of the L3 slice on whole body CT and determination of psoas andother muscles mass and density.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Chest-CT assessed PsD is an independent predictor of all-cause mortality in patients with mild to severe COPD.if our findingsare confirmed in other studies, an effort may be made to guarantee that CT's include the psoasas a target to measure in routine CT scans of the chest. Furthermore, new algorithms wouldallow automatic detection of the L3 slice on whole body CT and determination of psoas andother muscles mass and density.

SPR-CH-14   Performance Of Clinical Readers In Detecting Chronic Thromboembolic Pulmonary Hypertension (CTEPH) On Computed Tomography Pulmonary Angiograms (CTPAs): A Pilot Study.

Participants
Deepa Gopalan, MRCP, FRCR, Stockholm, Sweden (*Presenter*) Speakers Bureau, Bayer AG and Actelion

PURPOSE

Chronic thromboembolic pulmonary hypertension (CTEPH) is an underdiagnosed form of pulmonary hypertension characterized by obstruction of the pulmonary vasculature by thromboembolic material. CTEPH.AI software aims to support radiologists by assessing computed tomography pulmonary angiograms (CTPAs) to identify salient features of CTEPH. We present baseline data from an ongoing pilot study on the performance of readers unaided by CTEPH.AI to detect CTEPH.*Methods and Materials The CTEPH.AI pilot is a multiple-reader, multiple-case, retrospective study of data from 100 selected adult patients who underwent CTPA in routine clinical practice (30 CTEPH positive, 70 CTEPH negative). Twenty board-certified readers (16 community-based and four cardiothoracic radiologists) reviewed all cases unaided. Prior to the study, all readers were informed of the study purpose to detect CTEPH. The primary endpoint is the area under the receiver operating characteristic curve (AUC) and the secondary endpoints are sensitivity and specificity to detect CTEPH. Results were assessed overall and in community and cardiothoracic reader subgroups.*Results Performance was variable amongst unaided readers. AUC ranged from 0.68 to 0.88 with a mean of 0.78 (95% confidence interval [CI] 0.69-0.88), a mean (95% CI) sensitivity of 0.63 (0.46-0.80), and a mean specificity of 0.81 (0.54-1.00). Performance was slightly higher in cardiothoracic radiologists (mean AUC [95% CI], 0.80 [0.74-0.86]; sensitivity, 0.66 [0.63-0.69]; specificity, 0.87 [0.71-1.00]) than community radiologists (mean AUC [95% CI], 0.78 [0.67-0.88]; sensitivity, 0.62 [0.43-0.82]; specificity, 0.80 [0.51-1.00]).*Conclusions Despite awareness of the study purpose, almost a third of CTEPH cases were missed by unaided readers with wide variability amongst readers, demonstrating a high unmet diagnostic need. There is therefore a potential role for CTEPH.AI in improving the diagnosis of CTEPH.*Clinical Relevance/Application The CTEPH.AI pilot study evaluates the

performance of radiologists to detect CTEPH unaided when specifically reviewing CTPAs for CTEPH and reveals a high unmet need to increase diagnostic accuracy.

RESULTS

Performance was variable amongst unaided readers. AUC ranged from 0.68 to 0.88 with a mean of 0.78 (95% confidence interval [CI] 0.69-0.88), a mean (95% CI) sensitivity of 0.63 (0.46-0.80), and a mean specificity of 0.81 (0.54-1.00). Performance was slightly higher in cardiothoracic radiologists (mean AUC [95% CI], 0.80 [0.74-0.86]; sensitivity, 0.66 [0.63-0.69]; specificity, 0.87 [0.71-1.00]) than community radiologists (mean AUC [95% CI], 0.78 [0.67-0.88]; sensitivity, 0.62 [0.43-0.82]; specificity, 0.80 [0.51-1.00]).

CLINICAL RELEVANCE/APPLICATION

The CTEPH.AI pilot study evaluates the performance of radiologists to detect CTEPH unaided when specifically reviewing CTPAs for CTEPH and reveals a high unmet need to increase diagnostic accuracy.

SPR-CH-15   Can CTAnalysis Predict Esophageal Fistula In Patients With Advanced Esophageal Cancer Treated By Chemotherapy Or Chemoradiotherapy: Exploration And Validation

Participants
Yiyuan Wei, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Esophageal fistula entailing high mortality is one of the most serious complications of chemotherapy or chemoradiotherapy (CRT) for advanced esophageal cancer leading to additional procedures. This study aimed to evaluate the performance of quantitative computed tomography (CT) analysis and to establish a practical imaging model for predicting esophageal fistula in esophageal cancer patients administered chemotherapy or chemoradiotherapy.*Methods and Materials This study retrospectively enrolled 204 esophageal cancer patients (54 patients with fistula, 150 patients without fistula) and all patients were allocated to the test and validation cohorts according to the time of inclusion in a 1:1 ratio. Ulcer depth, tumor thickness and length, and minimum and maximum enhanced values for esophageal cancer were measured in pretreatment CT imaging.*Results Exploration: What predictive value can quantitative CT provide when used between SCC patients with esophageal fistula and non-esophageal fistula SCC patients? In baseline CT's quantitative analysis, logistic regression analysis revealed that esophageal cancer with high R-ulcer had elevated predicted rate of esophageal fistula. Lower R-HU value and higher THK-tumor was associated with higher rate of esophageal fistula after treatment. This quantitative CT model containing R-ulcer, R-HU and THK-tumor for predicting esophageal fistula had great performance with an AUC of 0.946 and an accuracy of 92.2% in the test cohort.Validation: How is the performance of using quantitative CT parameters for predicting risks of esophageal fistula in SCC patients treated by chemotherapy or chemoradiotherapy? Quantitative CT model was used to validate the predictive performance of esophageal fistula in the validation cohort and revealed a same high results as showing in the test cohort with an AUC of 0.841 and an accuracy of 78.4%.*Conclusions We provide and validate a handy and effective imaging model based on quantitative pretreatment CT parameters with excellent performance in predicting the risk of fistula formation in esophageal cancer patients administered chemotherapy or CRT. This model offers an individualized assessment approach for esophageal SCC patients to guide clinical treatment for esophageal cancer with high risk of esophageal fistula.*Clinical Relevance/Application To facilitate clinical use, a nomogram based on quantitative CT parameters, including THK-tumor, R-ulcer and R-HU, was developed. The probability of fistula formation after treatment ranged from 0 to 1. A probability nearing 1 indicated high odds of esophageal fistula. Patients with esophageal cancer could benefit from this prediction model.

RESULTS

Exploration: What predictive value can quantitative CT provide when used between SCC patients with esophageal fistula and non-esophageal fistula SCC patients? In baseline CT's quantitative analysis, logistic regression analysis revealed that esophageal cancer with high R-ulcer had elevated predicted rate of esophageal fistula. Lower R-HU value and higher THK-tumor was associated with higher rate of esophageal fistula after treatment. This quantitative CT model containing R-ulcer, R-HU and THK-tumor for predicting esophageal fistula had great performance with an AUC of 0.946 and an accuracy of 92.2% in the test cohort.Validation: How is the performance of using quantitative CT parameters for predicting risks of esophageal fistula in SCC patients treated by chemotherapy or chemoradiotherapy? Quantitative CT model was used to validate the predictive performance of esophageal fistula in the validation cohort and revealed a same high results as showing in the test cohort with an AUC of 0.841 and an accuracy of 78.4%.

CLINICAL RELEVANCE/APPLICATION

To facilitate clinical use, a nomogram based on quantitative CT parameters, including THK-tumor, R-ulcer and R-HU, was developed. The probability of fistula formation after treatment ranged from 0 to 1. A probability nearing 1 indicated high odds of esophageal fistula. Patients with esophageal cancer could benefit from this prediction model.

SPR-CH-19   Challenges Of Diagnosing Interstitial Lung Abnormality (ILA) According To Fleischner Society Guideline By Using Routine Chest CT For A Health Screening: Comparative Analysis With ILA Quantification

Participants
Minseon Kim, Incheon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the reproducibility of radiological criteria of interstitial lung abnormality (ILA) proposed by Fleischner Society and test a fully automated screening tool for ILA in routine chest CT.*Methods and Materials In this retrospective study, patients who underwent chest CT for a health screening were consecutively screened for ILA by thoracic radiologist (R1). Patients who were positive for ILA or equivocal for ILA, and negative for ILA were matched at a ratio of 1:2 by using age and sex variables. A total of 192 patients (55 patients with ILA) were included. Two thoracic radiologists (R2 and R3) independently reviewed the CT images according to Fleischner Society guideline and rated the presence (ILA, equivocal ILA, no ILA) and subtype of ILA, and semi-quantitatively evaluated the extent of ILA in each lung zone. We tested the dedicated automated screening tool for ILA, which provide ILA quantification according to guideline using deep learning based CT quantification, using each readers' diagnosis as a gold standard.*Results Among total patients, 19 patients underwent routine dose nonenhanced chest CT and 173 patients underwent routine dose enhanced chest CT. Interreader agreement for ILA (no ILA, equivocal ILA or ILA) between two radiologists was substantial (weighted ? = 0.69) and for ILA subtype was moderate (? = 0.44). The mean quantified ILA of the lung zone

visually rated more than 5% were about 7% (interquartile range: 1-13) and of the zone rated less than 5% was 2.5% to 3.7% (interquartile range: 0-6). The diagnosis of presence of ILA based on automatic tool quantifying total extent of ILA in each zones with 5% cut-off, had a sensitivity of 62.2% and a specificity of 66.9% for the detection of ILA for R2 diagnosis and a sensitivity of 56.1% and a specificity of 64.5% for R3 diagnosis.*Conclusions Significant interreader variability exists for diagnosing ILA according to Fleischner society guideline. Screening with quantification may aid the diagnosis to define the extent of ILA objectively and according to guideline but the diagnostic sensitivity should be improved.*Clinical Relevance/Application The current radiological criteria of the ILA may not be highly reproducible. Screening with quantification can provide a more reproducible assessment and have potential in aiding the diagnosis and follow-up of ILA.

RESULTS

Among total patients, 19 patients underwent routine dose nonenhanced chest CT and 173 patients underwent routine dose enhanced chest CT. Interreader agreement for ILA (no ILA, equivocal ILA or ILA) between two radiologists was substantial (weighted ? = 0.69) and for ILA subtype was moderate (? = 0.44). The mean quantified ILA of the lung zone visually rated more than 5% were about 7% (interquartile range: 1-13) and of the zone rated less than 5% was 2.5% to 3.7% (interquartile range: 0-6). The diagnosis of presence of ILA based on automatic tool quantifying total extent of ILA in each zones with 5% cut-off, had a sensitivity of 62.2% and a specificity of 66.9% for the detection of ILA for R2 diagnosis and a sensitivity of 56.1% and a specificity of 64.5% for R3 diagnosis.

CLINICAL RELEVANCE/APPLICATION

The current radiological criteria of the ILA may not be highly reproducible. Screening with quantification can provide a more reproducible assessment and have potential in aiding the diagnosis and follow-up of ILA.

SPR-CH-20   Personalized Chest CT: Optimal Examination Protocols For The Detection Of Fibrosis, Nodules, And Pneumonia.

Participants
Markus Kopp, Erlangen, Germany (*Presenter*) Speakers Bureau, Siemens AG

PURPOSE

The purpose of this study was to evaluate the minimum diagnostic radiation dose level for the detection of high-resolution (HR) lung structures, pulmonary nodules (PN), and infectious diseases (ID).*Methods and Materials Preclinical CT examinations were performed with a human cadaver in exponential radiation dose settings. We used tin filter-based spectral shaping protocols starting with the applicable minimum and ranging up to the institutional standard full dose protocol. Image findings were evaluated on a 5-point Likert scale, with 3 representing the minimum image quality. Subgroup analysis was carried out for optimal detection (Likert = 4) of HR lung structures, PN, and ID. We developed three specific protocols (HR-,PN- and ID-CT) and one minimum dose protocol (MIN-CT). Those protocols were prospectively used in 88 consecutive patients. We compared radiation dose parameters, objective and subjective image quality.*Results Optimal or perfect lesion detection (Likert = 4) was achieved for HR-, PN-, and ID-CT under consideration of the individual clinical focus. HR-CT (CTDIvol: 5.4 (± 1.4) mGy*cm) was performed in 38 patients, PN-CT (1.2 (± 0.4) mGy*cm) in 21 patients, ID-CT (0.6 (± 0.2) mGy*cm) in 20 patients and MIN-CT (ED: 0.2 (± 0.1) mGy*cm) in 9 patients. CTDIvol differed significantly within the study groups, and also post-hoc analysis was significant (p < 0.001), except for the comparison of ID-CT and MIN-CT (p = 0.262). Dose normalized contrast to noise ratio (CNRD) was comparable between all groups (p = 0.087). Overall image quality (OA) and delineation for HR structures, PN, and ID differed significantly within the study groups (p < 0.001). Post-hoc analysis showed no significant difference between PN- and ID-CT protocols for OA, HR lung structures, PN and ID (p = 0.575, p = 1.000, p = 0.681, p = 1.000). Comparison of HR- and PN-CT protocols was not significant for the detection of PN and ID (p = 0.051, p = 0.177). MIN-CT showed borderline image quality (Likert = 3) for the delineation of PN and ID, was insufficient for HR structures, and reached a dose reduction up to 96.7% compared to HR-CT.*Conclusions Personalized chest CT protocols tailored to specific clinical indications lead to substantial dose reduction without reducing interpretability.*Clinical Relevance/Application The use of personalized chest CT protocols leads to significant dose reduction without reducing interpretability under consideration of the clinical indication. Additionally, this study suggests a validated low-dose CT protocol for detecting pneumonia in the COVID-19 pandemic. MIN-CT allows to control or exclude pulmonary pathologies at dose levels comparable to a chest radiograph in two planes.

RESULTS

Optimal or perfect lesion detection (Likert = 4) was achieved for HR-, PN-, and ID-CT under consideration of the individual clinical focus. HR-CT (CTDIvol: 5.4 (± 1.4) mGy*cm) was performed in 38 patients, PN-CT (1.2 (± 0.4) mGy*cm) in 21 patients, ID-CT (0.6 (± 0.2) mGy*cm) in 20 patients and MIN-CT (ED: 0.2 (± 0.1) mGy*cm) in 9 patients. CTDIvol differed significantly within the study groups, and also post-hoc analysis was significant (p < 0.001), except for the comparison of ID-CT and MIN-CT (p = 0.262). Dose normalized contrast to noise ratio (CNRD) was comparable between all groups (p = 0.087). Overall image quality (OA) and delineation for HR structures, PN, and ID differed significantly within the study groups (p < 0.001). Post-hoc analysis showed no significant difference between PN- and ID-CT protocols for OA, HR lung structures, PN and ID (p = 0.575, p = 1.000, p = 0.681, p = 1.000). Comparison of HR- and PN-CT protocols was not significant for the detection of PN and ID (p = 0.051, p = 0.177). MIN-CT showed borderline image quality (Likert = 3) for the delineation of PN and ID, was insufficient for HR structures, and reached a dose reduction up to 96.7% compared to HR-CT.

CLINICAL RELEVANCE/APPLICATION

The use of personalized chest CT protocols leads to significant dose reduction without reducing interpretability under consideration of the clinical indication. Additionally, this study suggests a validated low-dose CT protocol for detecting pneumonia in the COVID-19 pandemic. MIN-CT allows to control or exclude pulmonary pathologies at dose levels comparable to a chest radiograph in two planes.

SPR-CH-21   Application Of AI - Based Emphysema Quantification Algorithm On 512 And 1024-matrix Chest CT Images: Variability Demands Standardization

Participants
Shadi Ebrahimian, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Ultra-high-resolution acquisition mode on modern multidetector-row CT scanners allows reconstruction of 512-matrix as well as 1024-matrix images. With emerging improvements in CT technology, in-plane resolution is expected to reach 2048-matrix. We

assessed variations in lung and lobe distribution of the low attenuation area (LAA< -950HU) quantified with AI-based emphysema algorithm on chest CT images reconstructed with 512- and 1024 matrix.*Methods and Materials With IRB approval and HIPAA compliance, we included 77 patients (mean age 70 ± 14 years; male: female 34:43) who were scanned on a 512-slice, single-source, MDCT scanner (GE Revolution CT) using High-Definition acquisition mode where the scanner acquires 2496 views per gantry rotation instead of 984 views in regular mode. We reconstructed two transverse image series using 512 and 1024 square matrix (both with 0.625 mm section thickness and HD-Detail reconstruction algorithm with a commercial, ASIRv iterative reconstruction technique at a strength of 30%). Deidentified 512- and 1024-matrix image series were separately processed on an offline commercial AI-based emphysema quantification algorithm (Coreline, South Korea). Data were analyzed to determine the difference (Student t test) between volume of LAA on the two series.*Results Overall, 46/77 CT had evidence of emphysema and the remaining 31/77 patients had no emphysema. There was a significant difference in LAA percentage volume (regarded significant when difference >5%) estimated from 512- and 1024-matrix images (p=0.014). In 21/77 patients, LAA in 1024-matrix images was substantially higher than on 512-matrix (5-13% change). In 4/77 patients, LAA percentage volume was greater on 512-matrix images than on 1024-matrix (5-9% change). The absolute LAA volumes on 512-matrix (LAA volume = 96.2±165.3 ml) and 1024-matrix images (391.3±404.3 ml) were substantially different (p<0.001). Subjective analysis revealed differences in image noise, texture, and sharpness of small pulmonary structures between the two-image series.*Conclusions Differences in reconstructed matrix size (512 vs. 1024) is associated with random variations in estimation of low-attenuation areas (< -950 HU) for CT-based emphysema quantification.*Clinical Relevance/Application When using emphysema quantification algorithms, users must pay close attention to the matrix size to avoid technique-related variations in estimation of low-attenuation areas on chest CT.

RESULTS

Overall, 46/77 CT had evidence of emphysema and the remaining 31/77 patients had no emphysema. There was a significant difference in LAA percentage volume (regarded significant when difference >5%) estimated from 512- and 1024-matrix images (p=0.014). In 21/77 patients, LAA in 1024-matrix images was substantially higher than on 512-matrix (5-13% change). In 4/77 patients, LAA percentage volume was greater on 512-matrix images than on 1024-matrix (5-9% change). The absolute LAA volumes on 512-matrix (LAA volume = 96.2±165.3 ml) and 1024-matrix images (391.3±404.3 ml) were substantially different (p<0.001). Subjective analysis revealed differences in image noise, texture, and sharpness of small pulmonary structures between the two-image series.

CLINICAL RELEVANCE/APPLICATION

When using emphysema quantification algorithms, users must pay close attention to the matrix size to avoid technique-related variations in estimation of low-attenuation areas on chest CT.

SPR-CH-22 AI - Based Lung Features Extraction, Classification, And Quantification In Interstitial Lung Diseases

Participants
Shadi Ebrahimian, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Variations in classification and quantitation of interstitial lung diseases (ILD) are known limitations of qualitative interpretation of chest CT in ILD. We assessed the role of an AI algorithm in extraction, classification, and quantification of lung features from thin-section CT in ILD patients.*Methods and Materials Our IRB approved study included 194 patients with ILD (mean age 69±12year; M:F 108:86) on thin-section chest CTs. Two thoracic radiologists recorded lobar distribution, finding types (such as groundglass, reticulations, honeycombing, cysts, consolidation), and classification of scan patterns (UIP, probable UIP, indeterminate for UIP, and alternative diagnosis) according to the ATS/ERS/JRS/ALAT Practice Guideline for idiopathic pulmonary fibrosis (IPF). Surgical pathology, clinical and/or radiologic diagnosis were obtained from medical records. Thin-section CTs were processed with the Lung Texture AI algorithm (Coreline, S. Korea) for lung feature extraction and computing volumes of honeycombing, reticulation, emphysema, consolidation, GGO, and normal lung in the whole lung and each lobe separately. Data were analyzed with independent sample t-test, one-way ANOVA, and area under the ROC curve (AUC).*Results AI-based volumes of reticulation (AUC=0.87) and honeycombing (AUC=0.80) were the best differentiators between the different scan patterns (p<0.001). Higher AUCs were calculated from extracted reticulation and honeycombing volumes from lower lobes (AUC=0.82) than upper and middle lobes (AUC=0.69) (p<0.001). AI predicted the presence of honeycombing, reticulation, and consolidation with AUCs of 0.81, 0.93, and 0.78, respectively. AI differentiated chest CT with IPF from other diseases with AUCs of 0.88, 0.82, and 0.72 (p<0.001) for the volume of reticulation, consolidation, and honeycombing, respectively. The highest AUCs for differentiating hypersensitivity pneumonitis was noted for reticulation (AUC=0.85), honeycombing (AUC=0.73), and consolidation (AUC=0.74) (p<0.001).*Conclusions The Lung Texture AI can help extract and quantify volume of different chest CT findings in ILD as well as aid in classifying scan patterns in patients with IPF. This can help reduce interobserver discordance and quantify disease burden.*Clinical Relevance/Application Fully-automated, AI-based extraction and classification of ILD/IPF-related findings along with whole lung and lobar quantification can help predict disease patterns and differentiate common ILDs.

RESULTS

AI-based volumes of reticulation (AUC=0.87) and honeycombing (AUC=0.80) were the best differentiators between the different scan patterns (p<0.001). Higher AUCs were calculated from extracted reticulation and honeycombing volumes from lower lobes (AUC=0.82) than upper and middle lobes (AUC=0.69) (p<0.001). AI predicted the presence of honeycombing, reticulation, and consolidation with AUCs of 0.81, 0.93, and 0.78, respectively. AI differentiated chest CT with IPF from other diseases with AUCs of 0.88, 0.82, and 0.72 (p<0.001) for the volume of reticulation, consolidation, and honeycombing, respectively. The highest AUCs for differentiating hypersensitivity pneumonitis was noted for reticulation (AUC=0.85), honeycombing (AUC=0.73), and consolidation (AUC=0.74)(p<0.001).

CLINICAL RELEVANCE/APPLICATION

Fully-automated, AI-based extraction and classification of ILD/IPF-related findings along with whole lung and lobar quantification can help predict disease patterns and differentiate common ILDs.

SPR-CH-23 Pulmonary Arterial Thrombosis 3 Months After A SARS-Cov2 Infection: Frequency On Dual-Energy CT (DECT) Angiographic Examinations In 55 Patients

Participants
Martine J. Remy-Jardin, MD, PhD, Lille, France (*Presenter*) Research Grant, Siemens AG;Speaker, Siemens AG

PURPOSE

During COVID-19, the main manifestations of the disease are not only pneumonia but also coagulation disorders. We present preliminary data on the pulmonary vascular abnormalities detectable 3 months after hospitalization for severe SARS-Cov2 infection.*Methods and Materials Among the 320 patients with confirmed COVID-19 hospitalized between March and April 2020 who participated in a systematic follow-up at 3 months, 67 patients with residual respiratory symptoms were referred for specialized follow-up. Fifty-five of them (30 males; 25 females; mean age: 60.4 yr) underwent a DECT angiographic examination on a 3rd-generation dual-source CT system (Force, Siemens Healthineers) with reconstruction of perfusion images (Lung PBV).*Results All patients had partial (n=40; 72.7%) or complete (n=15; 27.3%) resolution of COVID-19 lung infiltration. CT angiographic images were normal in 52 patients (52/55; 94.6%) and showed non-obstructive thrombi in 3 patients (3/55; 5.4%) at the level of (a) one (n=1) and two (n=1) segmental arteries of a single lobe; and (b) central and peripheral arteries of both lungs (n=1); none showed features of lung infarction. Lung perfusion was rated as non-interpretable in 2 patients (3.6%; shoulder prosthesis/morbid obesity), normal in 17 patients (30.9%) and abnormal in 36 patients (65.5%), the latter group comprising 32 patients with residual COVID-19 opacities (32/55; 58%) and 4 patients with normal lung parenchyma (4/55; 7%). Perfusion abnormalities consisted of (a) patchy perfusion defects in both lungs (30/36; 83%), (b) PE-type perfusion defects (6/36; 16.6%) in presence (n=1) or absence of proximal thrombosis (n=5); and (c) focal areas of hypoperfusion (2/36; 5.5%).*Conclusions DECT depicted non-obstructive proximal thrombosis in 5.4% of patients and perfusion abnormalities suggestive of widespread microangiopathy in 65.5% of patients. Lung microcirculation was abnormal in 7% of patients with a normal lung parenchyma.*Clinical Relevance/Application DECT depicted unexpected arterial thrombosis (5.4%), perfusion abnormalities suggestive of microangiopathy (65.5%) and areas of increased perfusion matching residual SARS-CoV-2 pneumonia abnormalities.

RESULTS

All patients had partial (n=40; 72.7%) or complete (n=15; 27.3%) resolution of COVID-19 lung infiltration. CT angiographic images were normal in 52 patients (52/55; 94.6%) and showed non-obstructive thrombi in 3 patients (3/55; 5.4%) at the level of (a) one (n=1) and two (n=1) segmental arteries of a single lobe; and (b) central and peripheral arteries of both lungs (n=1); none showed features of lung infarction. Lung perfusion was rated as non-interpretable in 2 patients (3.6%; shoulder prosthesis/morbid obesity), normal in 17 patients (30.9%) and abnormal in 36 patients (65.5%), the latter group comprising 32 patients with residual COVID-19 opacities (32/55; 58%) and 4 patients with normal lung parenchyma (4/55; 7%). Perfusion abnormalities consisted of (a) patchy perfusion defects in both lungs (30/36; 83%), (b) PE-type perfusion defects (6/36; 16.6%) in presence (n=1) or absence of proximal thrombosis (n=5); and (c) focal areas of hypoperfusion (2/36; 5.5%).

CLINICAL RELEVANCE/APPLICATION

DECT depicted unexpected arterial thrombosis (5.4%), perfusion abnormalities suggestive of microangiopathy (65.5%) and areas of increased perfusion matching residual SARS-CoV-2 pneumonia abnormalities.

SPR-CH-24 Immune-related Thyroiditis In Patients With Advanced Lung Cancer Treated With Immune-checkpoint Inhibitors: The Incidence, Imaging Features, And Clinical Implications

Participants
Hyesun Park, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the incidence and imaging characteristics of thyroiditis in the setting of immune-checkpoint inhibitor (ICI) therapy and correlate with clinical features.*Methods and Materials The study included 534 patients with advanced non-small cell lung cancer (NSCLC) treated with ICI using PD-1/PD-L1 inhibitors. The imaging and medical records were retrospectively reviewed with IRB approval. Two radiologists independently reviewed the baseline and serial follow-up scans (chest CT and F18-FDG-PET-CT) during ICI therapy, without access to the clinical records. The imaging findings indicative of thyroiditis included morphology (enlargement or atrophy) and attenuation (diffusely hypodense or heterogeneous) on CT, and hypermetabolism on PET-CT, which was new on follow-up scans. Discordant cases were reviewed by the third reader to determine the final interpretation.*Results Among 534 patients, 50 patients (9.4%) had imaging findings indicative of thyroiditis. The median time from the initiation of therapy to the first positive scan was 9.5 weeks (range, 0.9-87.4 weeks). Most common finding was diffuse hypoattenuation of the glands (36/50, 72%), with gland enlargement in 15 and atrophy in 12 patients. Heterogeneous attenuation of the glands was noted in 12 patients (12/50, 24%), with enlargement in 7 and atrophy in one patient. Diffuse increased FDG uptake in the glands on PET-CT was noted in 2 patients (2/50, 4%) without morphologic changes. Seventy-seven patients had clinically diagnosed thyroiditis with abnormal TSH, including 22 with both clinical and radiological diagnoses. Among 77 clinically diagnosed cases, patients who also had positive CT/PET findings more frequently received hormone replacement therapy than those without CT/PET findings (20/22 vs. 20/55; Fisher p<0.0001).*Conclusions Immune-related thyroiditis during ICI therapy commonly presents with diffuse hypoattenuation of thyroid glands on chest CT, with or without enlargement or atrophy, and was noted in 9.4% of advanced NSCLC patients.*Clinical Relevance/Application Awareness of the imaging findings of immune-related thyroiditis on chest CT is important because of the therapeutic implications for thyroiditis.

RESULTS

Among 534 patients, 50 patients (9.4%) had imaging findings indicative of thyroiditis. The median time from the initiation of therapy to the first positive scan was 9.5 weeks (range, 0.9-87.4 weeks). Most common finding was diffuse hypoattenuation of the glands (36/50, 72%), with gland enlargement in 15 and atrophy in 12 patients. Heterogeneous attenuation of the glands was noted in 12 patients (12/50, 24%), with enlargement in 7 and atrophy in one patient. Diffuse increased FDG uptake in the glands on PET-CT was noted in 2 patients (2/50, 4%) without morphologic changes. Seventy-seven patients had clinically diagnosed thyroiditis with abnormal TSH, including 22 with both clinical and radiological diagnoses. Among 77 clinically diagnosed cases, patients who also had positive CT/PET findings more frequently received hormone replacement therapy than those without CT/PET findings (20/22 vs. 20/55; Fisher p<0.0001).

CLINICAL RELEVANCE/APPLICATION

Awareness of the imaging findings of immune-related thyroiditis on chest CT is important because of the therapeutic implications for thyroiditis.

SPR-CH-25 Can Dual-Energy CT Lung Perfusion Detect Abnormalities At The Level Of Lung Circulation In Systemic Sclerosis (SSc)? Preliminary Experience In 101 Patients

Participants
Martine J. Remy-Jardin, MD, PhD, Lille, France (*Presenter*) Research Grant, Siemens AG;Speaker, Siemens AG

PURPOSE

To evaluate lung perfusion in patients with systemic sclerosis (SSc) and search for potential relationships between perfusion abnormalities and clinical, functional and hemodynamic characteristics.*Methods and Materials The study population included 101 patients who underwent dual-energy CT (DECT) angiography in the follow-up of SSc. CT examinations were obtained on a 3rd-generation dual-source CT system (Force, Siemens Healthineers) with reconstruction of morphologic and perfusion images. All patients underwent pulmonary function tests within two months of the follow-up CT scan. Fifteen patients had right heart catheterization-proven PH.*Results Based on HRCT scans, our population included patients without SSc-lung involvement (Group A; n=37), patients with SSc-related ILD (Group B; n=56) of variable extent (Group B mild: =10% of lung parenchyma: n=17; Group B moderate: between 11-50%: n=31; Group B severe: >50%: n=8) and patients with pulmonary veno-occlusive disease/pulmonary capillary hemangiomatosis (PVOD/PCH) (Group C; n=8). Lung perfusion was abnormal in 8 patients in Group A (21.6%), 14 patients in Group B (25%) and 7 patients in Group C (87.5%). Perfusion changes were mainly composed of bilateral perfusion defects, including patchy, PE-type perfusion defects and areas of hypoperfusion of variable size. In Group A and Group B mild (n=54): (a) patients with abnormal lung perfusion (n=14) had a significantly higher proportion of NYHA III/IV scores of dyspnea (p=0.031), a shorter mean walking distance at the 6MWT (p=0.042) and a trend towards lower mean DLCO% (p=0.055) when compared to patients with normal lung perfusion (n=40); (b) a negative albeit weak correlation was found between the iodine concentration in both lungs and the DLCO% (r=-0.27; p=0.059) whereas no correlation was found with the PAPs (r=0.16; p=0.29) and walking distance during the 6MWT (r=-0.029; p=0.84).*Conclusions DECT lung perfusion provides complementary information to standard HRCT scans, depicting perfusion changes in SSc patients with normal or minimally infiltrated lung parenchyma.*Clinical Relevance/Application Our results show a clinically relevant complementarity between morphology and perfusion in the evaluation of SSc patients, suggesting a greater role for dual-energy CT in patient management.

RESULTS

Based on HRCT scans, our population included patients without SSc-lung involvement (Group A; n=37), patients with SSc-related ILD (Group B; n=56) of variable extent (Group B mild: =10% of lung parenchyma: n=17; Group B moderate: between 11-50%: n=31; Group B severe: >50%: n=8) and patients with pulmonary veno-occlusive disease/pulmonary capillary hemangiomatosis (PVOD/PCH) (Group C; n=8). Lung perfusion was abnormal in 8 patients in Group A (21.6%), 14 patients in Group B (25%) and 7 patients in Group C (87.5%). Perfusion changes were mainly composed of bilateral perfusion defects, including patchy, PE-type perfusion defects and areas of hypoperfusion of variable size. In Group A and Group B mild (n=54): (a) patients with abnormal lung perfusion (n=14) had a significantly higher proportion of NYHA III/IV scores of dyspnea (p=0.031), a shorter mean walking distance at the 6MWT (p=0.042) and a trend towards lower mean DLCO% (p=0.055) when compared to patients with normal lung perfusion (n=40); (b) a negative albeit weak correlation was found between the iodine concentration in both lungs and the DLCO% (r=-0.27; p=0.059) whereas no correlation was found with the PAPs (r=0.16; p=0.29) and walking distance during the 6MWT (r=-0.029; p=0.84).

CLINICAL RELEVANCE/APPLICATION

Our results show a clinically relevant complementarity between morphology and perfusion in the evaluation of SSc patients, suggesting a greater role for dual-energy CT in patient management.

SPR-CH-26 Pulmonary MR Imaging With Ultra-short TE: Capability For Nodule Detection And Lung-RADS Classification Compared With That Of Standard- And Reduced-dose CTs

Participants
Yoshiharu Ohno, MD,PhD, Toyoake, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation;Research Grant, DAIICHI SANKYO Group

PURPOSE

Pulmonary MR imaging with ultra-short echo time (UTE) has been tested for nodule detection or nodule subtype classification compared with standard- or reduced-dose CTs. However, no reports have been published regarding a direct comparison of these methods' capabilities for Lung-RADS evaluation. The purpose of this study was to compare the capabilities of pulmonary MR imaging with UTE with those of standard- or reduced-dose thin-section CTs for nodule detection and Lung-RADS classification in screening situation.*Methods and Materials Standard- and reduced-dose chest CTs (270 mA and 60 mA) and MR imaging with UTE were used to examine 365 subjects, 209 males (mean age, 64±8 years [mean±standard deviation]) and 156 females (mean age, 64±9 years) as lung cancer screening. Probability of nodule presence was assessed for all methods with a 5-point visual scoring system. All detected nodules were then classified based on Lung-RADS classification using each method. To compare nodule detection capability of the three methods, consensus for performances was rated by using jackknife free-response receiver operating characteristic analysis. Then, sensitivity and false positive rate (/data set) for consensus assessment were also compared among the three methods by using McNemar's test or the signed rank test. In addition, weighted kappa statistics were used to determine the agreement of Lung-RADS classification obtained with each method with standard reference.*Results Sensitivity (SE) of pulmonary MR imaging with UTE (SE=0.88) was significantly higher than that of standard-dose CT (SE=0.87, p=0.008) and reduced-dose CT (SE=0.87, p=0.004), although there was no significant difference in figure of merit among the three methods (F=3.0, p=0.25). Moreover, there were no significant differences of in false-positive rate/case in consensus evaluation among of all methods (p>0.05). Agreements for Lung-RADS among all methods were determined as significant or almost perfect (standard-dose CT: ?=0.82, p<0.0001; reduced-dose CT: ?=0.82, p<0.0001; pulmonary MR imaging with UTE: ?=0.81, p<0.0001).*Conclusions Pulmonary MR imaging with UTE was found to be as useful for nodule detection and Lung-RADS classification evaluation as standard- or reduced-dose CTs in lung cancer screening.*Clinical Relevance/Application Pulmonary MR imaging with UTE was found to be as useful for nodule detection and Lung-RADS classification evaluation as standard- or reduced-dose CTs in lung cancer screening.

RESULTS

Sensitivity (SE) of pulmonary MR imaging with UTE (SE=0.88) was significantly higher than that of standard-dose CT (SE=0.87, p=0.008) and reduced-dose CT (SE=0.87, p=0.004), although there was no significant difference in figure of merit among the three methods (F=3.0, p=0.25). Moreover, there were no significant differences of in false-positive rate/case in consensus evaluation among of all methods (p>0.05). Agreements for Lung-RADS among all methods were determined as significant or almost perfect (standard-dose CT: ?=0.82, p<0.0001; reduced-dose CT: ?=0.82, p<0.0001; pulmonary MR imaging with UTE: ?=0.81, p<0.0001).

CLINICAL RELEVANCE/APPLICATION

Pulmonary MR imaging with UTE was found to be as useful for nodule detection and Lung-RADS classification evaluation as standard- or reduced-dose CTs in lung cancer screening.

SPR-CH-3 Identification Of Risk Factors For Brain Metastasis In Newly Diagnosed Non-Small Cell Lung Cancer: A Cohort Study

Participants
Sohee Park, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To identify risk factors for brain metastasis from staging chest CT and clinical characteristics in patients with newly diagnosed non-small cell lung cancer (NSCLC) dichotomized according to resectability.*Methods and Materials Patients newly diagnosed with NSCLC of clinical stages II-IV between November 2017 and October 2018 were enrolled and classified into resectable (TNM stage II and IIIA) and unresectable stages (TNM stage IIIB/C and IV) on chest CT. Associations of clinicopathological characteristics and staging chest CT findings with brain metastasis were analyzed using univariable and multivariable logistic regression for each stage group. Predictive models were constructed, and their performances were evaluated using receiver operating characteristics curve analysis. A subgroup analysis for unresectable-stage patients with known epidermal growth factor receptor gene (EGFR) mutation was also performed.*Results 911 NSCLC patients (mean age, 65 ± 11 years; 620 men), of whom 194 were diagnosed with brain metastasis. 335 patients (25 brain metastases) were classified as resectable stages and 576 patients (169 brain metastases) as unresectable stages. Independent risk factors for brain metastasis were as follows: N2-stage, absence of air-bronchogram/bubble lucency, and presence of spiculation for resectable stages; and younger age, female, extrathoracic metastasis, and adenocarcinoma for unresectable stages. The predictive models gave areas under the curve (AUCs) of 0.736 for resectable stages and 0.675-0.766 for unresectable stages. In the subgroup with known EGFR-mutation status, extrathoracic metastasis and positive EGFR mutation were independent risk factors, with the model showing AUCs of 0.641-0.732.*Conclusions CT-derived imaging features, clinical stages, lung cancer subtype, and EGFR mutation were associated with brain metastasis in patients with newly diagnosed NSCLC. The risk factors were completely different between resectable and unresectable stages.*Clinical Relevance/Application CT-derived imaging features, clinical stage, lung cancer subtype, and EGFR mutation were risk factors for brain metastasis in patients with newly diagnosed NSCLC, which showed different associations depending on resectability.

RESULTS

911 NSCLC patients (mean age, 65 ± 11 years; 620 men), of whom 194 were diagnosed with brain metastasis. 335 patients (25 brain metastases) were classified as resectable stages and 576 patients (169 brain metastases) as unresectable stages. Independent risk factors for brain metastasis were as follows: N2-stage, absence of air-bronchogram/bubble lucency, and presence of spiculation for resectable stages; and younger age, female, extrathoracic metastasis, and adenocarcinoma for unresectable stages. The predictive models gave areas under the curve (AUCs) of 0.736 for resectable stages and 0.675-0.766 for unresectable stages. In the subgroup with known EGFR-mutation status, extrathoracic metastasis and positive EGFR mutation were independent risk factors, with the model showing AUCs of 0.641-0.732.

CLINICAL RELEVANCE/APPLICATION

CT-derived imaging features, clinical stage, lung cancer subtype, and EGFR mutation were risk factors for brain metastasis in patients with newly diagnosed NSCLC, which showed different associations depending on resectability.

SPR-CH-4 Differences In Prognostic Implication Of Ground-glass Opacity At CT In Resectable Lung Cancers According To Nodal Status

Participants
Sohee Park, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Although the presence of GGO on CT indicated a favorable prognosis in early-stage non-small cell lung cancer (NSCLC), it is still unclear whether this impact will be preserved in resectable NSCLCs with more advanced stages. This study was aimed to clarify the prognostic significance of GGO component according to tumor stage and pathological nodal status in resectable NSCLCs.*Methods and Materials Patients who underwent curative resection for NSCLC between July 2010 and December 2017 were retrospectively included in this study. Patients were divided into GGO and solid groups based on the presence of GGO component. The interaction (a) between the presence of the GGO and pathological nodal status and (b) between the presence of GGO and cT stage on survival was evaluated. Cox regression was conducted in each subgroup stratified according to their interactions.*Results Out of 1,545 patients (mean age, 63 years; 908 men), 548 patients were classified into GGO group (pN0: 457, pN1/2: 91) and 997 patients into solid group (pN0: 660, pN1/2: 337). There were interactions between the presence of GGO and pathological nodal metastasis on both for 5-year disease-free survival (DFS) (p=0.006) and 5-year overall survival (OS) (p=0.02). The multivariable analysis revealed that 5-year DFS and 5-year OS of patients in GGO group were better than those of patients in solid group, only in pN0 stage (hazard ratio [HR], 0.63; p=0.003 and HR, 0.56; p=0.02, respectively), but not in pN1/2 stage. Moreover, in pN0 stage, the favorable prognostic value of GGO was limited to cT1 stage for 5-year DFS (adjusted HR, 0.48; p<0.001) and cT1/2 stage for 5-year OS (adjusted HR, 0.36; p=0.001).*Conclusions The presence of GGO was a favorable predictor for survival only in pN0 stage. Further, its significance was valid only in cT1 stage for DFS and cT1/2 stage for OS.*Clinical Relevance/Application In patients without pathological nodal metastasis, the presence of GGO provided additional prognostic value in a favorable direction, which may help further patient stratification and prognostication beyond the current staging system.

RESULTS

Out of 1,545 patients (mean age, 63 years; 908 men), 548 patients were classified into GGO group (pN0: 457, pN1/2: 91) and 997 patients into solid group (pN0: 660, pN1/2: 337). There were interactions between the presence of GGO and pathological nodal metastasis on both for 5-year disease-free survival (DFS) (p=0.006) and 5-year overall survival (OS) (p=0.02). The multivariable analysis revealed that 5-year DFS and 5-year OS of patients in GGO group were better than those of patients in solid group, only in pN0 stage (hazard ratio [HR], 0.63; p=0.003 and HR, 0.56; p=0.02, respectively), but not in pN1/2 stage. Moreover, in pN0 stage, the favorable prognostic value of GGO was limited to cT1 stage for 5-year DFS (adjusted HR, 0.48; p<0.001) and cT1/2 stage for 5-year OS (adjusted HR, 0.36; p=0.001).

CLINICAL RELEVANCE/APPLICATION

In patients without pathological nodal metastasis, the presence of GGO provided additional prognostic value in a favorable direction, which may help further patient stratification and prognostication beyond the current staging system.

SPR-CH-5 A Multi-modality Tumor And Non-tumor Radiomics Model For Recurrence Risk-stratification In Non-

small Cell Lung Cancer

Participants
Jaryd Christie, BMedSc, London, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

To develop a multi-modal model integrating quantitative imaging features from the tumor and non-tumor regions of interest, qualitative features, and clinical data to improve recurrence risk-stratification of patients with non-small cell lung cancer (NSCLC) over cancer staging.*Methods and Materials A dataset of 135 patients with early-stage NSCLC who had surgery as their primary form of treatment was analyzed. The tumor and peri-tumoral volumes on both pre-treatment CT and PET were segmented, while the bone marrow (L3-L5 vertebral bodies) was segmented on PET. The Quantitative Image Feature Engine was used to compute shape, size, first-order, and texture radiomic features from these volumes. Combined with the clinical and qualitative CT features, feature selection was performed using the least absolute shrinkage and selection operator (LASSO) on the 1030 features to select the top features to predict time to any recurrence in the training cohort (n=94). A Cox model was built in the training cohort and evaluated on the testing cohort (n=41). Model performance was assessed using the concordance index and compared to a clinical stage-only model. Kaplan-Meier curves were generated to separate patients into high- and low-risk groups using the median risk score in the training cohort.*Results A total of 14 features were selected as the top performing features to predict post-surgical recurrence. Twelve of the top features were texture features (two CT tumor, six CT peri-tumoral, two PET peri-tumoral, and two PET bone marrow) with the remaining two features being cancer stage and patient age. Patients with a more heterogenous texture in the tumor and non-tumor regions were more likely to recur. The model significantly stratified patients into high- and low-risk groups in the training (n=94, p<0.005) and testing (n=41, p=0.01) cohorts, respectively. The radiomics based model achieved a concordance of 0.84 and 0.81, outperforming the clinical stage-only model, with concordances of 0.69 and 0.68 in the training and testing cohorts, respectively.*Conclusions Our radiomics model outperformed the stage-only model for NSCLC recurrence risk stratification. These results demonstrate that non-invasive radiomic features from the tumor and non-tumor regions on CT and PET could aid physicians in identifying patients who are at higher risk of treatment failure.*Clinical Relevance/Application CT and PET radiomics have the potential to augment staging to improve recurrence risk-stratification and could aid physicians in identifying patients that may benefit from more aggressive treatment options.

RESULTS

A total of 14 features were selected as the top performing features to predict post-surgical recurrence. Twelve of the top features were texture features (two CT tumor, six CT peri-tumoral, two PET peri-tumoral, and two PET bone marrow) with the remaining two features being cancer stage and patient age. Patients with a more heterogenous texture in the tumor and non-tumor regions were more likely to recur. The model significantly stratified patients into high- and low-risk groups in the training (n=94, p<0.005) and testing (n=41, p=0.01) cohorts, respectively. The radiomics based model achieved a concordance of 0.84 and 0.81, outperforming the clinical stage-only model, with concordances of 0.69 and 0.68 in the training and testing cohorts, respectively.

CLINICAL RELEVANCE/APPLICATION

CT and PET radiomics have the potential to augment staging to improve recurrence risk-stratification and could aid physicians in identifying patients that may benefit from more aggressive treatment options.

SPR-CH-6   Validation Of Definitions Of Central Tumors On CT In Patients With Clinical T1N0M0 Non-small Cell Lung Cancer: A Dual-institution, Multi-reader Study

Participants
Hyungjin Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Stockholder, Medical IP;Stock options, Medical IP;Research Grant, Lunit Inc

PURPOSE

Definitions for central lung cancer have been ambiguous in guidelines, causing difficulty in selecting candidates for invasive mediastinal staging among patients with radiologically node-negative, early-stage lung cancer. We aimed to validate the proposed definitions for central lung cancer with further extensions using a methodology designed to complement the paucity of existing evidence in patients with clinical T1N0M0 lung cancer.*Methods and Materials Two retrospective cohorts were evaluated for the associations of central lung cancer according to 13 definitions based on chest CT with occult nodal metastasis. Univariable and multivariable ordinal logistic regression analyses were performed with the pathological N category as an ordinal outcome. Robust definitions, which retained statistical significance across multi-reader, dual-institutional datasets, were identified. For these definitions, binary diagnostic performance and inter-reader agreement were investigated.*Results In the two cohorts, 807 patients (median age, 63 years; interquartile range, 56-71 years; 410 women; 33 pN1, 48 pN2, and 1 pN3) and 510 patients (median age, 65 years; interquartile range, 58-71 years; 267 women; 33 pN1, 20 pN2, and no pN3) were included, respectively. Three definitions robust to inter-reader variation and dataset heterogeneity were identified: definition 7 (concentric lines arising from the midline, inner one-third, medial margin; adjusted odds ratio [OR], 2.10; 95% confidence interval [CI], 1.13-3.51; P=0.02), definition 10 (location index-based inner one-third, center; adjusted OR, 3.60; 95% CI, 1.49-8.25; P=0.003), and definition 12 (location index-based inner one-third, medial margin; adjusted OR, 3.57; 95% CI, 1.91-6.52; P<0.001). Definition 12 showed higher inter-reader agreement than definition 7 (Cohen ?, 0.80 vs. 0.66; P=0.005). Nevertheless, the sensitivity and positive predictive value of the three definitions were below 50%.*Conclusions Three robust definitions for central lung cancer were verified. However, candidate selection for invasive mediastinal staging solely based on a central tumor location would be suboptimal.*Clinical Relevance/Application We verified three definitions for CLC that are robust to perturbations due to reader and institutional variation, and can be assessed qualitatively or quantitatively using distance measurements on CT. However, a prediction model to ensure high sensitivity for occult nodal metastasis is needed.

RESULTS

In the two cohorts, 807 patients (median age, 63 years; interquartile range, 56-71 years; 410 women; 33 pN1, 48 pN2, and 1 pN3) and 510 patients (median age, 65 years; interquartile range, 58-71 years; 267 women; 33 pN1, 20 pN2, and no pN3) were included, respectively. Three definitions robust to inter-reader variation and dataset heterogeneity were identified: definition 7 (concentric lines arising from the midline, inner one-third, medial margin; adjusted odds ratio [OR], 2.10; 95% confidence interval [CI], 1.13-3.51; P=0.02), definition 10 (location index-based inner one-third, center; adjusted OR, 3.60; 95% CI, 1.49-8.25; P=0.003), and definition 12 (location index-based inner one-third, medial margin; adjusted OR, 3.57; 95% CI, 1.91-6.52; P<0.001). Definition 12 showed higher inter-reader agreement than definition 7 (Cohen ?, 0.80 vs. 0.66; P=0.005). Nevertheless, the sensitivity and positive predictive value of the three definitions were below 50%.

CLINICAL RELEVANCE/APPLICATION

We verified three definitions for CLC that are robust to perturbations due to reader and institutional variation, and can be assessed qualitatively or quantitatively using distance measurements on CT. However, a prediction model to ensure high sensitivity for occult nodal metastasis is needed.

SPR-CH-7   Predicting Progression-free Survival In NSCLC Undergoing EGFR-TKI Therapy Based On Intratumoral And Peritumoral Radiomic Features From Time Serial CT Imaging

Participants
Xiaobo Zhang, Nanning, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the value of time serial CT radiomics features in predicting progression-free survival (PFS) for non-small cell lung cancer (NSCLC) patients after epidermal growth factor receptor- tyrosine kinase inhibitor (EGFR-TKI) therapy.*Methods and Materials One hundred and eighteen NSCLC patients treated with EGFR-TKI therapy between January 2015 and September 2020 were retrospectively enrolled and randomly divided into training and validation cohorts with a 7:3 ratio. PFS was defined as the duration from therapy initiation to disease progression. Intratumoral and peritumoral features were extracted from time serial non-contrast chest CT (including pre-therapy and 1st follow-up images); moreover, the percentage variation per unit time (day) was introduced to adjust for the different follow-up period of each patient. Test-retest was performed to exclude irreproducible features, while Boruta algorithm was used to select critical radiomic features. Random forest survival models were constructed in the training cohort with baseline features alone, as well as combining time serial radiomics features. The added value of time serial features was further evaluated in the validation cohort by comparing the concordance index (C-index) between models.*Results This study included 118 patients (68 women, 57.6%; 56.9 ± 11.4 years), with 84 in the training cohort (median PFS 9.0 months; interquartile range, 7.00-12.00 months) and 34 in the validation cohort (median PFS 9.0 months; interquartile range, 6.25-11.75 months). In the combined model, 7 of the 10 most important contributors were unit time feature variation. The combination of time serial features outperformed the pre-therapy baseline features alone in predicting PFS (C-Index in training: 0.80, 95% CI: [0.71, 0.89] versus 0.72, 95% CI: [0.63, 0.81], p = 0.006; C-Index in validation: 0.72, 95% CI: [0.58, 0.87] versus 0.64, 95% CI: [0.49, 0.78], p = 0.030).*Conclusions Compared to the radiomic features from pre-therapy images alone, time serial features provided additional information and improved PFS prediction in NSCLC patients treated with EGFR-TKIs.*Clinical Relevance/Application The dynamic concept of percentage variation per unit time holds promise of monitoring treatment response and achieving personalized management.

RESULTS

This study included 118 patients (68 women, 57.6%; 56.9 ± 11.4 years), with 84 in the training cohort (median PFS 9.0 months; interquartile range, 7.00-12.00 months) and 34 in the validation cohort (median PFS 9.0 months; interquartile range, 6.25-11.75 months). In the combined model, 7 of the 10 most important contributors were unit time feature variation. The combination of time serial features outperformed the pre-therapy baseline features alone in predicting PFS (C-Index in training: 0.80, 95% CI: [0.71, 0.89] versus 0.72, 95% CI: [0.63, 0.81], p = 0.006; C-Index in validation: 0.72, 95% CI: [0.58, 0.87] versus 0.64, 95% CI: [0.49, 0.78], p = 0.030).

CLINICAL RELEVANCE/APPLICATION

The dynamic concept of percentage variation per unit time holds promise of monitoring treatment response and achieving personalized management.

SPR-CH-8   Application Of Computer-aided Detection (CAD) For Lung-RADS Categorization In CT Screening For Lung Cancer: Effect On Inter-reader Agreement

Participants
Sohee Park, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the effects of computer-aided detection (CAD) on inter-reader agreement in Lung Imaging Reporting and Data System (Lung-RADS) categorization.*Methods and Materials Two hundred baseline CT scans covering all Lung-RADS categories were randomly selected from the National Lung Cancer Screening Trial. Five radiologists independently reviewed the CT scans and assigned Lung-RADS categories without CAD and then with CAD. The CAD system presented up to five of the most risk-dominant nodules with measurements and suggested Lung-RADS category. Inter-reader agreement was analyzed using multirater Fleiss ? statistics.*Results The five readers had 139-151 negative screening results without CAD and 126-142 with CAD. With CAD, readers tended to upstage (average, 12.3%) rather than downstage Lung-RADS category (average, 4.4%), leading to slightly shortened follow-up intervals (average, 9.4 vs. 8.9 months). Inter-reader agreement of the five readers for Lung-RADS categorization was moderate (kappa, 0.60) without CAD, and slightly improved to substantial (kappa, 0.65) with CAD. The major cause for disagreement was assignment of different risk-dominant nodules in both reading sessions without and with CAD (54.2% [201/371] vs. 62.7% [229/365]). The proportion of disagreement in nodule size measurement was reduced from 27.5% (102/371) to 17.0% (62/365) with the use of CAD. In 31 cancer-positive cases, substantial management discrepancies among reader pairs, referring to a difference in follow-up interval of at least 9 months (category 1/2 vs. 4A/B), decreased with application of CAD by 50% (32/310 vs. 16/310).*Conclusions Application of CAD demonstrated a minor improvement in inter-reader agreement of Lung-RADS category, while CAD had the potential to reduce measurement variability and substantial management change in cancer-positive cases.*Clinical Relevance/Application Application of computer-aided detection demonstrated a minor improvement in inter-reader agreement of Lung-RADS category, while showing the potential to reduce measurement variability and substantial management change in cancer-positive cases.

RESULTS

The five readers had 139-151 negative screening results without CAD and 126-142 with CAD. With CAD, readers tended to upstage (average, 12.3%) rather than downstage Lung-RADS category (average, 4.4%), leading to slightly shortened follow-up intervals (average, 9.4 vs. 8.9 months). Inter-reader agreement of the five readers for Lung-RADS categorization was moderate (kappa, 0.60) without CAD, and slightly improved to substantial (kappa, 0.65) with CAD. The major cause for disagreement was assignment of different risk-dominant nodules in both reading sessions without and with CAD (54.2% [201/371] vs. 62.7% [229/365]). The proportion of disagreement in nodule size measurement was reduced from 27.5% (102/371) to 17.0% (62/365) with the use of CAD. In 31 cancer-positive cases, substantial management discrepancies among reader pairs, referring to a difference in follow-up interval of at least 9 months (category 1/2 vs. 4A/B), decreased with application of CAD by 50% (32/310 vs. 16/310).

SPR-CH-9   Radiologist Level End-to-end Incidental Pulmonary Nodule Diagnosis In Diagnostic Chest CTs

Participants
Ryan Najafi, PhD, Palo Alto, California (*Presenter*) Employee, Alphabet Inc;Stockholder, Alphabet Inc

PURPOSE

Diagnostic chest CTs, commonly performed on symptomatic patients, can display a broader spectrum of abnormalities and imaging protocols than screening CTs. Incidental Pulmonary Nodule (IPN) assessment may not necessarily be a primary focus during interpretation in patients without lung cancer suspicion. Previous AI approaches have focused on lung CT screening, where reader pools tend to be specialized, and with guidelines more consistently followed. We aimed to develop an end-to-end AI system for assessing IPNs in diagnostic CTs.*Methods and Materials 109,756 screening and diagnostic chest CT volumes were collected from a US hospital system and NLST for training. A biopsy confirmed cancer within two years after imaging (6290 cases) resulted in a positive label, whereas no cancer-suspicious follow-ups resulted in a negative label. We trained a two-stage architecture to process single CT volumes, starting with a single-shot detector using an inflated Inception-V1 based feature extractor. The detections were then fed to a similar architecture for classification to produce a malignancy score. The system was evaluated on diagnostic CT data meeting IPN criteria (age = 35, non-immunocompromised, no prior cancer) from an independent site (261 patients, 12 with contrast, 53 positives). Six board certified radiologists (avg. 10 years of experience) interpreted the cases with access to priors CTs and provided management recommendations and malignancy suspicion scores. They were free to use the Fleischner criteria or their own judgment. The model results were compared against the readers.*Results Our system had comparable performance to radiologists in detecting malignant IPNs (89.3% for radiologists vs. 89.5% for the model with no significant difference, P=0.87).*Conclusions We have presented a system offering radiologist-level performance in assessing IPN malignancy under challenging conditions of greater variability and more background findings than in screening CT. Integrating this model into workflows may aid as either a background or concurrent reader for IPNs.*Clinical Relevance/Application Diagnostic chest CTs, among the most frequent CT acquisitions, have IPNs at rates around 31%. Our AI achieves radiologist-level lung cancer diagnosis on these challenging and diverse cases.

RESULTS

Our system had comparable performance to radiologists in detecting malignant IPNs (89.3% for radiologists vs. 89.5% for the model with no significant difference, P=0.87).

CLINICAL RELEVANCE/APPLICATION

Diagnostic chest CTs, among the most frequent CT acquisitions, have IPNs at rates around 31%. Our AI achieves radiologist-level lung cancer diagnosis on these challenging and diverse cases.

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Participants
Vinil Shah, MD, San Francisco, California (*Moderator*) Nothing to Disclose

Sub-Events

SSNR11-2 Deep-learning Based MR Image Reconstruction Of The Spine Produces Similar Image Quality To Conventional Imaging

Participants
Sanders Chang, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning algorithms can improve the quality of images via denoising and enhancing image resolution while overall decreasing acquisition time. This project aims to compare the image quality of spine MR images acquired by a deep learning enhancement algorithm known as SubtleMRTM ("subtle") against conventionally acquired images.*Methods and Materials SubtleMR and conventional spine MR imaging case-control pairs were prospectively acquired from 43 subjects (mean, 51.6 ± 18.2 years of age; range, 20-89 years of age), totaling 98 image sets. Each case included conventional T1- and T2-weighted, STIR and deep-learning based reconstructions of the cervical, thoracic, and/or lumbar spine on sagittal view. Images were randomized and independently assessed by 2 blinded neuroradiologists for diagnostic quality on a binary scale (usable for diagnosis vs. unusable for diagnosis), legibility of osseous and extraosseous structures (all or most anatomic landmarks identifiable vs. few or none of the anatomic landmarks identifiable), and presence of artifacts.*Results Interobserver agreement was very good (? agreement = 0.85). No significant difference in diagnostic quality was found between conventional and subtle images across all sequences (p > 0.05). Legibility of both osseous and extraosseous structures were observed in = 98% of cases and were not significantly different between conventional and subtle images (p > 0.05). Artifacts were observed in 30.1% of conventional cases and 36.1% of subtle cases over all sequences (p > 0.05). Most observed artifacts overall were secondary to susceptibility from hardware (16.2%) and motion (14.9%). *Conclusions Overall imaging quality of a deep learning image enhancement algorithm was similar to that of conventionally acquired T1- and T2-weighted, and STIR sequences of the spine.*Clinical Relevance/Application Spine MR imaging enhanced by deep learning methods can produce quality similar to conventionally acquired images. This may help improve acquisition times and in turn allow for improved patient experience and better imaging efficiency.

RESULTS

Interobserver agreement was very good (? agreement = 0.85). No significant difference in diagnostic quality was found between conventional and subtle images across all sequences (p > 0.05). Legibility of both osseous and extraosseous structures were observed in = 98% of cases and were not significantly different between conventional and subtle images (p > 0.05). Artifacts were observed in 30.1% of conventional cases and 36.1% of subtle cases over all sequences (p > 0.05). Most observed artifacts overall were secondary to susceptibility from hardware (16.2%) and motion (14.9%).

CLINICAL RELEVANCE/APPLICATION

Spine MR imaging enhanced by deep learning methods can produce quality similar to conventionally acquired images. This may help improve acquisition times and in turn allow for improved patient experience and better imaging efficiency.

SSNR11-3 Lateral Cervical Puncture: Anatomic Features Relevant To Procedural Safety

Participants
Ross Frederick, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

Lateral cervical puncture is perceived to be more dangerous to perform than lumbar puncture. Injury to the posterior inferior cerebellar artery or a vertebral artery course overlying the posterior third of the spinal canal are of primary concern. In addition, the width of the dorsal subarachnoid space at the C1-2 level influences the difficulty of accessing the CSF without contacting the spinal cord. The purpose of this study is to analyze the location of PICA and the vertebral artery and the size of the target subarachnoid space at the C1-2 level to assess the risk of vascular and spinal cord injury in lateral cervical puncture.*Methods and Materials In this retrospective study 420 consecutive CT angiograms were evaluated by 2 radiologist investigators. The inferior extent of the PICA (or AICA-PICA) and the PICA origins and the location of the vertebral artery at the C1-2 level were recorded. The width of the posterior subarachnoid space at the C1-2 level was measured. The soft tissue distance from skin surface to target was measured.*Results 400 cases meeting criteria were evaluated. 32 total PICA loops extended below the foramen magnum but above the inferior margin of C1. 6 PICA origins were found between the foramen magnum and C1. No origins or loops were seen below C1. The vertebral artery at the C1-2 level was anterior to the canal in 742/778 (95%) arteries. None reached the posterior 1/3 of the canal. The width of the dorsal subarachnoid space at the C1-2 level was 2mm- 8mm, average 5mm.*Conclusions No PICA origins or loops were found below the C1 level, and no vertebral arteries extended to the posterior 1/3 of the canal, thus were not at risk in lateral C1-2 puncture. The dorsal subarachnoid space was equal to or greater than 2mm in all subjects. These results increase confidence in the safe application of this procedure.*Clinical Relevance/Application We found no patients with vascular anatomy that would put them at risk of injury with C1-2 puncture. Under CT guidance, the spinal cord and dorsal subarachnoid

space are easily seen for targeting. Many patients require CSF sampling but have site-specific contraindications to lumbar puncture. These results increase confidence in the safe application of this important procedure.

RESULTS

400 cases meeting criteria were evaluated. 32 total PICA loops extended below the foramen magnum but above the inferior margin of C1. 6 PICA origins were found between the foramen magnum and C1. No origins or loops were seen below C1. The vertebral artery at the C1-2 level was anterior to the canal in 742/778 (95%) arteries. None reached the posterior 1/3 of the canal. The width of the dorsal subarachnoid space at the C1-2 level was 2mm- 8mm, average 5mm.

CLINICAL RELEVANCE/APPLICATION

We found no patients with vascular anatomy that would put them at risk of injury with C1-2 puncture. Under CT guidance, the spinal cord and dorsal subarachnoid space are easily seen for targeting. Many patients require CSF sampling but have site-specific contraindications to lumbar puncture. These results increase confidence in the safe application of this important procedure.

SSNR11-4   Proximity Of DTI And Compression Ratio Measurements To Site Of Injury Has Significant Relationship To Predicting Neurologic Impairment In Acute Spinal Cord Injury (SCI)

Participants
Arichena Manmatharayan, MBBS, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Diffusion tensor imaging (DTI) can be used to evaluate microstructural changes in the spinal cord post-injury, however, the optimal rostral-caudal spinal cord location to obtain the measurements is not well understood. The purpose of this study was to conduct a comprehensive analysis of diffusion and structural measurements at specific spinal cord levels and correlate them with motor, sensory and AIS examination scores to determine where the strongest relationship to neurologic function exists.*Methods and Materials Data from 62 acute cervical spinal cord injury (SCI) patients and 21 healthy controls were analyzed retrospectively and stratified into hemorrhagic cord (HC; n=14) and non-hemorrhagic cord (NHC, n=48). Axial gradient echo sequence was used to measure compression ratio (CR) using Spinal Cord Toolbox. DTI metrics were obtained from single-shot echo-planar imaging (EPI) sequence or a zonally magnified oblique multi-slice EPI technique. Tensor metrics (Fractional Anisotropy, Axial (AD), Radial (RD) and Mean Diffusivity (MD) were extracted and adjusted with metrics values from controls generating Z-scores. Holocord regions of interest were obtained at five levels: two and one vertebral level rostral to upper limit of lesion, injury epicenter, one and two vertebral levels caudal to the lower limit of lesion. Spearman correlation was done between diffusion metric Z-scores and CR with upper and lower motor index scores (UEMS & LEMS), lower extremity sensory score (LESS), and ASIA impairment scale (AIS). $p<0.05$ was considered significant.*Results In HC, CR strongly correlated with AIS at 2 levels above (r= -0.77) and at 1 level below the lesion (r= -0.75) and with LESS (r= =0.75). At the injury epicenter in HC, FA strongly correlated with LEMS (r= -0.66), LESS (r = -0.61) and AIS (r= -0.61), AD correlated with UESS (r= -0.70) and RD correlated with LEMS (r= 0.59). In NHC, significant weak correlations were seen at the injury epicenter between AD and LESS (r= 0.32), RD and LEMS (r=0.29) and LESS (r= 0.49).*Conclusions This study suggests that diffusion and structural measures can be reliably obtained immediately adjacent to the lesion epicenter in addition to the injury epicenter in acute cervical SCI for correlation with neurologic impairment scales.*Clinical Relevance/Application Our results suggest that DTI and structural measures adjacent to lesion epicenter and at the injury epicenter show strong correlation to clinical scores in acute SCI. MRI and DTI biomarkers obtained at these locations could potentially supplement clinical examinations, especially in those patients where a complete evaluation is not possible.

RESULTS

In HC, CR strongly correlated with AIS at 2 levels above (r= -0.77) and at 1 level below the lesion (r= -0.75) and with LESS (r= =0.75). At the injury epicenter in HC, FA strongly correlated with LEMS (r= -0.66), LESS (r = -0.61) and AIS (r= -0.61), AD correlated with UESS (r= -0.70) and RD correlated with LEMS (r= 0.59). In NHC, significant weak correlations were seen at the injury epicenter between AD and LESS (r= 0.32), RD and LEMS (r=0.29) and LESS (r= 0.49).

CLINICAL RELEVANCE/APPLICATION

Our results suggest that DTI and structural measures adjacent to lesion epicenter and at the injury epicenter show strong correlation to clinical scores in acute SCI. MRI and DTI biomarkers obtained at these locations could potentially supplement clinical examinations, especially in those patients where a complete evaluation is not possible.

SSNR11-5   Detection Of Critical Spinal Epidural Pathologies On CT Using A Machine Learning Algorithm

Participants
Robert Harris, PhD, Eden Prairie, Minnesota (*Presenter*) Scientist, Virtual Radiologic Corporation

PURPOSE

Critical pathologies in the spinal epidural space can cause paralysis if left untreated. Patients with these pathologies often present emergently and are first imaged with CT. We hypothesized that we could train a machine learning algorithm to identify epidural pathologies on CT images and use this model as part of quality assurance to notify radiologists in real time if an epidural pathology has been potentially missed.*Methods and Materials Natural language processing (NLP) of radiology CT reports was used retrospectively to identify 114 studies containing epidural hematoma, abscess, phlegmon, or fluid collection. A sagittal image series from each of these studies was annotated by a Board Certified radiologist by segmenting the epidural pathology using an in-house brush tool. These segmentations were converted into bounding boxes; 475 annotated images were used as positives, and 475 sagittal CT images with no epidural pathology were used as negatives in the training dataset. A yolo-v3 bounding box model was used for training. The model was applied to a test dataset consisting of 20 negative studies and 11 positive studies for epidural pathology, including 4 studies where the epidural pathology had been missed by the reading radiologist. This model was then integrated with our teleradiology practice to screen prospective patients for critical epidural pathologies for an eight-week period.*Results The model achieved an AUC of 0.965 on the test dataset, with 3 of the 4 cases missed by the radiologist classified as positive. For live prospective data, 38,620 CT studies were inferenced, of which 7 were positive for a critical epidural pathology. The model correctly identified 5 of these for a sensitivity of 71.4% and specificity of 86.8%.*Conclusions An artificial intelligence model was trained to identify critical spinal epidural pathologies on CT imaging and was implemented in a real-time clinical workflow. To our knowledge, this is the first use of machine learning to identify spinal epidural pathologies on CT images. This model is currently undergoing iterative retraining with false positives and false negatives from prospective data and is being updated to include input from axial CT images.*Clinical Relevance/Application Critical epidural pathologies are sometimes missed by radiologists on CT and can lead to preventable long-term injury. A model to assist with detection of sometimes critical epidural disease may

prevent missed diagnoses and improve patient care.

RESULTS

The model achieved an AUC of 0.965 on the test dataset, with 3 of the 4 cases missed by the radiologist classified as positive. For live prospective data, 38,620 CT studies were inferenced, of which 7 were positive for a critical epidural pathology. The model correctly identified 5 of these for a sensitivity of 71.4% and specificity of 86.8%.

CLINICAL RELEVANCE/APPLICATION

Critical epidural pathologies are sometimes missed by radiologists on CT and can lead to preventable long-term injury. A model to assist with detection of sometimes critical epidural disease may prevent missed diagnoses and improve patient care.

SSNR11-6   Pulsed Radiofrequency For Sciatica And Disc Herniation: A Randomized Trial

Participants
Alessandro Napoli, MD, Rome, Italy (*Presenter*) Nothing to Disclose

PURPOSE

Sciatica can be disabling and evidence regarding effective non-operative management remains limited. We performed a randomized clinical trial to determine whether combined treatment using pulsed radiofrequency (PRF) and epidural steroid injection (TFESI) was superior to TFESI-alone for acute sciatica due to lumbar disc herniation (LDH)*Methods and Materials This multicenter, double-blind, randomized clinical trial involved patients with sciatica due to LDH not responsive to conventional medical and/or physical treatment (NCT04209322). Eligible patients were randomly assigned to receive a single session of PRF+TFESI, or TFESI-alone.The primary outcome was the leg-pain intensity score (numerical rating scale, NRS, range 0 to 10) at week 1 following the intervention; and at week 52 as a secondary time point. Secondary outcomes included Roland Disability Questionnaire for Sciatica and Oswestry Disability Index at 4, 12, and 52 weeks.*Results Among 289 patients who were randomized, 145 received PRF/TFESI and 144 underwent TFESI. At baseline, NRS was 8.1±1.1 in the PRF/TFESI group and 7.9±1.1 in the TFESI group. At week 1, NRS was 3.3±0.2 in PRF/TFESI group and 5.0±0.2 in TFESI group (adjusted mean difference, 1.67; 95% Confidence Interval [CI] 1.09 to 2.26; P<0.001); at week 52, NRS was 1.5±0.2 in PRF/TFESI group and 2.7±0.3 in TFESI group (adjusted mean difference, 1.19; 95% CI, 0.52 to 1.86; P<0.001). Secondary outcomes were in the same direction as the primary outcome. No severe adverse events were reported. Eleven patients in the PRF/TFESI group and 24 patients in the TFESI group required further interventional or surgical management.*Conclusions In this trial of patients with acute sciatica caused by LDH, PRF+TFESI demonstrated faster and more durable control of leg pain over the course of 1 year follow-up as compared to TFESI-alone.*Clinical Relevance/Application Patients with sciatica not responding to conventional treatment may benefit from a combination of PRF-TFESI (10 min session) as a means of durable treatment, avoiding further interventions including surgery.

RESULTS

Among 289 patients who were randomized, 145 received PRF/TFESI and 144 underwent TFESI. At baseline, NRS was 8.1±1.1 in the PRF/TFESI group and 7.9±1.1 in the TFESI group. At week 1, NRS was 3.3±0.2 in PRF/TFESI group and 5.0±0.2 in TFESI group (adjusted mean difference, 1.67; 95% Confidence Interval [CI] 1.09 to 2.26; P<0.001); at week 52, NRS was 1.5±0.2 in PRF/TFESI group and 2.7±0.3 in TFESI group (adjusted mean difference, 1.19; 95% CI, 0.52 to 1.86; P<0.001). Secondary outcomes were in the same direction as the primary outcome. No severe adverse events were reported. Eleven patients in the PRF/TFESI group and 24 patients in the TFESI group required further interventional or surgical management.

CLINICAL RELEVANCE/APPLICATION

Patients with sciatica not responding to conventional treatment may benefit from a combination of PRF-TFESI (10 min session) as a means of durable treatment, avoiding further interventions including surgery.

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Participants

Michael F. Morris, MD, Paradise Valley, Arizona (*Moderator*) Educator, Medtronic plc;
Phillip M. Young, MD, Rochester, Minnesota (*Moderator*) Advisory Board, Arterys Inc

Sub-Events

SSCA10-1 AI Vs Manual Cardiac MRI Measurements - Clinical Benchmarking Using Heart Catheterization And Mortality Prediction

Participants

Andrew Swift, BMedSc, FRCR, Sheffield, United Kingdom (*Presenter*) Consultant, Johnson & Johnson;Consultant, General Electric Company

PURPOSE

Cardiac magnetic resonance (CMR) is the gold standard to measure biventricular volumes and function and has been shown to have diagnostic value and predict mortality. The aim of this study is to compare artificial intelligence (AI) and manually obtained CMR measurements against clinically objective outcomes such as invasive right heart catheterization (RHC) and mortality prediction.*Methods and Materials A deep learning model for CMR segmentation was developed in a multi-pathology and multi-vendor (Siemens and General Electric) cohort. The training cohort included patients with left heart and lung disease and pulmonary hypertension (n = 400, ASPIRE registry). The CMRs of a retrospective cohort of 2204 patients with a median follow-up of 4 years were analysed both manually and with the AI segmentation tool. Manual cardiac segmentation was performed as part of routine clinical practice by expert cardiac MRI readers. Mortality prediction was estimated using hazard ratios (HR) from univariate Cox regression models and calculated for both the manual and AI-derived CMR measurements. CMR measurements in the Cox regression were corrected for age and sex. Variable normalisation was performed by subtracting the mean for each variable and dividing it by its standard deviation. Of the retrospective cohort, 1305 patients had RHC within 48 hours of the CMR. Spearman correlation coefficient (rho) was calculated to compare CMR with RHC-thermodilution derived left ventricular stroke volume (LVSV) and RVEF with mean pulmonary artery pressure (mPAP) and pulmonary vascular resistance (PVR).*Results CMR measurements correlated with RHC and showed a more robust relationship with the AI measurements. The correlation coefficient graphs showed a tighter spread of variables in the AI parameters. The rho for AI-RVEF with mPAP and PVR was -0.62 and -0.67, respectively, compared to -0.59 and 0.60, respectively, for manual-RVEF. The mortality rate was 38% over the 4 year follow-up period. Most CMR measurements were significant predictors of mortality. The AI measurements showed similar univariate hazard ratios with slightly larger effect sizes compared to manual measurements.*Conclusions In a large cohort, AI obtained CMR measurements outperformed manual assessment when compared to objective clinical benchmarks including invasive heart catheterization and mortality prediction.*Clinical Relevance/Application CMR is essential in the workup and follow-up of several cardiac diseases. AI-powered fully automated biventricular measurements further improve the utility of CMR in a clinical setting.

RESULTS

CMR measurements correlated with RHC and showed a more robust relationship with the AI measurements. The correlation coefficient graphs showed a tighter spread of variables in the AI parameters. The rho for AI-RVEF with mPAP and PVR was -0.62 and -0.67, respectively, compared to -0.59 and 0.60, respectively, for manual-RVEF. The mortality rate was 38% over the 4 year follow-up period. Most CMR measurements were significant predictors of mortality. The AI measurements showed similar univariate hazard ratios with slightly larger effect sizes compared to manual measurements.

CLINICAL RELEVANCE/APPLICATION

CMR is essential in the workup and follow-up of several cardiac diseases. AI-powered fully automated biventricular measurements further improve the utility of CMR in a clinical setting.

SSCA10-2 Deep Learning Based Automated Coronary Labeling For Structured Reporting Of Coronary CT Angiography

Participants

Verena Brandt, MD, Charleston, South Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate a novel deep learning (DL)-based automated coronary labeling approach for structured reporting of coronary artery labeling according to the guidelines of the Society of Cardiovascular Computed Tomography (SCCT) on Coronary CT Angiography (CCTA).*Methods and Materials A retrospective cohort of 106 patients with a median age of 63 (range 28 - 84) years (61% male) who had undergone prospective ECG-gated CCTA were included. Coronary centerlines were automatically extracted, labeled, and validated by two expert readers according to SCCT guidelines. The DL algorithm has been trained on 706 radiologist-annotated cases for the task of automatically labeling coronary artery centerlines. The architecture leverages Tree-structured Long Short Term Memory (Tree-LSTM) recurrent neural networks to capture the full topological information of the coronary trees by using a two-step approach: a bottom-up encoding step, followed by a top-down decoding step. The first module encodes each sub-tree into fixed-sized vector representations. The decoding module then selectively attends to the aggregated global context to perform

the local assignation of labels.*Results A total number of 1491 segments were identified. The AI-based software approach yielded a diagnostic accuracy of 94.4% for coronary artery labeling with an average computational time of 0.5s per case. The resulting labeling accuracy for SCCT coronary segments are presented in Table 1, which shows the percent overlap measures between the algorithm detected versus human annotated labels averaged across patients, respectively.*Conclusions Our approach of DL-based coronary artery labeling provides fast and precise fully automated structured reporting of CCTA, which improves user variability and therefore allows standardization of radiological reports.*Clinical Relevance/Application The DL approach enables high diagnostic accuracy for structured CCTA reporting which may have utility to improve diagnostic workflows in a more time-efficient manner.

RESULTS

A total number of 1491 segments were identified. The AI-based software approach yielded a diagnostic accuracy of 94.4% for coronary artery labeling with an average computational time of 0.5s per case. The resulting labeling accuracy for SCCT coronary segments are presented in Table 1, which shows the percent overlap measures between the algorithm detected versus human annotated labels averaged across patients, respectively.

CLINICAL RELEVANCE/APPLICATION

The DL approach enables high diagnostic accuracy for structured CCTA reporting which may have utility to improve diagnostic workflows in a more time-efficient manner.

SSCA10-3   Feasibility And Diagnostic Performance Of A New CCTA-derived And AI-based Fully Automated System For Detection Of Coronary Artery Disease

Participants
Verena Brandt, MD, Charleston, South Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate a novel coronary CT angiography (CCTA)-derived fully automated artificial intelligence (AI)-based software solution for automated coronary artery segmentation and stenosis assessment using the Coronary Artery Disease Reporting & Data System (CAD-RADS).*Methods and Materials Image datasets of 100 consecutive patients (48% male, 48.3±10.8 years) who underwent clinically indicated CCTA were retrospectively analyzed. Two readers independently evaluated CCTAs for the degree of coronary artery stenosis on a per-segment level using the 18-coronary artery segment model with subsequent CAD-RADS classification according to SCCT guidelines. A fully automated investigational AI-based software prototype by Siemens was designed and tested on the CCTA datasets and compared to human reading. Inter-reader agreement was assessed using Cohen's kappa. Subsequently, the diagnostic performance of the software prototype for detection of diseased coronary artery segments were assessed.*Results Forty-one patients had CAD with stenosis in at least one segment. Agreement between expert readers was 0.83 for CAD-RADS and 0.89 for the identification of diseased segments. The software prototype yielded a sensitivity of 97.6% (92.8-100), and a negative predictive value of 96.9% (90.8-100) for the detection of diseased segments, respectively. The software prototype reliably detected 40 out of 41 patients with CAD. One patient who was not correctly identified had a small, calcified plaque without associated coronary artery stenosis (CAD-RADS 1). The average computational time of the software prototype was 240s per case.*Conclusions The fully automated investigational AI-based software prototype demonstrated fast and reliable identification of patients with coronary artery stenosis on CCTA with high diagnostic accuracy.*Clinical Relevance/Application Fully automated coronary segmentation and stenosis detection using AI may have utility to improve diagnostic accuracy in a more time-efficient manner.

RESULTS

Forty-one patients had CAD with stenosis in at least one segment. Agreement between expert readers was 0.83 for CAD-RADS and 0.89 for the identification of diseased segments. The software prototype yielded a sensitivity of 97.6% (92.8-100), and a negative predictive value of 96.9% (90.8-100) for the detection of diseased segments, respectively. The software prototype reliably detected 40 out of 41 patients with CAD. One patient who was not correctly identified had a small, calcified plaque without associated coronary artery stenosis (CAD-RADS 1). The average computational time of the software prototype was 240s per case.

CLINICAL RELEVANCE/APPLICATION

Fully automated coronary segmentation and stenosis detection using AI may have utility to improve diagnostic accuracy in a more time-efficient manner.

SSCA10-6   Fully Automated Deep Learning Based Flow Quantification Of Cardiovascular 2D Phase Contrast MRI: Machine Vs Human Performance

Participants
Maurice Pradella, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

2D Phase Contrast (2D-PC) MRI allows for analysis of blood flow in many cardiovascular (CV) abnormities such as valve disease. Due to close anatomical relations between aorta, pulmonary artery (PA) and other vascular structures, accurate delineation of vessel contours is necessary to achieve reliable flow quantification. The goal of this study was to evaluate the feasibility of a Deep Learning (DL) application for fully automated contour delineation and subsequent flow quantification of 2D-PC data compared to manual analysis by a CV radiologist.*Methods and Materials We included 25 consecutive patients (pts) who underwent CV MRI with PC imaging in November 2020. All pts received 2D-PC flow measurements at the sinotubular junction (STJ). In a subgroup (n=11), 2D-PC data was also collected for the main PA. All exams were performed on 1.5T MRI systems (Siemens, Germany).A CV radiologist with 3 years of experience performed the manual analysis. The outer vessel contour was delineated on the first time point of the magnitude image, forwarded and adjusted for each time point. The DL application (Circle, Canada) autonomously identified the scan location (STJ or PA) and performed automated vessel contour detection across all cardiac time points. STL and PA net flow was calculated for both DL and manual analysis. Manual and DL contours were compared using mean dice scores (DSC).*Results 36 2D-PC MRI measurements (STJ: 25, PA: 11) were performed with a median of 30 cardiac time points (range: 20-30). Mean manual measurement times were 2:40±0:57min at STJ and 3:00±0:47min at PA. DL analysis was performed for 34 data sets (34/36, 95%; STJ: 24, PA: 10) with analysis time of 1s/case; in 2 cases no results were produced by DL. Mean DL vs human DSC at STJ was 0.84 (interquartile range (IQR): 0.04), and 0.82 (IQR: 0.12) at PA.Bland Altman plots showed DL vs human mean differences for net flow of 2.82ml (limits of agreement (LoA): -20.15-25.79ml) for STJ and 1.71ml (LoA: -4.98-8.39ml) for PA. LoA at STJ was strongly influenced by a congenital heart disease case with incorrect delineation of STJ contours by DL. With this outlier removed, DL performance substantially improved (STJ LoA: -10.06-9.98ml) indicating reliable DL measurements in 33/36 (92%) of

cases.*Conclusions Fully automated DL flow quantification provided reliable results compared to an experienced human observer in 92% of enrolled patients with significantly reduced analysis times. Complex anatomy resulted in erroneous segmentations in two cases, indicating the need for further refinement of the DL analysis workflow by including more complex cases in the training set.*Clinical Relevance/Application The evaluated software tool supports radiologists by providing reliable, expert-level flow measurements in 92% of cases.

RESULTS

36 2D-PC MRI measurements (STJ: 25, PA: 11) were performed with a median of 30 cardiac time points (range: 20-30). Mean manual measurement times were 2:40±0:57min at STJ and 3:00±0:47min at PA. DL analysis was performed for 34 data sets (34/36, 95%; STJ: 24, PA: 10) with analysis time of 1s/case; in 2 cases no results were produced by DL. Mean DL vs human DSC at STJ was 0.84 (interquartile range (IQR): 0.04), and 0.82 (IQR: 0.12) at PA.Bland Altman plots showed DL vs human mean differences for net flow of 2.82ml (limits of agreement (LoA): -20.15-25.79ml) for STJ and 1.71ml (LoA: -4.98-8.39ml) for PA. LoA at STJ was strongly influenced by a congenital heart disease case with incorrect delineation of STJ contours by DL. With this outlier removed, DL performance substantially improved (STJ LoA: -10.06-9.98ml) indicating reliable DL measurements in 33/36 (92%) of cases.

CLINICAL RELEVANCE/APPLICATION

The evaluated software tool supports radiologists by providing reliable, expert-level flow measurements in 92% of cases.

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Participants

Michael M. Zeineh, MD,PhD, Stanford, California (*Moderator*) Research funded, General Electric Company;Consultant, Biogen Idec Inc;

Sumit Niogi, MD, PhD, New York, New York (*Moderator*) License agreement, MRIBank

Sub-Events

SSNR12-1   The MIITRA Multimodal Templates Of Older Adult Brain At 0.5mm Resolution: Creation And Evaluation

Participants

Yingjuan Wu, MS,BEng, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

The Multichannel Illinois Institute of Technology & Rush university Aging (MIITRA) atlas project aims at developing a multimodal older adult brain atlas with high spatial resolution. The goal of this work was to develop high quality T1-weighted (T1w) and diffusion tensor imaging (DTI) multimodal templates at 0.5mm resolution for the MIITRA atlas using data from a large, diverse, community cohort of non-demented older adults and quantitatively evaluate the new templates.*Methods and MaterialsData: T1w and DTI data were collected on 400 non-demented older adults (50% male; 65-99 yrs; 54% white, 43% black; 318 with no cognitive impairment, 82 with mild cognitive impairment) participating in longitudinal cohort studies of aging with two 3T MRI scanners.Template Construction: First, a recently introduced approach for the development of high quality multimodal templates was conducted in a 0.5mm isotropic resolution space. Spatial normalization was driven by T1w and DTI information alternatively and the resulting transformations were applied on both modalities. Then an approach for the development of high spatial resolution templates based on principles of super-resolution was used to eliminate interpolations in conventional template building methods. The resulting templates are named MIITRA templates.Evaluation: The MIITRA templates were compared to other standardized templates in terms of the inter-subject and inter-modality spatial normalization accuracy when each template was used as a reference for normalization from 202 T1w and DTI older adult data from ADNI3.*Results Visual inspection showed that the MIITRA T1w and DTI templates with 0.5mm isotropic voxels exhibit high sharpness and are free of artifacts. It was demonstrated that the MIITRA templates provided higher inter-subject spatial normalization accuracy of older adult data and required less deformation than other templates. Finally, the MIITRA T1w and DTI templates exhibited high spatial matching to each other and allowed higher inter-modality spatial matching of normalized older adult data.*Conclusions This work developed high quality T1w and DTI multimodal templates at 0.5mm resolution for the MIITRA atlas using data from a large, diverse, community cohort of non-demented older adults. The new templates allowed higher inter-subject and inter-modality spatial normalization of older adult data compared to other templates.*Clinical Relevance/Application The 0.5mm T1w and DTI multimodal templates developed in this work allowed higher inter-subject and inter-modality spatial normalization of older adult data compared to other templates.

RESULTS

Visual inspection showed that the MIITRA T1w and DTI templates with 0.5mm isotropic voxels exhibit high sharpness and are free of artifacts. It was demonstrated that the MIITRA templates provided higher inter-subject spatial normalization accuracy of older adult data and required less deformation than other templates. Finally, the MIITRA T1w and DTI templates exhibited high spatial matching to each other and allowed higher inter-modality spatial matching of normalized older adult data.

CLINICAL RELEVANCE/APPLICATION

The 0.5mm T1w and DTI multimodal templates developed in this work allowed higher inter-subject and inter-modality spatial normalization of older adult data compared to other templates.

SSNR12-2   Spatial Stability Of Functional Networks: A Measure To Assess The Robustness Of Graph-theoretical Metrics To Spatial Errors Related To Brain Parcellation

Participants

Luca Pasquini, MD, New York City, New York (*Presenter*) Nothing to Disclose

PURPOSE

Brain parcellation represents a crucial step for graph-theoretical analysis of brain networks from functional MRI (fMRI). However, this procedure has multiple shortcomings which can affect inter and intra subject variability: anatomical and physiological cortical differences, shape variations from ageing and diseases. Discrepancies in brain boundaries can reflect on connectivity maps, since network properties are affected by node definition. In this study, we define the measure of spatial stability (SS) of functional networks, i.e. impact of parcellation changes on functional connectivity (FC), by testing the variability of multiple graph-theoretical measures to parcellation-related spatial errors.*Methods and Materials 110 subjects with anatomical and rs-fMRI data were included. Two atlases were used for parcellation (64 Standard Parcels-SP and 150 SP). A modification algorithm was implemented to simulate 100 new atlases on Freesurfer, by introducing random variations equal to 10% of parcel volume. New atlases contained the same number of Modified Parcels (MP) of the original. Rs-fMRI was used to develop functional networks from each generated parcellation from both atlases (200 networks per subject). 27 graph-theoretical measures were calculated for every network,

including centrality, clustering, core, degree, distance, modularity, physical connectivity and similarity. SS for every measure was defined by a variation factor (VF) equal to the mean variation of its value across generated networks.*Results The lowest VF values were obtained for Characteristic path length (<1%), Density and Transitivity, suggesting high stability to parcel variation. Intermediate SS was found for modularity, degree, clustering, core, distance and similarity. Katz and Bonachich centrality showed the higher VF values, suggesting lower stability.*Conclusions Our method reproduces inter and intra subjects parcellation variability to assess the impact of small parcellation changes on global and local connectivity measures. Some graph-theoretical measures are less stable than others, particularly Katz and Bonachich centrality. Our results suggest to pay close attention to parcellation-related spatial errors produced by inter- and intra-subject variability, since they may affect brain connectivity analysis as depicted by SS variations.*Clinical Relevance/Application Brain parcellation is a crucial step for every connectivity analysis. We demonstrated that graph theoretical measures are subject to significant variation depending on brain parcellation. Since gyral anatomy changes across subjects, parcellation-related spatial errors may affect the value of calculated metrics.

RESULTS

The lowest VF values were obtained for Characteristic path length (<1%), Density and Transitivity, suggesting high stability to parcel variation. Intermediate SS was found for modularity, degree, clustering, core, distance and similarity. Katz and Bonachich centrality showed the higher VF values, suggesting lower stability.

CLINICAL RELEVANCE/APPLICATION

Brain parcellation is a crucial step for every connectivity analysis. We demonstrated that graph theoretical measures are subject to significant variation depending on brain parcellation. Since gyral anatomy changes across subjects, parcellation-related spatial errors may affect the value of calculated metrics.

SSNR12-4   High-resolution Gray Matter Labels Of The MIITRA Atlas: Development And Evaluation

Participants
Mohammad Rakeen Niaz, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

The Multichannel Illinois Institute of Technology & Rush university Aging (MIITRA) atlas contains high resolution (0.5mm) T1-weighted (T1w) and diffusion tensor imaging (DTI) templates, constructed using high quality MRI data from non-demented older adults. The purpose of this work was twofold: a) to construct high resolution gray matter labels for the MIITRA atlas based on manually edited gray matter labels of the older adults included in the atlas, and b) to evaluate the performance of the new labels in labeling the gray matter of a separate group of older adults.*Methods and Materials T1w images (400 images, 1mm isotropic) from the older adults included in the MIITRA atlas (50% male; 64.9-98.9 age-range; 54% white, 43% black) were processed with Freesurfer's standard recon-all pipeline, which segmented subcortical and cortical gray matter into 84 regions according to the Desikan Killiany atlas. The Freesurfer output for all images was manually edited. The ANTs-derived transformations applied on individual T1w images to build the MIITRA T1w template were used to map the corresponding gray matter labels from raw space to exact physical locations in the final MIITRA space. The label in a 0.5mm isotropic voxel in MIITRA space was calculated using majority voting among all the labels that were mapped to that voxel. The performance of the MIITRA gray matter labels in segmentation of the gray matter of a separate group of 100 older adult individuals was evaluated in terms of label overlap, geometry, and dissimilarity when comparing the MIITRA labels warped to each individual's space, to the respective manually edited reference labels.*Results The measures of overlap were generally high, with an average Dice coefficient of 0.82±0.10, Jaccard coefficient of 0.70±0.13, sensitivity of 0.77±0.13, and specificity of 0.89±0.09. There was a high correlation in label geometry both in terms of the average volume (correlation coefficient=0.997, p-value<10-10) and in terms of the average surface area (correlation coefficient=0.988, p-value<10-10). The values of dissimilarity were low, with an average volume error of 0.18±0.18 and an average Hausdorff distance of 8.69±8.78.*Conclusions This work developed high-resolution gray matter labels for the MIITRA atlas. The new labels, in combination with the high-resolution (0.5mm isotropic) T1w template of the atlas, allow segmentation of the gray matter of older adults that is in good agreement with the manually-edited Freesurfer-based segmentation.*Clinical Relevance/Application The MIITRA gray matter labels, in combination with the high-resolution T1w template of the atlas, allow segmentation of the gray matter of older adults that is in good agreement with the manually-edited Freesurfer-based segmentation.

RESULTS

The measures of overlap were generally high, with an average Dice coefficient of 0.82±0.10, Jaccard coefficient of 0.70±0.13, sensitivity of 0.77±0.13, and specificity of 0.89±0.09. There was a high correlation in label geometry both in terms of the average volume (correlation coefficient=0.997, p-value<10-10) and in terms of the average surface area (correlation coefficient=0.988, p-value<10-10). The values of dissimilarity were low, with an average volume error of 0.18±0.18 and an average Hausdorff distance of 8.69±8.78.

CLINICAL RELEVANCE/APPLICATION

The MIITRA gray matter labels, in combination with the high-resolution T1w template of the atlas, allow segmentation of the gray matter of older adults that is in good agreement with the manually-edited Freesurfer-based segmentation.

SSNR12-5   Statistical Parametric Mapping In Amyloid Positron Emission Tomography: Use Cases And Future Directions

Participants
Natasha Smith, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Statistical Parametric Mapping (SPM) is a technique comparing single-subject Positron Emission Tomography (PET) to a healthy cohort. While routinely used in FDG-PET, SPM's utility in amyloid PET for Alzheimer's disease (AD) diagnosis is less established. Amyloid PET interpretations often employ binary terms (positive/negative), yet it is known that amyloid deposits occur in 20-30% of cognitively normal individuals. By providing stereotactic surface projections (SSP) of amyloid avidity relative to a cognitively normal sample, SPM could enhance diagnostic performance of amyloid PET. Our purpose was to build an atlas of amyloid PET scans from cognitively normal subjects and evaluate the feasibility of SPM analysis with our atlas.*Methods and Materials Following IRB approval, 34 cognitively normal individuals (22 F, 12 M; age 50-85) underwent amyloid PET/CT with 11C-Pittsburgh compound B (PiB). All subjects had a normal CSF analysis for AD-related biomarkers (t-tau=400?pg/mL, p-tau =60?pg/mL and Aß42 =?550? pg/mL)1 and had a mean mini-mental state examination (MMSE) of 29 +/- 1.0. To create the atlas, images were fit to the Montreal Neurological Institute standard space with syngo.va MI Neurology Workflow (cerebellar normalization, 12 mm FWHM, 75% brightest

voxels).Our test cases were two cognitively normal test subjects (S1: 58 y/o, F, MMSE: 30, totalTau = 295, ptau = 59, Aß42 = 1,090); S2: 73 y/o, M, MMSE: 30, totalTau = 236, ptau = 38, Aß42 = 496) and a subject with known AD (S3: 60 y/o, F). PiB PET/CT was performed per published protocol. Two physician-raters provided interpretations of the standard amyloid PET images. SPM analysis was performed with the atlas and SSP visualizations were created.*Results Both raters deemed S1 "amyloid positive" after evaluation of standard amyloid PET. However, SPM demonstrated that no region had a z-score for amyloid avidity over 2.6. S2 (positive for CSF Aß42 AD biomarker) was called "amyloid negative" by both raters from standard images, while SPM demonstrated that the middle cingulate, precuneus, and superior/middle temporal regions had z-scores over 5.8. S3 (known AD) demonstrated robust amyloid-avidity with z-scores up to 23.9.*Conclusions This feasibility study demonstrates the application of SPM in amyloid targeted PET and suggests that SPM may enhance diagnostic performance. We aim to validate this atlas on a larger cohort to ascertain if SPM improves accuracy of amyloid PET. With disease-modifying therapies for AD on the horizon, the accurate diagnosis of AD from amyloid PET will become increasingly important, and SPM could be a valuable tool to mitigate false positives and negatives.*Clinical Relevance/Application SPM could improve the diagnostic accuracy of amyloid PET imaging in the diagnosis of AD.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

SPM could improve the diagnostic accuracy of amyloid PET imaging in the diagnosis of AD.

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Participants

Gary Ulaner, MD,PhD, Irvine, California (*Moderator*) Speaker, Siemens AG;Speaker,Lantheus Holdings;Research support, General Electric Company;Research support, F. Hoffmann-La Roche Ltd;Research support, Lantheus Holdings;Research support, Novartis AG

Sub-Events

SSNMMI08-1 First In Human Imaging Of Fluorinated NP-59 (FNP-59): A New Technique To Image Cholesterol Metabolism Noninvasively

Participants

Benjamin Viglianti, MD,PhD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

NP-59, 6-beta-iodomethyl-19-norcholesterol, was first reported in 1975 and developed at the University of Michigan for non-invasive identification of abnormal cholesterol utilization focusing on adrenal cortical disorders, notably primary aldosterone's. Given the imaging limitations of iodine radionuclides and high radiation dosimetry, use ofNP-59 was limited. It was recognized at the time that a fluorine-18 variant of NP-59 (FNP-59) would be an improved alternative. For the past ~40 yrs all routes to the agent have failed, until now.*Methods and Materials We describe herein the development and validation of the synthesis for FNP-59 from cholesterol, radiation dosimetry/distribution in rats from 1 to 6 hours, toxicology study, PET imaging validation in normal and ApoE-/- mice, and rabbit models. Finally, first in human PET/CT images of FNP-59 in a normal patient was performed at 1, 3, and 6 hours after injection.*Results We successfully prepared FNP-59 and demonstrated an adrenal to liver ratio of 5:1 at 6 hrs in rats. Radiation dosimetry was significantly less compared to the historical data of I-131 NP-59, particularly in the gonads and thyroid. Animal toxicology studies demonstrated the agent had no adverse effects at a dose 1000 times greater than used for a PET/CT imaging study. Imaging of mice and rabbits demonstrated uptake in the expected locations including areas of pathology that accumulate cholesterol. First in human images also demonstrate imaging in expected tissues (liver and adrenal glands).*Conclusions FNP-59 has been successfully prepared and demonstrated to be safe in initial studies, offering the opportunity to image cholesterol metabolism noninvasively, making an old technique newly applicable again.*Clinical Relevance/Application When validated FNP-59 could allow detection of unilateral versus bilateral primary aldosteronism non-invasivly in the adrenal gland. Additionally, it may be able to quantify atherosclerotic disease improving risk stratification of patients who might need intervention.

RESULTS

We successfully prepared FNP-59 and demonstrated an adrenal to liver ratio of 5:1 at 6 hrs in rats. Radiation dosimetry was significantly less compared to the historical data of I-131 NP-59, particularly in the gonads and thyroid. Animal toxicology studies demonstrated the agent had no adverse effects at a dose 1000 times greater than used for a PET/CT imaging study. Imaging of mice and rabbits demonstrated uptake in the expected locations including areas of pathology that accumulate cholesterol. First in human images also demonstrate imaging in expected tissues (liver and adrenal glands).

CLINICAL RELEVANCE/APPLICATION

When validated FNP-59 could allow detection of unilateral versus bilateral primary aldosteronism non-invasivly in the adrenal gland. Additionally, it may be able to quantify atherosclerotic disease improving risk stratification of patients who might need intervention.

SSNMMI08-2 First In-human Trial Of Delta Like Ligand 3 (DLL3)-targeted PET Imaging Of Neuroendocrine Tumors With Zr-89 SC16.56.

Participants

Matthew Agee, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

DLL3 is a neuroendocrine tumor-specific cell surface protein, commonly overexpressed in NETs and well-validated as an important new therapeutic target, for which a non-invasive in vivo target biomarker assay is urgently needed.?? We are conducting a first-in-human?phase I?trial?of the humanized anti-DLL3 monoclonal antibody SC16.56, labeled with Zirconium-89 (89Zr-DFO-SC16.56) for PET imaging in patients with newly diagnosed or recurrent small cell lung cancer (SCLC).? The purpose of this report is to present our promising preliminary data.?*Methods and Materials SCLC?patients with?tumors having high DLL3-expression (=50% cells DLL3-positive by IHC)?received?2?mCi?of?89Zr-DFO-SC16.56 (mass ~2.5 mg).?89Zr-DFO-SC16.56 body PET/CT scans were obtained? approximately?1-4 hours, 1 day, 3 days, and 7 days post-injection.??*Results All patients (n=3 to-date)?tolerated 89Zr-DFO-SC16.56 with no side-effects. All known tumor sites (n=13) were detectable early, by 3 days?post injection, even sub-centimeter metastases, with tumors SUV continuing to increase to 7 days?post?injection;?with average tumor SUV 10.5?±11.7?(range?1.6-54.4).?Tracer uptake in normal tissues was scant (other than liver uptake,) providing excellent?tumor: muscle?uptake ratios of? 13.4±14.7.??*Conclusions Our first in-human demonstrates the feasibility of in vivo radiological detection of tumor DLL3?expression and?indicates Zr-89 DFO-SC16.56 PET imaging is a very promising, first-of-kind imaging biomarker of tumor DLL3 expression, with potential applications as a diagnostic, predictive and prognostic biomarker for NETs and in DLL3-targeted therapy.*Clinical Relevance/Application Tumor DLL3 expression is an important new oncotherapeutic target for which predictive biomarker assays are urgently needed. We hypothesize Zr-89 SC16.56 PET is a fit-for-purpose, first-of-kind DLL3 imaging biomarker in NET with multiple

clinical applications including tumor detection and response prediction.

RESULTS

All patients (n=3 to-date)?tolerated 89Zr-DFO-SC16.56 with no side-effects. All known tumor sites (n=13) were detectable early, by 3 days?post injection, even sub-centimeter metastases, with tumors SUV continuing to increase to 7 days?post?injection;?with average tumor SUV 10.5?±11.7?(range?1.6-54.4).?Tracer uptake in normal tissues was scant (other than liver uptake,) providing excellent?tumor: muscle?uptake ratios of?13.4±14.7.??

CLINICAL RELEVANCE/APPLICATION

Tumor DLL3 expression is an important new oncotherapeutic target for which predictive biomarker assays are urgently needed. We hypothesize Zr-89 SC16.56 PET is a fit-for-purpose, first-of-kind DLL3 imaging biomarker in NET with multiple clinical applications including tumor detection and response prediction.

SSNMMI08-5   CXCR4 PET Imaging For Post-treatment Evaluation Of Gastric Mucosa-associated Lymphoid Tissue (MALT) Lymphoma: A Biopsy-controlled Prospective Study

Participants
Marius Mayerhoefer, MD,PhD, New York, New York (*Presenter*) Speaker, Siemens AG;Speaker, Bristol-Myers Squibb Company;Speaker, General Electric Company

PURPOSE

Follow-up of gastric mucosa-associated lymphoid tissue (MALT) lymphoma currently relies on esophagogastroduodenoscopy with multi-site biopsies. The aim of this study was to evaluate PET with the novel CXCR4 (G-protein-coupled C-X-C chemokine receptor type 4) tracer [68Ga]Pentixafor as an alternative to biopsies in this setting, given that MALT lymphoma has previously demonstrated CXCR4 overexpression.*Methods and Materials In this prospective study, 46 [68Ga]Pentixafor-PET/MRI examinations of 26 gastric MALT lymphoma patients post helicobacter pylori eradication (with/without additional systemic immuno- or chemotherapy), and 20 [68Ga]Pentixafor-PET/MRI examinations of 20 control group patients with head/neck cancer or pancreatic adenocarcinoma were analyzed. In the MALT lymphoma group, matched gastric biopsies, and in the control group, same-day MRI and follow-up imaging were used as reference standard. Examination-based accuracy, sensitivity, specificity, and positive and negative predictive value (PPV, NPV) of [68Ga]Pentixafor-PET for detection of gastric MALT lymphoma and respective 95% confidence intervals (CI) were calculated. SUVmax, SUVmean, and tumor-to-background ratios (TBR-liver and TBR-blood) were also measured.*Results [68Ga]Pentixafor-PET was false-negative in two patients/scans with low-level MALT lymphoma infiltration at histology; and false-positive in one patient with chronic gastritis. There was no false-positives in the control group. Accordingly, accuracy, sensitivity, and specificity of [68Ga]Pentixafor-PET were 95.5% (CI, 86.4-98.6%), 95.0% (CI, 80.9-98.8%), and 96.2% (CI, 77.2-99.5%); and PPV and NPV were 97.4% (CI, 83.1-99.7%) and 92.6% (CI, 74.8-98.1%), respectively. MALT lymphoma mean SUVmax, SUVmean,TBR-liver, and TBR-blood, were 7.1±3.0, 3.7±0.8, 5.1±3.4, and 3.6±2.1.*Conclusions CXCR4 imaging with [68Ga]Pentixafor-PET is feasible for the detection of gastric MALT lymphoma at post-treatment follow-up, showing high sensitivity and specificity, and providing high lesion-to-background contrast.*Clinical Relevance/Application CXCR4 PET imaging may offer a reasonably accurate alternative to routine esophagogastroduodenoscopy for post-treatment follow-up of gastric MALT lymphoma.

RESULTS

[68Ga]Pentixafor-PET was false-negative in two patients/scans with low-level MALT lymphoma infiltration at histology; and false-positive in one patient with chronic gastritis. There was no false-positives in the control group. Accordingly, accuracy, sensitivity, and specificity of [68Ga]Pentixafor-PET were 95.5% (CI, 86.4-98.6%), 95.0% (CI, 80.9-98.8%), and 96.2% (CI, 77.2-99.5%); and PPV and NPV were 97.4% (CI, 83.1-99.7%) and 92.6% (CI, 74.8-98.1%), respectively. MALT lymphoma mean SUVmax, SUVmean,TBR-liver, and TBR-blood, were 7.1±3.0, 3.7±0.8, 5.1±3.4, and 3.6±2.1.

CLINICAL RELEVANCE/APPLICATION

CXCR4 PET imaging may offer a reasonably accurate alternative to routine esophagogastroduodenoscopy for post-treatment follow-up of gastric MALT lymphoma.

SSNMMI08-6   Validation Of Multimodal Hypoxia Imaging Using Po2 EPR, FMISO PET, and DCE MRI with H;E and CD31 Staining On SCC7 Squamous Cell Carcinomas

Participants
Inna Gertsenshteyn, BA, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Hypoxic tumors are resistant to radiation, and hypoxia correlates negatively with patient prognosis and survival. 18F-Misonidazole (FMISO) PET is used in clinical trials to localize tumor hypoxia with disputed accuracy. Electron paramagnetic resonance (EPR) imaging measures near-absolute pO2, with hypoxia defined by pO2 < 10 mmHg, but is not available clinically. Here we imaged hypoxic tumors with FMISO PET and perfusion images from Dynamic Contrast Enhanced (DCE) MRI, using EPR pO2 images as the reference standard of hypoxia. Immunohistochemical (IHC) H&E and CD31 stained slides were used to identify necrotic regions and vessels within the tumor. The purpose of this study was to use IHC to validate necrotic and vascular properties previously assumed based on in vivo imaging.*Methods and Materials 16 mice with SCC7 squamous cell carcinomas were imaged in a hybrid 720 MHz EPR/PET imager two hours post injection of ~230 μCi of FMISO tail-vein bolus for a 30 min static PET image. Near-absolute pO2 EPR images were acquired with an infusion of an oxygen sensitive spin probe. T2-weighted (for tumor/muscle contouring) and DCE MRI (Ktrans and ve) images were acquired in 9.4T scanner (Bruker, Germany). Two tumors with surrounding musculoskeletal structures were excised, formalin preserved, and decalcified. Ten-μm axial slices were stained with H&E and CD31 every 500 μm. MR and EPR/PET images were registered via embedded fiducials, then resampled to isotropic 0.5 mm voxel resolution in Matlab. Using morphological boundaries shown on H&E slides, a qualitative comparison of H&E and CD31 stains was made with in vivo MRI/EPR/PET images. Tumor vessels were thresholded based on brown CD31 stains using QuPath software.*Results Tumor regions with hypoxia shown in EPR (pO2 < 10 mmHg) and PET (TMR > 2.2), and low Ktrans and high ve, were consistent with H&E sections that showed necrosis and CD31 sections with little to no vasculature. Regions at edges of the tumor showed larger, more densely packed vessels and tumor nuclei, consistent with oxygenated regions shown in EPR/PET that also had high Ktrans and low ve. Work in HIF1-a staining to further validate hypoxia shown by EPR is ongoing.*Conclusions Using H&E and CD31 staining, pO2 EPR images were validated by showing deeply hypoxic tumor regions qualitatively correlated with necrotic regions without vasculature, as well as low Ktrans and high ve.*Clinical Relevance/Application Characterizing the hypoxic tumor microenvironment through in vivo and ex vivo imaging is valuable to validate the accuracy of FMISO PET and pO2 EPR imaging for future use in human clinical trials, as well

as potential DCE MRI correlates.

RESULTS

Tumor regions with hypoxia shown in EPR (pO2 < 10 mmHg) and PET (TMR > 2.2), and low Ktrans and high ve, were consistent with H&E sections that showed necrosis and CD31 sections with little to no vasculature. Regions at edges of the tumor showed larger, more densely packed vessels and tumor nuclei, consistent with oxygenated regions shown in EPR/PET that also had high Ktrans and low ve. Work in HIF1-a staining to further validate hypoxia shown by EPR is ongoing.

CLINICAL RELEVANCE/APPLICATION

Characterizing the hypoxic tumor microenvironment through in vivo and ex vivo imaging is valuable to validate the accuracy of FMISO PET and pO2 EPR imaging for future use in human clinical trials, as well as potential DCE MRI correlates.

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Participants

Reto Sutter, MD, Zurich, Switzerland (*Moderator*) Nothing to Disclose
Jan Fritz, MD, New York, New York (*Moderator*) Institutional research support, Siemens AGScientific Advisor, Siemens AGPatent agreement, Siemens AGInstitutional research support, Johnson & JohnsonInstitutional research support, Zimmer Biomet Holdings, IncInstitutional research support, BTG International

Sub-Events

SSMK03-1   Rethinking The Dexa Scan: Can We Utilize Deep Learning To Obtain Bone Mineral Density From Diagnosticimaging?

Participants
Simukayi Mutasa, MD, Newport Beach, California (*Presenter*) Nothing to Disclose

PURPOSE

While DEXA scans and extremity imaging utilize a similarly small amount of radiation, DEXA imaging provides no other diagnostic information. Our aim is to show that a convolutional neural network (CNN) can obtain bone mineral density from diagnostic imaging performed for other purposes, beginning with hip radiographs.*Methods and Materials We applied a natural language processing tool to perform a retrospective search of all DEXA scans performed at our institution since 2010 along with all the hip and pelvic radiographs obtained during the same time period in patients over 25. The results were cross-referenced to find patients whoobtained both a DEXA scan and radiograph within one year of each other. Over 4400 patients met inclusion criteria. A script was applied to extract quantitative and qualitative bone density labels. Qualitative labels consisted of normal bone density, osteopenia, and osteoporosis. Quantitative labelswere the average of the T-score from the hip, L-spine, femur, and forearm when available.Manual bounding box annotation of Ward's triangle on AP view was performed for each radiograph. A novel 40-layer CNN based on the focal loss principle was trained from random initialization to isolate Ward's triangle on AP view radiographs of the hip based on the annotations. Asecond CNN classified the images of each hip as containing osteoporosis or osteopenia, with a third and fourth class for normal hips and images not containing the hip respectively.10% of the patients were sequestered to be utilized as a testing set. 20% were used for validation and the remaining 70% for training. Accuracy, aggregate sensitivity and specificity, and average AUC were used as performance metrics.*Results Patients ranged in age from 20 to 93. 89% of the patients were female. Preliminary qualitative validation results on 515 images from 389 patients demonstrate a CNN classification accuracy of 81.16% with aggregate sensitivity and specificity of 0.838 and 0.772 respectively at the chosen operating point.The aggregate AUC was 0.809. Data is preliminary and further training on the remaining 4000 patients is ongoing for a more robust model.*Conclusions A deep learning system, when applied to extremity radiographs such as the hip, can diagnose abnormalities in bone mineral density similar to a DEXA scan.*Clinical Relevance/Application Bone mineral density can now be obtained from diagnostic imaging performed for other purposes.

RESULTS

Patients ranged in age from 20 to 93. 89% of the patients were female. Preliminary qualitative validation results on 515 images from 389 patients demonstrate a CNN classification accuracy of 81.16% with aggregate sensitivity and specificity of 0.838 and 0.772 respectively at the chosen operating point.The aggregate AUC was 0.809. Data is preliminary and further training on the remaining 4000 patients is ongoing for a more robust model.

CLINICAL RELEVANCE/APPLICATION

Bone mineral density can now be obtained from diagnostic imaging performed for other purposes.

SSMK03-2   Diagnosis On Foot Deformity With Automated Landmark Identification Using A Cascade Convolutional Neural Network On Foot Standing Lateral Radiographs

Participants
Seung Min Ryu, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate diagnosis on foot deformity with automated identification of landmarks using a cascade convolutional neural network (CNN) on foot standing lateral radiographs.*Methods and Materials A total of 1200 foot standing lateral radiographs was acquired from the Regional Military Manpower Administration of the Republic of Korea from April 2019 to Dec 2019. These radiographs were obtained using X-ray system while examinees were standing on a table with their feet in neutral position. Randomly selected 1050 X-rays were included as the train set, and the 150 X-rays as test set. One orthopedic surgeon (A) with 8 years of clinical experience and 3 years of military service experience to classify conscripted examinee according to orthopedic disease including pes planus and pes cavus identified the 25 anatomic landmarks per radiograph using a Visual Geometry Group (VGG) Image Annotator, which was regarded as the gold standard. Two orthopedic surgeons (A and B with 8 years of clinical experience) and general physician (GP) independently identified the landmarks of test dataset using same method. After 2 weeks later, Surgeon B and GP independently identified the landmarks once again under the guidance of the artificial intelligence (AI) CNN model. Mean absolute distance (MAD) and foot deformity angles including talo-first metatarsal angle (TMA), and calcaneal pitch angle (CPA) between

landmarks of gold standard and model prediction were evaluated. After 2 weeks later, all observers (A, B and GP) independently identified the landmarks of randomly selected 50 X-rays in test set without any guidance.*Results The overall detection errors for AI, Surgeon B, and GP were 0.85 ± 0.74 mm, 1.23 ± 1.13 mm, and 1.42 ± 1.40 mm, in MAD, 0.58 ± 1.68°, 2.57 ± 2.21 °, and 0.09 ± 2.50 °, in TMA, 0.22 ± 0.46°, 0.09 ± 0.47 °, and 0.12 ± 0.74 °, in CPA, respectively. In addition, the overall AI guided detection errors with Surgeon B and GP were 0.9 ± 0.3 mm and 1.2 ± 0.3 mm, in MAD, 1.83 ± 2.17 ° and 2.36 ± 2.31 °, in TMA, 0.07 ± 0.45 ° and 0.13 ± 0.55°, in CPA, respectively. Intra-observer difference of the landmarks for A, B and GP were 0.62 ± 0.08 mm, 0.83 ± 0.15 mm and 1.06 ± 0.35 mm.*Conclusions Guidance with this CNN model showed better and more consistent outcome in inexperienced doctors for classifying foot deformity and determine landmarks. With the help of AI, inexperienced doctors can identify the anatomic landmarks better than without.*Clinical Relevance/Application The automated foot deformity landmark detection model may aid preliminary screening and accurate measurement for diagnosis of foot deformity.

RESULTS

The overall detection errors for AI, Surgeon B, and GP were 0.85 ± 0.74 mm, 1.23 ± 1.13 mm, and 1.42 ± 1.40 mm, in MAD, 0.58 ± 1.68°, 2.57 ± 2.21 °, and 0.09 ± 2.50 °, in TMA, 0.22 ± 0.46°, 0.09 ± 0.47 °, and 0.12 ± 0.74 °, in CPA, respectively. In addition, the overall AI guided detection errors with Surgeon B and GP were 0.9 ± 0.3 mm and 1.2 ± 0.3 mm, in MAD, 1.83 ± 2.17 ° and 2.36 ± 2.31 °, in TMA, 0.07 ± 0.45 ° and 0.13 ± 0.55°, in CPA, respectively. Intra-observer difference of the landmarks for A, B and GP were 0.62 ± 0.08 mm, 0.83 ± 0.15 mm and 1.06 ± 0.35 mm.

CLINICAL RELEVANCE/APPLICATION

The automated foot deformity landmark detection model may aid preliminary screening and accurate measurement for diagnosis of foot deformity.

SSMK03-3   Deep Learning Identifies Body Composition Changes Over Time In Total-body DXA Imaging To Predict All-cause Mortality

Participants
Yannik Glaser, Honolulu, Hawaii (*Presenter*) Nothing to Disclose

PURPOSE

From total body dual energy X-ray absorptiometry (TBDXA) scans it is known that older adults who lose higher muscle mass and weight than expected have a higher mortality risk compared to those who preserve muscle. Based on this, we propose two additions to mortality risk models. First, we hypothesize that TBDXA scans provide relevant body composition information beyond what is reflected in traditional risk factors. Second, we hypothesize that tracking changes in body composition over time further improves mortality models.*Methods and Materials Deep neural network (DNN) models were trained on 3075 patient's records from the Health, Aging and Body Composition study (HealthABC), a prospective cohort study of white and black men and women aged 70 to 79 years, with 1992 deaths over the 15 years of observation. HealthABC DXA scans were taken with a Hologic system (Hologic Inc., MA) in addition to traditional mortality risk factors: blood markers, general fitness indicators, and disability. Participants were split into training (70%) and validation (10%) sets for model tuning, and a test (20%) set for final evaluation. For both "single-record" and "record-sequence" scenarios, DNNs were trained on traditional risk factors, only TBDXA scans, and both modalities combined.*Results Hypothesis one was confirmed by comparing test set AUROC scores of the three models trained on isolated records: 0.69 for traditional risk factors, 0.63 for image-only, and 0.71 for combined modalities. Hypothesis two was confirmed by comparing test set AUROC scores for models trained on multi-record sequences: 0.76 for traditional risk factors, 0.73 for image-only, and 0.79 for combined modalities.*Conclusions This study is the first to examine baseline and sequential TBDXA scans combined with traditional mortality risk factors. The single-record performance shows that TBDXA contains complementary information to known risk factors, while the sequence model performance gains indicate that changes in body composition over time are stronger predictors of mortality than isolated datapoints. We demonstrate that deep learning can extract this information to improve all-cause mortality predictions.*Clinical Relevance/Application This approach provides a powerful way to study overall change in body composition characteristics coupled to clinical risk factors, paving a way for better intervention strategies to prolong lifespan.

RESULTS

Hypothesis one was confirmed by comparing test set AUROC scores of the three models trained on isolated records: 0.69 for traditional risk factors, 0.63 for image-only, and 0.71 for combined modalities. Hypothesis two was confirmed by comparing test set AUROC scores for models trained on multi-record sequences: 0.76 for traditional risk factors, 0.73 for image-only, and 0.79 for combined modalities.

CLINICAL RELEVANCE/APPLICATION

This approach provides a powerful way to study overall change in body composition characteristics coupled to clinical risk factors, paving a way for better intervention strategies to prolong lifespan.

SSMK03-4   Deep Neural Network And Radiomics Nomograms For Predicting The Intraoperative Massive Blood Loss Of Pelvic And Sacral Tumors

Participants
Ping Yin, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Patients with pelvic and sacral tumors are prone to massive blood loss (MBL) during surgery, which may endanger their lives. Preoperative prediction of the likelihood of MBL in these patients is necessary because misjudgment in preoperative evaluation may endanger the patient's life or cause the waste of blood products. This study aimed to determine the feasibility of using deep neural network (DNN) and radiomics nomogram (RN) based on 3D computed tomography (CT) features and clinical characteristics to predict the intraoperative MBL of pelvic and sacral tumors.*Methods and Materials This single-center retrospective analysis included 810 patients (445 males, 365 females; mean age of 42.5 ± 17.3 years, range 4-85 years) with pelvic and sacral tumors. 1316 CT and CT enhanced radiomics features were extracted. RN1 and RN2 were constructed by random grouping and time node grouping, respectively. The DNN models were constructed for comparison with RN. The following risk factors that were potentially associated with MBL were analyzed: sex, age, maximal tumor size, tumor type (chondrosarcoma, osteosarcoma, chordoma, giant cell tumor, multiple myeloma, schwannoma, neurofibroma, Ewing's sarcoma, metastatic tumor, and others), tumor location, neoadjuvant chemo-radiotherapy, surgical methods, surgical approaches, surgical operator, preoperative embolization, and aortic balloon occlusion. The area under the receiver operating characteristic curve (AUC) and accuracy (ACC) were used to evaluate

different models.*Results The overall blood loss ranged from 50 mL to 11000 mL with a median of 1500 (800, 2387.5) mL. Radscore, tumor type, tumor location, and sex were significant predictors of the MBL of pelvic and sacral tumors (P < 0.05), of which radscore (OR, ranging from 2.109 to 4.706, P < 0.001) was the most important. The clinical-DNN and clinical-RN performed better than DNN and RN. Both clinical-DNN and clinical-RN could be powerful tools for preoperatively predicting the MBL of patients with pelvic and sacral tumors, but the clinical-DNN model based on CT features was superior. The best-performing clinical-DNN model based on CT features exhibited an AUC of 0.92 and an ACC of 0.97 in the training set, and an AUC of 0.92 and an ACC of 0.75 in the validation set.*Conclusions The clinical-DNN and clinical-RN can be powerful tools for preoperatively predicting the MBL of patients with pelvic and sacral tumors, reducing the risk of surgical failure due to the preoperative misjudgment of blood loss.*Clinical Relevance/Application Our model could help clinicians develop individualized treatment plans, prepare blood products in advance, and reduce the risk of surgical failure and waste of blood products.

RESULTS

The overall blood loss ranged from 50 mL to 11000 mL with a median of 1500 (800, 2387.5) mL. Radscore, tumor type, tumor location, and sex were significant predictors of the MBL of pelvic and sacral tumors (P < 0.05), of which radscore (OR, ranging from 2.109 to 4.706, P < 0.001) was the most important. The clinical-DNN and clinical-RN performed better than DNN and RN. Both clinical-DNN and clinical-RN could be powerful tools for preoperatively predicting the MBL of patients with pelvic and sacral tumors, but the clinical-DNN model based on CT features was superior. The best-performing clinical-DNN model based on CT features exhibited an AUC of 0.92 and an ACC of 0.97 in the training set, and an AUC of 0.92 and an ACC of 0.75 in the validation set.

CLINICAL RELEVANCE/APPLICATION

Our model could help clinicians develop individualized treatment plans, prepare blood products in advance, and reduce the risk of surgical failure and waste of blood products.

SSMK03-5 Evaluation Of The Medical Impact Of Artificial Intelligence For Limb And Pelvic Bone Fracture Detection

Participants
Nor-Eddine Regnard, MMed, Paris, France (*Presenter*) Founder, GLEAMER;Officer, GLEAMER;Stockholder, GLEAMER

PURPOSE

To compare the performance of routine radiological interpretation and artificial intelligence (AI) in the detection of limb and pelvic bone fractures and assess its impact in terms of changes in medical care.*Methods and Materials We retrospectively evaluated all X-ray exams performed for a suspected limb or pelvic bone fracture during 3 consecutive months (Jan.-Mar. 2017) in a private imaging group of 17 centers. Each exam was analyzed by the AI BoneViewTM and its results were compared to those of the initial report. In case of discrepancy, the exam was reviewed by a senior skeletal radiologist to settle on the presence of one or several fractures. He specified whether a complementary imaging exam was necessary following the change in diagnosis and evaluated the possible consequences of a delay in therapeutic care (0: none, 1: low, 2: impact on limb function, 3: vital).*Results A total of 4774 exams (0-103 y.o., 30% pediatrics, 49% women) were included in the study. The anatomical locations of the exams were: hand (22%), wrist (4%), foot (13%), ankle (11%), leg (5%), knee (23%), arm (3%), elbow (2%), shoulder (9%), pelvis (8%). There were a total of 703 discordant exams reviewed by the senior radiologist. Of the 785 positive exams, 903 fractures were detected by either the AI and the initial report together (n=651, 72.1%) or by the senior radiologist in discordant cases (n=252, 27.9%). Of these 252 fractures, the senior radiologist confirmed the presence of 235 fractures detected by the AI and not mentioned in the initial report (26%) and of 17 fractures (1.9%) present in the initial report but not pointed by the AI. Among these 235 fractures, 46 were second fractures. Of the 235 additional fractures detected by the AI, 69 (29.4%) should have led to another imaging exam (CT or MRI) to confirm the diagnosis (n=61, 26%) or to characterize the severity of the fracture (n=48, 20.4%). The knowledge of the fracture could have led to a change in therapeutic care for 144 fractures (61.3%) and a possible surgery for 51 (21.7%). The consequences of a delay in therapeutic care were evaluated as low (score 1) for 155 fractures (66%) and as a source of impact on limb function (score 2) for 24 fractures (10.2%). Of the 235 additional fractures, 32 were impactful fractures: 6 pelvises, 5 scaphoids, 4 tibial plateau, 16 distal radii, and 1 fibula neck.*Conclusions On a clinical routine dataset with natural prevalence, the AI detected 235 additional fractures with 46 multi-fracture exams, corresponding to an increase of 26% in fracture detection. Overall, 5% of exams were subject to medical errors. The best performances were obtained by the radiologist + AI.*Clinical Relevance/Application AI-aid has the potential to prevent medical errors like missed fractures on initial X-ray exams thus impacting patient care.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

AI-aid has the potential to prevent medical errors like missed fractures on initial X-ray exams thus impacting patient care.

Abstract Archives of the RSNA, 2021

Participants
Matthew Bucknor, MD, San Francisco, California (*Moderator*) Nothing to Disclose
Melissa Davis, MD, Atlanta, Georgia (*Moderator*) Nothing to Disclose

Sub-Events

SSNPM01-2 Underrepresentation Of Female Speakers At Musculoskeletal Radiology Conferences - Potential Strategies To Mitigate Gender Gap

Participants
Aline Serfaty Sr, MD, Cabo Frio, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

Our objectives are to assess gender distribution and disparities in the musculoskeletal field at radiology conferences and to identify factors associated with imbalance of women as speakers.*Methods and Materials This cross-sectional study evaluated data publicly available online from seven musculoskeletal radiology conference programs from different radiological societies across 3 regions (Europe, North and South Americas) from 2016 to 2020.Gender of invited speakers, moderators and planning committee members, as well as the occurrence of single gender panels for general and plenary sessions of each conference were assessed. Statistical analysis was performed to determine associations between the proportion of female participation and radiologists' gender composition of include dregions.*Results A total of 531 sessions, 2580 speakers, 603 moderators and 231 planning committee members were assessed. Women accounted for 26.6% of total speakers (P<0.001), 33.3% of moderators (P<0.001) and 31.2% of planning committee members (P=0.381). All-male panels were 26.7%, with 21.1% of women moderating these panels (P<0.001). The proportion of female speakers in musculoskeletal sessions in regard to the radiology specialty gender composition, was29.7% in North American, 26.6% in European and 12.9% in South American conferences (all P<0.05), while the proportion of female speakers in plenary sessions was 34.6 % in North American (P<0.052), 25.0% in European(P>0.199) and 13.6% in South American (P=0.001). The proportion of female moderators in musculoskeletal sessions was 35.0% in North American (P=0.002), 37.1% in European (P=0.914), and 13.8% in South American conferences(P<0.001). A linear relationship was observed in the proportion of women as speakers, moderators and as planning committee members (P<0.05).*Conclusions Women were underrepresented as speakers in the musculoskeletal field of radiological conferences worldwide, with significant differences in Europe and South America in all years evaluated. Women as moderators were also significantly underrepresented in South America, and in all-male panels in all regions.*Clinical Relevance/Application Women have consistently been underrepresented in radiology globally. Acknowledging gender biases and increasing the number of women on planning committees may help address gender imbalance and promote gender equity.

RESULTS

A total of 531 sessions, 2580 speakers, 603 moderators and 231 planning committee members were assessed. Women accounted for 26.6% of total speakers (P<0.001), 33.3% of moderators (P<0.001) and 31.2% of planning committee members (P=0.381). All-male panels were 26.7%, with 21.1% of women moderating these panels (P<0.001). The proportion of female speakers in musculoskeletal sessions in regard to the radiology specialty gender composition, was29.7% in North American, 26.6% in European and 12.9% in South American conferences (all P<0.05), while the proportion of female speakers in plenary sessions was 34.6 % in North American (P<0.052), 25.0% in European(P>0.199) and 13.6% in South American (P=0.001). The proportion of female moderators in musculoskeletal sessions was 35.0% in North American (P=0.002), 37.1% in European (P=0.914), and 13.8% in South American conferences(P<0.001). A linear relationship was observed in the proportion of women as speakers, moderators and as planning committee members (P<0.05).

CLINICAL RELEVANCE/APPLICATION

Women have consistently been underrepresented in radiology globally. Acknowledging gender biases and increasing the number of women on planning committees may help address gender imbalance and promote gender equity.

SSNPM01-3 Recent Changes In Women Representation In The United States Diagnostic Radiology Residency Programs: Opportunities Or Unintentional Consequences?

Participants
Faezeh Sodagari, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

To assess recent trends in the proportion of female residents and faculty members in diagnostic radiology residency programs in the United States (US).*Methods and Materials Using the American Medical Association Fellowship and Residency Electronic Interactive Database (FREIDA), diagnostic radiology residency programs in the US were identified and the program-reported data such as the type of residency programs, number of faculty members, as well as the proportions of female faculty and female residents were extracted in 2015, 2018, and 2021 and the data were compared between 2015 and 2021.*Results The number of diagnostic radiology residency programs increased from 184 programs in 2015 to 193 in 2018 and 195 in 2021. These programs consisted of 101 (52%) university-based, 66 (34%) university-affiliated, 19 (10%) community, and 7 (4%) military programs in 2021. The number of programs that reported their residents' gender diversity information increased from 82 (47%) programs in 2015 to 121

(62%) programs in 2021. There was no significant change between the proportions of female faculty (26.5% ±10.4% vs 26.6% ± 9.9%, P: 0.91) or female resident (24.8% ± 9.1% vs 25.7% ± 10.1%, P: 0.42) between 2015 and 2021. The proportion of female residents did not show a significant correlation with program female faculty proportion or the size of the residency program and was independent of the program director gender (all P> 0.05). Although not statistically significant, community programs without affiliation with universities showed a marked visual decline in the median proportions of female residents (30.3% to 17.9%, P: 0.28) and female faculty (24.2% to 12.3%, P: 0.15) between 2015 to 2021, while the university-based programs showed a slight visual increase from 20.8% to 26.7% (P: 0.12) and 26.4% to 28.1% (P: 0.15), respectively.*Conclusions Despite recent initiatives to increase traditional gender diversity in radiology, no significant overall change is observed in female faculty or resident representation in radiology departments in the US between 2015 to 2021. Declining trends in the proportion of female faculty members and residents are perceived in community programs while academic programs show a slight but not statistically significant increase in female representation.*Clinical Relevance/Application Without addressing the pipeline of female medical students entering radiology residency programs, the overall female representation in radiology appears unchanged in recent years. The perceived increased recruiting efforts in academic programs without an increase in the pipeline resulted in a shift of female residents and faculty from community to university-based programs without affecting the overall gender diversity in the specialty.

RESULTS

The number of diagnostic radiology residency programs increased from 184 programs in 2015 to 193 in 2018 and 195 in 2021. These programs consisted of 101 (52%) university-based, 66 (34%) university-affiliated, 19 (10%) community, and 7 (4%) military programs in 2021. The number of programs that reported their residents' gender diversity information increased from 82 (47%) programs in 2015 to 121 (62%) programs in 2021. There was no significant change between the proportions of female faculty (26.5% ±10.4% vs 26.6% ± 9.9%, P: 0.91) or female resident (24.8% ± 9.1% vs 25.7% ± 10.1%, P: 0.42) between 2015 and 2021. The proportion of female residents did not show a significant correlation with program female faculty proportion or the size of the residency program and was independent of the program director gender (all P> 0.05). Although not statistically significant, community programs without affiliation with universities showed a marked visual decline in the median proportions of female residents (30.3% to 17.9%, P: 0.28) and female faculty (24.2% to 12.3%, P: 0.15) between 2015 to 2021, while the university-based programs showed a slight visual increase from 20.8% to 26.7% (P: 0.12) and 26.4% to 28.1% (P: 0.15), respectively.

CLINICAL RELEVANCE/APPLICATION

Without addressing the pipeline of female medical students entering radiology residency programs, the overall female representation in radiology appears unchanged in recent years. The perceived increased recruiting efforts in academic programs without an increase in the pipeline resulted in a shift of female residents and faculty from community to university-based programs without affecting the overall gender diversity in the specialty.

SSNPM01-4 Advancing Culture Change In Radiology Through Communication: The Value Of Large Versus Small Group Discussions

Participants
Amber Simmons, BS, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Our department, as part of a concerted institutional effort, adopted a strategic framework to address institutional health inequities, bias, and racism and advance culture change. Understanding the importance of employees' voices in this process, we deployed two forms of communication-based initiatives, of variable group sizes, to solicit ideas, identify critical action items, and generate feedback from employees. However, the ideal methods of departmental communication and the effect of group size, especially regarding DEI discussions, are not well understood.*Methods and Materials A 60-minute large group (LG) and seven 90-minute small group (SG) sessions were conducted virtually. All sessions consisted of a heterogenous group of employees, except two SGs of trainees only. All participants could communicate verbally or by chat during the session, or through an anonymous online form before and after each session. De-identified written transcripts were recorded and anonymous surveys conducted after each session. Our primary outcome was employee perception of effectiveness of LG versus SG sessions, assessed through the anonymous survey. Our secondary outcomes were the effectiveness of SG versus LG and homogeneous (Group A-SG) versus heterogeneous (Group B-SG) SGs in generating action ideas. To assess this, a scale of 0-5 was developed to grade the strength of an action proposal and a score was assigned by three blinded reviewers. Chi-squared and Fischer exact tests were performed.*Results There were 156 LG and 155 SG participants, with 22 survey responses from the LG and 38 from the SGs (14.1% and 24.5% response rate, respectively). There were 11 group A-SG and 27 group B-SG responders. Of 16 survey questions, 9 showed significant differences between LG and SG using Chi-squared trend test, with 5 also significant by Fisher exact (Figure 1). Only one question demonstrated significant difference on Fischer exact test between group A-SG and B-SG. Of 412 comments, 400 were from SGs with only 12 from the LG, precluding statistical comparison. There was no difference in comment strength between Group A-SG or Group B-SG (p-value 0.643).*Conclusions Our study shows that, compared to LG, SG settings are perceived by employees as more effective in having purposeful discussions and for idea generation with less fear of judgement and bias, with trainee-only SGs more likely to express fear of judgement from leadership. It also highlights significant limitations of LGs in facilitating idea generation and sharing, even with expanded avenues to provide comments.*Clinical Relevance/Application These findings can serve as a guide to engaging employees and promoting organization culture change, especially as it relates to diversity, equity, and inclusion.

RESULTS

There were 156 LG and 155 SG participants, with 22 survey responses from the LG and 38 from the SGs (14.1% and 24.5% response rate, respectively). There were 11 group A-SG and 27 group B-SG responders. Of 16 survey questions, 9 showed significant differences between LG and SG using Chi-squared trend test, with 5 also significant by Fisher exact (Figure 1). Only one question demonstrated significant difference on Fischer exact test between group A-SG and B-SG. Of 412 comments, 400 were from SGs with only 12 from the LG, precluding statistical comparison. There was no difference in comment strength between Group A-SG or Group B-SG (p-value 0.643).

CLINICAL RELEVANCE/APPLICATION

These findings can serve as a guide to engaging employees and promoting organization culture change, especially as it relates to diversity, equity, and inclusion.

SSNPM01-5 Temporal And Geospatial Variations Among The Female Interventional Radiology Physician Workforce In The United States.

Participants
Suryansh Bajaj, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

With the growing role of IR in patient management across a broad spectrum of disease processes and with the aging patient population, it is imperative to maintain an adequate Vascular and Interventional Radiology (VIR) workforce across the country in order to provide adequate access to specialized interventional care to our patients. This study aims to analyze the temporal trends and state-wise geospatial variations in the Vascular and Interventional Radiology (VIR) female physician workforce in the United States and compare its growth rate with the female physician workforce of other surgical fields.*Methods and Materials The State Physician Workforce Data was accessed for years 2015, 2017, and 2019. The variables collected for each state included total active female physicians, total female physicians per specialty, and total female physicians per 100,000 population in VIR. Comparative data were obtained for otolaryngology (ENT), general surgery (GS), interventional cardiology (IC), neurosurgery (NSG), ophthalmology (OP), orthopedic surgery (OS), plastic surgery (PS), thoracic surgery (TS), vascular surgery (VS) and urology (UR). The annual growth rate for female physicians in each state was computed for each specialty.*Results From 2015 to 2019, the total active female physicians in the United States grew by 3.82% per year. 34.61% of total physicians are female, and out of the specialties analyzed, ophthalmology has the highest number of female physicians at 22.14%, whereas females made up only 3.04% of VIR workforce. The annual growth rate of female physicians was highest in VS (12.61%) which was followed by IR (7.80%), IC (7.48%), NSG (7.15%), UR (6.12%), PS (5.02%), TS (4.51%), OP (4.09%), ENT (3.86%) and OS (3.28%). The state of Massachusetts has the highest proportion of women in VIR at 19%. Utah had the highest growth rate in the number of female VIR physicians at 16.55%.*Conclusions Female VIR physicians make up a small fraction of the VIR workforce, but their numbers have increased at a faster rate than most surgical specialties except vascular surgery. There is a substantial geographic variation in the distribution of the female VIR physician workforce.*Clinical Relevance/Application Improving the gender diversity amongst interventional radiologists is imperative to provide optimal healthcare to the population. Gender diversity among health professionals has been shown to improve access to care, patient satisfaction with their treatment, and communication with their provider.

RESULTS

From 2015 to 2019, the total active female physicians in the United States grew by 3.82% per year. 34.61% of total physicians are female, and out of the specialties analyzed, ophthalmology has the highest number of female physicians at 22.14%, whereas females made up only 3.04% of VIR workforce. The annual growth rate of female physicians was highest in VS (12.61%) which was followed by IR (7.80%), IC (7.48%), NSG (7.15%), UR (6.12%), PS (5.02%), TS (4.51%), OP (4.09%), ENT (3.86%) and OS (3.28%). The state of Massachusetts has the highest proportion of women in VIR at 19%. Utah had the highest growth rate in the number of female VIR physicians at 16.55%.

CLINICAL RELEVANCE/APPLICATION

Improving the gender diversity amongst interventional radiologists is imperative to provide optimal healthcare to the population. Gender diversity among health professionals has been shown to improve access to care, patient satisfaction with their treatment, and communication with their provider.

SSNPM01-6 If We Want Diversity, We Have To Pay For It: The Effects Of Compensation And Promotion Practices On Retaining Diverse Resident Graduates As Future Faculty.

Participants
Daniel T. Kawakyu-O'Connor, MD, Pittsford, New York (*Presenter*) Nothing to Disclose

PURPOSE

To assess the distribution of resident graduates by gender and ethnic identity from a university-based radiology department across local radiology practices and survey how compensation and promotion policies influence choice of practice environment*Methods and Materials A roster of radiologists completing a university based residency between 2010 and 2020 reviewed to identify those who entered practice within 75 miles. The distribution of radiologists by gender and ethnic identity across practice settings was analyzed. Former residents were surveyed regarding compensation and promotion practices as factors in their choice of practice setting.*Results Resident graduates who identified as women or non White overwhelmingly favored non university based practices. Residents who were hired as faculty at the university practice were more likely to leave within 3 years than those who joined other practices. Faculty retention at the university practice favored radiologists who identified as White men. Participants indicated several factors as influencing their choice of practice. Lower compensation at the university-based practice was a leading factor in the decision to join other practices. Incentive compensation plans and academic promotion practices at the university-based practice were perceived as less favorable for women and non-White faculty.*Conclusions Radiologists graduating from a university residency program identifying as women or non White favored practices other than the university group, a concerning finding for an academic institution. The leading factor was lower compensation in the university setting, suggesting that the long standing practice of compensating academic radiologists less than community peers contributes to the lack of diverse representation in some academic settings. Incentive based compensation and promotion practices were both perceived to favor non White male faculty, which is aligned with literature showing that women and non-White ethnic groups publish less, serve on fewer and less influential committees, and are less likely to have leadership roles, all of which are common metrics for incentivized compensation and promotion. This finding implicates academic environments as maintaining institutional and structural bias as an impediment promoting equity and inclusion.*Clinical Relevance/Application Promoting equitable compensation between academic and non-academic radiology practices is an overlooked opportunity in promoting diversity. Incentive compensation plans and promotion criteria should be reassessed to eliminate policies that embed bias against women and non-White faculty. Promoting a culture of equity and inclusion alone without these interventions is of lesser value.

RESULTS

Resident graduates who identified as women or non White overwhelmingly favored non university based practices. Residents who were hired as faculty at the university practice were more likely to leave within 3 years than those who joined other practices. Faculty retention at the university practice favored radiologists who identified as White men. Participants indicated several factors as influencing their choice of practice. Lower compensation at the university-based practice was a leading factor in the decision to join other practices. Incentive compensation plans and academic promotion practices at the university-based practice were perceived as less favorable for women and non-White faculty.

CLINICAL RELEVANCE/APPLICATION

Promoting equitable compensation between academic and non-academic radiology practices is an overlooked opportunity in promoting diversity. Incentive compensation plans and promotion criteria should be reassessed to eliminate policies that embed bias against women and non-White faculty. Promoting a culture of equity and inclusion alone without these interventions is of lesser value.

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SSGI20

Gastrointestinal (LIRADS/Ultrasound/Oncology)

Participants

Victoria Chernyak, MD,MS, Bronx, New York (*Moderator*) Consultant, Bayer AG
Jeong Min Lee, MD, Seoul, Korea, Republic Of (*Moderator*) Nothing to Disclose

Sub-Events

SSGI20-1   **Diagnostic Performance Of Ultrasound Texture Parameters Extracted Using Various Beamforming Sound Speeds In Detecting Hepatic Steatosis**

Participants

Kibo Nam, PhD, Philadelphia, Pennsylvania (*Presenter*) Equipment support from Canon Medical Systems Corporation and GE Healthcare, Material support from Lantheus Medical Imaging, Research fund support from Canon Medical Systems Corporation

PURPOSE

Conventional ultrasound uses an assumed speed of sound (SOS) for beamforming, which may cause an image texture change by defocusing if the actual tissue SOS mismatches the assumed one. Fat build-up by hepatic steatosis lowers a liver SOS and its image texture has been quantified to detect hepatic steatosis. However, the texture features extracted using a single (1540 m/s) beamforming SOS failed to achieve reliable diagnostic performance. The aim of this study was to investigate if the texture features extracted using various beamforming SOSs can improve the diagnostic reliability in detecting hepatic steatosis*Methods and Materials Patients with suspected non-alcoholic fatty liver disease (NAFLD) undergoing liver biopsy or MRI proton density fat fraction (PDFF), were prospectively recruited. Subjects were imaged with a C1-6 probe on a Logiq E9 scanner (GE Healthcare). The radio-frequency (RF) data from subjects' right lobe were collected using 6 beamforming SOSs: 1300, 1350, 1400, 1450, 1500, and 1540 m/s and analyzed offline using Matlab (MathWorks). The texture parameters, i.e. contrast, correlation, energy, and homogeneity from gray-level co-occurrence matrix of normalized envelope were obtained from the region of interest (ROI) in the liver parenchyma. The diagnostic performance of texture parameters from each beamforming SOS was assessed independently and in combination (by averaging its values from multiple beamforming SOSs) using a receiver operating characteristic analysis.*Results To date, 21 subjects were included in the analysis. 13 subjects were diagnosed of NAFLD (7 by biopsy steatosis = 5% and 6 by MRI-PDFF = 6.5%) and 8 subjects had normal liver (5 by biopsy steatosis < 5% and 3 by MRI-PDFF < 6.5%). The correlation values from either 1300 (AUC: 0.82; specificity: 85%; sensitivity: 63%), 1350 (AUC: 0.88; specificity: 85%; sensitivity: 100%), or 1400 m/s (AUC: 0.90; specificity: 85%; sensitivity: 88%) were significantly lower (p<0.03) in the NAFLD livers than in normal livers. The diagnostic performance of correlation was improved or comparably achieved by averaging its values from multiple beamforming SOSs (1350-1400 m/s, 1300-1400 m/s or 1300-1540 m/s). The averaged correlation value from 1350-1400 m/s showed the highest accuracy of 91% with 85% specificity and 100% sensitivity.*Conclusions The diagnostic reliability of ultrasound texture parameter in detecting hepatic steatosis may be improved by averaging its values extracted using various beamforming SOSs.*Clinical Relevance/Application It may be possible to improve the diagnostic performance of ultrasound texture parameter in detecting hepatic steatosis using images acquired with various beamforming SOSs.

RESULTS

To date, 21 subjects were included in the analysis. 13 subjects were diagnosed of NAFLD (7 by biopsy steatosis = 5% and 6 by MRI-PDFF = 6.5%) and 8 subjects had normal liver (5 by biopsy steatosis < 5% and 3 by MRI-PDFF < 6.5%). The correlation values from either 1300 (AUC: 0.82; specificity: 85%; sensitivity: 63%), 1350 (AUC: 0.88; specificity: 85%; sensitivity: 100%), or 1400 m/s (AUC: 0.90; specificity: 85%; sensitivity: 88%) were significantly lower (p<0.03) in the NAFLD livers than in normal livers. The diagnostic performance of correlation was improved or comparably achieved by averaging its values from multiple beamforming SOSs (1350-1400 m/s, 1300-1400 m/s or 1300-1540 m/s). The averaged correlation value from 1350-1400 m/s showed the highest accuracy of 91% with 85% specificity and 100% sensitivity.

CLINICAL RELEVANCE/APPLICATION

It may be possible to improve the diagnostic performance of ultrasound texture parameter in detecting hepatic steatosis using images acquired with various beamforming SOSs.

SSGI20-2   **Targeted Liver Biopsy: Using Logistic Regression Model To Choose Ultrasound Versus CT Guidance**

Participants

Yarab Al Bulushi, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

While most institutions perform targeted liver biopsies on a daily basis, no clear guidelines exist on modality choice for image guidance. Ultrasound is usually preferred given the lack of ionizing radiation, wide availability, and low cost. However, some liver lesions can be difficult to visualize or target with ultrasound guidance causing delay in care, anxiety and inconvenience to the patients. Our goal was to determine the factors that limit ultrasound targeting of liver lesions, build a model that will predict feasibility of US-guided liver lesion biopsy and thus aid in counseling the patient and in appropriate allocation of the radiology resources.*Methods and Materials This is IRB-approved HIPAA-compliant retrospective review of consecutive targeted liver ultrasound-guided biopsies performed or attempted between January 2018 and September 2020 at a single tertiary academic

institution by fellowship-trained abdominal radiologist and a trainee with a total of 511 patients included. Mann-Whitney and chi-squared tests were used to compare continuous and categorical variables respectively. Logistic regression model was used to predict feasibility of successful ultrasound guided biopsy.*Results Liver lesion biopsy could not be performed with US guidance in 73/511 (14.3%) patients. Lesions not amenable for US biopsy were smaller (median size 1.6 cm vs 3.3 cm, p<0.0001) and deeper within the liver (median depth 9.0 cm vs 5.8 cm, p<0.0001). Lesions located within segments II (75%) and VIII (78%) were significantly less amenable for US targeted biopsy (p<0.03), while lesions in segments V (94%) and IVb (96%) were more feasible targets (p<0.003). US targeting in patients with 1 or 2 lesions was less feasible than in patients with 3 or more lesions, 127/182 (70%) vs 303/321 (94%), (p<0.0001). Subsequent successful biopsy was performed in 31/72 (43%) patients (29 by CT and 2 surgically). Model including lesion size, depth and location, and number of lesions predicts feasibility of US guided biopsy with area under the ROC curve AUC = 0.92.*Conclusions Linear logistic regression model that includes lesion size, depth and location, and number of lesions is highly successful in predicting feasibility of ultrasound guided biopsy for liver lesions. In general, smaller lesions, deeper lesions, lesions in segment II and VIII in patients with less than 3 lesions were less feasible for ultrasound-guided biopsy of liver lesions.*Clinical Relevance/Application Model accurately predicting feasibility of targeted liver biopsy with ultrasound allows for counseling patient ahead of the biopsy, aid in appropriate allocation of radiology resources, limiting delay in care and patient anxiety.

RESULTS

Liver lesion biopsy could not be performed with US guidance in 73/511 (14.3%) patients. Lesions not amenable for US biopsy were smaller (median size 1.6 cm vs 3.3 cm, p<0.0001) and deeper within the liver (median depth 9.0 cm vs 5.8 cm, p<0.0001). Lesions located within segments II (75%) and VIII (78%) were significantly less amenable for US targeted biopsy (p<0.03), while lesions in segments V (94%) and IVb (96%) were more feasible targets (p<0.003). US targeting in patients with 1 or 2 lesions was less feasible than in patients with 3 or more lesions, 127/182 (70%) vs 303/321 (94%), (p<0.0001). Subsequent successful biopsy was performed in 31/72 (43%) patients (29 by CT and 2 surgically). Model including lesion size, depth and location, and number of lesions predicts feasibility of US guided biopsy with area under the ROC curve AUC = 0.92.

CLINICAL RELEVANCE/APPLICATION

Model accurately predicting feasibility of targeted liver biopsy with ultrasound allows for counseling patient ahead of the biopsy, aid in appropriate allocation of radiology resources, limiting delay in care and patient anxiety.

SSGI20-3   Liver Reporting And Data System (LI-RADS) Major Features: Individual Patient Data Meta-analysis Of Diagnostic Accuracy Studies For Diagnosis Of Hepatocellular Carcinoma

Participants
Mustafa Bashir, MD, Cary, North Carolina (*Presenter*) Research Grant, Siemens AGResearch Grant, NGM Biopharmaceuticals, IncResearch Grant, Madrigal Pharmaceuticals, IncResearch Grant, Metacrine, IncResearch Grant, ProSciento, IncResearch Grant, Medscape, LLCResearch Grant, Carmot Therapeutics Inc

PURPOSE

The Liver Reporting and Data System (LI-RADS) assigns a risk category for hepatocellular carcinoma (HCC) to observations on imaging. Establishing the contributions of major features for diagnosis of HCC can inform system improvement. The purpose of this study is to perform a systematic review and individual patient meta-analysis to establish the probability of HCC for each LI-RADS major feature using CT/MRI and contrast-enhanced ultrasound (CEUS) LI-RADS in high-risk patients.*Methods and Materials Multiple databases were searched up to September 2019 for studies evaluating the accuracy of CT, MRI and CEUS for HCC using LI-RADS (CT/MRI v2014/v2017/v2018; CEUS v2016/v2017). Study data were collected and centralized into a single dataset. Clustering was addressed at the study/patient levels using mixed models. Adjusted odds ratios (OR) with 95% confidence intervals (95%CI) were determined for each major feature using multivariable logistic regression with stepwise selection. The preferred reference standard was histopathology, otherwise a composite clinical reference standard was accepted. Risk of bias was assessed using QUADAS-2.*Results 32 studies were included with 1,170 observations on CT, 3,341 on MRI and 853 on CEUS. On multivariable analysis of CT/MRI LI-RADS, all major features were significantly associated with HCC except threshold growth (OR 1.64, 95%CI 0.74-3.63). Nonperipheral washout (OR 13.15, 95%CI 9.00-19.22) and nonrim arterial phase hyperenhancement (APHE) (OR 10.25, 95%CI 6.73-15.62) had stronger associations with HCC than enhancing capsule (OR 2.39, 95%CI 1.65-3.46) which persisted on sensitivity analysis limited to observations from studies at low risk of bias. Using CEUS, APHE (OR 7.26, 95%CI 4.60-11.48), late and mild washout (OR 4.12, 95%CI 2.56-6.63) and size =20 mm (OR 1.61, 95%CI 1.04 - 2.50) were associated with HCC. Twenty-five studies (78%) were at high risk of bias due to reporting ambiguity or study design flaws.*Conclusions LI-RADS major features have different independent associations with HCC. Well-designed research studies with lower risk of bias are needed to inform optimization of the system.*Clinical Relevance/Application Most CT/MRI and CEUS LI-RADS major features have independent associations with HCC; APHE and washout pattern have strong association whereas for CT/MRI LI-RADS, threshold growth has no association.

RESULTS

32 studies were included with 1,170 observations on CT, 3,341 on MRI and 853 on CEUS. On multivariable analysis of CT/MRI LI-RADS, all major features were significantly associated with HCC except threshold growth (OR 1.64, 95%CI 0.74-3.63). Nonperipheral washout (OR 13.15, 95%CI 9.00-19.22) and nonrim arterial phase hyperenhancement (APHE) (OR 10.25, 95%CI 6.73-15.62) had stronger associations with HCC than enhancing capsule (OR 2.39, 95%CI 1.65-3.46) which persisted on sensitivity analysis limited to observations from studies at low risk of bias. Using CEUS, APHE (OR 7.26, 95%CI 4.60-11.48), late and mild washout (OR 4.12, 95%CI 2.56-6.63) and size =20 mm (OR 1.61, 95%CI 1.04 - 2.50) were associated with HCC. Twenty-five studies (78%) were at high risk of bias due to reporting ambiguity or study design flaws.

CLINICAL RELEVANCE/APPLICATION

Most CT/MRI and CEUS LI-RADS major features have independent associations with HCC; APHE and washout pattern have strong association whereas for CT/MRI LI-RADS, threshold growth has no association.

SSGI20-5   Factors Affecting The Diagnostic Sensitivity Of Early-stage LI-RADS-5 (LR-5) Hepatocellular Carcinoma By Dynamic Contrast Enhanced Magnetic Resonance Imaging (MRI)

Participants
Anum Aslam, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

Our study's purpose was to quantify the impact of patient and technical factors on the sensitivity of Liver Imaging Reporting and Data System (LI-RADS) MRI Category-5 (LR-5) in cirrhosis patients per surgical pathology as the reference standard.*Methods and Materials We conducted a retrospective cohort study among three academic centers in the U.S. including 245 patients with histologically-confirmed untreated HCCs between 2009 and 2019, who had multiphasic MRI with extracellular contrast agent within 3 months of liver resection or liver transplantation. Patients beyond Milan criteria by pathology (late-stage, n=56) and HCCs = 1cm (sub-clinical, n=14) were excluded. Patient demographics, cirrhosis etiology and Child Pugh score were extracted from medical records. Two radiologists per institution independently reviewed pre-surgical MRI images and subjectively recorded technical factors, including overall image quality, motion-related image degradation, quality-limiting ascites, and arterial phase timing, as well as size and location of LR-5 observations. We used logistic regression analyses to evaluate the impact of each patient and technical factor on the lesion-level false negative rate (FNR)=(1-sensitvity), of LR-5. Clustering effect due to multiple lesions and/or multiple readers was corrected using generalized estimating equation (GEE).*Results In 175 patients with early-stage HCC, 186 tumors were confirmed on resection (n=134) and explant (n=40) specimens. Median age was 61.3 years (IQR: 57.5-66.3 years), with 136 (78%) males. Overall sensitivity of LR-5 for HCC was 0.52 [95%CI 0.48,0.56]. Child Pugh C, poor image quality, motion degradation and inadequate arterial phase timing resulted in 2.5 [95%CI 5.56,1.14], 2.56 [95%CI 4.50, 1.44], 4.5 [95% CI 20,1.02], and 3.1 [95% CI 7.69,1.29] -fold increased odds of missing LR-5 observations, respectively (Table 1).*Conclusions Factors affecting sensitivity (1-FNR) for early-stage HCC by dynamic contrast-enhanced MRI include Child C cirrhosis, overall image quality, motion degradation, and inadequate arterial phase timing.*Clinical Relevance/Application Advances in technology to remediate quality limiting factors e.g., motion compensation and automatic bolus detection, may improve sensitivity of MRI for early-stage HCC in patients with cirrhosis.

RESULTS

In 175 patients with early-stage HCC, 186 tumors were confirmed on resection (n=134) and explant (n=40) specimens. Median age was 61.3 years (IQR: 57.5-66.3 years), with 136 (78%) males. Overall sensitivity of LR-5 for HCC was 0.52 [95%CI 0.48,0.56]. Child Pugh C, poor image quality, motion degradation and inadequate arterial phase timing resulted in 2.5 [95%CI 5.56,1.14], 2.56 [95%CI 4.50, 1.44], 4.5 [95% CI 20,1.02], and 3.1 [95% CI 7.69,1.29] -fold increased odds of missing LR-5 observations, respectively (Table 1).

CLINICAL RELEVANCE/APPLICATION

Advances in technology to remediate quality limiting factors e.g., motion compensation and automatic bolus detection, may improve sensitivity of MRI for early-stage HCC in patients with cirrhosis.

SSGI20-6   Diagnostic Performance and Positive Predict Value For HCC of CEUS and CT/MRI LI-RADS : A Systematic Review And Meta-analysis

Participants
Zhengyi Qin, Tianjin, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the proportion of HCC (hepatocellular carcinoma) in each CEUS LI-RADS and CT/MRI LI-RADS category and the diagnostic performance of LR-5/M.*Methods and Materials We searched PubMed, Embase, and Cochrane Central from 2014 to October 2020 for studies on CT/MRI LI-RADS V2014, V2017, and V2018 and CEUS LI-RADS V2016 and V2017. The proportion of HCC and overall malignancy in each LI-RADS category and the sensitivity and specificity of LR-5 and LR-M categories were determined using a random effects model. The quality of the included studies was assessed using the QADAS-2 tool.*Results Initially, 534 studies were identified, of which only 34 were included: CEUS LI-RADS and CT/MRI LI-RADS (n=1), CEUS LI-RADS (n=7), and CT/MRI LI-RADS (n=26). The CT/MRI studies comprised 4,656 patients with 5,839 lesions, including 4,088 HCCs, and the CEUS studies comprised 4,977 patients with 5,464 lesions, including 3,994 HCCs. There was no HCC in LR-1, and there was no significant difference in the proportion of HCC in LR-2--5 between CEUS and CT/MRI LI-RADS. The sensitivity and specificity of CEUS LR-5 for HCC were 0.73 (95% CI: 0.68--0.78) and 0.94 (95% CI: 0.90--0.96), respectively, and the area under the SROC curve was 0.72. The LR-5 sensitivity and specificity of CT/MRI were 0.69 (95% CI: 0.64--0.74) and 0.92 (95% CI: 0.89--0.94), respectively, and the area under the SROC curve was 0.74. There were no significant differences in the sensitivity and specificity of CEUS and CT/MRI LR-5. The sensitivity and specificity of CEUS LR-M for non-HCC malignant tumors were 0.80 (95% CI: 0.88--0.88) and 0.92 (95% CI: 0.87-0.95), respectively, and the area under the SROC curve was 0.89. The sensitivity and specificity of CT/MRI LR-M were 0.67 (95% CI: 0.61--0.72) and 0.97 (95% CI: 0.95--0.99), respectively, and the area under the SROC curve was 0.79. The differences in sensitivity and specificity of CEUS and CT/MRI LR-M were statistically significant.*Conclusions Both CEUS and CT/MRI LR-5 have similar diagnostic performance and can be efficient tools in HCC diagnosis. With the increase in LI-RADS category, the proportion of HCC increased. CEUS and CT/MRI had similar positive predictive values for HCC in LR-1-5 categories. For non-HCC malignancies, CEUS LR-M had higher sensitivity and may be helpful for diagnosis.*Clinical Relevance/Application 1.CEUS and CT/MRI LI-RADS have similar PPV of HCC in each category. So there may be no need to manage observations in same category differently.2.CEUS and CT/MRI LR-M have their own advantage for diagnosing non-HCC malignancies , a combination of multiple imaging and laboratory examination may diagnose LR-M observations better.

RESULTS

Initially, 534 studies were identified, of which only 34 were included: CEUS LI-RADS and CT/MRI LI-RADS (n=1), CEUS LI-RADS (n=7), and CT/MRI LI-RADS (n=26). The CT/MRI studies comprised 4,656 patients with 5,839 lesions, including 4,088 HCCs, and the CEUS studies comprised 4,977 patients with 5,464 lesions, including 3,994 HCCs. There was no HCC in LR-1, and there was no significant difference in the proportion of HCC in LR-2--5 between CEUS and CT/MRI LI-RADS. The sensitivity and specificity of CEUS LR-5 for HCC were 0.73 (95% CI: 0.68--0.78) and 0.94 (95% CI: 0.90--0.96), respectively, and the area under the SROC curve was 0.72. The LR-5 sensitivity and specificity of CT/MRI were 0.69 (95% CI: 0.64--0.74) and 0.92 (95% CI: 0.89--0.94), respectively, and the area under the SROC curve was 0.74. There were no significant differences in the sensitivity and specificity of CEUS and CT/MRI LR-5. The sensitivity and specificity of CEUS LR-M for non-HCC malignant tumors were 0.80 (95% CI: 0.88--0.88) and 0.92 (95% CI: 0.87-0.95), respectively, and the area under the SROC curve was 0.89. The sensitivity and specificity of CT/MRI LR-M were 0.67 (95% CI: 0.61--0.72) and 0.97 (95% CI: 0.95--0.99), respectively, and the area under the SROC curve was 0.79. The differences in sensitivity and specificity of CEUS and CT/MRI LR-M were statistically significant.

CLINICAL RELEVANCE/APPLICATION

1.CEUS and CT/MRI LI-RADS have similar PPV of HCC in each category. So there may be no need to manage observations in same category differently.2.CEUS and CT/MRI LR-M have their own advantage for diagnosing non-HCC malignancies , a combination of multiple imaging and laboratory examination may diagnose LR-M observations better.

Abstract Archives of the RSNA, 2021

Participants
Anup Shetty, MD, Saint Louis, Missouri (*Moderator*) Nothing to Disclose
Daniel Ludwig, MD, Saint Louis, Missouri (*Moderator*) Nothing to Disclose

Sub-Events

SSMS02-1   Assessment Of Endothelial Dysfunction In Type 2 Diabetics By Carotid Artery Intimal Medial Thickness(CIMT) And Brachial Artery Flow-mediated Dilation (FMD) Response.

Participants
Chetankumar Mehta, MBBS,MD, Vadodara, India (*Presenter*) Nothing to Disclose

PURPOSE

Endothelial dysfunction is an important determinant of altered vascular reactivity and plays a major role in the genesis of micro- and macro-vascular complications in diabetes. Endothelial dysfunction can be expressed as the impairment of endothelial dependent vasodilation and increased CIMT which is a non-invasive marker of atherosclerosis. The purpose of this study is to assess the endothelial function in patients with Type 2 diabetes mellitus (T2DM) using brachial artery flow-mediated dilation (FMD) response and carotid artery intima-media thickness (CIMT) and to assess the correlation between the two parameters.*Methods and Materials T2DM patients with and without complications who had visited the OPD were enrolled for the study. Individuals with hypertension, impaired renal function, dyslipidaemia, smokers and those with any other major disease were excluded. 37 T2DM patients were included. 37 age and sex matched controls were enrolled. They were examined using 5-12 MHz linear array transducer of Phillips Affiniti 50G at the Radiology Department. CIMT was measured at the posterior wall of the common carotid artery, 2 cm before the bifurcation, as the distance between first and second echogenic lines of anterior and posterior arterial walls in supine position. Brachial artery diameter was measured from two-dimensional images 2-15 cm above the elbow. The lumen diameter (LD) was measured: (i) at baseline after at least 10 min of rest in the supine position; (ii) during reactive hyperaemia induced by a forearm cuff inflated to supra-systolic levels for 5 min. The difference between the two LD was expressed as percentage change related to the baseline scan (FMD).The data was analysed with standard statistical tests.*Results Brachial artery FMD value in type 2 diabetic (4.67±2.53%) was significantly lower (P < 0.05) when compared with the control (9.87±3.72%). CIMT in type 2 diabetic (1.03±0.17mm) was significantly higher (P < 0.05) as compared with the control (0.55±0.15mm). FMD correlated negatively with CIMT (r = -0.14, P < 0.05).*Conclusions Abnormal FMD and increased CIMT were present in type 2 diabetic patients. Both these parameters negatively correlated with each other which suggest an independent association between impaired FMD and endothelial dysfunction.*Clinical Relevance/Application Increased CIMT and impaired FMD in the brachial artery reflect changes of endothelial dysfunction; the initial step in diabetic vascular complications and atherosclerosis which may be reversible in early stages. CIMT and FMD can hence be used for screening of endothelial dysfunction in patients with T2DM and prevention of complications by early initiation of prophylaxis.

RESULTS

Brachial artery FMD value in type 2 diabetic (4.67±2.53%) was significantly lower (P < 0.05) when compared with the control (9.87±3.72%). CIMT in type 2 diabetic (1.03±0.17mm) was significantly higher (P < 0.05) as compared with the control (0.55±0.15mm). FMD correlated negatively with CIMT (r = -0.14, P < 0.05).

CLINICAL RELEVANCE/APPLICATION

Increased CIMT and impaired FMD in the brachial artery reflect changes of endothelial dysfunction; the initial step in diabetic vascular complications and atherosclerosis which may be reversible in early stages. CIMT and FMD can hence be used for screening of endothelial dysfunction in patients with T2DM and prevention of complications by early initiation of prophylaxis.

SSMS02-2   Bridging The Gap: Examining Disparities In Cancer Screening Among Asian Subgroups

Participants
Eric Davis, MD, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

While Asian Americans are the fastest growing racial minority group in the United States, little research exist examining cancer screening disparities in this population. As breast cancer and colorectal cancer (CRC) rates have been increasing in Asian Americans, we aimed to examine the racial differences in breast cancer screening and CRC screening adherence as they pertain to Asian Americans.*Methods and Materials Retrospective analysis of the 2018 National Health Interview Survey (NHIS) data was performed. This dataset was a nationally representative, annual federal cross-sectional survey (response rate 64%). Multiple variable analyses evaluated the association between all Asians and Asian ethnic subgroups with breast cancer and colorectal cancer screening adherence, accounting for complex survey design.*Results Regarding CRC screening, 11,003 respondents between 50-75 years old were included. Of eligible respondents, 65.2% reported receiving recommended CRC screening, while 54.8% of Asian participants reported receiving recommended CRC screening. Multiple variable analyses revealed that Asian participants were less likely to report recommended CRC screening (OR 0.58, 95% CI 0.46 to 0.75, p < 0.001), compared with Whites. Compared with Whites, Asian Indian (OR 0.46, 95% CI 0.28 to 0.76, p = 0.003) and Other Asian participants (OR 0.52, 95% CI 0.36 to 0.76, p =

0.001) were less likely to report recommended CRC screening. Regarding breast cancer screening, 7,511 respondents between 40-74 years old were included. Of eligible respondents, 58.8% reported receiving breast cancer screening within 1 year, 54.1% of Asian participants reported receiving breast cancer screening. Multiple variable analyses revealed that Asian participants were less likely to report breast cancer screening (OR 0.74, 95% CI 0.55 to 0.99, p = 0.049), compared with Whites. No statistically significant differences were found comparing individual Asian subgroups with Whites.*Conclusions When compared to Whites, Asian Americans are less likely to be up-to-date with recommended CRC screening. Additionally, Asian Americans had a lower odds of reporting breast cancer screening when compared to Whites. As the incidence of breast cancer and CRC increases in Asian Americans, targeted interventions are needed to improve care and reduce health disparities in this population.*Clinical Relevance/Application To the authors' knowledge, this is the largest study to date examining breast cancer screening and CRC screening in Asian Americans. Also, it is the largest study examining screening difference and sociodemographic differences between Asian American subgroups.

RESULTS

Regarding CRC screening, 11,003 respondents between 50-75 years old were included. Of eligible respondents, 65.2% reported receiving recommended CRC screening, while 54.8% of Asian participants reported receiving recommended CRC screening. Multiple variable analyses revealed that Asian participants were less likely to report recommended CRC screening (OR 0.58, 95% CI 0.46 to 0.75, p < 0.001), compared with Whites. Compared with Whites, Asian Indian (OR 0.46, 95% CI 0.28 to 0.76, p = 0.003) and Other Asian participants (OR 0.52, 95% CI 0.36 to 0.76, p = 0.001) were less likely to report recommended CRC screening. Regarding breast cancer screening, 7,511 respondents between 40-74 years old were included. Of eligible respondents, 58.8% reported receiving breast cancer screening within 1 year, 54.1% of Asian participants reported receiving breast cancer screening. Multiple variable analyses revealed that Asian participants were less likely to report breast cancer screening (OR 0.74, 95% CI 0.55 to 0.99, p = 0.049), compared with Whites. No statistically significant differences were found comparing individual Asian subgroups with Whites.

CLINICAL RELEVANCE/APPLICATION

To the authors' knowledge, this is the largest study to date examining breast cancer screening and CRC screening in Asian Americans. Also, it is the largest study examining screening difference and sociodemographic differences between Asian American subgroups.

SSMS02-3   Clinical Utility, Safety ; Efficacy Of ClariscanTM - Multinational Experience From Two Post Marketing Surveillance Studies.

Participants
Anand Bherwani, MD, Brookfield, Wisconsin (*Presenter*) Leaders Program, General Electric Company;Medical Director, General Electric Company

PURPOSE

To evaluate the safety, efficacy and clinical usage patterns of ClariscanTM (gadoterate meglumine) in multi-regional, multi-ethnic population subgroups in a real-world clinical setting from different regions of the globe.*Methods and Materials Data was obtained from two individual cross-sectional multicenter observational studies with prospective recruitment in different regions [Europe (2018-2019) & South Korea (2019-2020)] for patients undergoing CE (contrast enhanced) - MR imaging with Clariscan as part of their routine clinical workup. Demographic information, clinical diagnoses, relevant medical histories, concomitant medications, indication for CE-MR, contrast dosage and procedure details were recorded for all the participating patients by trained study staff. The diagnostic efficacy was based on the data collected by the local radiologist including changes in radiological diagnosis, diagnostic confidence, and image quality on a 4-point scale (poor, fair, good, excellent). Any spontaneous reports of AEs (adverse events) were recorded up to 7 days after MR procedure and classified in terms of severity, course of treatment and latency (immediate: <1h post-injection, delayed: 1h-7d post-injection).*Results A total of 1513 patients from 8 centers across 5 European countries and 1379 patients from 6 centers in South Korea were included. For the total cohort of 2892 patients, mean age was 54 ±21 years, 56% were females, 522 patients (18%) suffered from comorbid conditions and 129 patients (4.5%) had a history of allergy. The indication for CE-MR examinations included CNS in 53%, musculoskeletal in 14%, abdominal 11%, breast 8% and others 14%. The mean dose of Clariscan administered was 0.11 mmol/kg (body weight). Change in radiological diagnosis was recorded in 39% of the patients and enhanced diagnostic confidence in 93% of the patients. The percentage of cases with level of confidence >80% increased from 21.4% at baseline to 66.4% after CM (contrast media) administration. Image quality after administration of CM was considered good in 39% cases and excellent in 59%. A total of 14 patients (0.5%) reported AEs with only 1 (0.03%) considered serious. All the AEs were treated conservatively and resolved spontaneously.*Conclusions This multi-national study confirmed the real-world clinical usage of Clariscan for a wide range of indications with an excellent safety and efficacy profile.*Clinical Relevance/Application The recent concerns from gadolinium retention have led to a steady decline in the use of linear agents and shift of clinical trend towards usage of macrocyclic agents. The current study looks at the real-world CM usage patterns, safety & efficacy of Clariscan™ (gadoterate meglumine) in multi-regional, multi-ethnic population.

RESULTS

A total of 1513 patients from 8 centers across 5 European countries and 1379 patients from 6 centers in South Korea were included. For the total cohort of 2892 patients, mean age was 54 ±21 years, 56% were females, 522 patients (18%) suffered from comorbid conditions and 129 patients (4.5%) had a history of allergy. The indication for CE-MR examinations included CNS in 53%, musculoskeletal in 14%, abdominal 11%, breast 8% and others 14%. The mean dose of Clariscan administered was 0.11 mmol/kg (body weight). Change in radiological diagnosis was recorded in 39% of the patients and enhanced diagnostic confidence in 93% of the patients. The percentage of cases with level of confidence >80% increased from 21.4% at baseline to 66.4% after CM (contrast media) administration. Image quality after administration of CM was considered good in 39% cases and excellent in 59%. A total of 14 patients (0.5%) reported AEs with only 1 (0.03%) considered serious. All the AEs were treated conservatively and resolved spontaneously.

CLINICAL RELEVANCE/APPLICATION

The recent concerns from gadolinium retention have led to a steady decline in the use of linear agents and shift of clinical trend towards usage of macrocyclic agents. The current study looks at the real-world CM usage patterns, safety & efficacy of Clariscan™ (gadoterate meglumine) in multi-regional, multi-ethnic population.

SSMS02-4   Frequent Whole-body MRI Plus Serological Follow-up Identifies Some But Not All Smoldering Multiple Myeloma Patients Before Progressing Into Symptomatic Disease With End-Organ Damage

Participants
Markus Wennmann, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The goal of this prospective study was to investigate the clinical course of smoldering multiple myeloma (SMM) patients with whole-body magnetic resonance imaging (wb-MRI) and serological follow-up every 6 months for the study.*Methods and Materials From 2014 to 2019, ninety-six SMM patients negative for end-organ damage and SLiM-criteria at initial assessment were prospectively included in this study. Wb-MRI and serological follow-up were performed at baseline and every 6 months thereafter for the study, and every patient was seen every 3 months either at our center or by an experienced, local oncologist. Primary endpoint was time to progression into MM according to SLiM-CRAB-criteria. This study was approved by the institutional review board.*Results The 1-, 2- and 3-year progression rates according to the current SLiM-CRAB-criteria of the International Myeloma Working Group (IMWG) were 10%, 19% and 25%, respectively. Seven of the 22 patients (32%) who progressed into MM showed SLiM-criteria but no end-organ damage. Of these, 4 progressed with > 1 focal lesion (FL) or a growing FL, and 3 due to serum free light-chain (SLFC)-ratio >=100. Fifteen out of the 22 progressing patients (68%) however, had end-organ damage at progression. Four of those 7 patients who only progressed by SLiM-criteria without end-organ damage were identified by MRI only. In all but one patient, osteolytic lesions (OL) showed corresponding FL in the wb-MRI at time of their initial diagnosis. The time between first appearance of the corresponding FL and the diagnosis of the respective OL was highly variable between patients.*Conclusions The updated disease definition of the IMWG reduced the proportion of patients with end-organ damage at progression by only one third. Therefore, further improvement of prognostic factors and closer follow-up intervals are needed. Wb-MRI accounts for detection of more than half of patients who progress with SLiM-criteria only, and consequently is crucial to reduce the appearance of end-organ damage in SMM patients.*Clinical Relevance/Application In 2014, SLiM-criteria (including >1 FL in MRI) were added to the definition of MM in order to enable earlier therapy initiation to avoid occurrence of end-organ damage.

RESULTS

The 1-, 2- and 3-year progression rates according to the current SLiM-CRAB-criteria of the International Myeloma Working Group (IMWG) were 10%, 19% and 25%, respectively. Seven of the 22 patients (32%) who progressed into MM showed SLiM-criteria but no end-organ damage. Of these, 4 progressed with > 1 focal lesion (FL) or a growing FL, and 3 due to serum free light-chain (SLFC)-ratio >=100. Fifteen out of the 22 progressing patients (68%) however, had end-organ damage at progression. Four of those 7 patients who only progressed by SLiM-criteria without end-organ damage were identified by MRI only. In all but one patient, osteolytic lesions (OL) showed corresponding FL in the wb-MRI at time of their initial diagnosis. The time between first appearance of the corresponding FL and the diagnosis of the respective OL was highly variable between patients.

CLINICAL RELEVANCE/APPLICATION

In 2014, SLiM-criteria (including >1 FL in MRI) were added to the definition of MM in order to enable earlier therapy initiation to avoid occurrence of end-organ damage.

SSMS02-6   Automatic MRI Analysis In Multiple Myeloma: A Framework Combining Deep Learning For Automatic Pelvic Bone Marrow Segmentation And Radiomics For Prediction Of Plasma Cell Infiltration In Multiple Myeloma Patients

Participants
Markus Wennmann, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To establish an automated framework including (I) automatic pelvic bone marrow (BM) segmentation from MRI and (II) a radiomics model to predict the plasma cell infiltration (PCI) in Multiple Myeloma (MM) patients.*Methods and Materials Five cohorts including a total of 541 MRIs from 270 patients were included; 158 patients had received MRI on one 1.5T MRI Scanner and had information on PCI from concomitant biopsy at the iliac crest available. MRIs without biopsy data were used for training of the nnU-Net only, which is state of the art for medical image segmentation. MRIs with biopsy data were split by date into a training-set (n=116) for both, nnU-Net and radiomics model, and an independent test-set for the framework (n=42). BM segmentations of the right and left pelvic bone on coronal T1tse images on the training cohort were used for training of the nnU-Net. A random forest classifier was trained on the pelvic radiomics features to predict PCI. The framework was then tested on the independent test-set. Dice scores report accuracy of segmentations and mean absolute error (MAE) in [%PCI] reports the accuracy of the PCI prediction. For comparison, two radiologists rated the diffuse infiltration according to 3 levels of severity (none-to-mild vs. moderate vs. severe). The mean PCI within each severity level from the training set was determined and assigned as a prediction to patients with the same level diffuse infiltration in the test-set (the radiologists` PCI prediction). This study was approved by the institutional review board.*Results The mean Dice score of the nnU-Net segmentation for right / left pelvic bone marrow on 8 cases of the test-set (last 8 by acquisition date) were 0.94 and 0.94, respectively, the mean Dice score between manual pelvic BM segmentation of two radiologists on these 8 cases were 0.87 and 0.88. The MAE of the prediction of PCI by the automated framework was 14.3 [%PCI]. The MAE of the radiologists PCI predictions were 16.1 [%PCI] (rater 1) and 16.7 [%PCI] (rater2).*Conclusions We established automatic BM segmentation with radiologist level precision, which is a critical step towards automated analysis of MM MRI. Radiomics analysis of these segmentations can predict PCI with considerable accuracy. Further improvement of the PCI prediction model is necessary and is currently in progress, by (I) adding T2 and DWI sequences, (II) adding 600 additional cases from a second institution, (III) a prospective, multi-scanner radiomics feature stability study (recruitment and measurements completed, data analysis in progress).*Clinical Relevance/Application Automatic bone marrow (BM) segmentation is a crucial step to automate reading of multiple myeloma (MM) MRI. Plasma cell infiltration (PCI) is a critical marker for staging and risk assessment in MM.

RESULTS

The mean Dice score of the nnU-Net segmentation for right / left pelvic bone marrow on 8 cases of the test-set (last 8 by acquisition date) were 0.94 and 0.94, respectively, the mean Dice score between manual pelvic BM segmentation of two radiologists on these 8 cases were 0.87 and 0.88. The MAE of the prediction of PCI by the automated framework was 14.3 [%PCI]. The MAE of the radiologists PCI predictions were 16.1 [%PCI] (rater 1) and 16.7 [%PCI] (rater2).

CLINICAL RELEVANCE/APPLICATION

Automatic bone marrow (BM) segmentation is a crucial step to automate reading of multiple myeloma (MM) MRI. Plasma cell

infiltration (PCI) is a critical marker for staging and risk assessment in MM.

Abstract Archives of the RSNA, 2021

Participants

Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Moderator*) Researcher, Siemens AGConsultant, Siemens AGResearcher, Bayer AGConsultant, Bayer AGResearcher, Medtronic plcConsultant, Medtronic plcResearcher, Becton, Dickinson and CompanyConsultant, Becton, Dickinson and CompanyResearcher, ScreenPoint Medical BVConsu

Sub-Events

SSBR08   Keynote Speaker

Participants
Savannah Partridge, PhD, Seattle, Washington (*Presenter*) Research Grant, General Electric Company;Research Support, Koninklijke Philips NV;

SSBR08-3   Evaluation Of ADC In Regard To Reproducibility And Diagnostic Accuracy As Well As Possible Significance Of Pre - And Post - Contrast Acquisition And Employment Of Different B Values.

Participants
Raoul Varga, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

Quantative evaluation of the apparent diffuse coefficient (ADC) obtain by DWI imaging has been proven as a viable decision guidance tool to determined malignancy in a lesion.An international working group recommends certain parameters for breast DWI. We evaluated the reproducibility and accuracy of ADC calculated from the suggested b-value combinations and investigated the influence of contrast media (CM) administration on the ADC.*Methods and Materials In this IRB approved, monocentric, cross-sectional retrospective study patients with a histologically verified suspicious finding who underwent breast MRI were included. The 3T breast MRI protocol included a DWI sequence with multiple b-values, which was acquired prospectively before and after CM administration. ADC maps were calculated by in-line monoexponential fitting with b-values 0 /800 mm/s2 and 50 and 800mm/s2).Two independent readers (R1, R2) reviewed the images in separate sessions for 0/800 and 50/800 pre- and post-CM. The standard of reference was histology.Bland Altmann plots as well as intraclass correlation coefficients (ICCs) for intrareader and interreader agreement, different b values (0/800, 50/800 s/mm2) and pre- and post-CM was calculated. Diagnostic accuracy was evaluated and compared by calculating the area under the ROC curve (AUC).*Results 91 lesions in 89 patients were examined (mean age 50.7 years, standard deviation 13.9). ADC values were significantly lower post-CM compared to pre-CM (pre-CM 1.08, 95% CI1.01- 1.15 x 10-3 mm2/s; post-CM 1.13, 95% CI 1.06- 1.19 x 10-3 mm2/s, P<0.001) for both b-values 0/800 and 50/800 s/mm2.We found an almost perfect inter-reader agreement pre-/post-CM and with b values 0/800 and 50/800 (ICC ranging from 0.853 to 0.939). We found an almost perfect intra-reader agreement with ICC ranging from 0.919 to 0.957. Bland Altman plot demonstrated no systematic difference between readers.ROC diagnostic performance analysis revealed good diagnostic accuracy between b values 0/800 and 50/800 s/mm2 as well as pre- and post- without significant differences (P>0,05)*Conclusions High reproducibility and diagnostic accuracy prove reliable use of ADC characteristics, with no significant difference between pre- and post-CM and between different b values 0/800 and 50/800.*Clinical Relevance/Application Since pre- and post-contrast and adjusted b value sequences revealed no significant difference, individual tailoring of the image protocol to clinical needs becomes possible.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Since pre- and post-contrast and adjusted b value sequences revealed no significant difference, individual tailoring of the image protocol to clinical needs becomes possible.

SSBR08-6   Introduction Of A Bi-RADS Analogous Breast Apparent Diffusion Coefficient (bADC) Category System Derived From A Multicentric Breast MRI Database.

Participants
Hubert Bickel, MD, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

Diffusion weighted imaging (DWI) is increasingly used as an additional MRI tool to improve the diagnosis of breast lesions. This calls

for a simple tool to integrate Apparent Diffusion Coefficient (ADC) into clinical breast MRI reporting, such as the Breast Imaging Reporting and Data System (BI-RADS). The purpose of this study was to develop a simple, generally applicable breast ADC category (bADC) system comparable to the BI-RADS classification system.*Methods and Materials 1625 females (mean age: 55.9 (13.8) years) with 1736 pathologically verified breast lesions from eleven study populations from seven different institutions with different DWI acquisition schemes were included in this IRB approved retrospective study. Mean ADC values of different tumor subtypes were calculated and compared using one-way ANOVA and Games-Howell post-hoc test. Five BI-RADS analogous bADC categories (bADC I-V) were developed by plotting ADC versus cumulative malignancy rates and receiver operating characteristics (ROC) analysis.*Results Mean ADC differed significantly between benign and malignant lesions (p < .001), as well as between invasive cancers, ductal carcinoma in situ and benign lesions (p < .001). The calculated thresholds for the bADC categories were: bADC I =1.9 x 10-3 mm2/s (cumulative malignancy rate < 0.1%); bADC II 1.5 to <1.9 x 10-3 mm2/s (0.1 - 1.7 %); bADC III 1.2 to <1.5 x 10-3 mm2/s (1.8 - 10 %); bADC IV 1.0 to <1.2 x 10-3 mm2/s (10 - 24.5%); and bADC V <1.0 x 10-3 mm2/s (>24.5 %). The latter threshold was chosen at a positive predictive value of 95.8% for invasive versus non-invasive breast cancer according to the ROC-analysis.*Conclusions The presented bADC category system provides generally applicable, simple thresholds including rule-in and rule-out criteria, comparable to BI-RADS, to guide clinical decision making.*Clinical Relevance/Application The bADC category system provides a simple tool to in order to integrate ADC into clinical breast MRI reporting.

RESULTS

Mean ADC differed significantly between benign and malignant lesions (p < .001), as well as between invasive cancers, ductal carcinoma in situ and benign lesions (p < .001). The calculated thresholds for the bADC categories were: bADC I =1.9 x 10-3 mm2/s (cumulative malignancy rate < 0.1%); bADC II 1.5 to <1.9 x 10-3 mm2/s (0.1 - 1.7 %); bADC III 1.2 to <1.5 x 10-3 mm2/s (1.8 - 10 %); bADC IV 1.0 to <1.2 x 10-3 mm2/s (10 - 24.5%); and bADC V <1.0 x 10-3 mm2/s (>24.5 %). The latter threshold was chosen at a positive predictive value of 95.8% for invasive versus non-invasive breast cancer according to the ROC-analysis.

CLINICAL RELEVANCE/APPLICATION

The bADC category system provides a simple tool to in order to integrate ADC into clinical breast MRI reporting.

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![RSNA 2021 Redefining Radiology, November 28 to December 2]

Abstract Archives of the RSNA, 2021

Participants
Sharyn Katz, MD, Philadelphia, Pennsylvania (*Moderator*) Consultant, Trizell Ltd
Eric M. Hart, MD, Chicago, Illinois (*Moderator*) Nothing to Disclose

Sub-Events

SSCH02-2   Costal Pleura-attached Noncalcified Nodules Newly Seen On Annual Low-dose Ct Screenings

Participants
Ye Qing Zhu, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

It has previously been demonstrated that solid costal pleura-attached noncalcified nodules (CP-NCN) with average diameter<10.0 mm and lentiform, oval, semicircular (LOS) or triangular shapes and smooth margins on baseline CT do not need short-term follow-up and instead can be recommended to return for annual repeat screening. Determine whether the same criteria apply for new CP-NCNs seen on annual repeat screening rounds.*Methods and Materials In 111,102 annual screening scans in the International Early Lung Cancer Action Program between 1992 and 2019, we identified 21 new solid CP-NCNs, 3.0 mm to 30.0 mm in average diameter that were lung cancer (median months to diagnosis:1.8, IQR: 1.1-4.7). In 4,425 annual screening scans in the Mount Sinai Early Lung and Cardiac Action Program between 2010 and 2019, we identified 56 new solid CP-NCNs, 3.0 mm to 30.0 mm; 55 were benign (median follow-up: 79.6 months, IQR:61.0-102.5). Shape (triangular, LOS, polygonal, round, or irregular), margin (smooth or non-smooth), pleural attachment (broad or narrow), emphysema and fibrosis within 10 mm of each CP-NCN was determined. Intra- and inter-reader agreements (B statistic) on triangular/LOS shaped solid CP-NCN with smooth margin were assessed.*Results Mean age of the participants with the 76 CP-NCNs was 72.2 years (SD= 8.8 at time of annual repeat CT, median pack-years of smoking was 40.2 (IQR: 27.5-53.8); 35 (46.1%) were men and 41 (54.0%) women. Size, shape, margin, and emphysema and fibrosis within a 10.0mm radius of the CP-NCNs were significant predictors of malignancy status. The median diameter of the 55 solid benign CP-NCNs was significantly smaller than of the 21 solid malignant CP-NCNs (4.2 mm vs. 11.0 mm, p < .001). Emphysema and fibrosis within a 10.0 mm radius of the CP-NCN was significant as malignant CP-NCNs more frequently had emphysema [17 (81.0%) vs. 21 (38.2%), p=.003] and fibrosis [4 (19.0%) vs. 2 (3.6%), p=.045]. CP-NCN shape were significantly different between benign and malignant CP-NCNs (p=.02). All CP-NCNs< 10.0 mm in average diameter with triangular or LOS shapes and smooth margins were benign. None of the 21 malignant CP-NCNs of any size had triangular or LOS shapes and smooth margins when they were first identified on annual repeat screening round. Intra- and interobserver agreement for triangular or LOS shaped CP-NCNs with smooth margins were almost perfect based on the B-statistic.*Conclusions The same follow-up recommendation can be used for CP-NCNs newly seen on annual screening rounds that were developed for baseline CP-NCNs.*Clinical Relevance/Application New solid CP-NCNs<10 mm with triangular or LOS shapes and smooth margins on annual screening rounds were all benign. Annual follow-up is recommended rather than immediate work-up.

RESULTS

Mean age of the participants with the 76 CP-NCNs was 72.2 years (SD= 8.8 at time of annual repeat CT, median pack-years of smoking was 40.2 (IQR: 27.5-53.8); 35 (46.1%) were men and 41 (54.0%) women. Size, shape, margin, and emphysema and fibrosis within a 10.0mm radius of the CP-NCNs were significant predictors of malignancy status. The median diameter of the 55 solid benign CP-NCNs was significantly smaller than of the 21 solid malignant CP-NCNs (4.2 mm vs. 11.0 mm, p < .001). Emphysema and fibrosis within a 10.0 mm radius of the CP-NCN was significant as malignant CP-NCNs more frequently had emphysema [17 (81.0%) vs. 21 (38.2%), p=.003] and fibrosis [4 (19.0%) vs. 2 (3.6%), p=.045]. CP-NCN shape were significantly different between benign and malignant CP-NCNs (p=.02). All CP-NCNs< 10.0 mm in average diameter with triangular or LOS shapes and smooth margins were benign. None of the 21 malignant CP-NCNs of any size had triangular or LOS shapes and smooth margins when they were first identified on annual repeat screening round. Intra- and interobserver agreement for triangular or LOS shaped CP-NCNs with smooth margins were almost perfect based on the B-statistic.

CLINICAL RELEVANCE/APPLICATION

New solid CP-NCNs<10 mm with triangular or LOS shapes and smooth margins on annual screening rounds were all benign. Annual follow-up is recommended rather than immediate work-up.

SSCH02-3   Accuracy Of Nodule Volume Measurement For Lung Cancer Screening On A Photon-counting-detector (PCD) CT Scanner

Participants
Chelsea Dunning, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the accuracy of nodule volume quantification in lung cancer screening using an investigational whole-body photon-counting-detector (PCD) CT compared to conventional energy-integrating detector (EID) CT.*Methods and Materials Sixteen lung nodules at low and high contrasts (-630 & 100 HU), three sizes (5, 8, & 10 mm diameter), and two shapes (round and star) were attached throughout an anthropomorphic chest phantom (Lungman, Kyoto Kagaku). The phantom was scanned with a conventional

dual-source EID-CT scanner (SOMATOM Force, Siemens) using 100 kV with an added tin beam-shaping filter (100Sn) at three dose levels (volume CT dose index (CTDIvol): 0.3, 0.6, and 1.2 mGy). The phantom was also scanned with a whole-body PCD-CT (NAEOTOM Alpha, Siemens) at 100Sn kV using high-resolution mode at three dose levels that were approximately matched to those on the EID-CT. A high-dose scan was also acquired at 120 kV and 9.2 mGy, which is used as a reference. All images were reconstructed with quantitative kernels with iterative reconstruction or noise reduction (Qr54-3 for EID-CT; Qr56-3 for PCD-CT). The volumes of all nodules and the noise in each image series were measured using a semi-automated segmentation tool (MM Oncology, Siemens). The volume measurement accuracy was expressed as the percent difference between the segmented volume at each dose level and that of the highest dose for both EID-CT and PCD-CT.*Results PCD-CT reduced the image noise by 36%, 35%, and 45% at the three dose levels. For the high-contrast nodules, the percent errors for PCD-CT at 0.3 mGy (-7.5%, -2.7%, & -1.8% for 5, 8, & 10mm round nodules and -8.6%, -5.9%, & -4.8% for star-shaped nodules) were similar to EID-CT at 0.6 mGy (1.5%, -3.5%, & -0.4% for 5, 8, & 10mm round nodules and -8.1%, -1%, & -1.9% for star-shaped nodules). Among all the low-contrast nodules, the percent error ranged between -10.8% & -3.8% for PCD-CT at 0.3 mGy; which was comparable to the percent error range of -9.8% & 0% for EID-CT at 0.6 mGy.*Conclusions Volume measurement accuracy for lung cancer screening was maintained for both low- and high-contrast nodules for PCD-CT at a reduced dose, with the added benefit of reduced noise, compared to EID-CT.*Clinical Relevance/Application Measurement of nodule volume for lung cancer screening can be done on a PCD-CT scanner at lower radiation dose and noise without compromising volume accuracy.

RESULTS

PCD-CT reduced the image noise by 36%, 35%, and 45% at the three dose levels. For the high-contrast nodules, the percent errors for PCD-CT at 0.3 mGy (-7.5%, -2.7%, & -1.8% for 5, 8, & 10mm round nodules and -8.6%, -5.9%, & -4.8% for star-shaped nodules) were similar to EID-CT at 0.6 mGy (1.5%, -3.5%, & -0.4% for 5, 8, & 10mm round nodules and -8.1%, -1%, & -1.9% for star-shaped nodules). Among all the low-contrast nodules, the percent error ranged between -10.8% & -3.8% for PCD-CT at 0.3 mGy; which was comparable to the percent error range of -9.8% & 0% for EID-CT at 0.6 mGy.

CLINICAL RELEVANCE/APPLICATION

Measurement of nodule volume for lung cancer screening can be done on a PCD-CT scanner at lower radiation dose and noise without compromising volume accuracy.

SSCH02-5 Learning Curve For CT-guided Percutaneous Transthoracic Core Needle Biopsy In A Tertiary Referral Hospital

Participants
Rohee Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The experience required to adequately perform CT-guided percutaneous transthoracic needle biopsy (PTNB) has not been clearly determined. We aimed to investigate the learning curve for CT-guided PTNB in a tertiary referral hospital and determine the number of procedures required.*Methods and Materials From March 2011 to August 2017, 17 new operators performed CT-guided PTNBs. Up to 200 consecutive procedures were enrolled for each operator. Learning curves for CT-guided PTNB with respect to diagnostic performance, false negative rate, pneumothorax, and hemoptysis were evaluated using a cumulative summation method. Acceptable failure rates were defined as 0.1 for diagnostic performance and false negative rate; 0.25 for pneumothorax; and 0.05 for hemoptysis. A subgroup analysis according to prior experience of PTNB was performed.*Results A total of 3261 procedures in 3134 patients (mean age, 67.7±12.1 years; 1876 men) were included. Overall diagnostic accuracy was 94.2% (2191/3141). All 17 operators learnt the procedure with acceptable diagnostic performance (median required procedures, 33; range, 19-67). For an acceptable false negative rate for all 17 operators, 95 procedures were required (median, 33; range, 19-95). Operators with and without previous experience required a similar number of procedures to achieve acceptable diagnostic performance (median, 40 and 35, respectively). Pneumothorax occurred in 32.6% of procedures (1063/3261) and hemoptysis in 2.7% (89/3261). The learning curve for achieving an acceptable pneumothorax rate was highly variable (median, 34 procedures; range, 8-164), and only 10 operators achieved it. However, all but one operator achieved an acceptable hemoptysis rate (median, 55 procedures).*Conclusions At least 70 procedures were required for all operators to become proficient in CT-guided percutaneous transthoracic core needle biopsy with acceptable diagnostic performance, and 100 procedures may be required to achieve an acceptable false negative rate. Our study shows the number of procedures required to learn CT-guided percutaneous transthoracic needle biopsy, which can be used to determine when new operators perform it independently.*Clinical Relevance/Application At least 70 procedures were required for all operators to become proficient in CT-guided percutaneous transthoracic core needle biopsy with acceptable diagnostic performance, and 100 procedures may be required to achieve an acceptable false negative rate. Our study shows the number of procedures required to learn CT-guided percutaneous transthoracic needle biopsy, which can be used to determine when new operators perform it independently.

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CLINICAL RELEVANCE/APPLICATION

At least 70 procedures were required for all operators to become proficient in CT-guided percutaneous transthoracic core needle biopsy with acceptable diagnostic performance, and 100 procedures may be required to achieve an acceptable false negative rate. Our study shows the number of procedures required to learn CT-guided percutaneous transthoracic needle biopsy, which can be used to determine when new operators perform it independently.

SSCH02-6 Clinical Significance Of Lung Nodules Seen On Non-targeted CT Scans Of The Upper Lung Zones

Participants
Sonali Lala, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To determine the clinical significance of incidentally noted lung nodules on non-targeted CT scans of the upper lungs.*Methods and Materials A search of the EMR was performed at an academic medical center from 5/2011 to 12/2018 for incidental lung nodules identified on CT scan reports of the shoulder, cervical spine and neck in patients over 35 yrs. old. Patient demographics, clinical history, and original radiologist recommendations were recorded. Two fellowship-trained chest radiologists assessed all CTs for nodule characteristics and follow-up chest CTs for nodule change and relevant lung findings. The endpoint of lung cancer was determined based on EMR review. A positive outcome was documented lung cancer at any subsequent time point.*Results 101 cases were analyzed (mean age 68.8 years, 65.3% F, 34.6% M). At the time of initial CT scan, 39.6% (n=40) of patients had risk factors for lung cancer and 19.8% (n=20) had a preexisting non-lung cancer. 86.1% (n=87) of the nodules were in the upper lobes. 43.5% (n=44) cases demonstrated more than one nodule. The average largest nodule size was 5.33 ± 3.17 mm. The average length of clinical follow-up for patients was 652 ± 630.66 days (range 0-3217 days) with 42.5% (n=43) having at least 2 years of follow-up and 22.7% (n=23) having at least 3 years of follow-up. Pulmonary malignancy was identified in only 2% (n=2) of patients; 1 with metastatic lung disease from an uncertain primary on follow-up CT and 1 with primary lung cancer per clinical history. Original CT reports recommended follow-up as per the Fleischner criteria in 53.4% (n=54), though only 15.6% (n=16) of patients had a follow up chest CT. 75% (n=12) of nodules with follow-up CT were stable. Relevant pulmonary findings were found in 50% (n=8) of the follow-up CTs, including metastatic disease, nodules elsewhere in the chest, or systemic disease such as sarcoid.*Conclusions Few patients obtain follow-up CT imaging in the setting of incidentally noted lung nodules on shoulder, neck and cervical spine CT imaging, however the likelihood of primary lung cancer is low in this population. Follow-up CTs showed most nodules were stable, though did provide additional relevant information in half of cases.*Clinical Relevance/Application Incidentally noted lung nodules on CT scans of the upper extremities, neck and spine are often not malignant despite an upper lobe location that is thought to increase risk of malignancy.

RESULTS

101 cases were analyzed (mean age 68.8 years, 65.3% F, 34.6% M). At the time of initial CT scan, 39.6% (n=40) of patients had risk factors for lung cancer and 19.8% (n=20) had a preexisting non-lung cancer. 86.1% (n=87) of the nodules were in the upper lobes. 43.5% (n=44) cases demonstrated more than one nodule. The average largest nodule size was 5.33 ± 3.17 mm. The average length of clinical follow-up for patients was 652 ± 630.66 days (range 0-3217 days) with 42.5% (n=43) having at least 2 years of follow-up and 22.7% (n=23) having at least 3 years of follow-up. Pulmonary malignancy was identified in only 2% (n=2) of patients; 1 with metastatic lung disease from an uncertain primary on follow-up CT and 1 with primary lung cancer per clinical history. Original CT reports recommended follow-up as per the Fleischner criteria in 53.4% (n=54), though only 15.6% (n=16) of patients had a follow up chest CT. 75% (n=12) of nodules with follow-up CT were stable. Relevant pulmonary findings were found in 50% (n=8) of the follow-up CTs, including metastatic disease, nodules elsewhere in the chest, or systemic disease such as sarcoid.

CLINICAL RELEVANCE/APPLICATION

Incidentally noted lung nodules on CT scans of the upper extremities, neck and spine are often not malignant despite an upper lobe location that is thought to increase risk of malignancy.

Abstract Archives of the RSNA, 2021

SSGU06

Genitourinary (Kidney Function and Adrenal/Kidney/Bladder)

Participants
William C. Small, MD, PhD, Atlanta, Georgia (*Moderator*) Nothing to Disclose
David M. Hough, MD, Rochester, Minnesota (*Moderator*) Nothing to Disclose

Sub-Events

SSGU06-1 Risk Of Contrast Media-induced Acute Kidney Injury Following Abdominal Computed Tomography Using Iodixanol 270 And Iobitridol 300 Contrast Media In Hospitalized Old Patients

Participants
Seo Young Park, MD, Daegu, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To assess the association between a low-osmolar (Iobitridol 300) or an iso-osmolar(Iodixanol 270) contrast media (CM) exposure and acute kidney injury (AKI) in the hospitalized old patients by comparing with a propensity score-matched CM with two different osmolarity patient sample undergoing CT.*Methods and Materials Hospitalized old patients > 60 years with stable kidney function and available SCr measurement before and after CT with Iobitridol 300 or Iodixanol 270 between January 2015 and April 2020 were identified. The 1:1 propensity score matching was performed by using 21 covariates, stratified by eGFR before CT (= 60 mL/min/1.73m2 or, < 60 mL/min/1.73m2). AKI after CT was defined as Acute Kidney Injury Network SCr-related criteria. Univariable and multivariable logistic regression analyses were performed to assess the association between CM types and other covariates with the development of AKI after CT.*Results Total 1886 unique patients were included in the propensity score-matched samples (Iobitridol 300, 943 samples; 66.6 years ± 5.2 and Iodixanol 270, 943 samples; 72.2 years ± 4.8). The incidence of AKI with eGFR = 60 mL/min/1.73m2 was 2.48 % (22/885) and 2.25% (20/885) for Iobitridol 300 and Iodixanol 270, and with eGFR < 60 mL/min/1.73m2 was 12.0% (7/58) and 8.6% (5/58), respectively. Significant multivariable predictors of AKI were eGFR before CT, age, body mass index, presence of a chronic kidney disease, and nephrotoxic drug exposure. CM type was not predictive.*Conclusions Hospitalized old patients had a similar frequency of AKI compared with a propensity score-matched patient sample exposed to the Iobitridol 300 and Iodixanol 270.*Clinical Relevance/Application Contrast media, Iobitridol, Iodixanol, Acute kidney injury

RESULTS

Total 1886 unique patients were included in the propensity score-matched samples (Iobitridol 300, 943 samples; 66.6 years ± 5.2 and Iodixanol 270, 943 samples; 72.2 years ± 4.8). The incidence of AKI with eGFR = 60 mL/min/1.73m2 was 2.48 % (22/885) and 2.25% (20/885) for Iobitridol 300 and Iodixanol 270, and with eGFR < 60 mL/min/1.73m2 was 12.0% (7/58) and 8.6% (5/58), respectively. Significant multivariable predictors of AKI were eGFR before CT, age, body mass index, presence of a chronic kidney disease, and nephrotoxic drug exposure. CM type was not predictive.

CLINICAL RELEVANCE/APPLICATION

Contrast media, Iobitridol, Iodixanol, Acute kidney injury

SSGU06-2 Evaluation Of Renal Function In Healthy Volunteers And Patients With Chronic Kidney Disease With Varying Degrees Of Renal Damage By Apt Sequence

Participants
Ye Ju, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

This study explored the value of amide proton transfer-weighted (APTw) MRI in the diagnosis and monitoring of chronic kidney disease (CKD).*Methods and Materials This retrospective study was approved by the institutional IRB. 57 patients who underwent kidney axial APTw imaging at 3.0T (Ingenia CX, Philips Healthcare, Best, the Netherlands) in our hospital between August and October 2019 were included into this study. Imaging parameters detailed in Table 1. Among the 57 patients, 32 had clinically confirmed CKD, who were divided into a moderate group (Group A, n=15) and a severe group (Group B, n=17) based on their CKD severity. The rest 25 patients with no kidney disease history and symptoms formed the control group (Group C, n=25). Written informed consent was waived for this retrospective study. All the image measurements were performed on a IntelliSpace Portal workstation (Philips Healthcare). ROIs (5-7 mm2) were placed by a radiologist (XX with xx years of radiology experience) on the APTw images on the upper, middle, and lower kidney for both the renal cortex and medulla (hence 6 ROIs per patient). The sinus renalis, the blood vessels, and the surrounding tissues were avoided in ROI drawing with reference to the T2w images. The mean cortex and medulla APTw values (MTRasym) were averaged among the upper, middle, and lower kidney and were compared between the three groups using a ROC curve analysis (SPSS 26.0). P<0.05 was considered statistically significant.*Results As shown in Table 2, both cortex and medulla APTw values were highest in the severe group and lowest in the control group (P<0.05). Cortex APTw values were significantly higher than medulla in all three groups (P<0.05). As shown in Table 3, cortex APTw value yielded an AUC of 0.951 in differentiating control group and moderate group (cut-off 1.97%, sensitivity 100%, specific 92%). These numbers were 0.807, 1.95%, 71.4%, and 84% for medulla APTw values. Cortex APTw value yielded an AUC of 0.915 in differentiating moderate group and severe group (cut-off 3.20%, sensitivity 87.5%, specific 93%). These numbers were 0.991,

2.87%, 93.8%, and 100% if medulla APTw values were used.*Conclusions APTw MRI, in both renal cortex and medulla, has provided a reliable non-invasive tool to differentiate between healthy kidney and CKD and between moderate and severe CKD, both with high sensitivity and high specificity. The mechanism behind might be associated to the acidic environment in CKD tissue. With increased kidney function damage, ion-exchange rate increases, and the kidney tissue becomes more acidic, leading to increased APTw signal.*Clinical Relevance/Application Clinically , it can provide a new and non - invasive method , and have certain application prospects .

RESULTS

As shown in Table 2, both cortex and medulla APTw values were highest in the severe group and lowest in the control group (P<0.05). Cortex APTw values were significantly higher than medulla in all three groups (P<0.05). As shown in Table 3, cortex APTw value yielded an AUC of 0.951 in differentiating control group and moderate group (cut-off 1.97%, sensitivity 100%, specific 92%). These numbers were 0.807, 1.95%, 71.4%, and 84% for medulla APTw values. Cortex APTw value yielded an AUC of 0.915 in differentiating moderate group and severe group (cut-off 3.20%, sensitivity 87.5%, specific 93%). These numbers were 0.991, 2.87%, 93.8%, and 100% if medulla APTw values were used.

CLINICAL RELEVANCE/APPLICATION

Clinically , it can provide a new and non - invasive method , and have certain application prospects .

SSGU06-3 Non-invasive Characterization Of Racial Histologic Diversity In Small Renal Masses With The MRI Clear Cell Likelihood Score

Participants
Louis Vazquez, BS, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To develop a diagnostic model to estimate the distribution of histologic subtypes in SRM and assess the diagnostic performance of ccLS for patients with different racial and demographic backgrounds.*Methods and Materials Bi-institution retrospective cohort study in academic hospital and safety net hospital system. Patients with SRM underwent MRI and received ccLS prospectively with subsequent pathologic confirmation. Age, sex, race, body mass index (BMI) and ccLS were tabulated for each mass. Clinical pathology report was the reference standard. Univariate and multivariable analysis with generalized estimating equations were performed to estimate distributions in the proportion of ccRCC, pRCC, benign histology and other diagnosis across different patient subgroups.*Results 239 SRM in 231 patients were included. Race, BMI, and ccLS (p &lt 0.001) were associated with benign and malignant histology. Obese Hispanics had the highest estimated rate of ccRCC (48.3% in ccLS 1-2; 85.8% in ccLS 3; 97.3% in ccLS 4-5) and normal-weight non-Hispanic Black (NHB) the lowest (0.1% in ccLS 1-2; 2.1% in ccLS 3; 15.1% in ccLS 4-5). Normal-weight NHB had the highest estimated rate of pRCC (92.5% in ccLS 1-2; 39.5% in ccLS 3; 11.5% in ccLS 4-5) and obese Hispanics the lowest (28.6% in ccLS 1-2; 0.9% in ccLS 3; &lt 0.1% in ccLS 4-5).*Conclusions ccLS, race, and BMI offer synergistic information in the prediction of the proportion of specific histologic subtypes in SRM and can assist in management decisions for patients with SRM.*Clinical Relevance/Application The synergistic effects of ccLS, race and BMI in the proportion of specific histologic subtypes in SRM provides a platform for a predictive model that can assist in management decisions for these patients.

RESULTS

239 SRM in 231 patients were included. Race, BMI, and ccLS (p &lt 0.001) were associated with benign and malignant histology. Obese Hispanics had the highest estimated rate of ccRCC (48.3% in ccLS 1-2; 85.8% in ccLS 3; 97.3% in ccLS 4-5) and normal-weight non-Hispanic Black (NHB) the lowest (0.1% in ccLS 1-2; 2.1% in ccLS 3; 15.1% in ccLS 4-5). Normal-weight NHB had the highest estimated rate of pRCC (92.5% in ccLS 1-2; 39.5% in ccLS 3; 11.5% in ccLS 4-5) and obese Hispanics the lowest (28.6% in ccLS 1-2; 0.9% in ccLS 3; &lt 0.1% in ccLS 4-5).

CLINICAL RELEVANCE/APPLICATION

The synergistic effects of ccLS, race and BMI in the proportion of specific histologic subtypes in SRM provides a platform for a predictive model that can assist in management decisions for these patients.

SSGU06-4 Detecting Muscle Invasion Of Bladder Cancer Using A Proposed MRI Strategy

Participants
Xiangyu Wang, Shenzhen, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic performance of a new MRI strategy based on the integration of the VI-RADS and tumor contact length (TCL) for the diagnosis of muscle-invasive bladder cancer (MIBC).*Methods and Materials Three radiologists independently graded the VI-RADS score and measured the TCL on index lesion images. A proposed MRI strategy called VI-RADS_TCL was introduced by modifying the VI-RADS score, which was downgraded to VI-RADS 3F (equal to a VI-RADS score of 2) if VI-RADS=3 and TCL<3 cm. Intraclass correlation coefficients (ICCs), Mann-Whitney U test, chi-square tests, receiver operating characteristic (ROC) curves and 2×2 contingency tables were applied.*Results A group of 179 patients with a mean age of 67 years (range, 24.0-96.0) underwent multiparametric MRI (mpMRI) before surgery, including 147 (82.1%) males and 32 (17.9%) females. Twenty-four (13.4%), 90 (50.3%), 43 (24.0%), 15 (8.4%) and 7 (3.9%) cases were Ta, T1, T2, T3 and T4, respectively. Inter-reader agreement values were 0.941 (95% CI, 0.924-0.955) and 0.934 (95% CI, 0.916-0.948) for the TCL and VI-RADS score. The TCL was significantly increased in the MIBC group (6.40 - 6.85 cm) compared with the NMIBC group (1.98- 2.45 cm) (P<0.05). The specificity and positive predictive values (PPV) of VI-RADS_TCL were 82.46%- 7.72% and 90.91%-91.59%, which were significantly greater than VI-RADS score (P<0.05). Additionally, 52.17%-55.88% NMIBC lesions with VI-RADS 3 were downgraded to 3F by using VI-RADS_TCL.*Conclusions The proposed MRI strategy could reduce the false-positive rate of lesions with a VI-RADS score of 3 while retaining sensitivity.*Clinical Relevance/Application a) tumor contact length (TCL) was defined as the maximal curvilinear contact length between the tumor and the bladder wall. The TCL metric showed a significant difference between NMIBC and MIBC in our results. Furthermore, measuring the TCL does not require an additional examination sequence, avoiding an increase the patient's time-consuming or examination cost.b) A proposed MRI strategy called VI-RADS_TCL was introduced by modifying the VI-RADS score, which was downgraded to VI-RADS 3F (equal to a VI-RADS score of 2) if VI-RADS=3 and TCL<3 cm. When using the VI-RADS_TCL scoring approach, 52.17%-55.88% of lesions with a VI-RADS score of 3 were downgraded to VI-RADS 3F and were pathologically confirmed as NMIBC.

RESULTS

A group of 179 patients with a mean age of 67 years (range, 24.0-96.0) underwent multiparametric MRI (mpMRI) before surgery, including 147 (82.1%) males and 32 (17.9%) females. Twenty-four (13.4%), 90 (50.3%), 43 (24.0%), 15 (8.4%) and 7 (3.9%) cases were Ta, T1, T2, T3 and T4, respectively. Inter-reader agreement values were 0.941 (95% CI, 0.924-0.955) and 0.934 (95% CI, 0.916-0.948) for the TCL and VI-RADS score. The TCL was significantly increased in the MIBC group (6.40 - 6.85 cm) compared with the NMIBC group (1.98- 2.45 cm) (P<0.05). The specificity and positive predictive values (PPV) of VI-RADS_TCL were 82.46%-7.72% and 90.91%-91.59%, which were significantly greater than VI-RADS score (P<0.05). Additionally, 52.17%-55.88% NMIBC lesions with VI-RADS 3 were downgraded to 3F by using VI-RADS_TCL.

CLINICAL RELEVANCE/APPLICATION

a) tumor contact length (TCL) was defined as the maximal curvilinear contact length between the tumor and the bladder wall. The TCL metric showed a significant difference between NMIBC and MIBC in our results. Furthermore, measuring the TCL does not require an additional examination sequence, avoiding an increase the patient's time-consuming or examination cost.b) A proposed MRI strategy called VI-RADS_TCL was introduced by modifying the VI-RADS score, which was downgraded to VI-RADS 3F (equal to a VI-RADS score of 2) if VI-RADS=3 and TCL<3 cm. When using the VI-RADS_TCL scoring approach, 52.17%-55.88% of lesions with a VI-RADS score of 3 were downgraded to VI-RADS 3F and were pathologically confirmed as NMIBC.

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SSNR08

Science Session with Keynote: Neuroradiology (Brain: Trauma)

Participants
Gelareh Sadigh, MD, Atlanta, Georgia (*Moderator*) Research Grant, TailorMed Medical Ltd
Apostolos J. Tsiouris, MD, New York, New York (*Moderator*) Nothing to Disclose

Sub-Events

SSNR08   Keynote Speaker

Participants
Pratik Mukherjee, MD, PhD, San Francisco, California (*Presenter*) Research Grant, General Electric Company;Support, General Electric Company;Patent Patent, USPTO No. 62/269,778

SSNR08-2   Brain Glymphatic System Is Impaired In TBI Found With MRI: The First Human Study

Participants
Jianfeng Bao, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

The pathology of neurodegeneration and dementia following the traumatic brain injury (TBI) is still unknown. Recently, a new found/defined brain waste clearance system, named 'glymphatic system', was proved to be damaged in TBI rodent studies. Herein, the functionality of human brain glymphatic system of TBI patients and related healthy controls was evaluated and compared using MRI.*Methods and Materials The glymphatic function was assessed by T1W MRI scans with intrathecal gadolinium injection as tracer. Images were obtained from TBI patients (n = 16) and relatively healthy controls (n = 7) at 4 time points. Along the cerebrospinal fluid (CSF) drawing pathway, Fig.1, 4 predefined regions of interest (ROIs), were automatically generated using standard brain atlas templates. Each ROI was subsequently split into sub-ROIs including CSF and gray matter (GM) separately for analyzing the signal enhancement characteristics. The signal intensity on T1 weighted images at 4 time points of each ROI was extracted and normalized. The percentage changes of signal enhancements were used for group comparisons.*Results As shown in Fig.2, after 24 h contrast agent injection, the percentage changes of T1 signal intensity were significant higher in TBI patients than controls for CSF and GM, but not for WM in all ROIs (not show here). The CSF enhancement seems more pronounced than GM enhancement. The higher T1 signal in TBI patient at 24 h can be attributed to the reduced efficiency of the contrast agent clearance, which is the key function of glymphatic system.*Conclusions The significant delayed enhancements in CSF and GM in TBI group indicate the brain glymphatic system is impaired for TBI patients. Glymphatic dysfunction may provide a new clue to understanding its pathogenesis of the cognitive impairments along with TBI in the later life. What's more, this study reconfirmed the MRI scan with gadolinium intrathecal administration may hold a potential to explore the glymphatic function in human.*Clinical Relevance/Application The glymphatic system, brain waste clearance pathway, is impaired, which is prior to other dementia symptoms and maybe useful in predicting future cognitive decline and risk of dementia in TBI people.

RESULTS

As shown in Fig.2, after 24 h contrast agent injection, the percentage changes of T1 signal intensity were significant higher in TBI patients than controls for CSF and GM, but not for WM in all ROIs (not show here). The CSF enhancement seems more pronounced than GM enhancement. The higher T1 signal in TBI patient at 24 h can be attributed to the reduced efficiency of the contrast agent clearance, which is the key function of glymphatic system.

CLINICAL RELEVANCE/APPLICATION

The glymphatic system, brain waste clearance pathway, is impaired, which is prior to other dementia symptoms and maybe useful in predicting future cognitive decline and risk of dementia in TBI people.

SSNR08-3   Automated Detection Of Intracranial Hemorrhage With Artificial Intelligence (RAPID-ICH): Initial Clinical Experience

Participants
Warren Chang, MD,MBA, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Intracranial hemorrhage (ICH) has high morbidity and mortality with nearly 50% 30 day mortality for patients admitted to the ICU and as few as 20% of survivors demonstrating full neurologic recovery. Early intervention has been shown to improve clinical outcomes. Given high mortality and morbidity, prompt identification of ICH has high clinical utility. Several applications have emerged using artificial intelligence (AI) for automated detection of ICH, including RAPID ICH (iSchemaView, Menlo Park, CA). We present our initial clinical experience with RAPID ICH in a busy Level 1 trauma center.*Methods and Materials The study was performed under the supervision of the local institutional review board.Patients presenting to the emergency department (ED) receiving CT scans of the brain and inpatients (IP) scanned on the ED scanner at one level 1 trauma center were included in the study. The RAPID ICH output ("no ICH" or "suspected ICH") was recorded for each study. The initial interpreting emergency radiologist or neuroradiologist had access to the RAPID ICH output. Radiology reports reporting ICH were considered positive and

those reporting no ICH were considered negative. A board certified neuroradiologist reviewed each case who had access to the initial report, RAPID ICH output, and all subsequent examinations. In cases with disagreement between the readers, a third reader adjudicated the result and their decision was considered final. The expert reads were used as the gold standard and sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV) were calculated.*Results A total of 1388 patients were included in the study, 1251 from the ED and 137 IP. For the ED patients, 139 had ICH and 1112 did not, where as in the IP cohort, 100 had ICH and 37 did not. RAPID ICH demonstrated overall sensitivity of 79% (73% ED, 88% IP), overall specificity of 95% (96% ED, 84% IP), overall PPV of 76% (65% ED, 94% IP) and overall NPV of 96% (97% ED, 72% IP).*Conclusions RAPID ICH demonstrated relatively high sensitivity and very high specificity for ICH, with lower sensitivity and higher specificity in the ED, and higher sensitivity but lower specificity in the inpatient setting. Using AI applications such as RAPID ICH for active worklist reprioritization may allow timely triage of potentially positive studies, allowing early intervention and potentially leading to improved clinical outcomes, especially in the inpatient setting with longer average turnaround times for routine studies.*Clinical Relevance/Application RAPID ICH demonstrated relatively high sensitivity and specificity in both IP and ED settings. Active worklist reprioritization using RAPID ICH may improve turnaround times and allow earlier intervention and improved clinical outcomes.

RESULTS

A total of 1388 patients were included in the study, 1251 from the ED and 137 IP. For the ED patients, 139 had ICH and 1112 did not, where as in the IP cohort, 100 had ICH and 37 did not. RAPID ICH demonstrated overall sensitivity of 79% (73% ED, 88% IP), overall specificity of 95% (96% ED, 84% IP), overall PPV of 76% (65% ED, 94% IP) and overall NPV of 96% (97% ED, 72% IP).

CLINICAL RELEVANCE/APPLICATION

RAPID ICH demonstrated relatively high sensitivity and specificity in both IP and ED settings. Active worklist reprioritization using RAPID ICH may improve turnaround times and allow earlier intervention and improved clinical outcomes.

SSNR08-4   Positive CT Head Rate Performed Post Head Injury According To National Institute For Health And Care Excellence (NICE) Guidelines

Participants
Mark Woodward, MBChB,BSC, Salford, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

With an ever increasing demand for radiological investigations in the National Health Service (NHS), there is immense strain on radiology departments in the UK. Of the cross sectional investigations performed, CT head far outnumbers any other. Clinicians in the UK use NICE guidelines for head injury to help determine if a patient requires an acute CT head. Experience suggested that these recommendations are all encompassing and therefore qualify almost every patient for a CT head, even though most are negative. To assess this hypothesis, we undertook a dual center study to objectively determine the positive rate of CT heads performed according to the NICE guidelines for head injury.*Methods and Materials Data was collected retrospectively at two UK NHS District General Hospitals using the Computerised Radiology Information System (CRIS) software. CT heads performed during two random and continuous two week time periods were assessed; prior to the COVID-19 pandemic and during it. All adult A&E and inpatient acute CT heads performed for referrals that met the NICE guidelines for head injury were included. Reported intracranial hemorrhage or skull fracture were deemed a positive CT head, whilst incidental findings were classed as a negative scan.*Results In the two weeks prior to the pandemic, n=265 scans met the inclusion criteria, and n=216 during it. The mean age of patients prior to the COVID-19 pandemic was 65.2 years and 68.9 years during it. Prior to the pandemic there were n=18 positive CT heads (6.8%), and n=7 (3.2%) during it.*Conclusions As predicted, less CT heads were performed for head injury during the pandemic compared to prior to it. This was reflected by a 57% reduction in the number of patients presenting to A and E departments in the UK during April 2020 of the pandemic compared to the previous year. There was concern amongst the medical community in the UK that even patients with serious acute pathologies were not presenting to hospital. We hypothesised this more selective group of symptomatic patients would lead to a higher positive rate of CT heads. However, this was not the case, as shown by our results, which suggest that the NICE guidelines for CT head post head injury are too all encompassing and possibly need reviewing to improve selection criteria.*Clinical Relevance/Application This study has highlighted the possible need for review of the NICE guidelines for performing CT head post head injury to formulate stricter criterion. This should lead to clinicians relying on their clinical acumen to select patients for CT head, leading to less unnecessary scans being performed. This would reduce radiation exposure to patients and conserve limited NHS resources.

RESULTS

In the two weeks prior to the pandemic, n=265 scans met the inclusion criteria, and n=216 during it. The mean age of patients prior to the COVID-19 pandemic was 65.2 years and 68.9 years during it. Prior to the pandemic there were n=18 positive CT heads (6.8%), and n=7 (3.2%) during it.

CLINICAL RELEVANCE/APPLICATION

This study has highlighted the possible need for review of the NICE guidelines for performing CT head post head injury to formulate stricter criterion. This should lead to clinicians relying on their clinical acumen to select patients for CT head, leading to less unnecessary scans being performed. This would reduce radiation exposure to patients and conserve limited NHS resources.

SSNR08-5   A Multi Scanner Study Of Corpus Callosum Diffusion Imaging And Clinical Outcomes In Mild Traumatic Brain Injury

Participants
Alexander Asturias, Henderson, Nevada (*Presenter*) Nothing to Disclose

PURPOSE

To analyze associations between symptom presentation and longevity in chronic phase mild traumatic brain injury (mTBI) using corpus callosal (CC) diffusion tensor image (DTI).*Methods and Materials Clinical data were obtained retrospectively on 450 mTBI subjects (avg age 42 range 12-82) documenting incidence and longevity of 7 common mTBI clinical symptoms. Subjects were excluded if MRI showed hemorrhages or contusions. Median time between scanning and injury was 100 days. DTI data was obtained from 8 different 3T MRI scanners (3 GE: 2 Signa HDxt, 1 Signa Excite; 1 Philips Intera; 4 Siemens: 3 Verio, 1 TrioTim). Scanning parameters varied slightly but were at minimum 33 directions and 2.4 mm slice thickness with 90 flip angle. DTI post processing was performed on the Olea Sphere V3.0 SP12 free-standing workstation with motion correction. Hand traced fractional anisotropy (FA) values were calculated from regions of interests across the CC. Data harmonization was processed with MATLAB 2020b utilizing the published ComBat harmonization technique to reduce FA scanner variability. Logistic regression modeling was used to assess CC FA

values and symptom presentation/improvement associations. Symptom longevity was modeled in semi-parametric Cox proportional hazard models.*Results No regional FA values were associated significantly with symptom presentation. Increased longevity of post-concussive cognitive deficits was significantly associated with small FA values in the whole (p=0.01), anterior (p<0.01), and medial (p=0.03) CC. Small FA values in the posterior CC were significantly associated with longer duration of post concussive depression (p=0.04) and emotional lability (p=0.01). Subject age was negatively related to FA (p<0.001), but only 2.1% to 9.0% of the variation in FA was explained by age.*Conclusions This study reveals a number of significant associations between decreased CC FA values and longevity of mTBI symptomological sequalae, particularly cognitive.*Clinical Relevance/Application Corpus Callosal DTI may assist in predicting clinical outcomes in chronic phase mTBI subjects.

RESULTS

No regional FA values were associated significantly with symptom presentation. Increased longevity of post-concussive cognitive deficits was significantly associated with small FA values in the whole (p=0.01), anterior (p<0.01), and medial (p=0.03) CC. Small FA values in the posterior CC were significantly associated with longer duration of post concussive depression (p=0.04) and emotional lability (p=0.01). Subject age was negatively related to FA (p<0.001), but only 2.1% to 9.0% of the variation in FA was explained by age.

CLINICAL RELEVANCE/APPLICATION

Corpus Callosal DTI may assist in predicting clinical outcomes in chronic phase mTBI subjects.

SSNR08-6   Delayed Posttraumatic Intracranial Hemorrhage In Patients On Anticoagulant/antiplatelet Medications: Three Year Experience

Participants
Warren Chang, MD,MBA, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

The risk of delayed postraumatic intracranial hemorrhage (DH) in patients on anticoagulant/antiplatelet medications, especially patients on direct oral anticoagulant medications (DOAC), is not well established. The prevalence of DOACs is increasing and in a recent study on anticoagulated patients was as high as 50%. In our study, a majority of anticoagulated patients were taking DOACs. Some groups found a low risk of posttraumatic DH in patients taking warfarin/clopidogrel, however, newer reports have found >7% rate of DH and others found 1% mortality. We report our 3-year experience with DH including patients taking DOACs.*Methods and Materials This study was performed under the supervision of the local Institutional Review Board.Patients were included in the study if they were on antiplatelet and anticoagulant medications, including DOACs, and suffered head trauma. The radiology reports for the initial examinations on these patients included a recommendation for repeat imaging to evaluate for DH. Approximately 50% of patients in which repeat imaging was recommended received repeat imaging. Repeat examinations were typically performed within 24 hours (average follow-up time was 21 hours and 99% were within 3 days). Patients who had repeat examinations within the same hospitalization/incident were included in the study if their initial examination was interpreted as negative and there were no additional instances of trauma between the examinations. All positive studies were reviewed by two board certified neuroradiologists. Patients were excluded from the study if hemorrhage was retrospectively identified on the initial examination. Cases were reclassified as negative if hemorrhage on the follow-up examination was thought to be not present or thought to be artifactual. Cases were considered positive if the initial examination was considered negative and the follow-up examination demonstrated new hemorrhage.*Results A total of 1046 patients were included in the study, with 1.8% incidence of DH and 0.4% overall mortality. Patients on warfarin and clopidogrel had a higher rate of DH (3.2%), compared to 0.9% in the DOAC group, and the difference was statistically significant (p<0.01). All deaths were in the clopidogrel/warfarin group.*Conclusions Our study found 1.8% rate of DH with 0.4% mortality, higher than some previously published reports. DOACs demonstrated significantly lower risk of both DH and mortality than warfarin/clopidogrel.*Clinical Relevance/Application Patients on clopidogrel and warfarin had both significantly higher rate of DH and mortality from DH compared to patients taking DOACs. Repeat head CT should be considered on trauma patients on anticoagulant/antiplatelet medications, especially warfarin and/or clopidogrel.

RESULTS

A total of 1046 patients were included in the study, with 1.8% incidence of DH and 0.4% overall mortality. Patients on warfarin and clopidogrel had a higher rate of DH (3.2%), compared to 0.9% in the DOAC group, and the difference was statistically significant (p<0.01). All deaths were in the clopidogrel/warfarin group.

CLINICAL RELEVANCE/APPLICATION

Patients on clopidogrel and warfarin had both significantly higher rate of DH and mortality from DH compared to patients taking DOACs. Repeat head CT should be considered on trauma patients on anticoagulant/antiplatelet medications, especially warfarin and/or clopidogrel.

Abstract Archives of the RSNA, 2021

Participants
Ke Li, PhD, Madison, Wisconsin (*Moderator*) Research Consultant, Pulmera Inc.
Cynthia McCollough, PhD, Byron, Minnesota (*Moderator*) Research Grant, Siemens Healthcare GmbH

Sub-Events

SSPH07-1   Evaluation Of Iodine Quantification Accuracy In Spectral Images Derived From A Full Field-of-view Photon-counting-detector CT

Participants
Kishore Rajendran, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the quantitative accuracy of iodine concentration in material maps and iodine CT numbers in virtual monoenergetic images (VMI) from a 50 cm field-of-view photon-counting-detector (PCD) CT.*Methods and Materials Multi-energy CT phantoms (head size: 20 cm diameter; body size: 30 cm height and 40 cm lateral width) with solid iodine inserts (2, 5, 10 and 15 mg/cc) were scanned on an investigational dual-source whole-body PCD-CT system (NAEOTOM Alpha, Siemens Healthineers). Scan parameters used were 144 x 0.4 mm collimation, 120 kV with 20 and 65 keV thresholds, 140 kV with 20 and 70 keV thresholds, head CTDIvol = 36 mGy and abdomen CTDIvol = 12 mGy. Images were reconstructed using a quantitative kernel (Qr40, iterative reconstruction strength 3) at 3 mm slice thickness. Vendor-provided software was used to generate iodine maps and VMIs from 40 to 140 keV. Quantitative accuracy of iodine maps was assessed using the root-mean-squared-error (RMSE) between measured and true iodine concentrations. For VMI accuracy, the iodine CT number at each concentration and VMI energy level (keV setting) was compared to the expected monoenergetic CT numbers calculated using NIST data. Percent error was calculated between measured and expected VMI CT numbers. VMI and iodine maps were evaluated for each phantom size and acquisition kV.*Results Iodine maps demonstrated a RMSE of 0.27 mg/cc and 0.24 mg/cc for the head size phantom at 120 kV and 140 kV, respectively, and 1.06 mg/cc and 0.5 mg/cc for the body size phantom at 120 kV and 140 kV, respectively. For VMIs, the percent error was 4.89% and 4.05% for the head size at 120 kV and 140 kV, respectively. The percent error for the body size phantom was 14.94% and 9.44% for 120 kV and 140 kV, respectively. For both iodine maps and VMIs, the 140 kV acquisition yielded the lowest RMSE and percent error, respectively, owing to better spectral separation in the multi-energy data.*Conclusions At the same dose, use of 140 kV results in higher quantitative accuracy for PCD-CT spectral imaging. The evaluated PCD-CT system demonstrated quantitative accuracy for iodine maps and VMIs similar to or better than published results using dual-energy CT systems.*Clinical Relevance/Application Our study evaluated quantitative accuracy of iodine maps and VMI from a whole-body PCD-CT to determine optimal tube potential for clinical multi-energy applications, which was found to be 140 kV.

RESULTS

Iodine maps demonstrated a RMSE of 0.27 mg/cc and 0.24 mg/cc for the head size phantom at 120 kV and 140 kV, respectively, and 1.06 mg/cc and 0.5 mg/cc for the body size phantom at 120 kV and 140 kV, respectively. For VMIs, the percent error was 4.89% and 4.05% for the head size at 120 kV and 140 kV, respectively. The percent error for the body size phantom was 14.94% and 9.44% for 120 kV and 140 kV, respectively. For both iodine maps and VMIs, the 140 kV acquisition yielded the lowest RMSE and percent error, respectively, owing to better spectral separation in the multi-energy data.

CLINICAL RELEVANCE/APPLICATION

Our study evaluated quantitative accuracy of iodine maps and VMI from a whole-body PCD-CT to determine optimal tube potential for clinical multi-energy applications, which was found to be 140 kV.

SSPH07-2   High-pitch Photon-counting Detector CT For Angiography Of The Aorta - Intraindividual Comparison To Radiation Dose-matched Energy-integrating Detector CT With Automatic Tube Voltage Selection

Participants
Andre Euler, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To compare objective and subjective image quality of high-pitch CT angiography of the aorta between clinical photon-counting detector CT (PCD-CT) and conventional energy-integrating detector CT (EID-CT) with automatic tube voltage selection (ATVS) in the same patients at equal radiation dose.*Methods and Materials Patients receiving a follow-up CT angiography of the thoracoabdominal aorta were prospectively screened for prior imaging on a third-generation EID-CT in high-pitch mode and ATVS (CarekV, reference tube voltage 100kV). Follow-up was performed on a first-generation clinical dual-source PCD-CT in high-pitch and QuantumPlus mode at 120kV using the same contrast media protocol. Radiation dose between the two scans was matched by adapting tube current. Polychromatic images for both EID-CT and PCD-CT (T3D) and spectral-based virtual monoenergetic images at 40, 45, 50, 55 keV for PCD-CT were reconstructed. CT numbers were measured at multiple locations in the aorta. Noise was defined as the standard deviation of the CT number in the psoas muscle. Contrast-to-noise ratio (CNR) was calculated. Subjective image quality (noise, vessel attenuation, vessel sharpness, overall quality) was rated by two radiologists. Non-parametric tests (Kruskal-wallis and Krippendorf a) were performed.*Results Twenty-five consecutive patients were included (mean age, 64.3±10.3

years, 3 females, mean body mass index, 27.1±5.9 kg/m2). ATVS selected 70, 80, 90, 100, 110, 120kV in 1, 8, 8, 5, 1, 2 patients, respectively. Mean CNR was 15.7±7.5 for EID-CT, and 21.9±7.3, 19.7±6.5, 17.5±5.8, 15.5±5.1, 11.5±3.6 for PCD-CT at 40, 45, 50, 55keV, and T3D, respectively. CNR was significantly higher for 40 and 45keV of PCD-CT as compared to EID-CT (both, p<.05). Interreader agreement was substantial (a=.66). Subjective noise was rated superior for EID-CT and T3D as compared to 40-55 keV (all, p<.05). Vessel attenuation was significantly lower for T3D compared to the other reconstructions (all, p<.05). There was no significant difference among the reconstructions for vessel sharpness (p=.78) and overall quality (p=.84).*Conclusions High-pitch PCD-CT with VMI at 40 and 45 keV resulted in significantly increased CNR, inferior subjective noise but similar overall image quality as compared to EID-CT with ATVS for dose-matched CT angiography of the aorta.*Clinical Relevance/Application Increased CNR of PCD-CT could be used to reduce the amount of contrast media in CT angiography of the aorta.

RESULTS

Twenty-five consecutive patients were included (mean age, 64.3±10.3 years, 3 females, mean body mass index, 27.1±5.9 kg/m2). ATVS selected 70, 80, 90, 100, 110, 120kV in 1, 8, 8, 5, 1, 2 patients, respectively. Mean CNR was 15.7±7.5 for EID-CT, and 21.9±7.3, 19.7±6.5, 17.5±5.8, 15.5±5.1, 11.5±3.6 for PCD-CT at 40, 45, 50, 55keV, and T3D, respectively. CNR was significantly higher for 40 and 45keV of PCD-CT as compared to EID-CT (both, p<.05). Interreader agreement was substantial (a=.66). Subjective noise was rated superior for EID-CT and T3D as compared to 40-55 keV (all, p<.05). Vessel attenuation was significantly lower for T3D compared to the other reconstructions (all, p<.05). There was no significant difference among the reconstructions for vessel sharpness (p=.78) and overall quality (p=.84).

CLINICAL RELEVANCE/APPLICATION

Increased CNR of PCD-CT could be used to reduce the amount of contrast media in CT angiography of the aorta.

SSPH07-3 High-pitch, High Temporal Resolution, Multi-energy Cardiac Imaging On A Whole Body, Dual-Source Photon-Counting-Detector CT

Participants
David Campeau, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To assess the performance of a high-pitch, multi-energy (ME) scan mode on an investigational whole-body dual-source photon-counting-detector (DS-PCD) CT using phantom and patient studies.*Methods and Materials A scan mode (ME-Flash; 66 ms temporal resolution) on an investigational DS-PCD-CT system (NAEOTOM Alpha) permits multi-energy (ME) cardiac imaging with high helical pitch (3.2), fast rotation time (0.25 second) and energy discrimination capabilities. To assess temporal and spectral performance of this mode, a cardiac motion phantom containing a cylindrical iodine rod (20 mg/cc, QRM) was scanned at 120 kV, 100 effective mAs, and 7.26 mGy CTDIvol. A lateral motion profile with a 3mm amplitude triangle wave at 60bpm (velocity of 12 mm/s) was used, and scans were repeated 20 times. For comparison, the same phantom was also scanned with gated and non-gated spiral modes, both with 120 kV and 100 effective mAs (CTDIvol of 32.9 mGy and 7.26 mGy, respectively). The same phantom was also scanned without motion to create reference images. Iodine map and virtual monoenergetic images (VMI at 55 keV) were created using 1 mm thick images reconstructed with a quantitative kernel (Qr40). Contrast and noise were measured and artifacts assessed in axial and volume rendered images. Iodine concentration was measured for a region of interest in the iodine map, and diameter and circularity of the rod were calculated for each scan mode and compared. With IRB approval, a patient with suspected coronary artery disease was scanned using the ME-Flash mode and image quality assessed.*Results Moving iodine rods were clearly delineated without noticeable distortion, with similar contrast and noise as when static. Mean iodine concentration was 20.6 mg/cc, 3% higher than reference. Minor artifacts were observed in the uniform background close to the iodine rod that did not affect the rod shape or boundaries (diameter 4.42 vs 4.47mm, and circularity 0.954 vs 0.946 for static and motion phantoms, respectively). Patient images clearly delineated all coronary arteries and showed no evidence of motion artifacts. VMI and iodine map demonstrated the multi-energy capability of the ME-Flash mode, allowing assessment of anatomic information and material quantification.*Conclusions The ME-Flash mode on the DS-PCD-CT system enables high temporal resolution (66 ms), quantitatively accurate multi-energy (<=3% error) cardiac imaging at much lower radiation dose levels than conventional retrospectively-gated cardiac scanning.*Clinical Relevance/Application Flash mode PCD-CT can provide accurate quantitation of iodine enhancement using the highest temporal resolution available, potentially increasing the diagnostic value of coronary CTA.

RESULTS

Moving iodine rods were clearly delineated without noticeable distortion, with similar contrast and noise as when static. Mean iodine concentration was 20.6 mg/cc, 3% higher than reference. Minor artifacts were observed in the uniform background close to the iodine rod that did not affect the rod shape or boundaries (diameter 4.42 vs 4.47mm, and circularity 0.954 vs 0.946 for static and motion phantoms, respectively). Patient images clearly delineated all coronary arteries and showed no evidence of motion artifacts. VMI and iodine map demonstrated the multi-energy capability of the ME-Flash mode, allowing assessment of anatomic information and material quantification.

CLINICAL RELEVANCE/APPLICATION

Flash mode PCD-CT can provide accurate quantitation of iodine enhancement using the highest temporal resolution available, potentially increasing the diagnostic value of coronary CTA.

SSPH07-4 Spectral-based Virtual Removal Of Calcified Vascular Plaques In Dual Source Multi-energy Photon Counting CT

Participants
Thomas G. Flohr, PhD, Forchheim, Germany (*Presenter*) Employee, Siemens AG

PURPOSE

In case of cardio-vascular CT angiography examinations, calcified plaques often pose a challenge in the assessment of the true vessel lumen due to blooming and partial volume effects. We assessed the performance of a newly developed image reconstruction method utilizing spectral information to remove only the calcified parts of the volume while leaving the rest of the image intact via a modified in-place two-material decomposition for non-moving and moving calcified structures.*Methods and Materials For the study a dual source multi-energy photon counting CT (Siemens Healthineers) was used, which allows the readout of 4 energy thresholds. Scans were performed in standard and gated scan mode at 120 kV tube voltage and 100, 200 and 400 eff. mAs. In order to simulate various levels of stenosis, artificial stenosis phantoms (QRM, Möhrendorf, Germany) with three different vessel diameters (10 mm, 5mm and 3mm) were used, each of them equipped with three different levels of calcified stenosis: 15, 25 and 50%. To

simulate a realistic patient attenuation, the vessel phantoms were scanned submerged in a water bath, surrounded by a thorax phantom - with and without attenuation extension rings. Vessel phantoms were scanned at rest, and using a typical cardiac motion profile at 60, 70 and 90 bmp. To assess the quality of the plaque removal, we evaluated both - the visual quality and difference in stenosis levels as objective measure compared to the gold standard (phantom specification).*Results The visual impression of the calcium-removed stenosis matches the expectation given by the phantom specification. The deterioration in overall image quality towards lower exposure levels, due to an increase in image noise or due to vessel phantom motion with increasing heart rate is comparable between calcium removed and standard reconstructions. The quantitative stenosis evaluation based on voxel mask matching did exhibit a significant dependency on the applied heart rate.*Conclusions The presented method of reconstructing virtual calcium-removed images may provide additional information in the assessment of the true lumen in vessels with a high calcium burden in CT angiography examinations, by means of removing calcified plaques and the associated blooming artifacts.*Clinical Relevance/Application Virtual calcium-removed images calculated from multi-energy photon-counting CT have potential to aid in the assessment of stenosis.

RESULTS

The visual impression of the calcium-removed stenosis matches the expectation given by the phantom specification. The deterioration in overall image quality towards lower exposure levels, due to an increase in image noise or due to vessel phantom motion with increasing heart rate is comparable between calcium removed and standard reconstructions. The quantitative stenosis evaluation based on voxel mask matching did exhibit a significant dependency on the applied heart rate.

CLINICAL RELEVANCE/APPLICATION

Virtual calcium-removed images calculated from multi-energy photon-counting CT have potential to aid in the assessment of stenosis.

SSPH07-5 Characterization And Potential Standardization Of Energy Independent CT Reconstruction Techniques Using An Investigational Dual-Source Photon-Counting CT System - Preliminary Phantom Study

Participants
Fides Schwartz, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To assess the performance and the potential of an investigational dual-source photon-counting CT system (PCCT) for standardized image output independent of acquisition parameters.*Methods and Materials A Gammex multi-energy phantom (20 cm insert) was scanned on an investigational full field-of-view PCCT system (NAEOTOM Alpha, Siemens Healthineers) using diverse kV (90, Sn100, 120, and 140) with corresponding CTDI values (14.5, 3.2, 24 and 24 mGy, respectively). In all cases quantum or quantum plus standard modes were used (M4, with 352 um pixel size at isocenter). Images were reconstructed with Qr40 kernel, using monoenergetic images at 70 keV, and a slice thickness of 3 mm. Hounsfield units [HU] were measured in triplicate in three target inserts (insert 1: iodine at 15 mg/cc, insert 2: iodine at 10 mg/cc, insert 3: calcium at 50 mg/cc) as well as the background. Mean attenuation, noise, signal to noise ratio (SNR) and contrast to noise ratio (CNR=attenuationinsert - attenuationbackground/noise) as well as a dose weighted SNRD (SNR/sqrt(CTDIvol) and CNRD (CNR/sqrt(CTDIvol)) were calculated.*Results Average difference in CT number attenuation across the evaluated inserts was 4% (range: 0.9-14%). Mean HU of insert 1 was 396 ± 3, 392 ± 3, 371 ± 4, and 397 ± 8 at 140, 120, 90, and Sn100 kV, respectively. The corresponding values for inserts 2 and 3 where 269 ± 3 and 111 ± 3, 265 ± 3 and 108 ± 3, 246 ± 4 and 93 ± 4, and 273 ± 7 and 109 ± 6. SNRD had an average difference of 6.7% across the evaluated inserts (range: 0.6-15%). CNRD had an average difference of 3.8 % across the evaluated inserts (range: 1-11%).*Conclusions PCCT technology may enable standardization of attenuation values (HU) of iodine containing structures irrespective of the kV scanning technique. Image output can be standardized to produce comparable CT attenuation numbers in preliminary phantom data from an investigational photon-counting CT.*Clinical Relevance/Application Standardization of attenuation values (HU) irrespective of the kV selection may result in improved clinical implementation of patient-specific tube voltage modulation techniques.

RESULTS

Average difference in CT number attenuation across the evaluated inserts was 4% (range: 0.9-14%). Mean HU of insert 1 was 396 ± 3, 392 ± 3, 371 ± 4, and 397 ± 8 at 140, 120, 90, and Sn100 kV, respectively. The corresponding values for inserts 2 and 3 where 269 ± 3 and 111 ± 3, 265 ± 3 and 108 ± 3, 246 ± 4 and 93 ± 4, and 273 ± 7 and 109 ± 6. SNRD had an average difference of 6.7% across the evaluated inserts (range: 0.6-15%). CNRD had an average difference of 3.8 % across the evaluated inserts (range: 1-11%).

CLINICAL RELEVANCE/APPLICATION

Standardization of attenuation values (HU) irrespective of the kV selection may result in improved clinical implementation of patient-specific tube voltage modulation techniques.

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Participants
Eric E. Williamson, MD, Rochester, Minnesota (*Moderator*) Nothing to Disclose
Diana Litmanovich, MD, Boston, Massachusetts (*Moderator*) Nothing to Disclose
Jonathan Weir-McCall, MBBCh, FRCR, Cambridge, United Kingdom (*Moderator*) Nothing to Disclose

Sub-Events

SSCA07-1   Pre-Procedural CTA-based Left And Right Ventricular Longitudinal Strain Provides Superior Prediction Of Mortality Compared To Ejection Fraction In Transcatheter Aortic Valve Replacement

Participants
Gilberto Aquino, MD, Charleston, South Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To assess the predictive value of pre-procedural, multiphasic cardiac CT-based left (LV) and right ventricular (RV) long axis strain (LAS) for mortality in patients undergoing transcatheter aortic valve replacement (TAVR).*Methods and Materials One hundred and seventy-five patients (78.8 ± 8.9 years) with severe aortic stenosis who had previously undergone TAVR were retrospectively evaluated in this 24-months follow up study. Mortality was the primary endpoint. Pre-TAVR CTAs with 10-100% phases were analyzed in 4-chamber view. For LV-LAS, the distance between the epicardial border of the LV apex and the middle of the mitral plane was measured in both endsystole and enddiastole. For RV-LAS, the distance between the LV apex and the middle of the tricuspid plane was measured. LAS was then computed by LAS= ([lengthendsystole - lengthenddiastole)] / lengthenddiastole) x 100. ROC curve analysis was performed to acquire the optimal cutoff for LV-LAS and RV-LAS and these were then divided into normal or abnormal LAS. Survival analysis was done to obtain hazard ratios (HR) and Harrell's c-index was used to evaluate risk models. LV-LAS and RV-LAS were each adjusted for the Society of Thoracic Surgeons (STS) score for mortality currently used to risk stratify TAVR patients.*Results Median follow-up was 21 months. There were 38 deaths (22%). The optimal cutoffs for LV-LAS and RV-LAS were -9.0% and -11.4%, respectively. Abnormal LV-LAS (HR 2.8; 95% CI 1.2-6.6; p=0.022) and RV-LAS (HR 2.7; 1.3-5.6; p=0.008) were independently associated with mortality after adjustment for variables predictive on univariable analysis and LV and RV ejection fraction. When adjusted for the STS risk score, LV-LAS (HR 3.4; 1.5-7.7; p=0.004) and RV-LAS (HR 2.4; 1.2-4.8; p=0.016) remained significantly predictive. C-indices for LV-LAS and RV-LAS were 0.624 and 0.640, respectively. Adding LV-LAS and RV-LAS to the STS score significantly improved its c-index from 0.636 to 0.684 for prediction of mortality.*Conclusions Pre-TAVR, LV-LAS and RV-LAS independently predict post-TAVR mortality beyond ventricular ejection fraction and improve the current clinical risk-stratifying tool.*Clinical Relevance/Application CTA-based left and right ventricular longitudinal strain have the potential to improve risk stratification and post-treatment surveillance in patients undergoing TAVR.

RESULTS

Median follow-up was 21 months. There were 38 deaths (22%). The optimal cutoffs for LV-LAS and RV-LAS were -9.0% and -11.4%, respectively. Abnormal LV-LAS (HR 2.8; 95% CI 1.2-6.6; p=0.022) and RV-LAS (HR 2.7; 1.3-5.6; p=0.008) were independently associated with mortality after adjustment for variables predictive on univariable analysis and LV and RV ejection fraction. When adjusted for the STS risk score, LV-LAS (HR 3.4; 1.5-7.7; p=0.004) and RV-LAS (HR 2.4; 1.2-4.8; p=0.016) remained significantly predictive. C-indices for LV-LAS and RV-LAS were 0.624 and 0.640, respectively. Adding LV-LAS and RV-LAS to the STS score significantly improved its c-index from 0.636 to 0.684 for prediction of mortality.

CLINICAL RELEVANCE/APPLICATION

CTA-based left and right ventricular longitudinal strain have the potential to improve risk stratification and post-treatment surveillance in patients undergoing TAVR.

SSCA07-2   Feasibility And Comparison Of Resting Full-cycle Ratio And CT Fractional Flow Reserve In Patients With Relevant Aortic Valve Stenosis

Participants
Marcel Langenbach, MD, Cologne, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Data on the evaluation of either CT-derived fractional flow reserve (CT-FFR) or resting full-circle ration (RFR) in patients with severe aortic valve stenosis (AS) undergoing transcatheter aortic valve replacement (TAVR) are unknown. Therefore, purpose of the present study was to evaluate the diagnostic performance of CT-FFR derived from TAVR-planning CT compared to invasive RFR in patients with relevant AS and intermediate coronary stenosis.*Methods and Materials The study included patients with relevant AS undergoing ICA with pressure wire assessment and routine contrast enhanced pre-TAVR CTA without an additional coronary CTA. CT-FFR analysis were performed using on-site CT-FFR software (Siemens Healthineers, Inc) by two experienced CT angiographers.*Results 41 patients with 46 coronary lesions were investigated using RFR and CT-FFR. The mean age of the subjects was 80.1 ± 6.2 years. Of these patients, 21 (51.2%) were female. No complication during CTA or pressure wire assessment were observed. The RFR showed a significant correlation with CT-FFR (Pearson correlation coefficient, R =0.76, p<0.001). On a per-patient basis, diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV), and negative

predictive (NPV) value of CT-FFR were 84.8% (Sensitivity, 95% CI?=?71.1; 93.7), 72.7% (Specificity, 95% CI?=?49.8%; 89.3%), 95.8% (PPV, 95% CI?=?78.9%; 99.9%), 94.1% (NPV, 95% CI?=?69.8; 99.1), and 79.3% (PPV, 95% CI?=?65.8; 88.4), respectively. The optimal CT-FFR cut-off value for RFR =0.89 prediction was 0.795. Per-patient receiver operator curve using RFR = 0.89 as the reference standard analysis showed a larger area under the curve (AUC) for CT-FFR 0.91 (95% CI 0.83-0.99) compared with that for CTA >50% 0.56 (95% CI 0.40-0.73) and CTA >70% 0.72 (95% CI 0.56-0.87).*Conclusions CT-FFR assessed by routine pre-TAVR CTA is a safe and feasible method showing a significant correlation with invasive RFR in patients with relevant AS. Diagnostic accuracy of CT-FFR is superior to analysis of the coronary arteries in ICA, and percentage stenosis grading in CTA >50% and >70% in assessing the hemodynamic relevance of coronary lesions in patients with relevant AS.*Clinical Relevance/Application CT-FFR derived from routing pre-TAVR CTA in patients with relevant AS can be used for non-invasive assessment of the hemodynamic relevance of coronary lesions with the potential to reduce unnecessary pre-TAVR ICA in the present of intermediate coronary stenosis.

RESULTS

41 patients with 46 coronary lesions were investigated using RFR and CT-FFR. The mean age of the subjects was 80.1 ± 6.2 years. Of these patients, 21 (51.2%) were female. No complication during CTA or pressure wire assessment were observed. The RFR showed a significant correlation with CT-FFR (Pearson correlation coefficient, R =0.76, p<0.001). On a per-patient basis, diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive (NPV) value of CT-FFR were 84.8% (Sensitivity, 95% CI?=?71.1; 93.7), 72.7% (Specificity, 95% CI?=?49.8%; 89.3%), 95.8% (PPV, 95% CI?=?78.9%; 99.9%), 94.1% (NPV, 95% CI?=?69.8; 99.1), and 79.3% (PPV, 95% CI?=?65.8; 88.4), respectively. The optimal CT-FFR cut-off value for RFR =0.89 prediction was 0.795. Per-patient receiver operator curve using RFR = 0.89 as the reference standard analysis showed a larger area under the curve (AUC) for CT-FFR 0.91 (95% CI 0.83-0.99) compared with that for CTA >50% 0.56 (95% CI 0.40-0.73) and CTA >70% 0.72 (95% CI 0.56-0.87).

CLINICAL RELEVANCE/APPLICATION

CT-FFR derived from routing pre-TAVR CTA in patients with relevant AS can be used for non-invasive assessment of the hemodynamic relevance of coronary lesions with the potential to reduce unnecessary pre-TAVR ICA in the present of intermediate coronary stenosis.

SSCA07-3   Pre-Procedural CTA-based Left Atrial Function Independently Predicts Mortality In Transcatheter Aortic Valve Replacement

Participants
Gilberto Aquino, MD, Charleston, South Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To assess the predictive value of pre-procedural, multiphasic cardiac CT-based left atrial (LA) volume (LAV) and function for all-cause mortality in patients undergoing transcatheter aortic valve replacement (TAVR).*Methods and Materials One hundred and seventy-five patients (78.8 ± 8.9 years) with severe aortic stenosis who had previously undergone TAVR were retrospectively evaluated. All-cause mortality was the primary endpoint over a 24-month follow up period. Pre-TAVR CTAs with 10-100% phases were analyzed using the area-length method to measure maximum and minimum LAV in 2-chamber and 4-chamber views, and indexed LAV (LAVI = LAV/BSA) were then used. LA emptying fraction (LAEF) was obtained as (LAVmax-LAVmin)/LAVmax. LAVI and LAEF were divided into quintiles for analysis. Cox regression was performed for survival analysis to obtain hazard ratios (HR) and Harrell's c-index was used to evaluate risk models. LAV and LAEF were each adjusted for the Society of Thoracic Surgeons (STS) score for mortality currently used to risk stratify TAVR patients.*Results Median follow-up was 21 months. There were 38 deaths (22%). LAEF (HR 0.69; 95% CI 0.49-0.97; p=0.035; per quintile) was independently associated with mortality after adjustment for variables predictive on univariable analysis. LAVImax (HR 1.25; 0.93-1.69; p=0.147; per quintile) and LAVImin (HR 1.35; 0.90-2.03; p=0.147; per quintile) were not significant when adjusted for all of these confounders. When adjusted for the STS risk score, LAVImax (HR 1.32; 1.04-1.69; p=0.025), LAVImin (HR 1.42; 1.10-1.84; p=0.007), and LAEF (HR 0.73; 0.57-0.94; p=0.016) were significantly predictive for mortality. LAVImax, LAVImin, and LAEF had a c-index of 0.633, 0.668, and 0.667 for prediction of death, respectively, while STS score had a c-index of 0.636. Adding LAEF to the STS score significantly improved its c-index to 0.700 for prediction of mortality.*Conclusions Pre-TAVR, CTA-based LA volume and LA emptying fraction independently predict mortality post-TAVR and improve the current clinical risk-stratifying tool.*Clinical Relevance/Application CTA-based LAV and LAEF have the potential to improve risk stratification and post-treatment surveillance in patients undergoing TAVR.

RESULTS

Median follow-up was 21 months. There were 38 deaths (22%). LAEF (HR 0.69; 95% CI 0.49-0.97; p=0.035; per quintile) was independently associated with mortality after adjustment for variables predictive on univariable analysis. LAVImax (HR 1.25; 0.93-1.69; p=0.147; per quintile) and LAVImin (HR 1.35; 0.90-2.03; p=0.147; per quintile) were not significant when adjusted for all of these confounders. When adjusted for the STS risk score, LAVImax (HR 1.32; 1.04-1.69; p=0.025), LAVImin (HR 1.42; 1.10-1.84; p=0.007), and LAEF (HR 0.73; 0.57-0.94; p=0.016) were significantly predictive for mortality. LAVImax, LAVImin, and LAEF had a c-index of 0.633, 0.668, and 0.667 for prediction of death, respectively, while STS score had a c-index of 0.636. Adding LAEF to the STS score significantly improved its c-index to 0.700 for prediction of mortality.

CLINICAL RELEVANCE/APPLICATION

CTA-based LAV and LAEF have the potential to improve risk stratification and post-treatment surveillance in patients undergoing TAVR.

SSCA07-5   Combined Coronary CT-angiography And TAVI-planning For Ruling-out Significant Coronary Artery Disease: Added Value Of Machine-learning Based CT-FFR

Participants
Robin Gohmann, MD, Leipzig, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To analyze the ability of machine learning (ML)-based CT-derived fractional flow reserve (CT-FFR) to further increase the diagnostic performance of coronary CTA (cCTA) for ruling-out significant Coronary artery disease (CAD) during pre-transcatheter aortic valve implantation (TAVI) evaluation in patients with a high pre-test probability for CAD.*Methods and Materials Overall, 460 patients (79.6±7.4 years) undergoing pre-TAVI CT were included and examined with an ECG-gated CT-scan of the heart and high-pitch-scan of the vascular access route. Images were evaluated for significant CAD. Patients routinely underwent invasive coronary

angiography (ICA) (388/460), which was omitted at the discretion of the local Heart Team if CAD could be effectively ruled out on cCTA (72/460). CT-examinations where CAD could not be ruled out (CAD+) (n=272) underwent additional ML-based CT-FFR.*Results ML-based CT-FFR was performed successfully in 79.4% (216/272) of all CAD+ patients and correctly reclassified 25 patients as CAD negative. CT-FFR was not feasible in 20.6% because of reduced image quality (37/56) or anatomical variants (19/56). Sensitivity, specificity, PPV, and NPV were 94.9%, 55.2%, 53.9%, and 95.2%, respectively. The additional evaluation with ML-based CT-FFR increased accuracy by ?+5.4% (CAD+: ?+9.7%) and raised the total number of exams negative for CAD to 44.1% (138/460).*Conclusions ML-based CT-FFR may further improve the diagnostic performance of cCTA by correctly reclassifying a considerable proportion of TAVI patients with morphological signs of CAD on cCTA.*Clinical Relevance/Application CAD is a frequent co-morbidity in patients undergoing TAVI. Current guidelines recommend its assessment prior to TAVI. If significant CAD can be excluded on cCTA, ICA may be omitted.Although cCTA is a very sensitive test, it is limited by relatively low specificity and positive predictive value, particularly in high-risk patients. CT-FFR has the potential to improve the specificity and PPV of cCTA and to further reduce the need for ICA in this challenging elderly patient group prior to TAVI.

RESULTS

ML-based CT-FFR was performed successfully in 79.4% (216/272) of all CAD+ patients and correctly reclassified 25 patients as CAD negative. CT-FFR was not feasible in 20.6% because of reduced image quality (37/56) or anatomical variants (19/56). Sensitivity, specificity, PPV, and NPV were 94.9%, 55.2%, 53.9%, and 95.2%, respectively. The additional evaluation with ML-based CT-FFR increased accuracy by ?+5.4% (CAD+: ?+9.7%) and raised the total number of exams negative for CAD to 44.1% (138/460).

CLINICAL RELEVANCE/APPLICATION

CAD is a frequent co-morbidity in patients undergoing TAVI. Current guidelines recommend its assessment prior to TAVI. If significant CAD can be excluded on cCTA, ICA may be omitted.Although cCTA is a very sensitive test, it is limited by relatively low specificity and positive predictive value, particularly in high-risk patients. CT-FFR has the potential to improve the specificity and PPV of cCTA and to further reduce the need for ICA in this challenging elderly patient group prior to TAVI.

SSCA07-6 Retrospectively Gated Cardiac CT For Predicting Left Ventricular Dysfunction Following Mitral Valve Repair: Comparison With Echocardiography

Participants
Prajwal Reddy, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Current guidelines emphasize prophylactic mitral valve repair based on echocardiographic left ventricular ejection fraction (LV, LVEF) and end systolic diameter (LVESD) cutoffs to prevent irreversible LV dysfunction. Coronary CTA (CCTA) has been shown to be a viable alternative to invasive coronary angiography for preoperative assessment of coronary artery disease in patients undergoing mitral repair. Retrospectively gated CCTA can provide the same indices of LV size and function as echocardiography but has not been validated for this purpose. We sought to compare CCTA and echocardiography as predictors of post-mitral-repair systolic dysfunction.*Methods and Materials In this IRB-approved study, we retrospectively identified 243 adult patients (>18 years old) with primary mitral valve regurgitation who underwent repair between 2008 and 2018. Inclusion criteria were availability of standard of care pre-operative echocardiography, pre-operative retrospectively-gated CCTA, and post-operative echocardiogram after 6-36 months. Exclusion criteria included greater than mild mitral regurgitation at echocardiographic follow-up and inadequate CT image quality. Several indices of LV size and function measured on CCTA were compared with echocardiography in terms of predicting post-operative LV systolic dysfunction (echocardiographic LVEF < 50%). Area under the receiver operating characteristic curve (AUC) was used as the primary metric. The effect of biometric indexing with respect to body surface area was evaluated.*Results The best CCTA predictors of post-operative LV systolic dysfunction were LVEF (AUC 0.84) and indexed LV end systolic volume (LVESVi; AUC 0.88) and the best echocardiographic predictors were LVEF (AUC 0.70) and LVESD (AUC 0.79; Figure 1). CCTA-derived LVEF was a significantly better predictor of post-operative LV systolic dysfunction than echocardiography-derived LVEF (p = 0.02). LVESVi was a significantly better predictor than echocardiographic LVESD (p = 0.03).*Conclusions Retrospectively gated CCTA is superior to echocardiography in predicting left ventricular systolic dysfunction following mitral valve repair.*Clinical Relevance/Application Risk stratification based on CCTA-derived measures of LV size and function may reduce the incidence of postoperative LV dysfunction.

RESULTS

The best CCTA predictors of post-operative LV systolic dysfunction were LVEF (AUC 0.84) and indexed LV end systolic volume (LVESVi; AUC 0.88) and the best echocardiographic predictors were LVEF (AUC 0.70) and LVESD (AUC 0.79; Figure 1). CCTA-derived LVEF was a significantly better predictor of post-operative LV systolic dysfunction than echocardiography-derived LVEF (p = 0.02). LVESVi was a significantly better predictor than echocardiographic LVESD (p = 0.03).

CLINICAL RELEVANCE/APPLICATION

Risk stratification based on CCTA-derived measures of LV size and function may reduce the incidence of postoperative LV dysfunction.

Abstract Archives of the RSNA, 2021

Sub-Events

SPR-MS-1   Association Of Language With Image Utilization In An Emergency Department

Participants
Youyun Zheng, BS,BA, BOSTON, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Patients with Limited English Proficiency (LEP) are frequently encountered in the Emergency Department (ED). We hypothesize that patients with LEP will experience increased imaging compared to patients without these limitations, controlling for similar chief complaints and demographic factors.*Methods and Materials This IRB-approved retrospective study included patient visits to an academic quaternary ED from April to August 2019 and accompanying imaging data for 4 imaging modalities (CT, X-ray, MRI, and ultrasound). Imaging utilization on a per-patient basis was tallied for each patient within a 24-hour timeframe from the time of arrival. LEP status is formally recorded as a flag in our electronic health record as patients "requiring interpreter". Multivariable linear regression models were then constructed to identify the association between LEP, other baseline clinical covariates, and demographic variables with imaging study utilization.*Results 35646 ED patient visits were included (M 51.5%, F 48.5%, age 50 ± 22.2). Interpreters were required at the point of care in 11.8% of these patient visits. In total, we identified 11136 CTs, 15860 X-rays, 2744 MRIs, and 1854 ultrasound imaging records connected to these ED visits, with 24.0%, 32.8%, 3.9%, and 5.0% patients having at least 1 scan of each of the modalities respectively. Patients with LEP received on average 9.4% more CT scans (mean 0.32 scan per patient) and 9.1% more X-rays (mean 0.44 X-ray per patient). Moreover, we found other variables significantly associated with more CT and X-ray imaging including an emergent arrival method, having abdominal pain or chest pain, and age. Our analysis did not find a significant association between LEP status and neither MRI nor ultrasound imaging.*Conclusions These findings highlight the need for interpreter services, provider training with those services, and improved patient-provider communication in the ED.*Clinical Relevance/Application Overutilization of imaging for patients with LEP due to ED inefficiencies can be costly for the patient and institution. Better training and access to language services can improve care for these patients.

RESULTS

35646 ED patient visits were included (M 51.5%, F 48.5%, age 50 ± 22.2). Interpreters were required at the point of care in 11.8% of these patient visits. In total, we identified 11136 CTs, 15860 X-rays, 2744 MRIs, and 1854 ultrasound imaging records connected to these ED visits, with 24.0%, 32.8%, 3.9%, and 5.0% patients having at least 1 scan of each of the modalities respectively. Patients with LEP received on average 9.4% more CT scans (mean 0.32 scan per patient) and 9.1% more X-rays (mean 0.44 X-ray per patient). Moreover, we found other variables significantly associated with more CT and X-ray imaging including an emergent arrival method, having abdominal pain or chest pain, and age. Our analysis did not find a significant association between LEP status and neither MRI nor ultrasound imaging.

CLINICAL RELEVANCE/APPLICATION

Overutilization of imaging for patients with LEP due to ED inefficiencies can be costly for the patient and institution. Better training and access to language services can improve care for these patients.

SPR-MS-10   Optimizing Windowing Of Pancreatic And Kidney Pathology On Dual Energy CT Using A Simplex Algorithm

Participants
Gili Dar, MD, Jerusalem, Israel (*Presenter*) Nothing to Disclose

PURPOSE

To determine optimal window settings for conspicuity of inflammatory pancreatic and kidney processes on 50keV low-monoenergetic images derived from dual-layer spectral detector CT images.*Methods and Materials Fifteen patients each with either clinically proven pancreatitis or pyelonephritis with foci of inflammation on Dual energy abdominal CT scans (30 patients total) were identified and selected to serve as reference populations. 50keV low-monoenergetic images in the portal venous phase were iteratively evaluated by 6 abdominal radiologists in multiple different windows (7-350 center; 120-580 width). Each reader graded the parenchymal hypodense lesions conspicuity on a scale of 1-5 (1- impossible, 2- poor, 3 - acceptable, 4 - good, 5 - optimal), as well as the overall image background quality on a scale of 1-3 (1 - poor, 2- acceptable, 3 - optimal). Simplex algorithm, an efficient mathematical tool for solving linear programing problems to optimize system parameters was used in order to determine optimal window settings for lesion conspicuity . Three-dimensional contour maps expressing the relationship between window setting and overall reader grade were constructed for both pancreas and kidney, as well as for overall background quality.*Results Convergence was achieved over 18 iterations over a total of 3780 reads (twenty-one windows setting x 6 readers x 30 cases). Optimal conspicuity (grade >4.5±0.04) of hypodense pancreas parenchymal lesions ranged from 100-145 center over 420-460 width, whereas hypodense pyelonephritis foci had optimal conspicuity with a center ranging 160-260 and width 420-450. Optimal visualization of background structures was optimal at a lower 50-150 center maintaining a 400-540 width. An ideal range for visualizing both pancreas and kidney lesions together were 150/440 (>4±0.18), substantially higher than manufacturer recommended settings of 60/400 (center/width).*Conclusions 50keV low monoenergetic images require specific window setting to achieve optimal visualization of pathology in different abdominal organs. Simplex optimization may offer a robust method to tailor

settings to enable better lesion conspicuity compared to default window settings potentially improving diagnostic accuracy.*Clinical Relevance/Application We demonstrate the need and provide a robust method for organ-specific optimization of window settings to improve parenchymal lesion conspicuity and visualization at CT. Simplex algorithm optimization can be a powerful tool for tailored optimal default window setting definition for many diagnostic applications.

RESULTS

Convergence was achieved over 18 iterations over a total of 3780 reads (twenty-one windows setting x 6 readers x 30 cases). Optimal conspicuity (grade >4.5±0.04) of hypodense pancreas parenchymal lesions ranged from 100-145 center over 420-460 width, whereas hypodense pyelonephritis foci had optimal conspicuity with a center ranging 160-260 and width 420-450. Optimal visualization of background structures was optimal at a lower 50-150 center maintaining a 400-540 width. An ideal range for visualizing both pancreas and kidney lesions together were 150/440 (>4±0.18), substantially higher than manufacturer recommended settings of 60/400 (center/width).

CLINICAL RELEVANCE/APPLICATION

We demonstrate the need and provide a robust method for organ-specific optimization of window settings to improve parenchymal lesion conspicuity and visualization at CT. Simplex algorithm optimization can be a powerful tool for tailored optimal default window setting definition for many diagnostic applications.

SPR-MS-12   Role Of Cervical Spine Multi Detector Computed Tomography With The Assessment Of Paraspinal Fat Pad And Additional Parameters In Detecting Ligament, Intervertebral Disc, And Spinal Cord Injury In Adult Obtunded Suspected Cervical Spine Injury Patient

Participants
Pradeep Roul, MBBS, Rishikesh, India (*Presenter*) Nothing to Disclose

PURPOSE

To assess the diagnostic accuracy of masking of paraspinal fat pad (PFP) in only disco-ligamentous injury in cervical spine injury (CSI) and its comparison with prior defined cut-off of various measurements. We try to look for any significant correlation of masking of PFP and spondylolisthesis with posterior ligament complex (PLC), anterior and posterior longitudinal ligament injury and spinal cord signal changes. We also investigated whether there is significant correlation of grade of isolated reduction and angle of posterior widening of intervertebral disc (IVD) with disc injury.*Methods and Materials This prospective work enrolled 1045 patients after taking institutional ethical clearance and consent from legal guardian. Contraindication to MRI or previous surgery in cervical spine region was our exclusion criteria. Masking of PFP was graded from 0 to IV based on percentage of masked PFP volume; 0- no, I - 0-25 %, II - 26-50%, III - 51-75 %, and IV - 76-100%. Facet joint subluxation was graded from 0 to VI based on the percentage of articular surface in contact; 0- 100 %, I - 76-100 %, II - 51-75 %, III- 26-50 %; IV- 1-25 %, V- perched, and VI-locked facet joint. Angle of posterior widening of IVD and facet joint distance was measured in mid sagittal plane. For grading of spondylolisthesis, we used Meyerding Classification. The grade of reduction was graded from 0 to IV based upon percentage of reduction of IVD height in comparison to mean of just above and below IVD; 0= no reduction, 1= 1-25 %, 2= 26-50 %, 3=61-75 % and 4 = 75-100 % reduction. Patient was followed up after 4-6 weeks of institutional discharge.*Results Masking of PFP has sensitivity and specificity of around 87.5 % and 93.3 % respectively in detecting only disco-ligamentous injury (106 patients). Masking of PFP has significant associated with PLC injury (Odds ratio, 140.2, P<0.001). Grade = II of spondylolisthesis is associated with longitudinal ligament injury (odds ratio, 92.3, P<0.001) and spinal cord changes (odds ratio, 42.3, P<0.002). The angle of posterior widening more than 11 degree was associated with disc injury significantly (odds ratio, 32.3, P<0.01).*Conclusions Masking of paraspinal fat pad is has higher sensitivity, specificity and positive predictive value in detecting disc-ligamentous injury without any obvious bony or alignment abnormality in MDCT than various cervical spine measurements.*Clinical Relevance/Application 1. Masking of PFP can better guide of requirement of MRI cervical spine.2. Can predict ligament injury and help in further management in MRI contraindicated case.3. More confident CSI clearance with MDCT.

RESULTS

Masking of PFP has sensitivity and specificity of around 87.5 % and 93.3 % respectively in detecting only disco-ligamentous injury (106 patients). Masking of PFP has significant associated with PLC injury (Odds ratio, 140.2, P<0.001). Grade = II of spondylolisthesis is associated with longitudinal ligament injury (odds ratio, 92.3, P<0.001) and spinal cord changes (odds ratio, 42.3, P<0.002). The angle of posterior widening more than 11 degree was associated with disc injury significantly (odds ratio, 32.3, P<0.01).

CLINICAL RELEVANCE/APPLICATION

1. Masking of PFP can better guide of requirement of MRI cervical spine.2. Can predict ligament injury and help in further management in MRI contraindicated case.3. More confident CSI clearance with MDCT.

SPR-MS-13   'Disaster' CT - Validation Of An Abbreviated Whole Body Trauma CT Protocol For Use In Mass Casualty Incidents

Participants
Muhammad Israr Ahmad, MBBS, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

PURPOSE

In a Mass Casualty Incident (MCI), CT is and important tool for triage but can be a bottleneck to patient care. Improved scan efficiency allows more rapid patient throughput, helping more patients be assessed/treated. We propose that an abbreviated 'Disaster' whole body trauma CT (WBCT) protocol with minimal phases/reformats is an acceptable substitution for conventional WBCT in an MCI and is non-inferior for detecting acute traumatic injuries. This protocol expedites scanning/reformat creation and network traffic as less images are generated.*Methods and Materials This IRB-approved retrospective comparative study identified 10 complex trauma WBCT examinations. Only the required series (axial CT head, axial CT angiogram vertex to pelvis, sagittal reformat cervical spine) were isolated to a separate folder, anonymised, and interpreted by 4 fellowship-trained emergency radiologists (2 fellows, 2 staff) using speech-dictation and without time limit. Multi-planar reformat (MPR) creation was not permitted. Readers were blinded to clinical details, prior imaging and report/remaining series for index WBCT. Resultant reports were with compared with dictated reports for each WBCT and discrepancies documented. Missed findings were reviewed on reference CT and their likelihood of requiring immediate management determined. Data analysis was performed using appropriate quantitative/qualitative methods.*Results Across all readers, 92% of acute traumatic findings were detected (87% by fellows, 97%

by staff). Low grade cerebrovascular injury was the most common missed finding (n=10). Lack of MPRs may be contributory. Other missed findings included: intracranial hemorrhage (n=1), low grade solid organ injury (n=2 liver/n=1 spleen/n=3 kidney), hemoperitoneum (n=1), hemopneumothorax/lung contusion (n=4), cervical spine injury (n=2). Most missed injuries were low grade and would not require immediate treatment in an MCI. 9 false positive solid organ injury interpretations (n=7 kidney/n=2 spleen) were likely partly due to only arterial phase images being provided. Missed findings were more likely in fellows (2.5% v 1.25%) and false positives were more likely in staff (6.5% v 1.5%) suggesting experience with injury patterns impacts interpretation.*Conclusions An abbreviated 'Disaster' WBCT protocol, is non-inferior to standard protocol WBCT for detection of acute traumatic findings requiring immediate treatment in an MCI and may expedite patient triage. However, it is suboptimal for detection of low grade cerebrovascular injuries.*Clinical Relevance/Application Use of an abbreviated whole body trauma CT protocol in a mass casualty incident can expedite imaging without missing those injuries that require immediate treatment.

RESULTS

Across all readers, 92% of acute traumatic findings were detected (87% by fellows, 97% by staff). Low grade cerebrovascular injury was the most common missed finding (n=10). Lack of MPRs may be contributory. Other missed findings included: intracranial hemorrhage (n=1), low grade solid organ injury (n=2 liver/n=1 spleen/n=3 kidney), hemoperitoneum (n=1), hemopneumothorax/lung contusion (n=4), cervical spine injury (n=2). Most missed injuries were low grade and would not require immediate treatment in an MCI. 9 false positive solid organ injury interpretations (n=7 kidney/n=2 spleen) were likely partly due to only arterial phase images being provided. Missed findings were more likely in fellows (2.5% v 1.25%) and false positives were more likely in staff (6.5% v 1.5%) suggesting experience with injury patterns impacts interpretation.

CLINICAL RELEVANCE/APPLICATION

Use of an abbreviated whole body trauma CT protocol in a mass casualty incident can expedite imaging without missing those injuries that require immediate treatment.

SPR-MS-2   Radiological Findings In Victims Of Intimate Partner Violence On The Trauma Service - A Retrospective Analysis Of Two Level 1 Trauma Centers

Participants
Ellen Sun, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To identify and classify diagnostic imaging patterns of intimate partner violence (IPV) related injuries in patients presenting to the trauma service in the emergency departments (ED) based on anatomic location and mechanism of injury.*Methods and Materials We searched the trauma registry of two Level 1 trauma centers for adult patients reporting "abuse" over 3 and 5 years to identify IPV victims. Imaging and electronic medical records were then reviewed for the following information: type of abuse, demographics, type of injury, IPV/injury severity scores, days of hospitalization, level of inpatient care, and any previous or subsequent presentations for presumed IPV.*Results 29/18465 (0.2%) adult patients seen on trauma service had reported IPV. There were 26 females and 3 males (mean age 37, range 19-84). Majority of patients were Caucasian (20/29) and more than half had &9;psychiatric (55%) or substance use (52%) comorbidities. Blunt trauma (22/29) was more common than penetrating trauma (10/29) as the mechanism of injury; 3 patients had both injury types. Knife was used as a weapon in 80% of penetrating injuries. Craniofacial injuries were the most frequent (19/29), particularly midface soft tissue injuries (14/29). Thoracic injuries were the second most common (12/29), mainly rib fractures (7/12), followed by injuries to the upper and lower extremities, as well as the abdomen (11/29 each). No cervical spine fractures were observed in this cohort; however, 6 patients had either cervical soft tissue injury or ligamentous strain. Of the 3 patients with injury to the thoracolumbar spine, all had upper lumbar spine (L1 and L2) fractures. The average injury severity scale was 11.6 with 28/29 patients scoring grade 3 or 4 on the IPV severity grading scale. Average hospital stay was 5.5 days. Eight patients required ICU-level care and the average ICU stay was 3.9 days. 45% (13/29) of patients reported prior history of IPV. Four patients had prior ED presentations for IPV or suspected IPV. In all cases, the reported injuries were less severe than the index presentation.*Conclusions Despite its high prevalence, IPV remains underreported in patients presenting to trauma service in the ED. While craniofacial injuries dominate, thoracoabdominal, extremity and spinal injuries can also be the manifestations of IPV.*Clinical Relevance/Application IPV is not restricted to superficial bruises and contusions but can lead to severe multiorgan and life-threatening injuries. Early detection and intervention are critical to avoid escalating cycle of abuse and injuries. Our goal with this work is to create awareness of severity of IPV injuries.

RESULTS

29/18465 (0.2%) adult patients seen on trauma service had reported IPV. There were 26 females and 3 males (mean age 37, range 19-84). Majority of patients were Caucasian (20/29) and more than half had &9;psychiatric (55%) or substance use (52%) comorbidities. Blunt trauma (22/29) was more common than penetrating trauma (10/29) as the mechanism of injury; 3 patients had both injury types. Knife was used as a weapon in 80% of penetrating injuries. Craniofacial injuries were the most frequent (19/29), particularly midface soft tissue injuries (14/29). Thoracic injuries were the second most common (12/29), mainly rib fractures (7/12), followed by injuries to the upper and lower extremities, as well as the abdomen (11/29 each). No cervical spine fractures were observed in this cohort; however, 6 patients had either cervical soft tissue injury or ligamentous strain. Of the 3 patients with injury to the thoracolumbar spine, all had upper lumbar spine (L1 and L2) fractures. The average injury severity scale was 11.6 with 28/29 patients scoring grade 3 or 4 on the IPV severity grading scale. Average hospital stay was 5.5 days. Eight patients required ICU-level care and the average ICU stay was 3.9 days. 45% (13/29) of patients reported prior history of IPV. Four patients had prior ED presentations for IPV or suspected IPV. In all cases, the reported injuries were less severe than the index presentation.

CLINICAL RELEVANCE/APPLICATION

IPV is not restricted to superficial bruises and contusions but can lead to severe multiorgan and life-threatening injuries. Early detection and intervention are critical to avoid escalating cycle of abuse and injuries. Our goal with this work is to create awareness of severity of IPV injuries.

SPR-MS-4   Reduced Rate Of Brain Waste Clearance For TBI Patients: Glymphatic Function Assessed Via MRI Within A Short Time

Participants
Xiao Wang, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Dementia is commonly observed in traumatic brain injury (TBI) patients, however, there is no consensus on the exact mechanism of

how TBI promotes susceptibility to the development of dementia. Recent studies have shown that the glymphatic function was significantly affected in TBI mice. In this work, the TBI glymphatic function was assessed via MRI within a short time (1 hour) by measuring the rate of brain waste clearance.*Methods and Materials This study includes 16 TBI patients (5 females, mean age = 38, SD =3.7; rang 25-67 years) & 7 relative healthy controls (6 females, mean age=41, SD=2.5; rang 40-62) with no history of TBI. All the MRI experiments were performed on a 3.0 T Prisma scanner (Siemens, German) with a 64-channel head coil. Participants were instructed to keep awake during the scan on head first supine position. 3D high resolution T1 weighted brain images were obtained three times with 20 min intervals using MP2RAGE sequences after 4 hours lumbar intrathecal injections of gadolinium. Along the pathway of cerebrospinal fluid propagation, 4 regions(inferior frontal gyrus, parahippocampal gyrus, thalamus, Pons)in each hemisphere were predefined using standard atlas. The signal intensity of CSF nearby above regions was extracted for analyses. The rate of T1 signal change of two time points was simply calculated using the following equations $R2=(S2-S1)/S1$ & $R3=(S3-S1)/S1$, where Ri is the rate & Si is the signal intensity of corresponding time point.*Results As shown in Fig.1, significantly higher signal change rates were observed in 7 predefined CSF ROIs in TBI patients compared to controls within 1 hour scan after 4 hour injection gadolinium. The TBI patients show relatively slow clearance ability of gadolinium tracer for almost all predefined CSF regions.*Conclusions Besides previously reported the delayed enhancement after 24 hours injection of tracer, this work proved the glymphatic dysfunction can be assessed by signal intensity dynamic change rate within 20 min after 4 hour injection of the tracer as well. The deduced rate of tracer clearance in TBI patients may reflect damage of brain glymphatic system.*Clinical Relevance/Application The glymphatic impairment may cause the following dementia in TBI patients. The proposed rate of brain waste clearance in short time could be used as a novel biomarker to assess the glymphatic function.

RESULTS

As shown in Fig.1, significantly higher signal change rates were observed in 7 predefined CSF ROIs in TBI patients compared to controls within 1 hour scan after 4 hour injection gadolinium. The TBI patients show relatively slow clearance ability of gadolinium tracer for almost all predefined CSF regions.

CLINICAL RELEVANCE/APPLICATION

The glymphatic impairment may cause the following dementia in TBI patients. The proposed rate of brain waste clearance in short time could be used as a novel biomarker to assess the glymphatic function.

SPR-MS-5   Relationship Of Systemic And Pulmonary Thromboembolic Complications With The Severity Of Pulmonary Parenchymal Disease In COVID-19

Participants
Ali Elmokadem, MD,PhD, Mansoura, Egypt (*Presenter*) Nothing to Disclose

PURPOSE

To correlate thromboembolic (TE) complications secondary to COVID-19 with the extent of the pulmonary parenchymal disease using CT or CXR severity scores and other comorbidities. *Methods and Materials The final study cohort consisted of 144 patients after exclusion of 10 patients with non-diagnostic CT pulmonary angiography. Patients were classified into two groups based on the presence or absence of thromboembolic complications. The TE group included 40 patients with a mean age of 59.6±9.8 while the non-TE group included 104 patients with a mean age of 55.3±12.4. Thromboembolic complications were categorized based on location. Chest CT was used to assess the pulmonary parenchymal disease severity in 120 patients and CXR in 24 patients.*Results Thromboembolic complications were detected in 40 patients (27.7%). Patients with BMI>30 kg/m2 or having a history of smoking and HTN were found more frequently in the TE group (p<0.05). Patients admitted to ICU were significantly higher in the TE group (p =0.001). There was no statistically significant difference (p>0.05) in chest CT-SS between the TE group (25.4±8.4) and non-TE group (22.6±5.5), and CXR-SS between the TE group (11.8±4.7) and non-TE group (8.9±5.1). The percentage of moderate and severe parenchymal disease in the TE group was significantly higher compared to the non-TE group (p<0.05). Severe parenchymal disease, BMI>30kg/m2, smoking, and HTN had a higher and more significant odds ratio for developing TE complications.*Conclusions The present data suggest that severe pulmonary parenchymal disease secondary to COVID-19 associated with a higher incidence of thromboembolic complications.*Clinical Relevance/Application • Relationship of thromboembolic complication with the pulmonary parenchymal disease in COVID-19 patients. • Assessment of pulmonary parenchymal disease severity using chest CT and X-ray severity scoring. • Relationship of thromboembolic complication with comorbidities in COVID-19 patients.

RESULTS

Thromboembolic complications were detected in 40 patients (27.7%). Patients with BMI>30 kg/m2 or having a history of smoking and HTN were found more frequently in the TE group (p<0.05). Patients admitted to ICU were significantly higher in the TE group (p =0.001). There was no statistically significant difference (p>0.05) in chest CT-SS between the TE group (25.4±8.4) and non-TE group (22.6±5.5), and CXR-SS between the TE group (11.8±4.7) and non-TE group (8.9±5.1). The percentage of moderate and severe parenchymal disease in the TE group was significantly higher compared to the non-TE group (p<0.05). Severe parenchymal disease, BMI>30kg/m2, smoking, and HTN had a higher and more significant odds ratio for developing TE complications.

CLINICAL RELEVANCE/APPLICATION

• Relationship of thromboembolic complication with the pulmonary parenchymal disease in COVID-19 patients. • Assessment of pulmonary parenchymal disease severity using chest CT and X-ray severity scoring. • Relationship of thromboembolic complication with comorbidities in COVID-19 patients.

SPR-MS-7   Predictive Value Of Textural And Hybrid Imaging Features In Comparison To Laboratory Parameters In Patients With Diffuse Large B-cell Lymphoma Undergoing Car T Cell Therapy: Preliminary Results

Participants
Christian Reinert, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the predictive value of textural and hybrid imaging features in comparison to laboratory parameters in patients with diffuse large B-cell lymphoma (DLBCL) undergoing chimeric antigen receptor (CAR) T cell therapy.*Methods and Materials We retrospectively analyzed whole-body metabolic tumor volume (MTV) and total lesion glycolysis (TLG) derived from 18F-FDG-PET/CT, the 1st order textural features mean, entropy, uniformity and skewness as well as laboratory parameters (C-reactive protein [CRP], lactate dehydrogenase [LDH], leucocytes) at baseline and after CAR T cell therapy in 21 patients with DLBCL (mean age 57.7±14.7 yr.; 7 female). The interleukin 6 (IL-6) and interleukin-2 receptor (IL-2R) peaks were monitored immediately after CAR T cell treatment onset and compared with patient outcome judged by follow-up 18F-FDG-PET/CT.*Results In 12/21 patients (57%), a

complete remission (CR) was observed after CAR T cell therapy, whereas 9/21 patients (43%) showed a partial remission (PR). At baseline 18F-FDG-PET/CT, the whole-body MTV and TLG were significantly lower in patients achieving CR (35±38 cm3 and 319±362) compared to patients achieving PR (88±110 cm3 and 1487±2254; p<0.05). At baseline, the "entropy" proved lower (1.81±0.09) and the "uniformity" higher (0.33±0.02) in patients with CR compared to PR (2.08±0.22 and 0.28±0.47; p<0.05). Concerning the laboratory parameters, patients achieving CR had lower CRP, LDH and leucocytes at baseline compared to patients achieving PR (p<0.05). In the entire patient cohort, the whole-body MTV (62±86 cm3 vs. 4±5 cm3) and whole-body-TLG (925±1722 vs. 33±59) significantly decreased after therapy onset (p<0.01) becoming not measurable in the CR-group. Correspondingly, the leucocytes (5348±2514 1/µl vs. 2954±2024 1/µl) and CRP (2.8±5.6 µg/dl vs. 0.1±0.2 µg/dl significantly dropped in the cohort after CAR T cell therapy (p<0.01). The IL-6 (867±951 ng/L vs. 9121±11266 ng/L) and IL-2R peaks (2483±1164 U/mL vs. 5548±3949 U/mL) after therapy were lower in patients with CR compared to PR without statistical significance (p>0.05).*Conclusions Tumor volumetric parameters derived from 18F-FDG-PET/CT and 1st order textural features are predictive for therapy response in patients with DLBCL undergoing CAR T cell therapy.*Clinical Relevance/Application CD19-CAR-T cell therapy leads to strong immunological response with T-cell activation and cytokine release.The intention of this study was to identify potential prognostic biomarkers for DLBCL response to CD19-CAR-T cell therapy both in the baseline setting and shortly after treatment onset using morphologic and metabolic imaging parameters including quantification of radiomic metrics as well as of serologic markers.

RESULTS

In 12/21 patients (57%), a complete remission (CR) was observed after CAR T cell therapy, whereas 9/21 patients (43%) showed a partial remission (PR). At baseline 18F-FDG-PET/CT, the whole-body MTV and TLG were significantly lower in patients achieving CR (35±38 cm3 and 319±362) compared to patients achieving PR (88±110 cm3 and 1487±2254; p<0.05). At baseline, the "entropy" proved lower (1.81±0.09) and the "uniformity" higher (0.33±0.02) in patients with CR compared to PR (2.08±0.22 and 0.28±0.47; p<0.05). Concerning the laboratory parameters, patients achieving CR had lower CRP, LDH and leucocytes at baseline compared to patients achieving PR (p<0.05). In the entire patient cohort, the whole-body MTV (62±86 cm3 vs. 4±5 cm3) and whole-body-TLG (925±1722 vs. 33±59) significantly decreased after therapy onset (p<0.01) becoming not measurable in the CR-group. Correspondingly, the leucocytes (5348±2514 1/µl vs. 2954±2024 1/µl) and CRP (2.8±5.6 µg/dl vs. 0.1±0.2 µg/dl significantly dropped in the cohort after CAR T cell therapy (p<0.01). The IL-6 (867±951 ng/L vs. 9121±11266 ng/L) and IL-2R peaks (2483±1164 U/mL vs. 5548±3949 U/mL) after therapy were lower in patients with CR compared to PR without statistical significance (p>0.05).

CLINICAL RELEVANCE/APPLICATION

CD19-CAR-T cell therapy leads to strong immunological response with T-cell activation and cytokine release.The intention of this study was to identify potential prognostic biomarkers for DLBCL response to CD19-CAR-T cell therapy both in the baseline setting and shortly after treatment onset using morphologic and metabolic imaging parameters including quantification of radiomic metrics as well as of serologic markers.

SPR-MS-8   Blinded Reader Validation Study For Generalizable Deep Learning Denoising Reconstruction (DLR) Throughout Multiple Anatomies At 1.5T And 3T

Participants
Shelton Caruthers, PhD, Cleveland, Ohio (*Presenter*) Employee, Canon Medical Systems Corporation

PURPOSE

The purpose is to evaluate, in a prospective, randomized, blinded, multi-reader study, the hypothesis that a generalizable DLR technique, as compared to predicates, can be effectively extended to multiple sub-anatomical regions at both 1.5T & 3T. Recently, a generalizable DLR technique, based on a convolutional neural network, was published (Magn Reson Med Sci. 2020; 19: 195) with the intended use—and hence validation—limited to brain and knee. Herein, we evaluate if it can be applied, without re-training, to additional anatomies including abdominal, cardiac, spinal, pelvic, and musculoskeletal systems.*Methods and Materials MR images of typical weightings were acquired in 112 subjects at 1.5T (52) and 3T (60) covering a range of sub-anatomies from the categories above. The raw image data were stored and reconstructed 4 times employing the DLR technique and 3 commonly preferred clinical post-processing filters. De-identified images were presented, in random order, to 16 blinded board-certified Radiologists or Cardiologists, 3 per anatomy, by their specialty. They scored the images by a modified 5-point Likert scale in 8 categories focused on either overall image quality metrics or anatomy-specific feature quality metrics, e.g., noise, sharpness, and diagnostic confidence. Additionally, reviewers force ranked each of the 4 reconstructions. Scoring data was visualized as mean of pooled reviewer scores. However, statistical analysis was performed on un-pooled data using generalized estimating equations (GEE).*Results The DLR technique performed well in anatomies tested. All datasets scored as clinically diagnostic. Pooling reviewer data, the average scores for DLR were consistently better than or equal to the clinical standard filters. On individualized GEE analysis—with 972 total comparisons of the filters across reviewers, anatomies, and categories—596 had DLR scoring better, 329 the same, and 47 lower than the standards. Considering only forced ranking results for reviewer preference, DLR was statistically best (or tied as best) at 1.5T for 12/18 (4/18) and at 3T for 5/18 (10/18) of the rankings. When averaged, reviewer rankings put DLR as best (or tied) in all anatomies.*Conclusions The DLR technique can be effectively extended to these anatomies for clinical use. When ranked on preference by the blinded reviewers, in anatomies and field strengths tested, the DLR technique was preferred, i.e., ranked statistically as best or tied as best, 86% of the time, with 1.5T showing slightly greater benefit than 3T.*Clinical Relevance/Application This deep learning denoising reconstruction can, without additional training, be applied effectively to multiple anatomies and, in blinded review, is often preferred over existing clinical imaging filters.

RESULTS

The DLR technique performed well in anatomies tested. All datasets scored as clinically diagnostic. Pooling reviewer data, the average scores for DLR were consistently better than or equal to the clinical standard filters. On individualized GEE analysis—with 972 total comparisons of the filters across reviewers, anatomies, and categories—596 had DLR scoring better, 329 the same, and 47 lower than the standards. Considering only forced ranking results for reviewer preference, DLR was statistically best (or tied as best) at 1.5T for 12/18 (4/18) and at 3T for 5/18 (10/18) of the rankings. When averaged, reviewer rankings put DLR as best (or tied) in all anatomies.

CLINICAL RELEVANCE/APPLICATION

This deep learning denoising reconstruction can, without additional training, be applied effectively to multiple anatomies and, in blinded review, is often preferred over existing clinical imaging filters.

SPR-MS-9   Diagnostic Accuracy Of Ultra-low-dose Chest CT Versus Chest X-ray In Patients Suspected Of Non-

traumatic Pulmonary Disease At The Emergency Department

Participants
Maadrika Kanglie, MD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic accuracy of ultra-low-dose chest computed tomography (ULDCT) with that of chest X-ray (CXR) in the detection of pulmonary diseases at the emergency department (ED).*Methods and Materials In the OPTIMACT trial, ED patients suspected of non-traumatic pulmonary disease were randomized to either ULDCT or CXR. A radiological diagnosis was made in a standardized manner by a radiologist at the ED. An independent panel used all patient record information until 28 days after ED presentation to assign a day 28 diagnosis as reference standard. The following diagnoses were included in the present analysis: pneumonia, bronchitis/bronchiolitis, diseases presenting with pulmonary congestion (decompensated heart failure, fluid overload (iatrogenic or in renal failure) or acute respiratory distress syndrome), pleural effusion, interstitial lung disease, and lung cancer and pulmonary metastases. Estimates of sensitivity and specificity of the initial ULDCT and CXR diagnosis against day 28 diagnosis were calculated and compared between imaging modalities with a Chi-square test.*Results In total 1161 ULDCT and 1151 CXR patients were included. ULDCT had a higher sensitivity for pneumonia and bronchitis/bronchiolitis compared to CXR: 91% (256/281) versus 81% (169/210), P<0.01 and 47% (57/121) versus 12% (14/116), P<0.01, respectively. ULDCT had a lower specificity for pneumonia and bronchitis/bronchiolitis compared to CXR: 92% (811/880) versus 96% (902/941) P<0.01 and 87% (905/1040) versus 95% (985/1035), P<0.01, respectively. ULDCT had a higher specificity for pulmonary congestion compared to CXR: 98% (1068/1090) versus 95% (984/1039), P<0.01. For other diagnoses no significant differences were found.*Conclusions ULDCT is more sensitive and less specific in detecting pneumonia and bronchitis/bronchiolitis compared to CXR. Furthermore, ULDCT is more specific in detecting pulmonary congestion compared to CXR. For the other pulmonary diseases at the ED, ULDCT and CXR have comparable diagnostic estimates.*Clinical Relevance/Application ULDCT could be considered as first line diagnostic imaging modality in case of suspected pneumonia or bronchitis/bronchiolitis at the ED.

RESULTS

In total 1161 ULDCT and 1151 CXR patients were included. ULDCT had a higher sensitivity for pneumonia and bronchitis/bronchiolitis compared to CXR: 91% (256/281) versus 81% (169/210), P<0.01 and 47% (57/121) versus 12% (14/116), P<0.01, respectively. ULDCT had a lower specificity for pneumonia and bronchitis/bronchiolitis compared to CXR: 92% (811/880) versus 96% (902/941) P<0.01 and 87% (905/1040) versus 95% (985/1035), P<0.01, respectively. ULDCT had a higher specificity for pulmonary congestion compared to CXR: 98% (1068/1090) versus 95% (984/1039), P<0.01. For other diagnoses no significant differences were found.

CLINICAL RELEVANCE/APPLICATION

ULDCT could be considered as first line diagnostic imaging modality in case of suspected pneumonia or bronchitis/bronchiolitis at the ED.

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SSGU03

Genitourinary (Prostate I)

Participants
Silvia D. Chang, MD, Vancouver, British Columbia (*Moderator*) Nothing to Disclose
Alice W. Fung, MD, Portland, Oregon (*Moderator*) Nothing to Disclose
Antonio Westphalen, MD, Kirkland, Washington (*Moderator*) Shareholder, BotImage Inc;Research funded, BotImage Inc

Sub-Events

SSGU03-2   A Randomized Controlled Trial On The Role Of MRI For Prostate Cancer Screening - Prostate Cancer Secondary Screening In Sapienza - PROSA: Preliminary Results

Participants
Emanuele Messina, MD, Roma, Italy (*Presenter*) Nothing to Disclose

PURPOSE

(I)To investigate the role of MRI with a bi-parametric approach (without injection of paramagnetic contrast medium), as a secondary prevention test for the early diagnosis of prostate cancer, comparing it with the serum PSA test. (II) Comparison of the different combination of screening tests in terms of carcinoma detection rate, non-clinically significant and clinically significant cancer detection rate*Methods and Materials Monocentric, prospective, interventional randomized controlled trial. 168 men have been enrolled and blindly randomized in two different arms. Arm a) 52 patients performed MRI with a bi-parametric approach (without contrast medium) regardless their PSA value; Arm b) 54 patients performed MRI with a bi-parametric approach (without contrast medium) due to elevated PSA (>4 ng/ml or 2.5 ng/ml if positive family history). 62 patients of the same arm did not undergo MRI due to normal PSA. 64 patients were enrolled as control group. Patients with positive MRI defined as bPI-RADS =3, were directed to MRI targeted prostate biopsy using the TRUS-MRI image fusion technique.*Results We found that about 30 % of patients from arm a had a bPI-RADS = 3 and were directed to prostate biopsy, among those 89% had clinically significant prostate cancer. Among patients in arm b about 40% were directed to biopsy, and 36% had clinically significant cancer. The difference in accuracy was statistically different (p<0.05). Specificity, sensitivity, PPV and NPV were calculated for both arms and TRUS/MRI fusion biopsy was considered the gold standard. Interreader agreement was excellent (k=0.863). Limited sample size due to in-itinere analysis of the trial*Conclusions Prostate MRI without contrast media injection showed promising results compared to PSA as screening tool in men between 49-69 years of age.*Clinical Relevance/Application The use of non-contrast MRI in the screening setting, will likely reduce the number of useless prostate biopsies.

RESULTS

We found that about 30 % of patients from arm a had a bPI-RADS = 3 and were directed to prostate biopsy, among those 89% had clinically significant prostate cancer. Among patients in arm b about 40% were directed to biopsy, and 36% had clinically significant cancer. The difference in accuracy was statistically different (p<0.05). Specificity, sensitivity, PPV and NPV were calculated for both arms and TRUS/MRI fusion biopsy was considered the gold standard. Interreader agreement was excellent (k=0.863). Limited sample size due to in-itinere analysis of the trial

CLINICAL RELEVANCE/APPLICATION

The use of non-contrast MRI in the screening setting, will likely reduce the number of useless prostate biopsies.

SSGU03-5   Reduction Of Acquisition Time Of T2-weighted Imaging Of The Prostate Using Deep Learning Image Reconstruction

Participants
Sebastian Gassenmaier, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Multiparametric MRI (mpMRI) of the prostate has become standard of care in prostate cancer evaluation. Recently, deep learning image reconstruction (DLR) methods have been introduced with promising results regarding scan acceleration. Therefore, the purpose of this study was to investigate the impact of DLR in T2-weighted TSE imaging of the prostate on acquisition time, image quality, diagnostic confidence, and PI-RADS T2 score and overall PI-RADS score as compared to standard T2 imaging.*Methods and Materials 51 patients for evaluation of prostate cancer using 3T mpMRI were prospectively enrolled in this institutional review board-approved study between October 2020 and February 2021. After acquisition of standard T2 TSE imaging (T2S), the novel T2 TSE sequence with DLR (T2DLR) was applied in three planes. Overall, TA for T2S resulted in 10:21 min versus 3:50 min for T2DLR, providing a reduction of acquisition time above 60%. Image evaluation was performed by two radiologists independently in a blinded random order using a Likert scale ranging from 1-4 (4 best) regarding the following criteria: noise levels, artifacts, overall image quality, diagnostic confidence, and lesion conspicuity. Additionally, T2 and PI-RADS scoring was performed.*Results Mean patient age was 68±8 years (range 49-84 years). Noise levels as well as extent of artifacts were evaluated to be significantly improved in T2DLR versus T2S by both readers (p<0.05). Overall image quality was also evaluated to be superior in T2DLR versus T2S in all three planes (p<0.001 for axial, p=0.002 for coronal, and p=0.001 for sagittal). Lesion conspicuity was rated by both readers with a median of 4 in T2DLR versus a median of 3 in T2S (p<0.001). Inter-reader agreement regarding T2 and PI-RADS scoring ranged from 0.806 (T2 scoring using T2S) to 0.952 (PI-RADS scoring using T2DLR).*Conclusions T2DLR of the prostate is feasible with

improvement of image quality and allows an acquisition time reduction of more than 60%.*Clinical Relevance/Application DLR might be the door opener for ultra-fast screening protocols.

RESULTS

Mean patient age was 68±8 years (range 49-84 years). Noise levels as well as extent of artifacts were evaluated to be significantly improved in T2DLR versus T2S by both readers (p<0.05). Overall image quality was also evaluated to be superior in T2DLR versus T2S in all three planes (p<0.001 for axial, p=0.002 for coronal, and p=0.001 for sagittal). Lesion conspicuity was rated by both readers with a median of 4 in T2DLR versus a median of 3 in T2S (p<0.001). Inter-reader agreement regarding T2 and PI-RADS scoring ranged from 0.806 (T2 scoring using T2S) to 0.952 (PI-RADS scoring using T2DLR).

CLINICAL RELEVANCE/APPLICATION

DLR might be the door opener for ultra-fast screening protocols.

SSGU03-6   Baseline Quantitative Prostate ADC Predicts Pathology And Immunohistochemistry Markers Of Response To Intense Neoadjuvant Androgen Deprivation Therapy In Localized High-risk Prostate Cancer Patients

Participants
Fiona Fennessy, MD,PhD, Brookline, Massachusetts (*Presenter*) Consultant, VirtualScopics, Inc

PURPOSE

Patients with high-risk localized prostate cancer (PCa) are at increased risk of recurrence and death from PCa. As part of a phase 2 trial investigating the impact of intense androgen deprivation (IAD) on pathologic complete response (pCR) after radical prostatectomy (RP) in high-risk PCa patients (NCT02903368), we evaluated whether baseline tumor ADC (tADC) values from prostate MRI can predict pCR to IAD and if they correlate with immunohistochemistry (IHC) markers of response to therapy.*Methods and Materials Inclusion criteria for the trial were a Gleason score =4+3=7, PSA >20 ng/mL or T3 disease on MRI. Patients were prospectively consented for 2 prostate MRIs, at baseline and after 6 cycles (1 cycle=28 days) of IAD, followed by RP. MR imaging used a non-ecoil PI-RADS protocol on a GE Signa HDx 3.0T magnet (GE Healthcare, WI). ADC values (x 10-6mm2/sec) were obtained from DWI (b0, 1400 s/mm2). Tumors were contoured on ADC maps using 3D Slicer (www.slicer.org). RP specimen review determined pCR or minimum residual disease (MRD, tumor =5 mm). Residual tumor IHC biomarkers of response (AR, Ki67 and PTEN/ERG expression) was determined. Paired t-test compared tADC pre/post-IAD and an independent t-test compared tADC in those with and without pCR/MRD. Spearmans's correlation measured association between residual tumor volume on MR and pathology. Kruskal-Wallis test compared tADC in those with pCR/MRD to those with Ki67, AR and PTEN/ERG positive staining status.*Results 69 patients (median age 61; median Gleason score 8; median PSA 8.61 ng/ml) had both MRIs and underwent RP. 17 patients had pCR/MRD. Baseline tADC (mean ± SD) was significantly lower compared to post-IAD (866±149 pre vs. 959 ±163 post; p<0.001). Baseline tADC was higher in those who had a pCR/MRD (961±184) vs. those without (834 ±122), p=0.015. Post-IAD tumor volume correlated with residual cancer at RP (r=0.49, P<0.0001). Baseline tADC differed between those with a pCR/MRD (no staining), Ki67 0-1% and Ki67 >1% staining, and also between those with a pCR, strong AR and moderate-weak AR staining. There was no evidence that tADC differed amongst PTEN/ERG status.*Conclusions Baseline tADC can predict pCR/MRD and IHC markers of response positivity to IAD in high-risk localized PCa patients. Post-IAD tumor volume correlates with pathological tumor volume.*Clinical Relevance/Application Baseline quantitative ADC can predict which high-risk prostate cancer patients will optimally respond to intense androgen deprivation, based upon pathological complete response and immunohistochemistry markers of response.

RESULTS

69 patients (median age 61; median Gleason score 8; median PSA 8.61 ng/ml) had both MRIs and underwent RP. 17 patients had pCR/MRD. Baseline tADC (mean ± SD) was significantly lower compared to post-IAD (866±149 pre vs. 959 ±163 post; p<0.001). Baseline tADC was higher in those who had a pCR/MRD (961±184) vs. those without (834 ±122), p=0.015. Post-IAD tumor volume correlated with residual cancer at RP (r=0.49, P<0.0001). Baseline tADC differed between those with a pCR/MRD (no staining), Ki67 0-1% and Ki67 >1% staining, and also between those with a pCR, strong AR and moderate-weak AR staining. There was no evidence that tADC differed amongst PTEN/ERG status.

CLINICAL RELEVANCE/APPLICATION

Baseline quantitative ADC can predict which high-risk prostate cancer patients will optimally respond to intense androgen deprivation, based upon pathological complete response and immunohistochemistry markers of response.

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Abstract Archives of the RSNA, 2021

Participants

Ioannis Sechopoulos, PhD, Nijmegen, Netherlands (*Moderator*) Research Grant, Siemens AG;Speakers Bureau, Siemens AG;Research Grant, Canon Medical Systems Corporation;Scientific Advisory Board, Fischer Medical;Research Grant, Sectra AB;Research Grant, ScreenPoint Medical BV;Research Grant, Volpara Health Technologies Limited

Srinivasan Vedantham, PhD, Tucson, Arizona (*Moderator*) Research collaboration, Koning Corporation;Research collaboration, General Electric Company

Sub-Events

SSPH09-1   Radiation Dose Estimates For A Novel Spiral Breast CT Imager

Participants
Sojin Shim, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

Our study aimed to estimate the amount of radiation dose irradiated to the breast during a novel breast computed tomography (CT) scan on 1,037 patients. By assessing the correlation of the radiation dose with the breast structural features, the CT breast dose could be predicted for individual breasts without a lengthy simulation.*Methods and Materials For the retrospective radiation dose analysis, 1,037 spiral breast CT images acquired using a fixed exposure setup (x-ray tube current=32mA) during opportunistic or diagnostic breast scans were used. The breast images were segmented by our automatic segmentation method (implemented specifically for breast CT images using in-house developed image processing algorithms) into four components: adipose tissue, glandular tissue, skin and pectoralis major muscle. The automatically segmented images were validated against reference human readings according to five experienced radiologists' evaluation in a five-point Likert scale, resulting in good agreement (good (4)-excellent (5)). The breast and skin volume and the breast density were measured as breast features on the segmented image and a Monte Carlo (MC) dose simulation was performed on the resulting dataset. The MC simulation was then validated by the CT dose index (CTDI) comparison to the measurement on a CTDI phantom using an ionization chamber. The mean absorbed dose in the breast (MAD), mean glandular dose (MGD), mean skin dose (MSD), max 5% glandular dose (MaxGD), and max 5% skin dose (MaxSD) were calculated based on the MC dose calculation. The five dose parameters were correlated to the breast features.*Results The breast volume had the highest correlation with the dose parameters. Each dose parameter was correlated to the breast volume in a mono- or bi-exponential model. 70% of breasts had a volume larger than 390cm3; for these breasts the average MAD, MGD, MSD, MaxGD, and MaxSD values were equal to 6.6±0.4, 6.3±0.4, 10.7±0.5, 10.3±0.8 and 19.3±0.6mGy, respectively. The corresponding values for the smaller 30% of breasts were 7.7±0.8, 7.3±0.7, 11.6±0.8, 12.2±0.7, and 20.2±1.1mGy.*Conclusions We established for the first time a radiation dose estimation model for spiral breast CT scans that requires only a simple breast volume measurement. Our study discovered that, with the current exposure setup for a medium-large breast, the opportunistic and diagnostic breast CT scan results in MGD values compatible to or lower than the dose limit for a two-view mammography screening on a medium-large breast mandated by the European commission (<6-13mGy).*Clinical Relevance/Application Individual breast's radiation dose can be prospectively estimated based on the volume of the breast. The exposure setup can be adjusted in advance depending on the breast size.

RESULTS

The breast volume had the highest correlation with the dose parameters. Each dose parameter was correlated to the breast volume in a mono- or bi-exponential model. 70% of breasts had a volume larger than 390cm3; for these breasts the average MAD, MGD, MSD, MaxGD, and MaxSD values were equal to 6.6±0.4, 6.3±0.4, 10.7±0.5, 10.3±0.8 and 19.3±0.6mGy, respectively. The corresponding values for the smaller 30% of breasts were 7.7±0.8, 7.3±0.7, 11.6±0.8, 12.2±0.7, and 20.2±1.1mGy.

CLINICAL RELEVANCE/APPLICATION

Individual breast's radiation dose can be prospectively estimated based on the volume of the breast. The exposure setup can be adjusted in advance depending on the breast size.

SSPH09-2   The Problem With Synthetic Minority Oversampling: A Case Study Using Contrast-enhanced Mammography Data

Participants
Avishek Chatterjee, Maastricht, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

For Machine Learning classification, it is traditional to use a training set that is balanced with respect to the modeled outcome, as this improves balance between sensitivity and specificity. To achieve balance, Synthetic Minority Over-sampling Technique (SMOTE) has gained popularity in Radiomics, a domain that has high feature dimensionality. We hypothesized that SMOTE increases the correlation between radiomic features and the outcome, which incorrectly inflates training set performance.*Methods and Materials The dataset comprised 525 contrast-enhanced mammograms (250 benign, 275 malignant), and 3259 derived radiomic features. It was randomly sampled to create a baseline balanced set (250 per class), and feature selection was performed. First, features with AUCs > 0.6 or 0.7 or 0.8 (loose, medium, or tight selection, respectively) were retained. Then, pairwise feature

elimination was performed: if two features were highly correlated with each other (|R|>0.9), the one with lower AUC was removed. From each discovery set, four levels of imbalanced sets were randomly sampled (2:1, 3:1, 4:1, 5:1), each level instantiated 100 times. Each imbalanced set was balanced ten times using SMOTE, to estimate average effect. Scatter plots were made of Spearman correlations (?) between radiomic features and the outcome at baseline (x-axis) and the same for SMOTE-d set (y-axis) and fit to y = mx. This slope m captures the factor by which correlation gets inflated; m (median and 95% range for 100 imbalance level instances) was compared between the four imbalance levels, and between the three feature dimensionalities.*Results For loose selection (146 features), m at 2:1 imbalance was 1.04 (95% range: 0.94-1.09), and at 5:1 imbalance was 1.07 (0.93-1.24). For medium selection (72 features), the corresponding slopes were 1.02 (0.93-1.08) and 1.05 (0.93-1.19). For tight selection (26 features), the corresponding slopes were 1.01 (0.94-1.06) and 1.05 (0.92-1.14).*Conclusions SMOTE increases the correlation between radiomic features and the outcome. The effect is worsened with increasing imbalance and increasing feature dimensionality. Training on SMOTE-d data causes inflated performance estimation.*Clinical Relevance/Application We showed the danger of using synthetic minority oversampling on high-dimensional features. Biomarkers created using oversampling should be subjected to increased scrutiny before clinical adaptation.

RESULTS

For loose selection (146 features), m at 2:1 imbalance was 1.04 (95% range: 0.94-1.09), and at 5:1 imbalance was 1.07 (0.93-1.24). For medium selection (72 features), the corresponding slopes were 1.02 (0.93-1.08) and 1.05 (0.93-1.19). For tight selection (26 features), the corresponding slopes were 1.01 (0.94-1.06) and 1.05 (0.92-1.14).

CLINICAL RELEVANCE/APPLICATION

We showed the danger of using synthetic minority oversampling on high-dimensional features. Biomarkers created using oversampling should be subjected to increased scrutiny before clinical adaptation.

SSPH09-3 A Large Retrospective Study Of Non-Compliance Findings At Half Yearly Medical Physics Tests Of Digital Mammography Devices (DM) Using A Vendor Neutral (European) Test Protocol

Participants
Hannelore Verhoeven, MSc, Leuven, Belgium (*Presenter*) Nothing to Disclose

PURPOSE

The national breast cancer screening program requires obligatory half yearly medical physics tests following the vendor neutral European protocol for mammography equipment. This study tallied and categorized protocol non-compliant findings for a cohort of digital mammography (DM) devices over time.*Methods and Materials All 131 DM devices used within the mammography network between 2016 and 2020 were included in this retrospective study. Data were analyzed from the Acceptance test until the end of 2020 (103 devices) or until end of service if prior to 2020 (28 devices). All devices also undergo daily QC in which image receptor uniformity and automatic exposure control (AEC) reproducibility are analyzed. A total of 1752 half yearly reports were reviewed for all faults flagged by medical physics QC. All remarks were categorized and marked as "severe" if they exceeded the levels in EU document RP162 on Acceptability Criteria i.e. 'suspension required if the issue would not be solved'.*Results In total, 472 faults were found, of which 144 were severe, but none resulted in detector replacement. The remarks were divided as follows: homogeneity: 119 (no severe remarks), alignment of the x-ray field: 81 (80 severe), compression: 69 (20 severe), AEC thickness compensation: 42 (35 severe), AEC reproducibility: 39, change in clinical settings: 29, dosimetry: 23, tube voltage error: 23 (1 severe), local dense area test: 14, low contrast detectability (LCD): 11 (8 severe), software problems: 7, noise: 3 and other issues 12. For 28 devices with complete lifetime analysis, most problems were found at Acceptance (25 remarks in the first 10% of life time of 28 devices) and remained approx. constant for the remaining device lifetime (13 issues per 10% of device lifetime). Compression, AEC and LCD problems tended to occur early on in the device lifetime while alignment problems were more frequent towards the end.*Conclusions Medical physics testing detected a significant number of problems, notwithstanding daily QC and the department's active involvement in many quality initiatives. Problems can occur over the entire device lifetime, and are more frequent early on.*Clinical Relevance/Application Continued on-site, half-yearly medical physics testing, as prescribed in the (European) guidelines, ensures DM systems remain within EU Acceptable Performance criteria.

RESULTS

In total, 472 faults were found, of which 144 were severe, but none resulted in detector replacement. The remarks were divided as follows: homogeneity: 119 (no severe remarks), alignment of the x-ray field: 81 (80 severe), compression: 69 (20 severe), AEC thickness compensation: 42 (35 severe), AEC reproducibility: 39, change in clinical settings: 29, dosimetry: 23, tube voltage error: 23 (1 severe), local dense area test: 14, low contrast detectability (LCD): 11 (8 severe), software problems: 7, noise: 3 and other issues 12. For 28 devices with complete lifetime analysis, most problems were found at Acceptance (25 remarks in the first 10% of life time of 28 devices) and remained approx. constant for the remaining device lifetime (13 issues per 10% of device lifetime). Compression, AEC and LCD problems tended to occur early on in the device lifetime while alignment problems were more frequent towards the end.

CLINICAL RELEVANCE/APPLICATION

Continued on-site, half-yearly medical physics testing, as prescribed in the (European) guidelines, ensures DM systems remain within EU Acceptable Performance criteria.

SSPH09-4 A Stationary Breast Tomosynthesis System Using A Two Dimensional Multiple X-ray Source Array With Thermionic Cathodes

Participants
John Boone, PhD, Sacramento, California (*Presenter*) Board of Directors, Izotropic Corporation;Shareholder, Izotropic Corporation;Co-author with royalties, Wolters Kluwer nv;Patent agreement, The Phantom Laboratory;In-kind support, Canon Medical Systems Corporation

PURPOSE

Current breast tomosynthesis systems use an x-ray source swept through an arc above the patient breast to acquire projection data. X-ray source motion during acquisition causes motion blurring, and the 4-25 second scan times can lead to patient motion. A stationary tomosynthesis system is proposed with multiple x-ray sources positioned in 2D above the patient's breast, enabling a sub-second scan times with no source motion.*Methods and Materials A 11 x-ray source array (MXA) was fabricated from molybdenum to produce 11 anode discs on a single long shaft. A rotor, stator, and bearings from commercial x-ray tubes were used to rotate the shaft. Eleven cathodes were fabricated using tungsten filaments and mounted into grid assemblies opposite the

anodes. The whole assembly was mounted in a custom-built vacuum chamber. The MXA was mounted 70 cm above a flat panel detector with 0.127 mm detector element spacing. Custom electronics were developed to allow independent source pulsing synchrony with the detector acquisition frames. The detector was translated between three different positions to simulate a 2D source array, creating 33 source positions 10 cm apart. A clutter phantom was manufactured to simulate the breast with two 2.5 cm layers of small plastic spheres inserted into a water phantom. Between the two clutter phantoms, a thin sheet of plastic with holes with 3 different diameters, allowing signal difference to noise ratios (SDNR) to be assessed. Image reconstruction was performed with a penalized weighted least squares approach with Huber regularization with cutoff at 0.0005/mm. A volume with 0.5x0.5x0.5 mm voxels was reconstructed by optimizing the cost function with projection data.*Results Images were reconstructed and the SDNR was measured for disk images from the test object plane between the clutter phantoms. For the central linear source array, the SDNR values were 2.5, 2.2, and 2.3 for the 3, 4, and 5 mm disks. For the two dimensional source array using all 33 source locations, the corresponding SDNR values were 7.0, 6.9 and 6.0, with an average improvement of a factor of 2.85 (sd: 0.27).*Conclusions The 2D source geometry demonstrated in this work will fundamentally improve breast tomosynthesis images while delivering more symmetric and thinner slice sensitivity profiles. Eliminating source motion combined with sub-second acquisition times will also reduce motion blurring and improve spatial resolution for breast tomo synthesis.*Clinical Relevance/Application The proposed 2D MXA breast tomosynthesis system has the potential to revolutionize breast cancer screening with dramatically improved tomosynthesis images.

RESULTS

Images were reconstructed and the SDNR was measured for disk images from the test object plane between the clutter phantoms. For the central linear source array, the SDNR values were 2.5, 2.2, and 2.3 for the 3, 4, and 5 mm disks. For the two dimensional source array using all 33 source locations, the corresponding SDNR values were 7.0, 6.9 and 6.0, with an average improvement of a factor of 2.85 (sd: 0.27).

CLINICAL RELEVANCE/APPLICATION

The proposed 2D MXA breast tomosynthesis system has the potential to revolutionize breast cancer screening with dramatically improved tomosynthesis images.

SSPH09-5　Breast Imaging Using Deep-Learning-Enhanced High Resolution, Whole Body, Photon-Counting-Detector CT

Participants
Nathan Huber, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Imaging of primary breast cancer is generally not performed with CT due to intrinsic spatial and contrast resolution limitations. We sought to determine if high-resolution (HR) CT breast imaging using a whole-body photon-counting-detector (PCD) CT system, combined with a dedicated deep-learning-based CT image denoising algorithm, might permit visualization of breast microcalcifications associated with breast cancer.*Methods and Materials An investigational whole-body PCD-CT scanner (NAEOTOM Alpha, Siemens Healthineers) was used to image a Mammography Quality Standards Act (MQSA) certified phantom in HR mode at our routine clinical dose for CT evaluation of breast implants (CTDIvol=15 mGy), both with the MQSA phantom suspended in air (no torso attenuation) and placed under an anthropomorphic phantom (realistic patient attenuation). All scans were reconstructed with a high-resolution kernel (Br84) to generate near-isotropic, 150 um voxels. Deep learning image processing was performed using an in-house Generalizable noise and Artifact Reduction NETwork (GARNET). One patient with history of breast cancer and clinically indicated breast MRI and mammographic exams was scanned under IRB in HR mode using a CTDIvol of 15 mGy. Acquired data were reconstructed and processed with the same settings as the MQSA phantom, and images were reviewed by an experienced breast radiologist with attention to the detection of calcifications. CT images were compared to the patient's prior mammographic exam.*Results When the MQSA phantom was scanned in air, 0.32 mm calcifications were clearly visible. When the MQSA phantom was scanned beneath an anthropomorphic phantom, the increased noise obscured the calcifications. Following GARNET image processing, noise in the MQSA phantom image was reduced by 74 % and 0.4 mm microcalcifications were visible. When tested on a patient exam, calcifications visualized on the HR PCD-CT images with GARNET processing matched those seen on the mammographic reference images.*Conclusions High resolution whole-body PCD-CT with deep learning GARNET image processing permitted visualization of breast calcifications in the MQSA phantom when using realistic attenuation levels and also in patient images.*Clinical Relevance/Application High resolution PCD-CT with deep learning image processing permits visualization of breast microcalcifications, expanding the potential role of CT in breast imaging beyond implant evaluation.

RESULTS

When the MQSA phantom was scanned in air, 0.32 mm calcifications were clearly visible. When the MQSA phantom was scanned beneath an anthropomorphic phantom, the increased noise obscured the calcifications. Following GARNET image processing, noise in the MQSA phantom image was reduced by 74 % and 0.4 mm microcalcifications were visible. When tested on a patient exam, calcifications visualized on the HR PCD-CT images with GARNET processing matched those seen on the mammographic reference images.

CLINICAL RELEVANCE/APPLICATION

High resolution PCD-CT with deep learning image processing permits visualization of breast microcalcifications, expanding the potential role of CT in breast imaging beyond implant evaluation.

SSPH09-6　Plug-and-play Reconstruction With Deep Learning Denoising For Improving Detectability Of Microcalcifications In Digital Breast Tomosynthesis Images

Participants
Mingjie Gao, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

We proposed a plug-and-play (PnP) algorithm for digital breast tomosynthesis (DBT) reconstruction to reduce noise and improve the conspicuity of microcalcifications (MCs) in DBT images.*Methods and Materials We followed the alternating direction method of multiplier (ADMM) algorithm as the framework and plugged in a pre-trained deep convolutional neural network (DCNN) denoiser as regularizer for PnP DBT reconstruction. We dropped the Lagrangian multiplier term for simplicity. We previously developed the DCNN denoisers and found them to be effective for denoising DBT images. To handle the wide range of noise levels for different DBTs to be denoised, we trained the denoisers with virtual phantom DBT images generated with VICTRE and MCGPU that had a variety of

breast thicknesses (range: 3.1 cm to 6.2 cm), densities (glandular volume fraction range: 5% to 60%), and x-ray exposures (a factor of 0.25 to 1.4 times the estimated AEC settings). We grouped the virtual DBT images according to the estimated noise levels and then trained one denoiser for each group, resulting in a set of 12 denoisers. The reconstruction algorithm estimated the image noise level at the current iteration and selected a denoiser trained for a similar noise level for deployment. We found that 3 ADMM iterations were needed. The PnP algorithm was evaluated with a physical phantom containing 622 MCs of three nominal diameters ranging from 0.150 to 0.250 mm, and 9 human subject DBT scans with a total of 301 marked MCs. The DBT scans had 9 projections with a 24º scan angle.*Results We calculated the contrast-to-noise ratio (CNR) and the detectability index (d') using the non-prewhitening matched filter model observer with eye filter for individual MCs. The PnP algorithm significantly (p<0.0001) improved the CNR by 45.6-84.3% and d' by 43.6-63.3% for the phantom MCs, and the CNR by 70.4% and d' by 50.5% on average for human MCs compared to the unregularized SART algorithm. The parenchymal patterns in the reconstructed images were visually satisfactory without patchy appearance.*Conclusions The PnP reconstruction regularized with DCNN denoiser has the potential to reduce noise, enhance subtle MCs, and improve the detectability of MCs for DBTs.*Clinical Relevance/Application The PnP reconstruction approach has the potential to reduce patient dose for DBT imaging and increase the sensitivity of MC detection for breast cancer screening.

RESULTS

We calculated the contrast-to-noise ratio (CNR) and the detectability index (d') using the non-prewhitening matched filter model observer with eye filter for individual MCs. The PnP algorithm significantly (p<0.0001) improved the CNR by 45.6-84.3% and d' by 43.6-63.3% for the phantom MCs, and the CNR by 70.4% and d' by 50.5% on average for human MCs compared to the unregularized SART algorithm. The parenchymal patterns in the reconstructed images were visually satisfactory without patchy appearance.

CLINICAL RELEVANCE/APPLICATION

The PnP reconstruction approach has the potential to reduce patient dose for DBT imaging and increase the sensitivity of MC detection for breast cancer screening.

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Participants

Arlene Sirajuddin, MD, Bethesda, Maryland (*Moderator*) Nothing to Disclose

U. Joseph Schoepf, MD, Charleston, South Carolina (*Moderator*) Research Grant, Bayer AGResearch Grant, Bracco GroupResearch Grant, Elucid BioImaging IncConsultant, Elucid BioImaging IncResearch Grant: General Electric CompanyResearch Grant, Guerbet SAResearch Grant, Heartflow, IncSpeakers Bureau, Heartflow IncResearc

Jacobo Kirsch, MD, Weston, Florida (*Moderator*) Medical Advisory Board, Zebra Medical Vision Ltd

Sub-Events

SSCA02-2   Optimal Protocol Selection Methodology To Quantify Coronary Stenosis In Cardiac CT Images

Participants

Mojtaba Zarei, MSc, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To utilize a patient-informed Estimability index (e') in a comprehensive multi-factorial platform to optimize CT imaging for coronary plaque and stenosis.*Methods and Materials An estimability index was formulated as a basis to ascertain the dependency of the coronary stenosis measurement accuracy across clinical parameters affecting cardiac CT acquisition and to use the dependencies to determine optimum protocols. Factors included rotation time, pixel size, kernel sharpness, noise magnitude, and patient specifications such as vessel radius, cardiac motion velocity, plaque, and lumen materials, as informed by the CT Angiography Biomarker initiative of the RSNA Quantitative Imaging Biomarker Alliance (QIBA). An algorithm was developed to systematically assess and determine optimized CT acquisition parameters that maximize e' for a given set of un-controllable patient attributes. The findings were validated using 170 cases from the cardiac CT PROMISE clinical trial in which the patient attributes and acquisition protocols complied with QIBA that had been categorized by users as either high- or low-quality. For each case, we calculated e' for the applied protocol and derived the discrimination threshold from the associated ROC curve. The model was then used to find adjustments to the acquisition protocol that would have rendered a more favorable e' for each case.*Results In > 98% of the cases, the optimized protocols resulted in a better e' than the initial protocol. More specifically, in 33% of low-quality cases, the model indicated that the images could have been obtained to achieve a higher quality image. In the remaining 67% of such cases, the low quality was constrained by the condition of the patient and not the imaging condition.*Conclusions We developed a tool that selects CT acquisition parameters based on optimal patient attributes for a precise evaluation of stenosis percentages in CTA images.*Clinical Relevance/Application The critical need for reliable management of heart disease can be met by a modeling approach that can predict the likelihood of accurate quantification of stenosis in CTA images.

RESULTS

In > 98% of the cases, the optimized protocols resulted in a better e' than the initial protocol. More specifically, in 33% of low-quality cases, the model indicated that the images could have been obtained to achieve a higher quality image. In the remaining 67% of such cases, the low quality was constrained by the condition of the patient and not the imaging condition.

CLINICAL RELEVANCE/APPLICATION

The critical need for reliable management of heart disease can be met by a modeling approach that can predict the likelihood of accurate quantification of stenosis in CTA images.

SSCA02-5   Coronary Calcium Scoring With First Generation Dual-source Photon-counting CT And Quantum Technology - Phantom And In-vivo Experience

Participants

Matthias Eberhard, MD, Unterseen, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To compare the accuracy of coronary artery calcium (CAC) scoring on a first generation dual-source photon-counting detector CT (PCD-CT) using monoenergetic reconstructions and Quantum Iterative Reconstruction (QIR).*Methods and Materials In this IRB-approved prospective study, we scanned an anthropomorphic chest phantom, optimized for spectral imaging, containing 9 calcification inserts. Sequential acquisition on a first generation PCD-CT with Quantum Technology (tube voltage, 120kV) was performed at four different image quality (IQ) levels (20, 40, 60 and 80) resulting in a CTDIvol of 1.97, 3.84, 6.44, and 8.58 mGy. Images were reconstructed with T3D (conventional 120kV reconstruction), 75keV, 70keV, 65keV, and 60 keV with filtered back projection (FBP) or various QIR strength levels (QIR 1-4). For reference, the same chest phantom was scanned on a single-source energy-integrating detector CT (sequential acquisition; tube voltage, 120kV; image reconstruction, FBP) with identical CTDIvol. Sequential PCD-CT scans for CAC scoring in 10 patients (mean age, 74±12 years; tube voltage, 120kV; IQ level 20; mean CTDIvol, 3.8±1.3 mGy) were reconstructed as detailed above. The Friedman test was used to assess differences between related samples.*Results Results: For the phantom study, there were no significant differences between CAC scores of different IQ levels (P=<.90). For IQ level 20, the reference CAC score of the phantom was 653 AU. In comparison, CAC scores for all image reconstructions were slightly lower with a relative difference of -2.8% (60keV, FBP; CAC score, 635 AU) to -20% (75keV, QIR at strength level 4; CAC score, 523 AU). Reconstructions with FBP had significantly higher CAC scores compared to QIR at strength

level 2-4 (all, P<.001). The patient study (median CAC score, 179 [inter-quartile range: 33-1049] at 60keV with FBP) confirmed relationships and differences between reconstruction algorithms (all, P<.001) with highest scores for FBP and lowest scores for QIR at strength level 4.*Conclusions First phantom and in-vivo experience of calcium scoring on a clinically used dual-source PCD-CT suggest reliable values for CAC scores using monoenergetic reconstructions.*Clinical Relevance/Application Our study shows the clinical applicability of CT calcium scoring using monoenergetic reconstructions on a first generation dual-source photon-counting detector CT with Quantum Technology.

RESULTS

Results: For the phantom study, there were no significant differences between CAC scores of different IQ levels (P=<.90). For IQ level 20, the reference CAC score of the phantom was 653 AU. In comparison, CAC scores for all image reconstructions were slightly lower with a relative difference of -2.8% (60keV, FBP; CAC score, 635 AU) to -20% (75keV, QIR at strength level 4; CAC score, 523 AU). Reconstructions with FBP had significantly higher CAC scores compared to QIR at strength level 2-4 (all, P<.001). The patient study (median CAC score, 179 [inter-quartile range: 33-1049] at 60keV with FBP) confirmed relationships and differences between reconstruction algorithms (all, P<.001) with highest scores for FBP and lowest scores for QIR at strength level 4.

CLINICAL RELEVANCE/APPLICATION

Our study shows the clinical applicability of CT calcium scoring using monoenergetic reconstructions on a first generation dual-source photon-counting detector CT with Quantum Technology.

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Sub-Events

SPR-IR-1 Interventional Optical Imaging Permits Instant Visualization Of Three Pathological Zones Of Ablated Tumor Periphery

Participants
Xuefeng Kan, MD,PhD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

To develop a real-time optical imaging (OI) technique for in-vivo visualization of the three distinct pathological zones of ablated tumors, and thereby allowing for instant detection of residual viable tumor during a single ablation session.*Methods and Materials This study included three phases: (1) optimizing protocol of indocyanine green (ICG) parameters to achieve high-quality ICG-based OI; (2) in-vitro evaluating functionality/sensitivity of the interventional OI system using VX2 tumor cells; and (3) in-vivo validating the technical feasibility of the new ICG-based interventional OI system to instantly visualize three pathological zones of ablated tumor periphery on rabbit orthotopic VX2 tumor models. For optimizing ICG protocol, 3×10^5 cells were labeled with various ICG concentrations (0 to 200 μg/mL) and different incubation times (0 min to 48 h). Fluorescence signal intensities (SI) of different cell groups were measured by optical/x-ray imaging. For in-vitro evaluation, we first built the interventional OI system, which was then used to differentiate 1.5-mm3 living ICG-treated cells (ICG-cells) from 1.5-mm3 dead ICG-cells. For in-vivo validation, sixteen rabbits with orthotopic hepatic tumors were divided into two groups: incomplete radiofrequency ablation (RFA) and complete RFA. The ICG-based interventional OI system was used to differentiate residual viable tumors at the transition zone and completely ablated tumors. The average signal-to-background ratios (SBRs) among the residual viable tumors, transition zone, and completely ablated tumors were quantitatively compared. Subsequent ex-vivo OI and pathologic correlation were performed to confirm the findings of interventional OI.*Results Of in-vitro experiments, the optimal concentration and time-window for ICG-based OI were 100 μg/mL at 24 hours. ICG SI of untreated living cells was significantly higher than dead cells (187.0 ± 9.4 au vs. 65.1 ± 4.0 au, p < 0.001). Of in-vivo experiments, the interventional OI visualized three distinct pathological zones of incompletely or completely ablated tumor peripheries. The average SBR of residual viable tumors from incomplete RFA was significantly higher than those from transition zone and completely ablated tumors (2.77 ± 0.32 vs. 1.41 ± 0.04 vs. 0.57 ± 0.05, p < 0.001). Findings of interventional OI were confirmed by both ex-vivo OI and pathology (Figure).*Conclusions Interventional OI permits in-vivo visualization of three distinct pathological zones of ablated tumor periphery, which thus enables to differentiate incomplete and completed tumor ablation.*Clinical Relevance/Application This capability may open new avenues for instantly guiding complete tumor eradication during a single interventional ablation session.

RESULTS

Of in-vitro experiments, the optimal concentration and time-window for ICG-based OI were 100 μg/mL at 24 hours. ICG SI of untreated living cells was significantly higher than dead cells (187.0 ± 9.4 au vs. 65.1 ± 4.0 au, p < 0.001). Of in-vivo experiments, the interventional OI visualized three distinct pathological zones of incompletely or completely ablated tumor peripheries. The average SBR of residual viable tumors from incomplete RFA was significantly higher than those from transition zone and completely ablated tumors (2.77 ± 0.32 vs. 1.41 ± 0.04 vs. 0.57 ± 0.05, p < 0.001). Findings of interventional OI were confirmed by both ex-vivo OI and pathology (Figure).

CLINICAL RELEVANCE/APPLICATION

This capability may open new avenues for instantly guiding complete tumor eradication during a single interventional ablation session.

SPR-IR-2 Development Of A Bioresorbable Mesenchymal Stem Cell-loaded Radiopaque Polymer To Improve Rates Of Arteriovenous Fistula Maturation And Long-term Patency

Participants
Joy Vanessa Perez, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To develop a bioresorbable, perivascular polymeric scaffold loaded with bone marrow-derived mesenchymal stem cells (MSCs) and test its efficacy in reducing neointimal hyperplasia (NIH) to the outflow vein of an arteriovenous fistula (AVF) in Sprague Dawley rats. A secondary goal was to assess the use of positron emission tomography (PET) in detecting inflammation following AVF creation.*Methods and Materials The perivascular scaffold wraps were fabricated by electrospinning method from a polymeric mixture of polycaprolactone and gold nanoparticles (Au-PCL). Allogenic MSCs were collected from the bone marrow of euthanized rats and were seeded at 100,000 cells per scaffold. Chronic kidney disease models in Sprague Dawley rats were created by subtotal nephrectomy. Four weeks thereafter, an end-to-side external jugular vein to common carotid artery AVF was created and confirmation of arterial flow through the fistula was confirmed by color Doppler ultrasound 2 weeks following creation. Rats were divided into 3 groups (N=2/group): control AVF (no wrap), Au-PCL (non-seeded wrap), and Au-PCL+MSC (wrap seeded with MSC). The wraps were applied to the outflow vein at the time of AVF creation. Four weeks post-AVF creation, animals underwent 18F-FDG PET imaging followed by necropsy and histomorphometric analysis of the outflow vein within 0.5 mm of the anastomosis.*Results Compared to controls, the addition of biodegradable perivascular wraps increased luminal area while

simultaneously decreasing the intima:lumen (I:L) and intima:media (I:M) ratios; the I:L and I:M ratios decreased 81.6% and 74.9% for the AVFs wrapped in Au-PCL alone and 89.6% and 89.1%, respectively, for the AVFs wrapped in Au-PCL+MSC. Relative to controls, PET imaging at 4 weeks demonstrated 16.9% reduction in SUVmax of the AVF wrapped with Au-PCL alone and 57.5% reduction of the AVF wrapped with Au-PCL+MSC.*Conclusions Addition of a bioresorbable polymer scaffold around the outflow vein of an AVF improved outward remodeling (i.e. luminal expansion and wall thickening), which is associated with AVF maturation. Inhibition of NIH, a key driver of AVF failure, was also observed. Appreciable PET signal suggests that the evaluation of local inflammation can potentially be used to assess AVF maturation and NIH outcomes.*Clinical Relevance/Application Neointimal hyperplasia (NIH) is responsible for failure of arteriovenous fistula (AVF) maturation in patients with chronic kidney disease on hemodialysis. Mesenchymal stem cells (MSCs) are anti-inflammatory and have been shown to reduce NIH formation, but their efficacy is limited by rapid washout. MSC delivery and survival can be achieved by loading them onto a radiopaque bioresorbable polymer scaffold wrapped around the outflow vein

RESULTS

Compared to controls, the addition of biodegradable perivascular wraps increased luminal area while simultaneously decreasing the intima:lumen (I:L) and intima:media (I:M) ratios; the I:L and I:M ratios decreased 81.6% and 74.9% for the AVFs wrapped in Au-PCL alone and 89.6% and 89.1%, respectively, for the AVFs wrapped in Au-PCL+MSC. Relative to controls, PET imaging at 4 weeks demonstrated 16.9% reduction in SUVmax of the AVF wrapped with Au-PCL alone and 57.5% reduction of the AVF wrapped with Au-PCL+MSC.

CLINICAL RELEVANCE/APPLICATION

Neointimal hyperplasia (NIH) is responsible for failure of arteriovenous fistula (AVF) maturation in patients with chronic kidney disease on hemodialysis. Mesenchymal stem cells (MSCs) are anti-inflammatory and have been shown to reduce NIH formation, but their efficacy is limited by rapid washout. MSC delivery and survival can be achieved by loading them onto a radiopaque bioresorbable polymer scaffold wrapped around the outflow vein

SPR-IR-3 Impact Of Chemo-Embolic Choice On The Tumor Microenvironment And Local Immune Response To Transarterial Chemoembolization In A VX2 Rabbit Liver Tumor Model

Participants
Antonia Berz, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

To characterize the impact of various chemoembolic regimens on immune response and immune checkpoint marker expression in the setting of transarterial chemoembolization (TACE) in a VX2 rabbit liver tumor model.*Methods and Materials Approved by the institutional animal care and use committee (IACUC), twenty-four VX2 tumor-bearing New Zealand White rabbits were assigned to seven groups (n=3/group) undergoing locoregional therapy as follows: A) bicarbonate (BC) infusion, B) conventional TACE (cTACE) with Lipiodol, drug-eluting bead (DEB)-TACE with either C) Idarubicin-loaded OncozeneTM microspheres (40μm) or D) Doxorubicin-loaded LUMITM beads (40-90μm). To each therapy arm (B-D), a separate group treated with additional BC infusion was added to evaluate the effect of pH modification on the immune response. Three untreated rabbits served as controls. Tissue was harvested 24h post-treatment, followed by digital immunohistochemistry quantification (APERIO ImageScope) of tumor-infiltrating CD3+ T-cells, HLA-DR+ antigen-presenting cells (APCs), and the CTLA-4, and PD-1/L1 pathway axis expression. Statistical analysis was performed using the Kruskal-Wallis test (p=0.05).*Results Treatment with LUMITM bead TACE induced more APC recruitment in the tumor core than OncozeneTM TACE (HLA-DR: p=0.0113) and more intra-tumoral T-cell and APC infiltration than cTACE (CD3: p=0.0003, HLA-DR: p<0.0001). Additionally, LUMITM bead TACE treated tumors had higher intra-tumoral immune checkpoint marker expression as compared to OncozeneTM TACE (CTLA-4: p=0.0002, PD-1: p<0.0001, PD-L1: p=0.0021) and cTACE (CTLA-4: p<0.0001, PD-1: p<0.0001, PD-L1: p=0.002). Additional BC administration demonstrated the most significant effect on cTACE, showing increased intra-tumoral T-cell infiltration as compared to cTACE alone (p=0.0003).*Conclusions This preclinical study reveals marked differences in local immune response and immune checkpoint marker expression between various types of chemoembolic agents used for TACE. Doxorubicin-eluting LUMITM beads and BC-buffered cTACE might be the most promising options to achieve intra-tumoral T-cell infiltration when combining TACE with immune checkpoint inhibition (ICI).*Clinical Relevance/Application Prospective clinical trials evaluating the combination of TACE with ICI should consider the effects of chemoembolic regimens on the immune system to avoid confounded results.

RESULTS

Treatment with LUMITM bead TACE induced more APC recruitment in the tumor core than OncozeneTM TACE (HLA-DR: p=0.0113) and more intra-tumoral T-cell and APC infiltration than cTACE (CD3: p=0.0003, HLA-DR: p<0.0001). Additionally, LUMITM bead TACE treated tumors had higher intra-tumoral immune checkpoint marker expression as compared to OncozeneTM TACE (CTLA-4: p=0.0002, PD-1: p<0.0001, PD-L1: p=0.0021) and cTACE (CTLA-4: p<0.0001, PD-1: p<0.0001, PD-L1: p=0.002). Additional BC administration demonstrated the most significant effect on cTACE, showing increased intra-tumoral T-cell infiltration as compared to cTACE alone (p=0.0003).

CLINICAL RELEVANCE/APPLICATION

Prospective clinical trials evaluating the combination of TACE with ICI should consider the effects of chemoembolic regimens on the immune system to avoid confounded results.

SPR-IR-4 Magnetic Resonance Image Guided High Focused Ultrasound Surgery Of Adenomyosis Model Of Bama Pigs

Participants
Qi Zhang, Shang Hai, China (*Presenter*) Nothing to Disclose

PURPOSE

Magnetic resonance image guided focused ultrasound surgery (MRgFUS) ablation has been widely used as a non-surgical therapy for adenomyosis. Due to the noninvasive nature of the method, sampling cannot be done frequently and invasively from the adenomyosis patient. Therefore, using MRgFUS to treat adenomyosis animal model is beneficial to further study the process of the disease after ablation. The purpose of this study was to explore the feasibility of MRgFUS in the treatment of adenomyosis model of Bama pigs.*Methods and Materials Three healthy adult female Bama pigs were purchased and the uterine adenomyosis model of Bama pigs was established by autologous endometrial implantation method. Three months after modeling surgery, surgical sampling and imaging methods were used to evaluate disease progression. Adenomyosis lesions were successfully constructed in all three

Bama pigs and then treated with MRgFUS. Enhanced T1 scan was performed immediately after ablation. The uterine thickness of pigs was measured before and after ablation. Venous blood was extracted from pigs before and two months after treatment, and the levels of CA125 and CA199 were detected by enzyme linked immunosorbent assay (ELISA).*Results The adenomyosis model was successfully established by pathology after sampling of the three Bama pigs. All Bama pigs successfully constructed adenomyosis lesions received ablation treatment. The total ablation time of three Bama pigs was 163min, 102min and 85min, respectively. Bama pigs were all in good condition after the operation, and no obvious skin scald was observed. Before ablation, the average thickness of the uterus at the thickest part of the Bama pigs was 3.83±0.26cm. Two months after ablation, the mean uterine thickness at the thickest part was 2.97±0.25cm. The serum levels of CA125 and CA199 in Bama pigs were 83.02±10.31 pg/ml and 11.33±2.79ng/ml before ablation, and 72.78±11.86 pg/ml and 9.90±3.32 ng/ml after ablation, respectively.*Conclusions It is a safe and effective method to treat adenomyosis model of Bama pigs with MRgFUS. After ablation treatment, the uterine thickness and serum CA125 and CA199 levels of Bama pigs decreased compared with those before ablation, which was consistent with the clinical manifestations after adenomyosis treatment. It can be used to further study the mechanism of adenomyosis after MRgFUS.*Clinical Relevance/Application Using MRgFUS to treat adenomyosis animal model is beneficial to further study the process of the disease after ablation. It can be used to further study the mechanism of adenomyosis after MRgFUS.

RESULTS

The adenomyosis model was successfully established by pathology after sampling of the three Bama pigs. All Bama pigs successfully constructed adenomyosis lesions received ablation treatment. The total ablation time of three Bama pigs was 163min, 102min and 85min, respectively. Bama pigs were all in good condition after the operation, and no obvious skin scald was observed. Before ablation, the average thickness of the uterus at the thickest part of the Bama pigs was 3.83±0.26cm. Two months after ablation, the mean uterine thickness at the thickest part was 2.97±0.25cm. The serum levels of CA125 and CA199 in Bama pigs were 83.02±10.31 pg/ml and 11.33±2.79ng/ml before ablation, and 72.78±11.86 pg/ml and 9.90±3.32 ng/ml after ablation, respectively.

CLINICAL RELEVANCE/APPLICATION

Using MRgFUS to treat adenomyosis animal model is beneficial to further study the process of the disease after ablation. It can be used to further study the mechanism of adenomyosis after MRgFUS.

SPR-IR-5   Development Of A Computed Tomography-based Radiomics Nomogram For Prediction Of Transarterial Chemoembolization Refractoriness In Hepatocellular Carcinoma

Participants
Xiangke Niu, MD,MS, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate a computed tomography (CT)-based radiomics nomogram for the pre-treatment prediction of TACE refractoriness.*Methods and Materials This retrospective study consisted of a training dataset (n = 137) and an external validation dataset (n = 81) of patients with clinically/pathologically confirmed HCC who underwent repeated TACE from March 2009 to March 2016. Radiomics features were retrospectively extracted from preoperative CT images of the arterial phase. The pre-treatment radiomics signature was generated using least absolute shrinkage and selection operator Cox regression analysis. A CT-based radiomics nomogram incorporating clinical risk factors and the radiomics signature was built and verified by calibration curve and decision curve analyses. The usefulness of the CT-based radiomics nomogram was assessed by Kaplan-Meier curve analysis. We used the concordance index to conduct head-to-head comparisons of the radiomics nomogram with the other four models. All analyses were conducted according to the transparent reporting of a multivariable prediction model for individual prognosis or diagnosis statement.*Results The median number of TACE sessions was 4 (range, 3-7) in bothcohorts. Eight radiomics features were chosen from 869 candidate features to build a radiomics signature. The CT-based radiomics nomogram included the radiomics score (hazard ratio = 3.9, 95% confidence interval: 3.1-8.8, P < 0.001) and four clinical factors and classified patients into high-risk (score > 3.5) and low-risk (score = 3.5) groups with markedly different prognoses (overall survival: 12.3 mo vs 23.6 mo, P < 0.001). The accuracy of the nomogram was considerably higher than that of the other four models. The calibration curve and decision curve analyses verified the usefulness of the CT-based radiomics nomogram for clinical practice.*Conclusions The newly constructed CT-based radiomics nomogram can be used for the pre-treatment prediction of TACE refractoriness, which may provide better guidance for decision making regarding further TACE treatment.*Clinical Relevance/Application The main finding of this study is that our computed tomography (CT)-based radiomics nomogram can be used to individually predict patients' refractory state before the first session of TACE. This CT-based radiomics nomogram may provide an unprecedented opportunity to improve clinical decision making for the patients who are repeatedly treated by TACE and, eventually, improve the overall survival of these patients.

RESULTS

The median number of TACE sessions was 4 (range, 3-7) in bothcohorts. Eight radiomics features were chosen from 869 candidate features to build a radiomics signature. The CT-based radiomics nomogram included the radiomics score (hazard ratio = 3.9, 95% confidence interval: 3.1-8.8, P < 0.001) and four clinical factors and classified patients into high-risk (score > 3.5) and low-risk (score = 3.5) groups with markedly different prognoses (overall survival: 12.3 mo vs 23.6 mo, P < 0.001). The accuracy of the nomogram was considerably higher than that of the other four models. The calibration curve and decision curve analyses verified the usefulness of the CT-based radiomics nomogram for clinical practice.

CLINICAL RELEVANCE/APPLICATION

The main finding of this study is that our computed tomography (CT)-based radiomics nomogram can be used to individually predict patients' refractory state before the first session of TACE. This CT-based radiomics nomogram may provide an unprecedented opportunity to improve clinical decision making for the patients who are repeatedly treated by TACE and, eventually, improve the overall survival of these patients.

SPR-IR-7   Application And Quality Reserve Of Digital Variance Angiography And Color-coded Digital Variance Angiography In Prostatic Artery Embolization

Participants
Leona Alizadeh, MD, Frankfurt, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Kinetic imaging is defined as a novel X-ray image processing method for the visualization of contrast motion. The algorithm produces so-called Digital Variance Angiography (DVA) images. The study objective was to compare the performance of DVA versus

standard digital subtraction angiography (DSA) for vascular intervention in Prostatic Artery Embolization (PAE).*Methods and Materials The retrospective observational study enrolled 37 patients (mean age 67.47, SD 9.76, range 42-82) undergoing PAE at our institution between May and October of 2020. Altogether 142 acquisitions were included in the analysis. DSA and DVA images were generated from the same raw series. The CNR values were calculated, and the image quality was evaluated by 4 experienced readers in a randomized blinded survey, using a 5-grade-Likert-scale. Data were expressed as median and interquartile ranges (IQR) and analyzed by the Wilcoxon signed rank test.*Results DVA images provided 4.1 times higher CNR than DSA images, the median (IQR) CNR values were 29.5 (19.5-45.4) and 7.2 (4.9-11.1), respectively, p<0.001. DSA images received significantly higher Likert score than DSA images, the median (IQR) values were 4.33 (4.00-4.67) and 3.67 (3.00-4.00), respectively, p< 0.001.*Conclusions The data in this initial retrospective trial indicate that DVA has significantly higher CNR and enhanced image quality compared to DSA in PAE procedures. This quality reserve of DVA provides the opportunity for significant reduction of radiation exposure and iodinated contrast agent in PAE.*Clinical Relevance/Application Radiation dose and amount of contrast agent used during complex procedures, such as PAE, is needed to be further reduced to improve patient safety.

RESULTS

DVA images provided 4.1 times higher CNR than DSA images, the median (IQR) CNR values were 29.5 (19.5-45.4) and 7.2 (4.9-11.1), respectively, p<0.001. DSA images received significantly higher Likert score than DSA images, the median (IQR) values were 4.33 (4.00-4.67) and 3.67 (3.00-4.00), respectively, p< 0.001.

CLINICAL RELEVANCE/APPLICATION

Radiation dose and amount of contrast agent used during complex procedures, such as PAE, is needed to be further reduced to improve patient safety.

SPR-IR-8   Volume Flow-assisted Angioplasty Of Dysfunctional Autologous Arteriovenous Fistula: The Vola Pilot Study

Participants
Stavros Spiliopoulos, MD,PhD, Athens, Greece (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the feasibility of volume flow-assisted angioplasty (VFA) in dysfunctional arteriovenous fistula (AVF) using sequential intraprocedural duplex ultrasound (DUS), and utilize intraprocedural VF as a quantifiable, functional endpoint in endovascular treatment.*Methods and Materials This was a prospective study (clinicaltrials.gov NCT04430478) which included 20 consecutive patients (23 lesions; 16 men; mean age 67±16 years) with dysfunctional AVF undergoing fluoroscopically-guided, balloon angioplasty between June 2019-May 2020. Primary endpoints included: quantification of outcome using sequential VF DUS analysis following each dilation, procedural success (achievement of a postprocedural VF value =to the baseline steady-state access) and 6-months target lesion re-intervention (TLR)-free rate. Secondary endpoints included 6-months lesion late lumen loss (LLL), and correlation of VF values with balloon diameters and LLL measurements.*Results Mean VF increase after angioplasty was 168.5%±102.5% (range:24.24%-493.33%). Procedural success was 80% (16/20 cases). VFA improved procedural success by 20% (4/20 cases) compared to standard assessment (<30% residual stenosis and palpable thrill). TLR-free rate was 78.3%, 67.3% at 6 and 12 months. Significantly less TLR was noted in cases of procedural success (82.4% vs. 66.7% 6-months;p=0.041). Unweighted linear regression showed a significant positive relationship between the diameter of the balloon and VF (146.9±42.3ml/min VF gain per mm of balloon diameter;p=0.001,R2=0.23) and a significant negative relationship between LLL and VF decline at follow-up (102.0±34.6ml/min loss per mm of LLL;p=0.01,R2=0.35). Optimal postprocedural VF and percentile VF increase cut off values to predict access failure were 720 ml/min (sensitivity 58.3%, specificity 71.4%) and 153% (sensitivity 66.7%, specificity 85.7%); respectively.*Conclusions Intraprocedural VFA using DUS could optimize AVF angioplasty outcomes.*Clinical Relevance/Application Contrary to peripheral arterial procedures, the quantification of angioplasty outcomes in dialysis AVF, either by visual estimation or using the gold standard of quantitative vessel analysis can be extremely inaccurate, as AVF circuits usually include dilated or aneurysmal segments and different unaffected vessel diameters across the entire access conduit. The authors investigated the feasibility of Volume-Flow (VF)-assisted balloon angioplasty in dysfunctional AVF using sequential, intraprocedural VF assessment with percutaneous Duplex ultrasound in order to develop a novel simple, non-invasive strategy to accurately quantify a novel functional endpoint of AVF endovascular treatment.

RESULTS

Mean VF increase after angioplasty was 168.5%±102.5% (range:24.24%-493.33%). Procedural success was 80% (16/20 cases). VFA improved procedural success by 20% (4/20 cases) compared to standard assessment (<30% residual stenosis and palpable thrill). TLR-free rate was 78.3%, 67.3% at 6 and 12 months. Significantly less TLR was noted in cases of procedural success (82.4% vs. 66.7% 6-months;p=0.041). Unweighted linear regression showed a significant positive relationship between the diameter of the balloon and VF (146.9±42.3ml/min VF gain per mm of balloon diameter;p=0.001,R2=0.23) and a significant negative relationship between LLL and VF decline at follow-up (102.0±34.6ml/min loss per mm of LLL;p=0.01,R2=0.35). Optimal postprocedural VF and percentile VF increase cut off values to predict access failure were 720 ml/min (sensitivity 58.3%, specificity 71.4%) and 153% (sensitivity 66.7%, specificity 85.7%); respectively.

CLINICAL RELEVANCE/APPLICATION

Contrary to peripheral arterial procedures, the quantification of angioplasty outcomes in dialysis AVF, either by visual estimation or using the gold standard of quantitative vessel analysis can be extremely inaccurate, as AVF circuits usually include dilated or aneurysmal segments and different unaffected vessel diameters across the entire access conduit. The authors investigated the feasibility of Volume-Flow (VF)-assisted balloon angioplasty in dysfunctional AVF using sequential, intraprocedural VF assessment with percutaneous Duplex ultrasound in order to develop a novel simple, non-invasive strategy to accurately quantify a novel functional endpoint of AVF endovascular treatment.

![RSNA 2021 Redefining Radiology. November 28 to December 2]

Abstract Archives of the RSNA, 2021

Participants
Suzie Bash, MD, Woodland Hills, California (*Moderator*) Consultant, CorTechs Labs, Inc;Consultant, icoMetrix NV;Consultant, Subtle Medical, Inc;Consultant, Darmiyan, Inc
Andreas Rauschecker, MD,PhD, Mill Valley, California (*Moderator*) Nothing to Disclose

Sub-Events

SSNR13-1   Fully Automatic Segmentation And Treatment Response Assessment Of Brain Metastases On Magnetic Resonance Imaging

Participants
Jay Patel, Charlestown, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Measuring treatment response is vital for assessing efficacy of current treatment regimens for patients with brain metastases (BM). Given that patients often have multiple BM, longitudinal tracking of individual lesions on magnetic resonance (MR) imaging is challenging due to the time-consuming nature of manual tumor annotation. To overcome this challenge, we propose an automatic deep learning approach to longitudinally segment BM and to automate the quantification of measurable tumor burden as defined by the Response Assessment for Neuro-Oncology Brain Metastases (RANO-BM) criteria.*Methods and Materials A primary dataset of 82 patients (182 time-points total) with T1-weighted post-contrast MPRAGE sequences was retrospectively acquired from one institution, along with a secondary dataset of 133 patients (847 time-points total) acquired from a second institution. Ground truth segmentations were performed by expert neuroradiologists for all patient time-points. Using the primary dataset, a 3D UNet convolutional neural network (CNN) was trained to segment BM. This trained network was used to generate automatic segmentations for all time-points in the secondary dataset. Next, all time-points for a patient were co-registered to the baseline visit, and all lesions were automatically given a unique identifier to track them across time-points. Finally, an automatic RANO-BM measure was derived by summing the longest axial diameter of the patient's five largest target lesions (where a target lesion is defined as greater than 10mm in longest diameter). Segmentation performance was evaluated by the Dice similarity coefficient, and RANO-BM measures by the two-way mixed, single measure intra-class correlation coefficient (ICC).*Results For automatic segmentation of BM on the secondary dataset of 847 time-points, the median dice score was 0.819. Comparing the RANO-BM measure computed from the ground truth segmentations to that computed from the predicted segmentations, the ICC was 0.88.*Conclusions We developed a fully automatic pipeline that segments BM and computes a RANO-BM assessment. Moreover, we show high agreement between the RANO measure computed from the ground truth segmentations and the predicted segmentations, demonstrating the clinical utility of our automated method to quantify measurable tumor burden.*Clinical Relevance/Application This tool may help in clinical practice as well as in clinical trials by expediting accurate measurement of tumor burden and quantifying treatment response.

RESULTS

For automatic segmentation of BM on the secondary dataset of 847 time-points, the median dice score was 0.819. Comparing the RANO-BM measure computed from the ground truth segmentations to that computed from the predicted segmentations, the ICC was 0.88.

CLINICAL RELEVANCE/APPLICATION

This tool may help in clinical practice as well as in clinical trials by expediting accurate measurement of tumor burden and quantifying treatment response.

SSNR13-2   Deep Learning Enables 60% Accelerated Volumetric Brain MRI While Preserving Quantitative Performance-A Prospective, Multicenter, Multireader Trial

Participants
Suzie Bash, MD, Woodland Hills, California (*Presenter*) Consultant, CorTechs Labs, Inc;Consultant, icoMetrix NV;Consultant, Subtle Medical, Inc;Consultant, Darmiyan, Inc

PURPOSE

In this prospective, multicenter, multireader study, we evaluate the impact on both image quality and quantitative image analysis consistency (NeuroQuant™) of 60% accelerated volumetric MRI scans processed with a commercially available, vendor agnostic, DICOM-based deep learning (DL) tool (SubtleMR™) compared to that of the standard of care (SOC).*Methods and Materials With IRB approval and patient consent, 40 subjects underwent brain MRI exams on 6 scanners from 5 institutions. SOC and accelerated (FAST) datasets were acquired for each subject. The FAST scans were then enhanced with DL processing (FAST-DL). Both SOC and FAST-DL were subjected to quantitative volumetric analysis with NeuroQuant™ and classification by a neuroradiologist into clinical disease categories based on results. Quantitative biomarker concordance of SOC and FAST-DL was assessed. To evaluate subjective image quality, randomized, side-by-side, multiplanar datasets (360 series) were presented blinded to 2 neuroradiologists. Images were preference rated on a 5-point Likert scale for apparent signal-to-noise ratio, image sharpness, artifacts, lesion conspicuity, image contrast, and gray-white differentiation.*Results FAST-DL was statistically superior to SOC for perceived quality

across all imaging features despite a 60% scan time reduction (all p-values <0.05). Both FAST-DL and SOC were superior to FAST for all quality features. There was high inter-reader agreement of the Likert image quality ratings between the 2 neuroradiologists. Paired T-test analysis demonstrated excellent agreement of quantitative data between the SOC and FAST-DL datasets. Linear Regression graphs and Bland-Altman plot graph analysis further demonstrated strong concordance in quantitative values across the range of conditions (normal, MCI, Alzheimer's Disease). There was 100% agreement in clinical disease classification for both the SOC and FAST-DL datasets (n=29 normal/MCI and n=11 dementia).*Conclusions DL reconstruction allows 60% scan time reduction while maintaining high volumetric quantification accuracy, consistent clinical classification, and what radiologists perceive as superior image quality when compared with SOC.*Clinical Relevance/Application This trial supports the reliability, efficiency, and utility of DL based enhancement for quantitative imaging. Shorter scan times may boost utilization of volumetric quantitative MRI in routine clinical settings.

RESULTS

FAST-DL was statistically superior to SOC for perceived quality across all imaging features despite a 60% scan time reduction (all p-values <0.05). Both FAST-DL and SOC were superior to FAST for all quality features. There was high inter-reader agreement of the Likert image quality ratings between the 2 neuroradiologists. Paired T-test analysis demonstrated excellent agreement of quantitative data between the SOC and FAST-DL datasets. Linear Regression graphs and Bland-Altman plot graph analysis further demonstrated strong concordance in quantitative values across the range of conditions (normal, MCI, Alzheimer's Disease). There was 100% agreement in clinical disease classification for both the SOC and FAST-DL datasets (n=29 normal/MCI and n=11 dementia).

CLINICAL RELEVANCE/APPLICATION

This trial supports the reliability, efficiency, and utility of DL based enhancement for quantitative imaging. Shorter scan times may boost utilization of volumetric quantitative MRI in routine clinical settings.

SSNR13-4   Early Prediction Of Cognitive Deficit Using Quantitative Structural MRI In Very Preterm Infants With Ensemble Learning

Participants
Zhiyuan Li, BS,MS, Oxford, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

To develop an ensemble learning model using quantitative structural MRI features acquired at term equivalent age (TEA) for early prediction of cognitive deficits at 2 years corrected age (CA) in very preterm infants (VPIs; gestational age =32 weeks).*Methods and Materials Cohort. We included 197 VPIs (47.2% male) that had a mean (SD) gestational age at birth of 29.4 (2.4) weeks from Cincinnati Children's Hospital. At TEA, all subjects were imaged during unsedated sleep on a 3T Philips Ingenia scanner. T2-weighted imaging parameters: TR/TE 18567/166 ms, FA 90°, resolution 1.0 × 1.0 × 1.0 mm3. Each infant was assessed using Bayley III test at 2 years CA. Based on cognitive scores, we dichotomized the infants into low-risk (>85; N=129) vs. high-risk (=85; N=68) groups. Feature Quantification. We segmented the brain into 87 regions using a developing Human Connectome Project pipeline. For each region, the pipeline calculates brain volumes and cortical maturation features, including thickness, sulcal depth, curvature, gyrification index, and surface area. This resulted in 510 features for each VPI. Ensemble Learning Model. The model in the figure contains 1) six eXtreme Gradient Boosting (XGB) classifiers and each produces an individual probability of developing cognitive deficits using brain volumes/ cortical maturation features; 2) a neural network that takes the prior predicted probabilities and produces a final probability of developing cognitive deficit. We used a hybrid sampling algorithm to balance training data. Model performance was assessed using Leave-One-Out Cross-Validation.*Results Our model was able to identify high-risk infants for cognitive deficits with an accuracy of 68.0%, a sensitivity of 70.2%, and a specificity of 67.3%. It achieved a better AUC of 0.73 than a XGB classifier (AUC = 0.62) and a neural network (AUC = 0.61).*Conclusions The proposed model outperformed the peer models and incorporating multimodal MRI features is likely to further improve the performance.*Clinical Relevance/Application The proposed study may potentially facilitate risk stratification and enable early intervention strategies to improve developmental outcomes in infants at high risk for cognitive deficits.

RESULTS

Our model was able to identify high-risk infants for cognitive deficits with an accuracy of 68.0%, a sensitivity of 70.2%, and a specificity of 67.3%. It achieved a better AUC of 0.73 than a XGB classifier (AUC = 0.62) and a neural network (AUC = 0.61).

CLINICAL RELEVANCE/APPLICATION

The proposed study may potentially facilitate risk stratification and enable early intervention strategies to improve developmental outcomes in infants at high risk for cognitive deficits.

SSNR13-5   Machine Learning Model For Motion Detection And Quantification On Brain MR: A Multicenter Testing Study

Participants
Bernardo Bizzo, MD,PhD, Newton, Massachusetts (*Presenter*) Consultant, Diagnosticos da America (Dasa)

PURPOSE

Detection and quantitation of motion artifacts can help automate repeated acquisition and avoid interpretation pitfalls related to motion-impaired MR images and patient recall. We developed a machine learning-based Image Quality Dashboard (IQD) for detecting and quantifying motion artifacts for brain MR and tested its application in a multicenter study.*Methods and Materials For model development, we used a natural language processing approach to identify 1530 brain MR exams from US Site A (24 MR scanners from 2 vendors) presenting mention of motion artifacts in the radiology reports and containing six common sequences (T1 sagittal, T2 axial, T2 axial FLAIR, T1 axial pre-contrast, T1 axial post-contrast, and susceptibility-weighted angiography). We then built an XGBoost ensemble model (IQD) using four artificial neural networks based on Inception V3 framework; the model output scores represent weighted averages of probability. For testing, in addition to the primary test set from US Site A, we identified and processed brain MRs from US Site B (n=444; 11 MR scanners from 2 vendors with identical sequences) and Brazil Site C (n= 544; 19 MR scanners from 4 vendors; 9 sequences with additional sequences of T2 sagittal, T2 coronal and T2* axial). A panel of three radiologists graded motion severity (none, mild, moderate, and severe) at an image level for all exams from the three sites, unaware of IQD scores. We determined ranking accuracy (correct accuracy of IQD divided by the number of total rankings) to compare motion severity between radiologists and IQD.*Results Compared to the panel of radiologists, IQD accurately predicted the presence and severity of motion artifacts at the three testing sites (ranking accuracy- Site A: 91-100%; Site B: 94-98%; Site C:

90-100%). We noted a consistently high image-level performance of the IQD model across different MR sequences (ranking accuracy from 90% [T2* axial] to 100% [T1 axial post contrast]), MR units from four different vendors, or magnet strengths (accuracy - 1.5T: 94-98%; 3T: 100%).*Conclusions Multicenter testing study demonstrates that motion artifacts can be accurately detected and quantified with IQD for different MR scanners and sequences.*Clinical Relevance/Application IQD can help technologists trigger reacquisition of specific MR sequences in presence of motion artifacts, aid radiologists to avoid motion-related pitfalls in the interpretation of brain MR and decrease patient recall due to motion-degraded exams.

RESULTS

Compared to the panel of radiologists, IQD accurately predicted the presence and severity of motion artifacts at the three testing sites (ranking accuracy- Site A: 91-100%; Site B: 94-98%; Site C: 90-100%). We noted a consistently high image-level performance of the IQD model across different MR sequences (ranking accuracy from 90% [T2* axial] to 100% [T1 axial post contrast]), MR units from four different vendors, or magnet strengths (accuracy - 1.5T: 94-98%; 3T: 100%).

CLINICAL RELEVANCE/APPLICATION

IQD can help technologists trigger reacquisition of specific MR sequences in presence of motion artifacts, aid radiologists to avoid motion-related pitfalls in the interpretation of brain MR and decrease patient recall due to motion-degraded exams.

SSNR13-6   Mapping Whole Exome Sequencing To Noninvasive Imaging With Stereotactic Localization And Deep Learning

Participants
Jason Parker, PhD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

Evaluate the potential for predicting exome-wide mutation events from non-invasive imaging by combining stereotactic localization of tumor tissue samples and a feedforward dense network.*Methods and Materials Ten (10) treatment-naïve glioma patients underwent multiparametric MR (T1w, T1w+gad, T2w, T2w-FLAIR, DWI) a maximum of 7 days prior to surgery. Stereotactic localization of up to 4 tumor tissue samples was captured for each patient and used to identify spatially-correlated voxels in the pre-surgical images (Figure 1A). The tissue samples were processed immediately in the OR using a portable mass spectrometer and then flash frozen and studied using whole-exome sequencing, whole-exome methylation, and RNA Seq v2. A computational biology supercomputing framework was designed to identify important genomic targets by polymorphism discovery (Mutect2) against the GRCh38 human reference genome. The chromosomal locations for eight (8) mutational gene targets specific to glioma were then annotated by variant type (SnpSift) including PTEN, IDH1, TP53, EGFR, PIK3R1, PIK3CA, NF1, and RB1. At the time of this writing, a total of 8 patients have completed the genomic processing pipeline and proceeded to final analysis. For prediction analysis we implemented a 4 layer feedforward dense network using 8 nodes for the first layer, 16 nodes for second, 32 for the third, and finally mapping into the 8 output nodes for the exon outputs. Dropout was set to 0.75 and stochastic gradient descent optimization with binary cross entropy as a loss function was used. A total of 8 iterations of 25 epochs each were run in leave-one-patient-out cross validation design.*Results With all 8 exons included, the mean accuracy of the leave-one-patient-out analysis across all mutational targets was 76.5% ± 15% (Figure 1C). Individual patient prediction accuracy ranged from 0.54 to 0.997. The modes of exons 4 and 7 (EGFR and NF1, respectively) were found to be 0 across all patients (Figure 1B) and thus could have been removed to improve classification accuracy. This is the subject of current analyses.*Conclusions We have demonstrated the ability to predict single nucleotide point mutations from non-invasive imaging. We expect the accuracy of this classification will improve in currently ongoing analyses utilizing better tuning of hyperparameters, optimization of included exons, the addition of more patients, and matched-normal somatic variant calling using blood samples.*Clinical Relevance/Application Heterogeneity of solid tumors is the primary cause of treatment resistance and disease recurrence. Methods to map molecular and cellular properties across space hold the potential to overcome the sampling error of biopsy and dramatically reshape individualized therapy protocols.

RESULTS

With all 8 exons included, the mean accuracy of the leave-one-patient-out analysis across all mutational targets was 76.5% ± 15% (Figure 1C). Individual patient prediction accuracy ranged from 0.54 to 0.997. The modes of exons 4 and 7 (EGFR and NF1, respectively) were found to be 0 across all patients (Figure 1B) and thus could have been removed to improve classification accuracy. This is the subject of current analyses.

CLINICAL RELEVANCE/APPLICATION

Heterogeneity of solid tumors is the primary cause of treatment resistance and disease recurrence. Methods to map molecular and cellular properties across space hold the potential to overcome the sampling error of biopsy and dramatically reshape individualized therapy protocols.

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Participants
Daniel Ocazionez-Trujillo, MD, Houston, Texas (*Moderator*) Nothing to Disclose
Shaunagh McDermott, FFR(RCSI), Boston, Massachusetts (*Moderator*) Nothing to Disclose

Sub-Events

SSCH07-1   False Lumen Arc Length Is A Predictor For Late Complications In Initially Uncomplicated Type B Aortic Dissection: A Multicenter Study

Participants
Joost Hop, BMedSc, Groningen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Morphologic CT features such as maximum aortic diameter and false lumen angle are known predictors of late complications in patients with initially uncomplicated type B aortic dissection (uTBAD). Although maximum aortic diameter has shown to be a robust measure, the interobserver reliability of the false lumen angle is poor. False lumen arc length is a more reliable measurement than false lumen angle. We therefore consider false lumen arc length a potential replacement for false lumen angle. However, the association between false lumen arc length and late uTBAD complications is unknown. We aimed to evaluate whether false lumen arc length is associated with late complications.*Methods and Materials Baseline CT scans of uTBAD patients from a multicenter study were retrospectively analyzed for known morphologic features including (i) maximum aortic diameter (mm); (ii) false lumen angle (°); (iii) false lumen outflow volume (mL/min), and (iv) number of identifiable intercostal arteries (n). Additionally, (v) false lumen arc length (mm) was assessed as a novel marker. Univariate association of false lumen arc length with late complications was evaluated using the Youden Index, Kaplan Meier method, and Cox regression. Multicollinearity was defined as a variance inflation factor (VIF)>5. A previous Cox model was rebuilt with imaging features i-iv in addition to presence of connective tissue disease. Subsequently, false lumen angle was replaced by false lumen arc length in an updated Cox model. C-statistics were compared.*Results 313 patients with uTBAD were included with median (interquartile range) follow-up of 604 (190-1501) days. 147 (47%) patients developed late complications. Median false lumen arc length for patients that did and did not develop late complications were 85 (74-101) mm and 76 (66-88) mm, respectively. Kaplan Meier and Cox regression analyses indicated univariate association between a false lumen arc length >77.35 mm and late complications, with a hazard ratio (HR) of 1.93/mm (1.35-2.77, p<0.001). No indication for multicollinearity was found with VIFs between 1.0 and 1.6. The original Cox model with imaging features i-iv and presence of connective tissue disease resulted in a c-statistic of 0.69 (0.63-0.73). HRs were 1.08/mm (1.06-1.10, p<0.001) for maximum aortic diameter and 1.00/° (1.00-1.01, p=0.06) for false lumen angle. Replacing false lumen angle by false lumen arc length resulted in a similar c-statistic of 0.68 (0.63-0.73) and HR 1.01/mm (1.00-1.02, p=0.02).*Conclusions Our study showed that false lumen arc length is independently associated with late complications in uTBAD.*Clinical Relevance/Application False lumen arc length may replace false lumen angle as more robust image feature to predict late complications.

RESULTS

313 patients with uTBAD were included with median (interquartile range) follow-up of 604 (190-1501) days. 147 (47%) patients developed late complications. Median false lumen arc length for patients that did and did not develop late complications were 85 (74-101) mm and 76 (66-88) mm, respectively. Kaplan Meier and Cox regression analyses indicated univariate association between a false lumen arc length >77.35 mm and late complications, with a hazard ratio (HR) of 1.93/mm (1.35-2.77, p<0.001). No indication for multicollinearity was found with VIFs between 1.0 and 1.6. The original Cox model with imaging features i-iv and presence of connective tissue disease resulted in a c-statistic of 0.69 (0.63-0.73). HRs were 1.08/mm (1.06-1.10, p<0.001) for maximum aortic diameter and 1.00/° (1.00-1.01, p=0.06) for false lumen angle. Replacing false lumen angle by false lumen arc length resulted in a similar c-statistic of 0.68 (0.63-0.73) and HR 1.01/mm (1.00-1.02, p=0.02).

CLINICAL RELEVANCE/APPLICATION

False lumen arc length may replace false lumen angle as more robust image feature to predict late complications.

SSCH07-2   Prediction Of Lung Malignancy Progression And Survival With Machine Learning Based On Pre-Treatment FDG-PET/CT

Participants
John Sollee, BS, Providence, Rhode Island (*Presenter*) Nothing to Disclose

PURPOSE

Pre-treatment FDG-PET/CT scans were analyzed with machine learning to predict progression of lung malignancies and overall survival (OS).*Methods and Materials A retrospective review across four institutions identified patients that had a pre-procedure FDG-PET/CT and an associated malignancy diagnosis by biopsy or surgery. 1168 lesions were manually segmented (n=965 patients), and progression occurrence was collected. Lesions were split 7:2:1 between training, validation, and test sets, and convolutional neural networks (CNNs) were trained using CT/PET inputs to predict malignancy progression. Model performance was evaluated using area under the receiver operating curve (AUC-ROC), accuracy, sensitivity, and specificity. Image features were extracted

using the penultimate dense neuron layer of each CNN. Random survival forests (RSFs) were constructed to predict OS using the extracted features. OS predictions were evaluated with concordance index (C-index) and integrated brier score (IBS).*Results Of the 1168 lesions, 793 had progression and 375 were progression-free. The most common malignancies were adenocarcinoma (n=728) and squamous cell carcinoma (n=190). The CT CNN model predicted progression with an accuracy of 0.790 [95% confidence interval: 0.786, 0.831], AUC-ROC of 0.877, sensitivity of 0.736 [0.704, 0.765], and specificity of 0.964 [0.939, 0.979]. The PET progression model achieved an accuracy of 0.697 [0.611, 0.666], AUC-ROC of 0.553, sensitivity of 0.857 [0.831, 0.880], and specificity of 0.178 [0.143, 0.220]. A PET/CT ensemble model achieved an accuracy of 0.798 [0.768, 0.815], AUC-ROC of 0.871, sensitivity of 0.813 [0.784, 0.839], and specificity of 0.750 [0.704, 0.791]. The average OS length was 697 days (standard deviation: 605 days). The CT feature only RSF achieved a C-index of 0.715 and an IBS of 0.152, while a PET feature only RSF achieved a C-index of 0.709 and an IBS of 0.130. The combined CT+PET RSF achieved a C-index of 0.735 and an IBS of 0.132.*Conclusions CNNs trained using pre-treatment FDG-PET/CT data achieve good performance in prediction of progression of lung malignancy and OS. Metabolic information via PET further improves prediction compared to CT alone.*Clinical Relevance/Application Machine learning based on FDG-PET/CT can be used to assess progression and OS risk for lung malignancies, which is essential for accurate prognostication and planning of care.

RESULTS

Of the 1168 lesions, 793 had progression and 375 were progression-free. The most common malignancies were adenocarcinoma (n=728) and squamous cell carcinoma (n=190). The CT CNN model predicted progression with an accuracy of 0.790 [95% confidence interval: 0.786, 0.831], AUC-ROC of 0.877, sensitivity of 0.736 [0.704, 0.765], and specificity of 0.964 [0.939, 0.979]. The PET progression model achieved an accuracy of 0.697 [0.611, 0.666], AUC-ROC of 0.553, sensitivity of 0.857 [0.831, 0.880], and specificity of 0.178 [0.143, 0.220]. A PET/CT ensemble model achieved an accuracy of 0.798 [0.768, 0.815], AUC-ROC of 0.871, sensitivity of 0.813 [0.784, 0.839], and specificity of 0.750 [0.704, 0.791]. The average OS length was 697 days (standard deviation: 605 days). The CT feature only RSF achieved a C-index of 0.715 and an IBS of 0.152, while a PET feature only RSF achieved a C-index of 0.709 and an IBS of 0.130. The combined CT+PET RSF achieved a C-index of 0.735 and an IBS of 0.132.

CLINICAL RELEVANCE/APPLICATION

Machine learning based on FDG-PET/CT can be used to assess progression and OS risk for lung malignancies, which is essential for accurate prognostication and planning of care.

SSCH07-3　Diagnosis Of Emphysema In Low-dose CT Screenings For Lung Cancer Screening Using Multiple Instance Transfer Learning

Participants
Jordan Fuhrman, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

To develop a deep learning pipeline that infers the presence of emphysema and identifies important regions within the scan to extract additional clinically relevant information.*Methods and Materials This retrospective study utilized 868 CT scans obtained for lung cancer screening as part of the International-Early Lung Cancer Action Program. A trained radiologist evaluated each scan for the presence of emphysema and indicated disease severity based on extent and presentation, with these clinical assessments serving as ground truth for deep network training and evaluation. A multiple instance transfer learning approach was utilized to infer disease state. The framework evaluates bags of instances in which a bag prediction is determined based on the collection of instances; CT scans and sections are treated as bags and instances, respectively. In this study, features were extracted from CT sections using a pre-trained VGG19 architecture, pooled using an attention-based weight factor, and merged with a classifier to determine presence of emphysema in the scan. Performance was evaluated using ROC analysis with the area under the ROC curve (AUC) as the performance metric. The impact of variations in the presentation of emphysema is assessed relative to severity and associated CT features - bronchial wall thickening, ground glass opacity, micronodules, reticular/linear opacities, bronchiectasis, atelectasis, and architectural distortions.*Results The AUC for the task of diagnosing emphysema within lung cancer screening scans was 0.93 +/- 0.04, which is comparable or better than current values in published literature.*Conclusions The novel deep multiple instance transfer learning method developed in this study has strong potential in evaluating lung cancer screening scans for emphysema, and further investigation is needed to understand its ability to localize and characterize disease.*Clinical Relevance/Application With the rapidly increasing global use of CT for lung cancer screening, automatic detection and characterization of other diseases, such as emphysema, within the scan range is critical and achievable through the use of deep learning.

RESULTS

The AUC for the task of diagnosing emphysema within lung cancer screening scans was 0.93 +/- 0.04, which is comparable or better than current values in published literature.

CLINICAL RELEVANCE/APPLICATION

With the rapidly increasing global use of CT for lung cancer screening, automatic detection and characterization of other diseases, such as emphysema, within the scan range is critical and achievable through the use of deep learning.

SSCH07-4　Performance Of AI PE Triage On Suboptimal CT Pulmonary Angiography

Participants
Shadi Ebrahimian, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Suboptimal CT pulmonary angiography (sCTPA) from motion artifacts or limited contrast enhancement is not uncommon. We evaluated and compared performance of acute pulmonary embolism (PE) detection artificial intelligence (PE-AI) algorithm in sCTPA and optimal CTPA (oCTPA).*Methods and Materials Following IRB approval with waiver of informed consent, we identified 104 consecutive sCTPA which were deemed as suboptimal for PE evaluation in radiology reports due to motion, artifacts or inadequate contrast enhancement. We enriched this dataset, with additional 226 oCTPA (over same timeframe as sCTPA) with and without PE. Two thoracic radiologists (ground truth) independently reviewed all 330 CTPA for adequacy (to assess PE down to distal segmental level), reason for sCTPA (artifacts or poor contrast enhancement), as well as for presence and location of PE. CT numbers (HU) were measured in the main pulmonary artery. When available (n= 80 patients), repeat and/or follow-up CTPA were reviewed for same attributes. All CTPA were processed with a commercial PE-AI algorithm (Aidoc). Data were analyzed with receiver operating characteristics to obtain area under the curve (AUC) for assessing presence of PE on sCTPA and oCTPA.*Results In the 104 sCTPA

(age= 56 ± 15), 24/104 (23%) were misclassified as "suboptimal for PE" in the radiology reports but were rated as optimal in ground truth evaluation (sCTPA). On sCTPA, the average contrast enhancement in the main pulmonary trunk was 282.9±140.1 HU, and the average patient weight was 94.9±30.4 kg. sCTPA were deemed suboptimal for up to segmental PE due to poor contrast (n= 41) and/or motion artifacts (n=44). PEs were present in 87/330 CTPA. PE-AI had almost identical performance on sCTPA (sensitivity 100%; specificity 93%; AUC 0.97, 95% CI 0.93-1.00) and oCTPA (sensitivity 98%; specificity 91%; AUC 0.90, 95% CI 0.86-0.95). PE-AI detected all PEs regardless of quality of the CTPA.*Conclusions Suboptimal CTPA examinations do not impair high performance of PE-AI which retains clinically meaningful sensitivity and high specificity, similar to thoracic radiologists.*Clinical Relevance/Application PE-AI algorithm can help detect pulmonary emboli, avoid misclassification of CTPA as inadequate, and thus, decrease need for unnecessary repeat imaging and additional radiation dose.

RESULTS

In the 104 sCTPA (age= 56 ± 15), 24/104 (23%) were misclassified as "suboptimal for PE" in the radiology reports but were rated as optimal in ground truth evaluation (sCTPA). On sCTPA, the average contrast enhancement in the main pulmonary trunk was 282.9±140.1 HU, and the average patient weight was 94.9±30.4 kg. sCTPA were deemed suboptimal for up to segmental PE due to poor contrast (n= 41) and/or motion artifacts (n=44). PEs were present in 87/330 CTPA. PE-AI had almost identical performance on sCTPA (sensitivity 100%; specificity 93%; AUC 0.97, 95% CI 0.93-1.00) and oCTPA (sensitivity 98%; specificity 91%; AUC 0.90, 95% CI 0.86-0.95). PE-AI detected all PEs regardless of quality of the CTPA.

CLINICAL RELEVANCE/APPLICATION

PE-AI algorithm can help detect pulmonary emboli, avoid misclassification of CTPA as inadequate, and thus, decrease need for unnecessary repeat imaging and additional radiation dose.

SSCH07-5   Racial Disparities In COVID-19 Associated Pulmonary Embolism

Participants
Brandon Metra, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Pulmonary embolism is an important clinical complication of COVID-19. We sought to investigate potential racial disparities in COVID-19-associated pulmonary embolism by using a large multicenter electronic health record database.*Methods and Materials In this retrospective cohort study, we examined adults diagnosed with COVID-19 from January 20 to September 30, 2020, with TriNetX, a global research network aggregating the real-time electronic health records of over 73 million patients. We analyzed clinical outcomes of non-Hispanic white and black patients with COVID-19, with the primary outcomes of development of pulmonary embolism (PE) or mortality within 30 days of diagnosis of COVID-19. We used propensity matching to balance cohorts by sociodemographic and clinical variables (hypertension, diabetes, obesity, etc.).*Results A total of 346,953 patients were identified with COVID-19, 3879 of whom developed pulmonary embolism (1.18%). 157,049 white and 50,376 black patients were identified. Compared to white patients, black patients had a higher risk of mortality (risk ratio 1.890 [95% CI 1.727-2.067]; p < 0.0001) and pulmonary embolism (risk ratio 1.537 [95% CI 1.380-1.711]; p < 0.0001). Additionally, black patients with both COVID-19 and pulmonary embolism had a higher rate of 30-day mortality compared to white patients (risk ratio 1.397 [95% CI 1.059-1.084]; p = 0.0174). All outcome differences persisted in balanced cohorts after propensity matching.*Conclusions Black patients have a higher risk of pulmonary embolism and mortality after COVID-19, even after controlling for demographic and clinical variables. Additionally, black patients with COVID-19 and associated pulmonary embolism have a higher risk of mortality compared to white patients.*Clinical Relevance/Application Clinicians should consider racial disparities in the surveillance and management of pulmonary embolism associated with COVID-19.

RESULTS

A total of 346,953 patients were identified with COVID-19, 3879 of whom developed pulmonary embolism (1.18%). 157,049 white and 50,376 black patients were identified. Compared to white patients, black patients had a higher risk of mortality (risk ratio 1.890 [95% CI 1.727-2.067]; p < 0.0001) and pulmonary embolism (risk ratio 1.537 [95% CI 1.380-1.711]; p < 0.0001). Additionally, black patients with both COVID-19 and pulmonary embolism had a higher rate of 30-day mortality compared to white patients (risk ratio 1.397 [95% CI 1.059-1.084]; p = 0.0174). All outcome differences persisted in balanced cohorts after propensity matching.

CLINICAL RELEVANCE/APPLICATION

Clinicians should consider racial disparities in the surveillance and management of pulmonary embolism associated with COVID-19.

SSCH07-6   Non-aneurysmal Non-atherosclerotic Aortic Thrombus (NANAAT): Clinical And CT Imaging Findings In A Symptomatic Cohort

Participants
Kaitlin Marquis, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study is to evaluate the clinical characteristics, imaging distribution, imaging appearance, and treatment outcome in symptomatic patients with non-atherosclerotic, non-aneurysmal aortic thrombi (NANAAT).*Methods and Materials A retrospective study was conducted at one tertiary care center using a search for "thoracic aortic mobile thrombus", "aortic thrombus", and "TAMT" conducted on the institution's radiology information system. Dates included an 8 year period from 2013 to 2021. Only patients with aortic thrombi with no or mild atherosclerosis (and no atherosclerosis at the site of the thrombus) and no aneurysm were included. All patients included in the study were symptomatic with definable sites of embolization via imaging examinations. All CT images were reviewed by a board-certified radiologist, C.R., with 15 years of experience, a fellow, R.S., and a third-year resident, K.M., via consensus.*Results 28 patients (ages 37-68, mean 53) were included in the analysis. 15 were female, 13 were male. 14/28 (50%) of patients were found to have a hypercoagulable condition, 10 with hematologic disorders or clinical histories of thrombi, 2 with malignancies, and 2 who were recently post-surgery. 36 total aortic thrombi were observed with 22 patients having a single thrombus and 6 patients having multiple thrombi. 22 of the thrombi were pedunculated and 14 were sessile. Average maximum dimension of the thrombi was 27 mm (range 2-138 mm). 56% were located in the descending thoracic aorta, 22% in the ascending aorta, 11% in the arch, and 11% in the abdominal aorta. Medical therapy was the primary initial treatment in 21 patients and was successful or partially successful in 12 patients, unsuccessful in 7 patients, and of unknown result in 2 patients. Of the patients who failed medical therapy all had at least one pedunculated thrombus. 5 patients required endovascular repair, 1 went for initial surgical repair, and 2 of the patients who failed medical treatment went on for open surgical repair.*Conclusions In this study, 50% of patients with NANAAT were found to have an underlying hypercoagulable condition. NANAAT were most

commonly seen in the descending thoracic aorta, but were identified in the ascending aorta in 22% of patients, a greater percentage than typically reported elsewhere in the literature. In patients who failed medical therapy or who required endovascular or open surgical treatment, 12/13 (92%) had a pedunculated appearance suggesting this configuration may require more aggressive management.*Clinical Relevance/Application NANAAT is an important imaging diagnosis that must be recognized. A pedunculated configuration may not respond adequately to medical therapy and require more aggressive intervention.

RESULTS

28 patients (ages 37-68, mean 53) were included in the analysis. 15 were female, 13 were male. 14/28 (50%) of patients were found to have a hypercoagulable condition, 10 with hematologic disorders or clinical histories of thrombi, 2 with malignancies, and 2 who were recently post-surgery. 36 total aortic thrombi were observed with 22 patients having a single thrombus and 6 patients having multiple thrombi. 22 of the thrombi were pedunculated and 14 were sessile. Average maximum dimension of the thrombi was 27 mm (range 2-138 mm). 56% were located in the descending thoracic aorta, 22% in the ascending aorta, 11% in the arch, and 11% in the abdominal aorta. Medical therapy was the primary initial treatment in 21 patients and was successful or partially successful in 12 patients, unsuccessful in 7 patients, and of unknown result in 2 patients. Of the patients who failed medical therapy all had at least one pedunculated thrombus. 5 patients required endovascular repair, 1 went for initial surgical repair, and 2 of the patients who failed medical treatment went on for open surgical repair.

CLINICAL RELEVANCE/APPLICATION

NANAAT is an important imaging diagnosis that must be recognized. A pedunculated configuration may not respond adequately to medical therapy and require more aggressive intervention.

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SSPH12

Physics (Quantitative Imaging/CT Radiation Dose)

Participants

Joseph Lo, PhD, Durham, North Carolina (*Moderator*) Nothing to Disclose
Michael F. McNitt-Gray, PhD, Los Angeles, California (*Moderator*) Institutional research agreement, Siemens AG;Research Grant, Siemens AG;Scientific Advisory Board, Hura Imaging, LLC

Sub-Events

SSPH12-1   Beyond Iodine: Dose Reduction Potential With Patient-Specific Prefiltration In Hafnium-Enhanced CT Scans With Energy Integrating And Photon Counting Detectors

Participants
Joerg Steidel, BSC, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To analyze the impact of the contrast agent type on the potential dose reduction achievable with patient-specific prefilters in single energy CT applications.*Methods and Materials Prefilters mainly remove the low energy x-ray photons and thus help to significantly reduce patient dose. The most common CT contrast agent is iodine. However, due to its low k-edge energy of 33 keV iodine-to-soft tissue contrast is highest at low energies and is therefore reduced by prefiltration unless low tube voltages are used. Other possible contrast agents have higher k-edge energies. Hafnium's is at 65 keV. We here investigate how the difference in absorption impacts the dose reduction potential of prefiltration. For this purpose semiantropomorphic liver phantoms containing iodine and hafnium contrast inserts with the same number of atoms per volume were simulated at different sizes: 15×10 (child), 30×20 (adult) and 50×40 cm (obese). We simulated 0 to 5 mm prefilter thickness and 40 to 150 kV tube voltage with a maximum mAs product of 1000 mAs. Dose was assessed using Monte Carlo simulations of a 32 cm CTDI phantom. Contrast-to-noise ratios at unit dose (CNRD) were calculated for iodine and hafnium contrast. Dose reduction compared to reference scans without additional prefiltration and iodine contrast was determined for CT with energy integrating detector and with photon counting detector (given in parentheses).*Results Child, adult and obese phantoms showed dose reductions of 43%, 79%, 83% (26%, 68%, 79%) with hafnium and 57%, 49%, 39% (41%, 25%, 8%) with iodine. Except for the child, dose reduction with hafnium is far higher than with iodine. However, the child requires 50 kV. Today's lower voltage limit is 70 kV and unlikely to decrease. With this restriction iodine contrast dose reduction achievable with optimized prefiltration is as low as 3% (2%) for the child case, while hafnium is unaffected: 43% (26%).*Conclusions Dose reduction through the use of patient-specific prefilters is significantly higher in hafnium-contrasted scans than with iodine. This also applies to other high k-edge contrast agents such as gadolinium, tungsten and bismuth.*Clinical Relevance/Application Dose reduction in clinical CT is important for patient safety.

RESULTS

Child, adult and obese phantoms showed dose reductions of 43%, 79%, 83% (26%, 68%, 79%) with hafnium and 57%, 49%, 39% (41%, 25%, 8%) with iodine. Except for the child, dose reduction with hafnium is far higher than with iodine. However, the child requires 50 kV. Today's lower voltage limit is 70 kV and unlikely to decrease. With this restriction iodine contrast dose reduction achievable with optimized prefiltration is as low as 3% (2%) for the child case, while hafnium is unaffected: 43% (26%).

CLINICAL RELEVANCE/APPLICATION

Dose reduction in clinical CT is important for patient safety.

SSPH12-2   Can A Deep Learning Model Trained From One Clinical Site Be Applied To Other Sites?A Case Report From COVID-19 Pneumonia Classification Using Chest X-ray Radiographs

Participants
Ran Zhang, PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

Many artificial-intelligence (AI) based algorithms have been proposed for the detection of COVID-19 in chest x-ray radiographs. While the reported performance on an individual test set shows great promise, it is unclear how well a model trained from one site can be generalized to other sites. The purpose of this work was to evaluate the generalizability of a trained AI algorithm using multiple well-curated test sets.*Methods and Materials A deep neural network model was developed using 19,784 images (5,725 positive COVID-19 cases) from four sites within the Henry Ford Health System. Small datasets from the four sites were withheld for model validation purposes. To test the model's generalizability, seven external test sets were curated. These include: [A] A hold-out clinical site within the Henry Ford Health System that was not used for model development; [B] A publicly available database from Spain, i.e., the BIMCV-COVID19 dataset; [C] Dataset collected at the University of Wisconsin Hospitals and Clinics; [D] Dataset curated by RSNA, i.e., International COVID-19 Open Radiology Database (positive only); [E] Dataset curated and made publicly available from Italy, i.e., BrixIA Covid-19 dataset (positive only); [F] A public dataset from Arkansas, COVID-19-AR (positive only); [G] A public dataset from the MIMIC-CXR database (negative only).*Results For internal validation, the AUC ranges from 0.84 to 0.87 among the four internal test sites. In contrast, for external test datasets, the performance in terms of AUC and the corresponding 95% CI (confidence interval) are given below for all 7 external test data sets: [A] 0.83 (0.81-0.85); [B] 0.78 (0.78-0.79); [C] 0.77 (0.74-0.79). For COVID positive only test sets [D], [E], and [F], the sensitivity values are 76%, 85%, and

82%, respectively. For COVID negative-only test set [G], the specificity is 71%.*Conclusions 1. Test performance drops from internal test datasets to external test datasets to show a generalization gap; 2. Performance for the seven external test datasets varies and the generalization gap varies from 0.01 to 0.10.*Clinical Relevance/Application The results from this study give the very first set of scientific data regarding the generalizability of AI models in radiology. The AI models trained from one, or a limited number of clinical sites, will drop in performance when they are applied to external test datasets.

RESULTS

For internal validation, the AUC ranges from 0.84 to 0.87 among the four internal test sites. In contrast, for external test datasets, the performance in terms of AUC and the corresponding 95% CI (confidence interval) are given below for all 7 external test data sets: [A] 0.83 (0.81-0.85); [B] 0.78 (0.78-0.79); [C] 0.77 (0.74-0.79). For COVID positive only test sets [D], [E], and [F], the sensitivity values are 76%, 85%, and 82%, respectively. For COVID negative-only test set [G], the specificity is 71%.

CLINICAL RELEVANCE/APPLICATION

The results from this study give the very first set of scientific data regarding the generalizability of AI models in radiology. The AI models trained from one, or a limited number of clinical sites, will drop in performance when they are applied to external test datasets.

SSPH12-3   Deep Voxel Forecast: Combining Auto-encoder Image Representations With Multiscale Features To Predict Chemoradiation Spatial Response Patterns On FDG PET

Participants
Stephen Bowen, PhD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

Spatial response prediction on longitudinal FDG PET imaging during chemoradiation (CRT) can support precise multimodality treatment intensification and adaptive targeting of resistant cancer phenotypes. Current techniques such as imaging biomarker regression, radiomics, spatial statistical learning, and image-to-image deep learning all have different strengths / limitations. We developed a new prediction model, Deep Voxel Forecast, to combine spatially homogeneous features (patient-level), spatially heterogeneous features (voxel-level), and deep image representations (neighborhood-level) for predicting PET spatial response patterns.*Methods and Materials Within a trial of risk-adaptive CRT for unresectable non-small cell lung cancer (NSCLC), 25 patients underwent baseline (PETpre) and week 3 on-treatment (PETmid) imaging. Deep Voxel Forecast models of voxel response between PETpre and PETmid used custom generalized least squares to incorporate patient-level features (tumor volume, mean SUV, mean CRT dose), voxel-level feature maps (SUV, centroid distance, CRT dose), and neighborhood-level feature maps (auto-encoder network layer representations). Feature dimensionality was reduced via principal component analysis. Patient-specific Matérn variograms were constructed to learn spatial correlation structure in voxel-level and neighborhood-level feature maps. Leave-one-patient-out cross-validated root mean squared error (RMSE) of Deep Voxel Forecast was benchmarked against the previously published Voxel Forecast algorithm.*Results Over 11,100 voxels, 3 patient-level features, 3 voxel-level feature maps, and an average of 80 auto-encoder image representation feature maps (range: 63-132), the Deep Voxel Forecast multiscale model achieved a predicted tumor voxel response RMSE of 0.22, which was equivalent to the Voxel Forecast multiscale model RMSE of 0.22 (p=0.20) and superior to the patient-scale model RMSE of 0.33 (p<0.0001). Voxel-level feature maps were most important for spatial response prediction relative to patient-level features and neighborhood-level feature maps.*Conclusions Deep Voxel Forecast incorporated auto-encoder image representations with spatial and non-spatial data to predict PET tumor voxel response patterns during CRT. Equivalent performance to the Voxel Forecast benchmark motivates further study on optimal combinations of deep feature maps and multiscale features to improve clinical decision support of adaptive cancer therapies.*Clinical Relevance/Application Forecasting spatially variant cancer response dynamics and future image states in individual patients provides powerful clinical decision support for the growing therapeutic arsenal in precision oncology.

RESULTS

Over 11,100 voxels, 3 patient-level features, 3 voxel-level feature maps, and an average of 80 auto-encoder image representation feature maps (range: 63-132), the Deep Voxel Forecast multiscale model achieved a predicted tumor voxel response RMSE of 0.22, which was equivalent to the Voxel Forecast multiscale model RMSE of 0.22 (p=0.20) and superior to the patient-scale model RMSE of 0.33 (p<0.0001). Voxel-level feature maps were most important for spatial response prediction relative to patient-level features and neighborhood-level feature maps.

CLINICAL RELEVANCE/APPLICATION

Forecasting spatially variant cancer response dynamics and future image states in individual patients provides powerful clinical decision support for the growing therapeutic arsenal in precision oncology.

SSPH12-4   Texture Analysis And Deep Learning In The Diagnosis Of Hip Fractures In The Emergency Room Setting

Participants
Karen Drukker, PhD, Chicago, Illinois (*Presenter*) Royalties, Hologic

PURPOSE

To develop a texture analysis and deep learning method for the identification of subtle fractures in hip radiographs acquired in the emergency department.*Methods and Materials A deep learning texture and image analysis model was developed to identify hip radiographs with subtle fractures. Two experts (with 5 and 2 years of experience) indicated a region of interest of variable size that included the proximal femur (femoral head, right femoral neck as well as the intertrochanteric region), and manually outlined any fractures as reference standard. Texture images were calculated as the pixel value standard deviation within a roaming 32x32 pixel window. Texture images as well as the original images were sectioned into image patches, with each patch resized to 150 x 150 pixels and serving as the inputs to a VGG-19-based deep learning method. The method was trained and evaluated using a 5-fold cross-validation with stratification on the patient level to avoid leaking of information between training and test folds (64%/16%/20% training/validation/test folds). The dataset in this pilot study consisted of hip radiographs of 112 patients (25 normals, 18 obvious fractures, and 69 subtle fractures). Performance was evaluated using ROC and precision recall-analyses, both when including and when excluding the obvious fracture cases from the test set.*Results On a by-image-patch level, the area under the ROC curve (AUCROC), in the task of distinguishing between radiographs with/without fracture, reached 0.86 while by-patient AUCROC values were 0.75, with 95% confidence interval [0.60; 0.84], and 0.72 [0.57; 0.82] including and excluding the obvious fracture cases, respectively. The corresponding areas under the precision-recall curves, AUCPR, for this task were 0.88

[0.78; 0.94] and 0.84 [0.72; 0.91], respectively.*Conclusions In this pilot study, image texture analysis combined with deep learning demonstrated promise the task of identifying hip radiographs with subtle fractures that may go unnoticed in the emergency room setting.*Clinical Relevance/Application Mischaracterizing or missing a fracture in a radiograph can have severe consequences for patients, resulting in delayed treatment and poor recovery of function. Using image texture analysis combined with deep learning to aid radiologists has the potential of increasing the diagnostic accuracy and speed of radiologists in diagnosing hip fractures in the emergency setting and as a result, reducing patient morbidity.

RESULTS

On a by-image-patch level, the area under the ROC curve (AUCROC), in the task of distinguishing between radiographs with/without fracture, reached 0.86 while by-patient AUCROC values were 0.75, with 95% confidence interval [0.60; 0.84], and 0.72 [0.57; 0.82] including and excluding the obvious fracture cases, respectively. The corresponding areas under the precision-recall curves, AUCPR, for this task were 0.88 [0.78; 0.94] and 0.84 [0.72; 0.91], respectively.

CLINICAL RELEVANCE/APPLICATION

Mischaracterizing or missing a fracture in a radiograph can have severe consequences for patients, resulting in delayed treatment and poor recovery of function. Using image texture analysis combined with deep learning to aid radiologists has the potential of increasing the diagnostic accuracy and speed of radiologists in diagnosing hip fractures in the emergency setting and as a result, reducing patient morbidity.

SSPH12-5   A Mathematical Framework To Quantitatively Balance Clinical And Radiation Risk In Computed Tomography

Participants
Francesco Ria, DMP, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

Risk in medical imaging is a combination of radiation risk and clinical risk, which is largely driven by the effective diagnosis. While radiation risk has traditionally been the main focus of Computed Tomography (CT) optimization, such a goal cannot be achieved without considering clinical risk. The purpose of this study was to develop a comprehensive mathematical framework that considers both radiation and clinical risks based on the specific task, the investigated disease, and the interpretive performance (i.e., false positive and false negative rates), tested across a representative clinical CT population.*Methods and Materials The proposed mathematical framework defined the radiation risk to be a linear function of the radiation dose, the population prevalence of the disease, and the false positive rate. The clinical risk was defined to be a function of the population prevalence, the expected life-expectancy loss for an incorrect diagnosis, and the interpretative performance in terms of the AUC as a function of radiation dose. A Total Risk (TR) was defined as the sum of the radiation risk and the clinical risk. With IRB approval, the mathematical function was applied to a dataset of 80 adult CT studies investigating localized stage liver cancer (LLC) for a specific false positive rate of 5% reconstructed with both Filtered Back Projection (FBP) and Iterative Reconstruction (IR) algorithm. Linear mixed effects models were evaluated to determine the relationship between radiation dose and radiation risk and interpretative performance, respectively. Lastly, the analytical minimum of the TR curve was determined and reported.*Results TR is largely affected by clinical risk for low radiation dose whereas radiation risk is dominant at high radiation dose. Concerning the application to the LLC population, the median minimum risk in terms of mortality per 100 patients was 0.04 in FBP and 0.03 in IR images; the corresponding CTDIvol values were 38.5 mGy and 25.7 mGy, respectively.*Conclusions The proposed mathematical framework offers a complete quantitative description of risk in CT enabling a comprehensive risk-to-benefit assessment essential in the effective justification of radiological procedures and in the design of optimal clinical protocols.*Clinical Relevance/Application The quantification of both radiation and clinical risk using comparable units allows the calculation of the overall risk paving the road towards a comprehensive risk-to-benefit assessment in CT.

RESULTS

TR is largely affected by clinical risk for low radiation dose whereas radiation risk is dominant at high radiation dose. Concerning the application to the LLC population, the median minimum risk in terms of mortality per 100 patients was 0.04 in FBP and 0.03 in IR images; the corresponding CTDIvol values were 38.5 mGy and 25.7 mGy, respectively.

CLINICAL RELEVANCE/APPLICATION

The quantification of both radiation and clinical risk using comparable units allows the calculation of the overall risk paving the road towards a comprehensive risk-to-benefit assessment in CT.

SSPH12-6   Quantification Of Perfusion Defect Distal To Pulmonary Embolism Using Computed Tomography Angiography: Validation In A Swine Model

Participants
Sabee Y. Molloi, PhD, Irvine, California (*Presenter*) Research Grant, Canon Medical Systems Corporation

PURPOSE

Computed tomography pulmonary angiography (CTPA) is a first-line diagnostic technique used to assess patients with suspected pulmonary embolism (PE). PE risk stratification is necessary for the optimal patient management. This study validated an automated minimum-cost path (MCP) technique to enable accurate calculation of the subtended lung tissue distal to a PE using CTPA.*Methods and Materials A Swan-Ganz catheter was placed in the left pulmonary artery for 7 swine (body weight: 27-53 kg) to produce different severity PEs. A total of 33 PE conditions were generated, where the balloon tip was adjusted distally to proximally under fluoroscopic guidance via balloon inflation (balloon diameter: 2-4 mm). Under each PE condition, pulmonary angiography and dynamic CT perfusion (CTP) scans were acquired using a 320-slice CT scanner after a 0.5 ml/kg of contrast material injection followed by a 0.5 ml/kg saline chaser. The MCP technique was used to assign perfusion territories that were supplied by the nearest pulmonary arteries. The pulmonary artery tree was divided into distal and proximal portions based on the location of the balloon tip, where the distal territory was defined as the subtended PE-related territory. Dynamic CTP images were used as the reference standard PE-related perfusion defect territory. The accuracy of the MCP technique was evaluated by quantitatively comparing the MCP-derived perfusion territories to the reference standard territories by Dice coefficient, linear regression, and t-test.*Results All MCP PE-related territory masses (MMCP, g) and all reference standard perfusion 'defect' territory masses (MRS, g) were related by MMCP=1.04MRS+1.23 (r = 0.97, p=0.20). The mean Dice coefficient is 0.86.*Conclusions The perfusion defect distal to a pulmonary embolism can be accurately calculated using CTPA images. This technique can potentially be used for PE risk stratification.*Clinical Relevance/Application The quantification of PE severity with the MCP technique using CTPA

image data could potentially be used to select the most appropriate management approach for individual patients.

RESULTS

All MCP PE-related territory masses (MMCP, g) and all reference standard perfusion 'defect' territory masses (MRS, g) were related by MMCP=1.04MRS+1.23 (r = 0.97, p=0.20). The mean Dice coefficient is 0.86.

CLINICAL RELEVANCE/APPLICATION

The quantification of PE severity with the MCP technique using CTPA image data could potentially be used to select the most appropriate management approach for individual patients.

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SSGU01
Genitourinary (Pelvis and Prostate)

Participants
Elizabeth A. Sadowski, MD, Madison, Wisconsin (*Moderator*) Nothing to Disclose
Bryan R. Foster, MD, Portland, Oregon (*Moderator*) Royalties, RELX;Consultant, RELX
Jeanne M. Horowitz, MD, Chicago, Illinois (*Moderator*) Nothing to Disclose

Sub-Events

SSGU01-1 Use Of Contrast-Enhanced Ultrasound To Evaluate Uterine Fibroid Microvascularity Pre And Post Uterine Artery Embolization

Participants
Priscilla Machado, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To assess fibroid microvascularity before and after uterine artery embolization (UAE) using contrast-enhanced ultrasound (CEUS).*Methods and Materials To date 38 women with symptomatic uterine fibroids scheduled for UAE have been enrolled in this ongoing IRB-approved study. The women underwent 3 CEUS examinations (day 0 {pre-UAE} and days 15 and 90 post-UAE) using an Aplio i800 scanner (Canon Medical Systems, Tustin, CA, USA) with a curvilinear array (8C1). The ultrasound contrast agent Lumason (Bracco, Milan, Italy) was administered IV (dose: 2.0 ml). Digital CEUS clips were acquired for all cases, randomized off-line and assessed qualitatively by two independent radiologists that classified the fibroids as vascular or non-vascular. ImageJ (NIH, Bethesda, MD, USA) was used to quantify the fractional vascularity of the fibroids (FV). The pre procedure MRI and the post procedure clinical outcomes were used as the reference standard, and compared to CEUS. Results were analyzed using repeated ANOVAs and nonparametric Wilcoxon Sign Rank tests.*Results All 38 cases underwent the pre-UAE CEUS study, and so far 35 cases underwent the 15 days post-UAE CEUS study, while 28 cases underwent the 90 days post-UAE CEUS study, completing their enrollment in the study. The results showed excellent inter-reader agreement for all time points (p=0.67; kappa=0.96). The reference standard showed excellent agreement between the readers and the pre-UAE MRI (p=0.58). In addition, post-UAE clinical follow-ups agreed well with CEUS examinations performed at both 15 (p=0.38) and 90 days (p=0.39). Quantitative analysis of the FV across time points showed statistically significant differences between pre-UAE and the 2 post-UAE time points (p<0.0001).*Conclusions Results indicate that CEUS pre and post UAE can accurately evaluate fibroid microvascularity and, thus, can be a noninvasive and accurate alternative to monitoring treatment results; albeit based on a small sample size.*Clinical Relevance/Application UAE is a nonsurgical therapy to block blood flow to fibroids. CEUS can accurately evaluate fibroid microvascularity and, thus, can become a noninvasive and accurate alternative for monitoring treatment outcomes.

RESULTS

All 38 cases underwent the pre-UAE CEUS study, and so far 35 cases underwent the 15 days post-UAE CEUS study, while 28 cases underwent the 90 days post-UAE CEUS study, completing their enrollment in the study. The results showed excellent inter-reader agreement for all time points (p=0.67; kappa=0.96). The reference standard showed excellent agreement between the readers and the pre-UAE MRI (p=0.58). In addition, post-UAE clinical follow-ups agreed well with CEUS examinations performed at both 15 (p=0.38) and 90 days (p=0.39). Quantitative analysis of the FV across time points showed statistically significant differences between pre-UAE and the 2 post-UAE time points (p<0.0001).

CLINICAL RELEVANCE/APPLICATION

UAE is a nonsurgical therapy to block blood flow to fibroids. CEUS can accurately evaluate fibroid microvascularity and, thus, can become a noninvasive and accurate alternative for monitoring treatment outcomes.

SSGU01-2 Diagnostic Performance Of Ultrasound Algorithms For Evaluation Of Adnexal Masses: ACR-ORADS, GI-RADS, IOTA SR: Which Path Clears The Maze?

Participants
Shabnam Grover, MD,DMRD, Greater Noida, India (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study was to compare the diagnostic performance of ultrasound (US) based ACR-ORADS, GI-RADS and IOTA SR, for characterization and malignancy risk stratification of adnexal masses and propose the best amongst the three. The reference standard was histopathology.*Methods and Materials The Institutional Review Board approved prospective study, comprised of 100 patients with adnexal masses. After informed consent the patients underwent US examination by the same examiners, first & second author, all on a Siemens Acuson S3000 equipment. Using the recommended algorithms, O-RADS category, GI-RADS category and IOTA SR category was assigned to each examined tumor by consensus. The diagnostic performance of each system was subsequently assessed either by histopathology from biopsied/operated tumors as reference standard; or biannual survey of 12 months for conservatively managed tumors. Sensitivity, specificity, positive & negative predictive values, & diagnostic accuracy were computed for all three systems.*Results Of the evaluated tumors, 40 were benign & 60 were malignant. O-RADS and GI-RADS classification could be applied to all evaluated tumors, while IOTA simple rules could be applied to 85 tumors. The sensitivity, specificity, PPV & NPV for ACR O-RADS was found to be 100%, 55%, 77.5% & 100%. The sensitivity, specificity, PPV & NPV for GI-

RADS was found to be 93.3%, 60%, 77.8% & 85.7% respectively. For IOTA SR sensitivity, specificity, PPV & NPV was 90%, 80%, 87.1% & 84.2% respectively. Diagnostic accuracy for ACR O-RADS was 82.6%, for GI-RADS it was 80% and for IOTA SR it was 86%.*Conclusions ACR-ORADS algorithm was found to have the highest sensitivity, and highest NPV, the latter confirming benignity and suggesting recommended conservative management in this group. IOTA SR had the best specificity, however, PPV and diagnostic accuracy were found to be almost similar for O-RADS, GI-RADS and IOTA SR. Thus, the O-RADS algorithm appears to be the best path to clear the maze.*Clinical Relevance/Application Improved prognosis of ovarian malignancy is mainly impacted by early diagnosis & appropriate stratification for management & both factors are based on application of the best ultrasound algorithm.

RESULTS

Of the evaluated tumors, 40 were benign & 60 were malignant. O-RADS and GI-RADS classification could be applied to all evaluated tumors, while IOTA simple rules could be applied to 85 tumors. The sensitivity, specificity, PPV & NPV for ACR O-RADS was found to be 100%, 55%, 77.5% & 100%. The sensitivity, specificity, PPV & NPV for GI-RADS was found to be 93.3%, 60%, 77.8% & 85.7% respectively. For IOTA SR sensitivity, specificity, PPV & NPV was 90%, 80%, 87.1% & 84.2% respectively. Diagnostic accuracy for ACR O-RADS was 82.6%, for GI-RADS it was 80% and for IOTA SR it was 86%.

CLINICAL RELEVANCE/APPLICATION

Improved prognosis of ovarian malignancy is mainly impacted by early diagnosis & appropriate stratification for management & both factors are based on application of the best ultrasound algorithm.

SSGU01-3 A Fully Automated Deep Learning Pipeline For The Detection Of Clinically Significant Prostate Cancer Using Multiparametric MRI

Participants
Jason Cai, MD, Bronx, New York (*Presenter*) Nothing to Disclose

PURPOSE

Prostate cancer is the most common solid-organ malignancy in men. Multiparametric MRI (mpMRI) can be used to identify clinically significant prostate cancer (csPca), defined as Gleason Grade 2 or higher. However, reader experience and interobserver variability may affect the performance of PI-RADS. In contrast, deep learning (DL) produces deterministic outputs and can perform well in imaging tasks. We trained a fully automated DL pipeline to predict the presence of csPca.*Methods and Materials IRB approval was obtained. All patients without a history of csPca who underwent MRI from 2017-2019 were reviewed. Examinations originated from three sites and two scanner manufacturers. Inclusion criteria were: (1) patients undergoing screening or active surveillance who had pathological confirmation within 1 year after MRI, and (2) patients undergoing screening who had PI-RADS score 1 or 2 without pathological confirmation (considered as negative cases). Patients with poor quality DWI were excluded (n=56). Of 4731 patients (5734 examinations), 1373 had csPca. A 3D U-Net was trained to segment the prostate on ADC/DWI, T2, and dynamic T1 contrast-enhanced sequences. From each segmentation, a bounding box was created to crop the prostate gland. A VGG-style 3D convolutional neural network was trained on these images to predict the presence of csPca. The train:validation:test split was 80:10:10 at patient level. We evaluated our pipeline on an internal test set and the ProstateX dataset (lesion location information from ProstateX was not used). We also compared it to human performance (PI-RADS score) on the internal test set. Saliency maps were used for tumor localization. The DeLong test was used to compare AUC.*Results On the internal test set, the classifier had 0.87 AUC (0.80-0.92), 78% sensitivity, 86% specificity, and 83% accuracy, whereas PI-RADS score had 0.89 AUC (0.84-0.93), 82% sensitivity, 88% specificity, and 86% accuracy (p=0.51). On the ProstateX dataset, the classifier had 0.85 AUC (0.82-0.91) 87% sensitivity, 74% specificity, and 78% accuracy. For true positive cases, saliency maps consistently demonstrated increased activation over tumor regions.*Conclusions DL can accurately detect csPca on mpMRI without manual input. Saliency maps can be used to verify the prediction and identify the region of interest.*Clinical Relevance/Application Our fully automated DL pipeline can be a valuable adjunct to the clinical evaluation of prostate cancer on mpMRI.

RESULTS

On the internal test set, the classifier had 0.87 AUC (0.80-0.92), 78% sensitivity, 86% specificity, and 83% accuracy, whereas PI-RADS score had 0.89 AUC (0.84-0.93), 82% sensitivity, 88% specificity, and 86% accuracy (p=0.51). On the ProstateX dataset, the classifier had 0.85 AUC (0.82-0.91) 87% sensitivity, 74% specificity, and 78% accuracy. For true positive cases, saliency maps consistently demonstrated increased activation over tumor regions.

CLINICAL RELEVANCE/APPLICATION

Our fully automated DL pipeline can be a valuable adjunct to the clinical evaluation of prostate cancer on mpMRI.

SSGU01-4 MRI-targeted Fusion Prostate Biopsy: Impact Of Additional Systematic Cores And Reasons For Missing Clinically Significant Prostate Cancer

Participants
Lars Schimmoeller, MD, Dusseldorf, Germany (*Presenter*) Nothing to Disclose

PURPOSE

This study evaluates the diagnostic impact of systematic biopsies (SB) in addition to MRI-guided targeted biopsies (TB) and cases with clinically significant prostate cancer (csPCa) missed by targeted biopsy (TB) in a large patient collective.*Methods and Materials Consecutive patients with 3T multi-parametric MRI of the prostate and subsequent TB plus 12-core SB were included in this study from 01/2014 to 04/2019. The study objectives were the analysis of cases with a csPCa missed by TB, PCa detection with additional SB, the PCa detection and the correlation with clinical and MRI parameters.*Results In total 785 patients met the inclusion criteria. 342 patients had a csPCa (median PSAD 0.29 ng/ml/cm3). Additional SB misclassified 40% of csPCa and detected 9.5% additional insignificant PCa. In 42 patients (13%), a csPCa was detected only by SB. In 36 of these cases, the localization of the positive SB cores matched with the cancer suspicious region described on mpMRI (mCSR). Cases with a csPCA missed by TB showed either an insufficient MRI segmentation (prostate boundary correlation) (31%) and/or insufficient lesion registration (lesion transfer, tracking, and/or matching) (48%), a missed small lesion (14%), or a failed center of a large lesion (10%). Median PSAD of patients with nsPCa detected by SB was 0.15 ng/ml/cm3.*Conclusions Main reasons for missing a csPCa by TB were insufficient prostate segmentation or imprecise lesion registration within MRI/US fusion-guided biopsy. Consequently, verification of MRI quality, exact mCSR assessment, and advanced biopsy experience may improve accuracy. Altogether, an additional SB adds limited clinical benefit, especially in men with PSAD =0.15 ng/ml/cm3.*Clinical Relevance/Application MRI-targeted biopsy (TB) can miss MRI cancer suspicious regions (mCSR) and csPCA. Main reasons missing csPCa were insufficient segmentation (MRI/US correlation of the

prostate boundary) or imprecise registration (inaccurate lesion transfer, tracking or matching) within MRI/US fusion-guided biopsy. Pre-biopsy verification of MR image and report quality, segmentation, and registration next to clinical experience seems essential. Additional SB might cover inaccuracies of TB, but our data suggests that additional SB adds limited clinical value in cases with PSAD = 0.15 ng/ml/cm3.

RESULTS

In total 785 patients met the inclusion criteria. 342 patients had a csPCa (median PSAD 0.29 ng/ml/cm3). Additional SB misclassified 40% of csPCa and detected 9.5% additional insignificant PCa. In 42 patients (13%), a csPCa was detected only by SB. In 36 of these cases, the localization of the positive SB cores matched with the cancer suspicious region described on mpMRI (mCSR). Cases with a csPCA missed by TB showed either an insufficient MRI segmentation (prostate boundary correlation) (31%) and/or insufficient lesion registration (lesion transfer, tracking, and/or matching) (48%), a missed small lesion (14%), or a failed center of a large lesion (10%). Median PSAD of patients with nsPCa detected by SB was 0.15 ng/ml/cm3.

CLINICAL RELEVANCE/APPLICATION

MRI-targeted biopsy (TB) can miss MRI cancer suspicious regions (mCSR) and csPCA. Main reasons missing csPCa were insufficient segmentation (MRI/US correlation of the prostate boundary) or imprecise registration (inaccurate lesion transfer, tracking or matching) within MRI/US fusion-guided biopsy. Pre-biopsy verification of MR image and report quality, segmentation, and registration next to clinical experience seems essential. Additional SB might cover inaccuracies of TB, but our data suggests that additional SB adds limited clinical value in cases with PSAD = 0.15 ng/ml/cm3.

SSGU01-5 Diagnostic Accuracy And Inter-observer Reliability Of The O-rads Scoring System Amongst Staff Radiologists In North American Academic Clinical Setting

Participants
Yeli Pi, MD, Edmonton, Alberta (*Presenter*) Nothing to Disclose

PURPOSE

The objective of this study is to evaluate the diagnostic accuracy, interobserver variability, and common lexicon pitfalls of the ACR O-RADS scoring system amongst staff radiologists without prior experience to O-RADS.*Methods and Materials After independent review of the ACR O-RADS publications and 30 training cases, three fellowship-trained, board-certified staff radiologists scored 50 testing cases using the O-RADS system. The diagnostic accuracy and area under receiver operating characteristic were analyzed for each reader. Overall agreement and pair-wise agreement between readers was also analyzed.*Results Excellent specificities (92 to 100%) and negative predictive values (92 to 100%) were achieved. Variable sensitivities (72 to 100%) and positive predictive values (66 to 100%) were observed. Considering O-RADS 4 and O-RADS 5 as predictors of malignancy, individual reader AUC values range from 0.94-0.98 (p<0.001). Overall inter-reader agreement for all 3 readers was "very good", k = 0.82 (0.73 to 0.90, 95% CI, p < 0.001). Pair-wise agreement between readers were also "very good", k=0.86-0.92. Fourteen out of 150 lesions were misclassified, with the most common error represented by down-scoring of a solid lesion with irregular outer contours.*Conclusions Even without specific training, experienced ultrasound readers in North America can achieve excellent diagnostic performance and high inter-reader reliability with self-directed review of guidelines and cases.*Clinical Relevance/Application The study highlights the effectiveness of ACR O-RADS as a stratification tool for radiologists and supports its continued use in practice.

RESULTS

Excellent specificities (92 to 100%) and negative predictive values (92 to 100%) were achieved. Variable sensitivities (72 to 100%) and positive predictive values (66 to 100%) were observed. Considering O-RADS 4 and O-RADS 5 as predictors of malignancy, individual reader AUC values range from 0.94-0.98 (p<0.001). Overall inter-reader agreement for all 3 readers was "very good", k = 0.82 (0.73 to 0.90, 95% CI, p < 0.001). Pair-wise agreement between readers were also "very good", k=0.86-0.92. Fourteen out of 150 lesions were misclassified, with the most common error represented by down-scoring of a solid lesion with irregular outer contours.

CLINICAL RELEVANCE/APPLICATION

The study highlights the effectiveness of ACR O-RADS as a stratification tool for radiologists and supports its continued use in practice.

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SSNMMI07

Science Session with Keynote: Nuclear Medicine/Molecular Imaging (Response Insight on Oncologic PET)

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Participants
Gary L. Dillehay, MD, Chicago, Illinois (*Moderator*) Nothing to Disclose

Sub-Events

SSNMMI07   Keynote Speaker

Participants
Gary L. Dillehay, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

SSNMMI07-2   The Relationship Between Bone Marrow Involvement On18F-fluorodeoxyglucose Positron Emission Tomography/computed Tomography And Bone Marrow Biopsy In Patients With Multiple Myeloma

Participants
KIFLOM Gebreslassea, MD, Cape Town, South Africa (*Presenter*) Nothing to Disclose

PURPOSE

Multiple myeloma is a plasma cell neoplasm characterized by unrestrained monoclonal proliferation of malignant plasma cells, which develop from B lymphocytes within the bone marrow. Bone marrow biopsy plays a crucial role in the diagnosis and assessment of treatment response in myeloma. 18F-fluorodeoxyglucose positron emission tomography/computed tomography (18F-FDG PET/CT) has been shown to be a complementary measure of marrow involvement in lymphomas, particularly in Hodgkin lymphoma and diffuse large B cell lymphoma. However, only limited information is available on its potential role in the assessment of bone marrow involvement and its relationship with bone marrow biopsy in patients with multiple myeloma. Therefore, this study is aimed to compare these two modalities in assessing bone marrow involvement and/or tumor burden.*Methods and Materials From a retrospective review of 190 patients with multiple myeloma from January 2013 to July 2020, 103 patients were included. Plasma cell infiltration (PCI) on bone marrow biopsy was compared for three visual patterns of 18F-FDG bone marrow uptake (irregular, diffuse less than or equal to the liver, and diffuse greater than liver). The PCI was based on bone marrow biopsy and aspiration results. The 18F-FDG uptake at the site of bone marrow biopsy was assessed visually and semiquantitatively. A Kruskal-Wallis rank test and quantile regression were used to compare the two modalities.*Results Eighty-four patients had diffuse bone marrow uptake. Of these 25/84 had uptake greater than liver, all having PCI =60% and a median value of 85%. Of the 84 patients, the 59 patients with uptake less than or equal to liver had PCI <10% in 57.6% (34/59), and =10% in 42.4% (25/59) with a median value of 8%. Nineteen patients had irregular bone marrow uptake. Of these 4/19 (21.1%) had PCI of <10% and 15/19 (78.9%) =10%, with a median value of 23%. The median percentage of PCI across the three described patterns of FDG uptake was significantly different (P=0.0001).*Conclusions Bone marrow biopsy and 18F-FDG PET/CT showed a good concordance in patients with diffuse bone marrow 18F-FDG uptake in assessing the tumor burden in patients with multiple myeloma. However, bone marrow biopsy may underestimate the tumor burden in patients with an irregular pattern of 18F-FDG uptake with a potential risk of undertreatment of the patient.*Clinical Relevance/Application Based on our results 18F-FDG PET/CT may replace bone marrow biopsy in the majority of the patients with a diffuse and irregular pattern of bone marrow 18F-FDG uptake. However, its sensitivity in detecting PCI may be limited in low-grade bone marrow infiltration when compared to the bone marrow biopsy.

RESULTS

Eighty-four patients had diffuse bone marrow uptake. Of these 25/84 had uptake greater than liver, all having PCI =60% and a median value of 85%. Of the 84 patients, the 59 patients with uptake less than or equal to liver had PCI <10% in 57.6% (34/59), and =10% in 42.4% (25/59) with a median value of 8%. Nineteen patients had irregular bone marrow uptake. Of these 4/19 (21.1%) had PCI of <10% and 15/19 (78.9%) =10%, with a median value of 23%. The median percentage of PCI across the three described patterns of FDG uptake was significantly different (P=0.0001).

CLINICAL RELEVANCE/APPLICATION

Based on our results 18F-FDG PET/CT may replace bone marrow biopsy in the majority of the patients with a diffuse and irregular pattern of bone marrow 18F-FDG uptake. However, its sensitivity in detecting PCI may be limited in low-grade bone marrow infiltration when compared to the bone marrow biopsy.

SSNMMI07-4   Effects Of Anti-TNF-therapy On Osteoblastic Activity In Ankylosing Spondylitis - Results From A Prospective Study Using PET-MRI Of SIJ And Spine

Participants
Nils Bruckmann, MD, Duesseldorf, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Assess the effect of TNF-inhibitors on inflammatory and post-inflammatory lesions in relation to the effects on osteoblastic activity assessed by Na[18F]F PET/MRI in the axial skeleton of r-axSpA patients prior (baseline, BL) and up to 6 months after (follow-up, FU) treatment.*Methods and Materials Clinically active r-axSpA patients (11 male, 5 female, mean age 38.6±12.0 years) prospectively underwent Na[18F]F PET/MR images of the SIJ (n=16 patients) and the whole spine (n=10 patients) at BL and FU.

Three independent blinded readers (1 for PET/MRI, 2 for conventional MRI) evaluated all images. Inflammation (bone marrow edema, BME), structural lesions (fat lesions (FL), sclerosis, erosions and ankylosis) and Na[18F]F uptake were recorded on the level of sacroiliac joint quadrants (SIJ-Q) and vertebral quadrants (VQ). Chi-Square test was applied for comparisons between timepoints.*Results Overall, 11 male and 5 female patients (mean age 38.6±12.0 years) were followed up over a mean of 4.6 (3-6) months. A total of 128 SIJ-Q and 920 VQs were analyzed at each timepoint. At BL, Na[18F]F uptake was found in 96.0% SIJ-Qs with BME, 94.2% with sclerosis and 88.3% with FL at BL. At FU, 65.3% of SIJ-Q with BME (p<0.01), 33.8% with sclerosis (p=0.23) and 24.5% with FL (p=0.01) showed decrease of 1 Na[18F]F uptake. In VQ, Na[18F]F uptake was found in 81.5% with sclerosis, 41.9% with FL and 33.7% with BME at BL. At FU, 73.5% VQ with BME, 53.3% with FL and 55.6% with sclerosis showed decrease of Na[18F]F uptake.*Conclusions Anti-TNF treatment led to a significant decrease of osteoblastic activity within 4 months, which was most prominent at sites with inflammation.*Clinical Relevance/Application These data support the early anti-inflammatory treatment initiation for prevention of radiographic progression in axSpA.

RESULTS

Overall, 11 male and 5 female patients (mean age 38.6±12.0 years) were followed up over a mean of 4.6 (3-6) months. A total of 128 SIJ-Q and 920 VQs were analyzed at each timepoint. At BL, Na[18F]F uptake was found in 96.0% SIJ-Qs with BME, 94.2% with sclerosis and 88.3% with FL at BL. At FU, 65.3% of SIJ-Q with BME (p<0.01), 33.8% with sclerosis (p=0.23) and 24.5% with FL (p=0.01) showed decrease of 1 Na[18F]F uptake. In VQ, Na[18F]F uptake was found in 81.5% with sclerosis, 41.9% with FL and 33.7% with BME at BL. At FU, 73.5% VQ with BME, 53.3% with FL and 55.6% with sclerosis showed decrease of Na[18F]F uptake.

CLINICAL RELEVANCE/APPLICATION

These data support the early anti-inflammatory treatment initiation for prevention of radiographic progression in axSpA.

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SSNR04

Neuroradiology (Brain: Neoplasms (Diagnosis and Classification)/Brain: Neoplasms (Post-Treatment Evaluation))

Participants
Mark Shiroishi, MD, South Pasadena, California (*Moderator*) Nothing to Disclose

Sub-Events

SSNR04-1 Clinical And Imaging Prognostic Factors Of Stroke-like Migraine Attack After Radiation Therapy (SMART) Syndrome

Participants
Yoshiaki Ota, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

This study was aimed to assess clinical and imaging features to predict the clinical outcome of stroke-like migraine attacks after radiation therapy (SMART) syndrome.*Methods and Materials We retrospectively reviewed the clinical manifestations and imaging findings of 21 patients with SMART syndrome (mean age 47.9 ± 13.7, 6 females) diagnosed in multiple international centers between August 2015 and January 2020. Patients' demographics and MRI imaging features at the diagnosis of SMART syndrome were reviewed. This cohort was divided into the completely clinically recovered (CR) group and the incompletely clinically recovered (IR) group. The diagnosis of SMART syndrome was performed by neuroradiology and neurology consensus at each institution. The numerical variables were compared by t-test or Mann-Whitney U test, and categorical variables were by Fisher's exact test between 2 groups. As for MRI imaging findings, the inter-reader agreement was assessed by kappa analysis. All statistical tests were two-sided and p = 0.05 was considered to be statistically significant.*Results CR group (n=11, 2 females) and IR group (n=10, 4 females) constituted this study cohort.As for patients' demographic, there were statistically significant differences between CR and IR in age (mean age 41.4 ± 8.4 vs 55.0 ± 15.2 years, P= .018), months of follow-up (median (range): 1(1-24) vs 15 (1-70); P= .006), and presence of administration of steroid treatment at the diagnosis of SMART syndrome (CR vs IR: 3/11 vs 8/10, P= .03). As for MRI imaging findings, there were statistically significant differences between CR and IR in presence of SWI/T2*WI abnormality and restricted diffusion in the region of the gyral enhancement, which were more frequent in IR than CR (CR vs IR: 3/11 vs 9/10; P=.008, 0/11 vs 4/10; P=.035, respectively). Inter-reader agreement for MRI imaging findings was substantial to almost perfect (? = 0.7-1).*Conclusions Incomplete recovery was associated with older age, use of steroid treatment at the diagnosis of SMART syndrome, and MRI findings of abnormal susceptibility signal and restricted diffusion in the region of the gyral enhancement.*Clinical Relevance/Application The clinical outcome of SMART syndrome can be predicted from patient age and MRI imaging findings of local abnormal susceptibility signal and restricted diffusion. The worse clinical outcomes in the SMART group who underwent steroid administration in our study may suggest that the pros and cons of steroid use should be carefully considered prior to steroid treatment.

RESULTS

CR group (n=11, 2 females) and IR group (n=10, 4 females) constituted this study cohort.As for patients' demographic, there were statistically significant differences between CR and IR in age (mean age 41.4 ± 8.4 vs 55.0 ± 15.2 years, P= .018), months of follow-up (median (range): 1(1-24) vs 15 (1-70); P= .006), and presence of administration of steroid treatment at the diagnosis of SMART syndrome (CR vs IR: 3/11 vs 8/10, P= .03). As for MRI imaging findings, there were statistically significant differences between CR and IR in presence of SWI/T2*WI abnormality and restricted diffusion in the region of the gyral enhancement, which were more frequent in IR than CR (CR vs IR: 3/11 vs 9/10; P=.008, 0/11 vs 4/10; P=.035, respectively). Inter-reader agreement for MRI imaging findings was substantial to almost perfect (? = 0.7-1).

CLINICAL RELEVANCE/APPLICATION

The clinical outcome of SMART syndrome can be predicted from patient age and MRI imaging findings of local abnormal susceptibility signal and restricted diffusion. The worse clinical outcomes in the SMART group who underwent steroid administration in our study may suggest that the pros and cons of steroid use should be carefully considered prior to steroid treatment.

SSNR04-2 Combining Deep Learning And Radiomics Features From Preoperative MRI For Predicting CDKN2A/B Gene Loss In Patients With Glioblastoma

Participants
Evan Calabrese, MD, PhD, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

CDKN2A/B gene loss is a poor prognostic marker identified in approximately 50% of glioblastomas. Ongoing clinical trials have shown that downstream oncogenic pathways affected by CDKN2A/B loss can be inhibited using investigational drugs, yet assessment of CDKN2A/B status in glioblastomas remains uncommon. The purpose of this study was to non-invasively predict CDKN2A/B loss in patients with glioblastoma by using both engineered radiomics features and learned deep features from preoperative MRI.*Methods and Materials We analyzed 400 adult patients who had preoperative brain MRI, first time glioblastoma resection, and subsequent CDKN2A/B genetic assessment. The MRI protocol included 3D pre and post-contrast T1-, T2-, FLAIR-, diffusion-, and susceptibility-weighted images as well as DTI and ASL perfusion.Image preprocessing steps included co-registration, skull stripping, intensity

normalization, and tumor segmentation using a custom deep convolutional neural network (dCNN). Radiomics features were extracted from the tumor region using Pyradiomics 3.0.A 3D dCNN was developed to predict CDKN2A/B loss using multimodal whole tumor images and radiomics features. Deep features were learned using a 10-layer convolutional encoding limb with 3 max pooling steps. Radiomics features were combined with deep features via a dense CNN limb consisting of 2 hidden layers and a final output layer for predicting CDKN2A/B status. 5-fold cross validation was accomplished using 2 Nvidia V100 GPUs.*Results CDKN2A/B loss was identified in the study cohort with a prevalence of 53% by genetic sequencing. Cross-validation of the combined deep- and radiomics-feature model yielded accurate predictions of CDKN2A/B loss in the test dataset with a best point sensitivity of 0.70, a specificity of 0.88, and an area under the curve of 0.84. The combined model performed better than models based on radiomics or deep features alone.*Conclusions A deep neural network combining learned deep features and engineered radiomics features from preoperative MRI can non-invasively predict CDKN2A/B loss in patients with glioblastoma with moderate accuracy.*Clinical Relevance/Application Non-invasive identification of CDKN2A/B gene loss in glioblastomas could provide important prognostic information and help guide the use of investigational molecular targeted therapies.

RESULTS

CDKN2A/B loss was identified in the study cohort with a prevalence of 53% by genetic sequencing. Cross-validation of the combined deep- and radiomics-feature model yielded accurate predictions of CDKN2A/B loss in the test dataset with a best point sensitivity of 0.70, a specificity of 0.88, and an area under the curve of 0.84. The combined model performed better than models based on radiomics or deep features alone.

CLINICAL RELEVANCE/APPLICATION

Non-invasive identification of CDKN2A/B gene loss in glioblastomas could provide important prognostic information and help guide the use of investigational molecular targeted therapies.

SSNR04-3   Interrater Reliability Of A Standardized Reporting System For Brain Tumor MRIs

Participants
Maxwell Cooper, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

The Brain Tumor Reporting and Data System (BT-RADS) is a structured radiology reporting algorithm designed to decrease subjectivity among radiologists interpreting MRI exams of treatment response in brain tumor patients. The purpose of this study was to determine the agreement and interrater reliability for multiple radiologists using BT-RADS to score the same cohort of primary brain tumor MRI exams.*Methods and Materials A retrospective search was conducted for all adult patients with a primary parenchymal brain tumor receiving an MRI over a 2 month period at a single institution. Six radiologists were selected for this study, 4 faculty neuroradiologists and 2 radiology residents. Each reader scored all 103 patient's MRIs using the BT-RADS system (Fig 1A). Readers were blind to the MRI report and the BT-RADS score assigned by the radiologist that initially read the patient's imaging. Interrater agreement between readers were calculated using rates of exact agreement and linear weighted kappa extended to multiple raters using Light's method with bootstrapped confidence intervals. Consensus scoring was determined as agreement between all 4 faculty readers.*Results 103 consecutive primary brain tumor MRIs from 98 patients were included. Average patient age was 46.1 years (range 21-84). The majority of the tumors were an astrocytoma (79/103, 76.7%), with 45 (43.7%) classified as Grade 4 glioblastoma (Fig. 1B). The majority of MRI studies (54/103, 52.4%) received a score of 2 (Fig. 1C). The linear weighted kappa for all six readers was 0.62 (95% CI: 0.53, 0.70) (substantial agreement). All 6 readers agreed on 43.7% of cases. All 4 faculty readers and 3 of 4 faculty readers agreed on 52.4% (54/103) and 73.4% (76/103) of MRI studies, respectively (Fig. 1D).*Conclusions This study was the first quantifiable analysis of blinded interrater reliability for utilizing BT-RADS to score MRIs in brain tumor patients. All readers agreed on a significant fraction of the cases (43.7%), which likely represented cases with less challenging or conflicting findings. The interrater agreement was good although not perfect. This likely reflects intrinsic uncertainty in reading highly complex posttreatment brain tumor scans and the high number and heterogeneity of readers in this study. Further work is needed to understand the reasons for these individual discrepancies, to determine if system improvements can reduce variability, and how these structured scores correlate with patient outcome.*Clinical Relevance/Application The goal of BT-RADS is to maximize consistency between brain MRI reports to aid with monitoring treatment response and disease progression, serving as a guide for clinical management decisions.

RESULTS

103 consecutive primary brain tumor MRIs from 98 patients were included. Average patient age was 46.1 years (range 21-84). The majority of the tumors were an astrocytoma (79/103, 76.7%), with 45 (43.7%) classified as Grade 4 glioblastoma (Fig. 1B). The majority of MRI studies (54/103, 52.4%) received a score of 2 (Fig. 1C). The linear weighted kappa for all six readers was 0.62 (95% CI: 0.53, 0.70) (substantial agreement). All 6 readers agreed on 43.7% of cases. All 4 faculty readers and 3 of 4 faculty readers agreed on 52.4% (54/103) and 73.4% (76/103) of MRI studies, respectively (Fig. 1D).

CLINICAL RELEVANCE/APPLICATION

The goal of BT-RADS is to maximize consistency between brain MRI reports to aid with monitoring treatment response and disease progression, serving as a guide for clinical management decisions.

SSNR04-4   Impact Of MR Simulation Prior To Chemoradiation On Tumor Response And Pseudoprogression Reporting In High Grade Gliomas.

Participants
Divya Yadav, MBBS, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Radiological changes and even tumor progression can occur for high grade gliomas (HGG) between the post-operative (post-op) MRI and start of radiation (RT), motivating the growing use of a dedicated MR simulation (MRsim) for RT planning. The aim of this study was to determine the impact on tumor response assessment and reported pseudoprogression (PsP) at first follow-up (FU1) after completing RT when MRsim images are used as the baseline compared to the immediate post-op MRI.*Methods and Materials Patients with histologically confirmed HGG and planned for 6 weeks RT on a prospective study evaluating serial MRI for personalized RT, with available post-op MRI and at least 3 months follow up were included in this study. Pertinent patient, tumor and treatment characteristics were extracted. Scans were reviewed independently by 3 reviewers in a blinded manner using Response Assessment in Neuro-Oncology (RANO) criteria. PsP was defined as an enlarging area of contrast enhancement at FU1 which subsided or stabilized at subsequent follow-up scans without a change in therapy. Descriptive statistics were used to compare *the differences

in reported tumor response using the post-op MRI vs. MRsim as the baseline, and interobserver agreement between reviewers was evaluated.*Results Thirty patients (4 WHO grade 3; 26 WHO grade 4) with a median age of 59 years (range 25-68 years) at diagnosis were included. Median interval between surgery and RT was 34 days, and median follow-up after RT was 9.4 months (range 3-21 months). Overall, 7 patients had PsP at a median of 2 months after RT. In 9 patients (30%), tumor response at FU1 was partial response compared to MRsim vs. progressive disease (PD) or stable disease (SD) compared to post-op MRI. Similarly, 8 patients (26.7%) had SD at FU1 from MRsim but were reported to have PD or PsP from post-op MRI. The remaining 13 patients (43.3%) were reported analogous on both comparisons. Median overall survival from diagnosis (OS) for the entire cohort was not reached.*Conclusions Tumor response assessment differed in about 57% of our HGG patients when the baseline study for comparison was MRsim vs. immediate post-op MRI.*Clinical Relevance/Application MR simulation can better guide radiation treatment planning and serve as an updated baseline MR for treatment response.

RESULTS

Thirty patients (4 WHO grade 3; 26 WHO grade 4) with a median age of 59 years (range 25-68 years) at diagnosis were included. Median interval between surgery and RT was 34 days, and median follow-up after RT was 9.4 months (range 3-21 months). Overall, 7 patients had PsP at a median of 2 months after RT. In 9 patients (30%), tumor response at FU1 was partial response compared to MRsim vs. progressive disease (PD) or stable disease (SD) compared to post-op MRI. Similarly, 8 patients (26.7%) had SD at FU1 from MRsim but were reported to have PD or PsP from post-op MRI. The remaining 13 patients (43.3%) were reported analogous on both comparisons. Median overall survival from diagnosis (OS) for the entire cohort was not reached.

CLINICAL RELEVANCE/APPLICATION

MR simulation can better guide radiation treatment planning and serve as an updated baseline MR for treatment response.

SSNR04-5   Temporal DCE Profile Of Brain Metastasis With A Comparison Of Pseudoprogression Cases

Participants
Sevcan Turk, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

To demonstrate Dynamic Contrast-Enhanced (DCE) perfusion changes in brain mets patients after chemoradiation therapy and to compare with pseudoprogression group.*Methods and Materials 38 treatment response patients with brain metastasis (13 melanoma, 11 lung, 7 breast, 6 others) with 3 consecutive follow-up (pretreatment, early follow-up, and late follow-up) MRI and DCE perfusion and 7 melanoma patients with 10 pseudoprogression lesions with DCE perfusion were evaluated. All DCE MRI parameters including SER, wash-in, wash-out, KEP, VP, VE, Ktrans, TME, peak, curve-washout, peak-enhancement, AUC, and washout graphs increase (rapid, slow, medium) and course pattern (washout, plateau, persistent) were analyzed using SPSS and Phyton software. Paired t-test and Mann Whitney U were used to compare mean values of DCE parameters. Automatic assessment of washout curves by Olea Brain Software was reviewed.*Results Pretreatment wash-in mean value was significantly higher than that of post-treatment (15.3 ± 24.7 vs 5.80 ± 10.2, P<0.01). Pretreatment mean AUC value was significantly higher than that of post-treatment (141113 ± 184644 vs 79378 ± 119120, P<0.04). There was no statistically significant difference between pre- and post-treatment in the other perfusion parameters and washout graphs. There was no statistically significant difference between early and late follow-up DCE parameters for treatment response group. There was no statistically significant difference between true treatment response and pseudoprogression group.*Conclusions Wash-in and AUC values in DCE perfusion are significantly decreased after chemoradiation therapy. No statistically significant difference is shown between treatment response and pseudoprogression group; thus DCE may help identify lesions that are responding or demonstrate pseudoprogression. More research can be done to separate treatment responders and pseudoprogression from true progressive disease.*Clinical Relevance/Application DCE perfusion may provide further quantitative assessment of post-treatment changes and help identify lesions that show treatment response or pseudoprogression.

RESULTS

Pretreatment wash-in mean value was significantly higher than that of post-treatment (15.3 ± 24.7 vs 5.80 ± 10.2, P<0.01). Pretreatment mean AUC value was significantly higher than that of post-treatment (141113 ± 184644 vs 79378 ± 119120, P<0.04). There was no statistically significant difference between pre- and post-treatment in the other perfusion parameters and washout graphs. There was no statistically significant difference between early and late follow-up DCE parameters for treatment response group. There was no statistically significant difference between true treatment response and pseudoprogression group.

CLINICAL RELEVANCE/APPLICATION

DCE perfusion may provide further quantitative assessment of post-treatment changes and help identify lesions that show treatment response or pseudoprogression.

SSNR04-6   The Role Of Arterial Spin Labelling (ASL) Post Stereotactic Radiosurgery (SRS) Treatment

Participants
Meghavi Mashar, MBBCh, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Pseudocontinuous Arterial spin labelling (pCASL) allows quantification of cerebral blood flow that may aid stratification of patients with cerebral metastases. We aimed to study the utility of pCASL for patient stratification following stereotactic radiosurgery treatment from our single centre.*Methods and Materials 45 patients (25 female, mean age: 60.2 years) with intracranial metastases (primary 21 lung, 8 breast, 8 melanoma, 2 renal, 6 other) who had a first SRS treatment between 03/17 and 10/19 and pCASL sequence at first follow up (mean: 6.35 weeks post treatment). pCASL perfusion weighted image (PWI) was visually classified as either positive or negative (ASL+/-) by an experienced neuroradiologist. Three regions of interest: area of the lesion, perilesional area and contralateral grey matter were manually defined using Carestream PACS software. Ratios of signal intensity (SI) were calculated using Excel and GraphPad Prism v7. Radiological response post SRS and at 6 months (n=29) was categorised into non-progression and progression. Survival at 6 months was assessed (Alive n=39, Deceased n=6).*Results 15 had an ASL+ post-operative scan. The ratio of mean SI in the lesion to perilesional area (contrast to noise ratio) was higher in ASL+ scans (1.86 ± 0.15) versus ASL- (0.77 ± 0.05) (P<0.05) and similarly for the ratios of maximum SI [ASL+ (1.82 ± 0.23), ASL- (0.98±0.05)]. No difference relative to SI of contralateral grey matter. Treatment response at first follow up was similar in both groups: ASL+, non-progression n=15, 94%; ASL-, non-progression n=27, 93%, as was patients deceased at 6 months: ASL+, n=2, 13%; ASL-, n=4, 13%. Whilst there was limited follow up available for patients at 6 months (n=29), a higher proportion in the ASL- group had radiologically progressive disease at 6 months: n=11, 52% versus ASL+, n=1, 12.5%.*Conclusions This is one of few studies

investigating ASL in cerebral metastases and demonstrates that pCASL at first follow up post-SRS can stratify patients at 6 months. Visual assessment of pCASL PWI allows accurate classification of perfusion in metastases, highlighting the ease of this technique in clinical practice. There may be a correlation between ASL positivity and disease non-progression, which may represent increased vascularity secondary to a more powerful treatment effect.*Clinical Relevance/Application Cerebral metastases affect up to 26% of those whose cause of death is malignancy and incidence is increasing as life-prolonging treatments are developed. Appropriate management can improve neuro-cognitive symptoms and quality of life. pCASL may allow better characterisation of post-operative treatment response and recurrence for metastases.

RESULTS

15 had an ASL+ post-operative scan. The ratio of mean SI in the lesion to perilesional area (contrast to noise ratio) was higher in ASL+ scans (1.86 ± 0.15) versus ASL- (0.77 ± 0.05) (P<0.05) and similarly for the ratios of maximum SI [ASL+ (1.82 ± 0.23), ASL- (0.98±0.05)]. No difference relative to SI of contralateral grey matter. Treatment response at first follow up was similar in both groups: ASL+, non-progression n=15, 94%; ASL-, non-progression n=27, 93%, as was patients deceased at 6 months: ASL+, n=2, 13%; ASL-, n=4, 13%. Whilst there was limited follow up available for patients at 6 months (n=29), a higher proportion in the ASL- group had radiologically progressive disease at 6 months: n=11, 52% versus ASL+, n=1, 12.5%.

CLINICAL RELEVANCE/APPLICATION

Cerebral metastases affect up to 26% of those whose cause of death is malignancy and incidence is increasing as life-prolonging treatments are developed. Appropriate management can improve neuro-cognitive symptoms and quality of life. pCASL may allow better characterisation of post-operative treatment response and recurrence for metastases.

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Participants
Stacy D. O'Connor, MD, Wauwatosa, Wisconsin (*Moderator*) Nothing to Disclose
Richard J. Bruce, MD, Madison, Wisconsin (*Moderator*) Shareholder, ImageMover

Sub-Events

SSIN01   Keynote Speaker

Participants
Alex Towbin, MD, Cincinnati, Ohio (*Presenter*) Author, Reed ElsevierConsultant, Anderson Publishing, LtdAdvisory Board, KLAS Enterprises LLC

SSIN01-2   Impact Of AI-assisted Indication Selection On Appropriateness Order Scoring Using A Commercial Imaging Clinical Decision Support System

Participants
Lauren Shreve, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

The Protecting Access to Medicare Act requires clinicians to consult appropriate use criteria via a qualified Clinical Decision Support Mechanism (qCDSM) when ordering advanced imaging for Medicare patients. qCDSM only scores order appropriateness when a structured indication is selected at order entry. In our health system, 60% of outpatient imaging orders are not scored due to free-text only indications. We evaluated the impact of AI generated structured indications for free-text only orders on the rate of scored orders.*Methods and Materials An AI tool for free-text only orders was implemented within the qCDSM at our large multi-hospital system on 10/19/21. On order entry, clinicians enter a free-text indication, structured indication, or both. For free-text only orders, if established structured indications could be mapped to the free-text by the AI tool, the indication(s) were provided for selection. If a structured indication was chosen, the order was placed with both free-text and structured indications. Alternatively, providers could indicate a lack of a suitable structured indication or exit the tool. Final orders were categorized as free-text only, structured indication only, both, or neither. We examined all orders ten weeks before (7/13/20-9/21/20) and after (10/20/20-12/29/21) AI tool implementation. A chi-square test was used to compare the proportions of scored orders before and after AI deployment.*Results 98,303 advanced imaging orders were placed over the study period; 47,595 before and 50,708 after AI implementation. Scored orders increased from 31.8% (15,142/47,595) to 50.9% (25,801/50,708) after AI tool deployment (p<0.001). Free-text only orders declined from 59.3% (28,209/47,595) to 31.6% (16,005/50,708). Concomitantly, orders containing both structured and free-text indications rose from 6.7% (3,176/47,595) to 29.6% (15,023/50,708). Among the 16,005 free-text orders following AI deployment, users indicated a lack of an appropriate structured indication in 36.2% (5,792/16,005) of orders.*Conclusions Structured indications provided by an AI tool based on free-text entry increased the fraction of qCDSM scored orders and decreased the fraction of orders with free-text only indications. Even after intervention, one-third of orders lacked structured indications and half of orders remained unscored.*Clinical Relevance/Application Free-text imaging orders can be reduced using an AI tool; however, additional measures will be needed to address the half of orders which remain unscored.

RESULTS

98,303 advanced imaging orders were placed over the study period; 47,595 before and 50,708 after AI implementation. Scored orders increased from 31.8% (15,142/47,595) to 50.9% (25,801/50,708) after AI tool deployment (p<0.001). Free-text only orders declined from 59.3% (28,209/47,595) to 31.6% (16,005/50,708). Concomitantly, orders containing both structured and free-text indications rose from 6.7% (3,176/47,595) to 29.6% (15,023/50,708). Among the 16,005 free-text orders following AI deployment, users indicated a lack of an appropriate structured indication in 36.2% (5,792/16,005) of orders.

CLINICAL RELEVANCE/APPLICATION

Free-text imaging orders can be reduced using an AI tool; however, additional measures will be needed to address the half of orders which remain unscored.

SSIN01-3   Clinical Study Distribution Using Reinforcement Learning

Participants
Sun Young Park, San Diego, California (*Presenter*) Employee, IBM Corporation;

PURPOSE

We present new reinforcement learning methods that optimize clinical study distribution with multiple objectives including fairness, workload balance and personalization. The models are integrated into an automatic study distribution system that recommends readers for the incoming studies in a PACS system.*Methods and Materials We trained a reinforcement learning model to address fairness, workload balance and study priority optimization within a PACS distribution engine. We model the state of the worklist environment as a matrix of personalized radiologist status data (specialties, capacity, preferences, reading time, etc.) and a vector representing an incoming study. Our reinforcement learning algorithm sends the state to a two-input CNN that recommends a policy

for distributing the study to the radiologists. Our agent is rewarded for maximizing fair workload balance, correct allocation according to preference and specialty, and meeting deadlines for priority studies. Performance was evaluated versus an existing rule-based study distribution system.*Results We trained on simulations of real clinical sites (up to 1000 studies per hour), with realistic variance in RVUs, study types, and reading times. X-rays comprised 30-50% of the incoming studies, with the remaining studies divided among other sub-specialties. Some studies were also given priority due times. Each radiologist could read x-rays or one sub-specialty, and had personalized study preferences, chance of rejecting assigned studies and reading rate for each study type. We applied five distribution rules: lowest load (# of studies or RVUs), round robin, highest skill level, and a weighted combination, and applied six comparison metrics: average completion time per study, success rate in meeting priority study deadlines, and the standard deviations of the assigned RVUs, the average study preference level, the number of x-rays read, and the study rejection rates of each radiologist. Combining these factors into an overall score, our algorithm outperformed the five rules by 19.2%[16.3-21.7], 6.2%[3.2-9.1], 51.5%[47.6-55.69], 58.3%[49.6-67.0], and 9.6%[5.71-13.6] with 95% confidence intervals.*Conclusions We present a novel reinforcement learning framework for clinical study distribution that optimizes several factors. We have shown that our algorithm provides a more balanced, efficient, and comfortable study distribution than rule-based PACS distribution engines.*Clinical Relevance/Application We present a reinforcement learning system that optimizes clinical study distribution. The system accounts for personal preferences and specialties, ensuring that radiologists can work in their comfort zone as often as possible, which results in better patient outcomes.

RESULTS

We trained on simulations of real clinical sites (up to 1000 studies per hour), with realistic variance in RVUs, study types, and reading times. X-rays comprised 30-50% of the incoming studies, with the remaining studies divided among other sub-specialties. Some studies were also given priority due times. Each radiologist could read x-rays or one sub-specialty, and had personalized study preferences, chance of rejecting assigned studies and reading rate for each study type. We applied five distribution rules: lowest load (# of studies or RVUs), round robin, highest skill level, and a weighted combination, and applied six comparison metrics: average completion time per study, success rate in meeting priority study deadlines, and the standard deviations of the assigned RVUs, the average study preference level, the number of x-rays read, and the study rejection rates of each radiologist. Combining these factors into an overall score, our algorithm outperformed the five rules by 19.2%[16.3-21.7], 6.2%[3.2-9.1], 51.5%[47.6-55.69], 58.3%[49.6-67.0], and 9.6%[5.71-13.6] with 95% confidence intervals.

CLINICAL RELEVANCE/APPLICATION

We present a reinforcement learning system that optimizes clinical study distribution. The system accounts for personal preferences and specialties, ensuring that radiologists can work in their comfort zone as often as possible, which results in better patient outcomes.

SSIN01-4 Clinical Decision Support For CT Ordering In Pediatric Imaging: Results From A Quaternary Care Pediatric Hospital

Participants
Andrew Sher, MD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To analyze the effect of point-of-care ACR-clinical decision support (CDS) software embedded in the electronic health records (EHR) on CT ordering patterns in a quaternary care pediatric hospital.*Methods and Materials This study was HIPAA compliant and exempt from IRB approval. All CT exams across the enterprise ordered on patients less than 21 years old from 9/18/18 to 3/31/2021 were categorized by CDS software. ACR-CDS scores were recorded: Red (1-3; usually not appropriate), Yellow (4-6; may be appropriate), Green (7-9; usually appropriate) and a category of "no score". From 9/18/18 to 8/7/2019, no feedback was provided to the ordering provider (n = 12795). From 12/8/2019 to 3/31/2021, best practice alerts (BPA) provided feedback to the provider (n = 19914). Changes in order behavior were recorded and compared between the pre-BPA and post-BPA activation. Chi-square test for proportions was conducted.*Results Pre- versus post-BPA there was a statistically significant decrease in the rate of Red (14.4% vs 7.5%) scored and an increase in Green (49.2% vs 56%) scored studies, both (p<0.0001). Yellow (19.4% vs 18.9%) and 'No Score' (17% vs 17.7%) studies showed no statistically significant difference (p = .25 and p =.12 respectively). For Red scored studies, 7% (n = 104) of studies were changed or not signed after receiving a BPA; the remainder proceeded as ordered. Top reasons for bypassing the BPA included: Disagree with Appropriateness Score (20%), Consulted with Other Specialist (18%), Consulted with Radiology (6%), and Modality Unavailable (5%). 26% of bypassed orders provided no reason for proceeding.*Conclusions ACR-CDS recommendations decrease the ratio of clinically inappropriate to appropriate CT exams ordered by referring physicians. When CDS feedback stated "not inappropriate", only a small percentage of CT exams were actually changed. This baseline study can serve as a foundation to measure future incremental positive change in CT appropriateness after additional clinical educational outreach and improved EHR CDS user interfaces have been effected.*Clinical Relevance/Application ACR-CDS recommendations decrease the ratio of clinically inappropriate to appropriate CT exams ordered by referring physicians in a pediatric practice. Further work is needed to elucidate whether the improved ratio translates into improved and more timely patient care.

RESULTS

Pre- versus post-BPA there was a statistically significant decrease in the rate of Red (14.4% vs 7.5%) scored and an increase in Green (49.2% vs 56%) scored studies, both (p<0.0001). Yellow (19.4% vs 18.9%) and 'No Score' (17% vs 17.7%) studies showed no statistically significant difference (p = .25 and p =.12 respectively). For Red scored studies, 7% (n = 104) of studies were changed or not signed after receiving a BPA; the remainder proceeded as ordered. Top reasons for bypassing the BPA included: Disagree with Appropriateness Score (20%), Consulted with Other Specialist (18%), Consulted with Radiology (6%), and Modality Unavailable (5%). 26% of bypassed orders provided no reason for proceeding.

CLINICAL RELEVANCE/APPLICATION

ACR-CDS recommendations decrease the ratio of clinically inappropriate to appropriate CT exams ordered by referring physicians in a pediatric practice. Further work is needed to elucidate whether the improved ratio translates into improved and more timely patient care.

SSIN01-6 Patient Image Access Through Electronic Health Record Patient Portals: A Multi-institutional Experience

Participants
Hailey Choi, MD, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

To determine how patient access to viewing radiology images through an online patient portal affects radiologists*Methods and Materials Patient access to a web-based image viewer through patient portals was implemented at 3 academic institutions within the past 3 years. All 3 institutions were already sharing radiology reports with patients at time of implementation. At institution 1, all radiology and point-of-care (POC) imaging - except exams that could indicate pregnancy in teens - were shared. At institution 2, all radiographs and breast imaging were shared. At institution 3, all radiology, POC, and endoscopic images were shared. An anonymized survey was distributed to radiologists at the 3 institutions. The survey addressed how patient imaging access affected the radiologists' role, and whether radiologists were contacted by patients for imaging-related concerns.*Results A total of 254 radiologists responded to the survey. Majority (78.3%) responded that patient access had no impact on their role as a radiologist, 9.6% reported a positive impact, and 12.1% negative. Most radiologists (65.3%) were never approached by a patient for imaging-related concerns. Of the 86 who were contacted, 47.1% were contacted once or twice thus far, 47.1% 3-4 times a year, and 4.7% 3-4 times a month. In free text comments, 71 radiologists felt this was a positive step towards transparent medicine. 17 radiologists responded that workflow adjustments - i.e. attention to image annotation and report wording - are needed. Other concerns included creating patient confusion or anxiety and causing increased workload for radiologists and providers.*Conclusions Patients' online access to viewing their own radiology exams had little to no impact on radiologists. Only a minority of radiologists were contacted by patients for their imaging, typically a few times a year. While many radiologists feel that patients' access to radiology imaging is a positive step, some are also worried it would confuse and alarm patients. Minor workflow modifications may be warranted.*Clinical Relevance/Application Patients' access to their imaging exams through online portals did not significantly affect radiologists' workload, contrary to some perceived fears. Many radiologists are supportive of the change, and minor workflow alterations can be considered.

RESULTS

A total of 254 radiologists responded to the survey. Majority (78.3%) responded that patient access had no impact on their role as a radiologist, 9.6% reported a positive impact, and 12.1% negative. Most radiologists (65.3%) were never approached by a patient for imaging-related concerns. Of the 86 who were contacted, 47.1% were contacted once or twice thus far, 47.1% 3-4 times a year, and 4.7% 3-4 times a month. In free text comments, 71 radiologists felt this was a positive step towards transparent medicine. 17 radiologists responded that workflow adjustments - i.e. attention to image annotation and report wording - are needed. Other concerns included creating patient confusion or anxiety and causing increased workload for radiologists and providers.

CLINICAL RELEVANCE/APPLICATION

Patients' access to their imaging exams through online portals did not significantly affect radiologists' workload, contrary to some perceived fears. Many radiologists are supportive of the change, and minor workflow alterations can be considered.

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Participants

Leo Tsai, MD,PhD, Boston, Massachusetts (*Moderator*) Stockholder, Agile Devices Inc;Consultant, Agile Devices Inc
Sungmin Woo, MD, New York, New York (*Moderator*) Nothing to Disclose

Sub-Events

SSGU05-3 Pivotal Trial Of Magnetic Resonance Imaging-guided Transurethral Ultrasound Ablation In Men With Localized Prostate Cancer: Three-year Follow-up And Multiparametric Magnetic Resonance Imaging Prediction Of Salvage Treatment

Participants

Steven Raman, MD, Santa Monica, California (*Presenter*) Consultant, Johnson & Johnson;Consultant, Bayer AG;Consultant, Merck & Co, Inc;Consultant, Amgen Inc;Consultant, Profound Medical Inc

PURPOSE

MRI-guided transurethral ultrasound ablation (TULSA) is a minimally invasive procedure for prostate ablation using directional ultrasound. The treatment is controlled in real-time using MRI thermometry feedback. We report 3 year outcomes from the pivotal TULSA-PRO Ablation Clinical Trial (TACT).*Methods and Materials TACT enrolled 115 men with organ-confined prostate cancer (=T2b, PSA =15 ng/ml, Grade Group 1-2) across 13 centers. Treatment was whole-gland sparing the urethra and urinary sphincter. Primary endpoints were safety and PSA reduction at 1 year. Secondary endpoints included 1 year prostate volume reduction, mpMRI, and 10 core biopsy. Three year follow-up included adverse events, quality of life and PSA for men who are salvage-free, and mpMRI prediction of salvage therapy.*Results Median (IQR) baseline age was 65 (59-69) years, median PSA 6.3 (4.6-7.9) ng/mL, with Grade Group (GG) =2 disease in 72/115 men (63%). Targeted prostate volumes of 40 (32-50) cc were ablated in 51 (39-66) min. Grade 3 adverse events in 9 (8%) men included GU infection, stricture, retention, urethral calculus and pain, and urinoma, all resolved before 1 year. There were no rectal injuries or Grade =4 events. By 3 years, 15 men (13%) received salvage treatment. At 1 year MRI and biopsy, median prostate volume decreased from 37 to 3 cc, GG2 disease was eliminated in 54/68 (79%) men, and 72/111 (65%) had no evidence of any cancer. Median PSA decreased 95% to a nadir of 0.26 ng/mL, stable from 0.53 ng/mL at 1 year to 0.70 ng/ml (n=56) at 3 years. Median IPSS decreased from 7 at baseline to 4 (n=61) by 3 years. Moderate urinary incontinence (Grade 2, pads) in 3 men (2.6%) at 1 year persisted to 3 years in 1 patient, with no new incontinence past 1 year. The rate of moderate erectile dysfunction (Grade 2, responding to medication) was 23% at 1 year and 24% at 3 years. Median change in IIEF-5 was -2 from baseline to 1 year, and nil from 1 to 3 years (n=61). Erections sufficient for penetration (IIEF Q2 =2) were maintained by 36/50 (72%) and 40/50 (80%) men at 1 and 3 years. On follow-up mpMRI, a visible lesion was predictive of persistent or recurrent disease and salvage therapy at 3 years (p=0.001; aOR 31.0, CI [6.4,150.0]).*Conclusions With 3 year follow-up, MRI-guided transurethral ultrasound ablation (TULSA) showed durable control of localized prostate cancer with low toxicity and stable quality of life. The presence of a visible lesion on follow-up mpMRI predicted for persistent or recurrent disease and salvage therapy.*Clinical Relevance/Application Whole-gland ablation using MRI-guided TULSA achieves effective disease control at 3 years with favourable functional and safety outcomes. The 1 year follow-up mpMRI is predictive of salvage therapy by 3 years.

RESULTS

Median (IQR) baseline age was 65 (59-69) years, median PSA 6.3 (4.6-7.9) ng/mL, with Grade Group (GG) =2 disease in 72/115 men (63%). Targeted prostate volumes of 40 (32-50) cc were ablated in 51 (39-66) min. Grade 3 adverse events in 9 (8%) men included GU infection, stricture, retention, urethral calculus and pain, and urinoma, all resolved before 1 year. There were no rectal injuries or Grade =4 events. By 3 years, 15 men (13%) received salvage treatment. At 1 year MRI and biopsy, median prostate volume decreased from 37 to 3 cc, GG2 disease was eliminated in 54/68 (79%) men, and 72/111 (65%) had no evidence of any cancer. Median PSA decreased 95% to a nadir of 0.26 ng/mL, stable from 0.53 ng/mL at 1 year to 0.70 ng/ml (n=56) at 3 years. Median IPSS decreased from 7 at baseline to 4 (n=61) by 3 years. Moderate urinary incontinence (Grade 2, pads) in 3 men (2.6%) at 1 year persisted to 3 years in 1 patient, with no new incontinence past 1 year. The rate of moderate erectile dysfunction (Grade 2, responding to medication) was 23% at 1 year and 24% at 3 years. Median change in IIEF-5 was -2 from baseline to 1 year, and nil from 1 to 3 years (n=61). Erections sufficient for penetration (IIEF Q2 =2) were maintained by 36/50 (72%) and 40/50 (80%) men at 1 and 3 years. On follow-up mpMRI, a visible lesion was predictive of persistent or recurrent disease and salvage therapy at 3 years (p=0.001; aOR 31.0, CI [6.4,150.0]).

CLINICAL RELEVANCE/APPLICATION

Whole-gland ablation using MRI-guided TULSA achieves effective disease control at 3 years with favourable functional and safety outcomes. The 1 year follow-up mpMRI is predictive of salvage therapy by 3 years.

SSGU05-4 Development Of A Prostate Cancer Diagnosis Tool With Deep Neural Networks: Explainable Deep Learning Using PI-RADS Imaging Features

Participants
Charlie Hamm, MD, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To develop and test the performance of an explainable 3D deep learning system (DLS) that detects and classifies prostatic lesions on bi-parametric magnetic resonance imaging (bpMRI) and justifies its predictions using PI-RADS imaging features.*Methods and Materials This study included 1136 consecutive patients, who underwent bpMRI and consecutive transrectal ultrasound-guided biopsy resulting in a total of 3186 histologically proven prostatic lesions. A total of 1058 prostate cancer (PCa) (347 Gleason Score (GS)=6; 711 GS=7) and 2128 benign lesions (physiologic tissue, benign prostatic hyperplasia, cyst, prostatitis) were included in this data set and used to develop and train a DLS, of which 276 lesions were additionally labeled with PI-RADS imaging features on bpMRI. Based on prostate segmentations and balanced training sets, the DLS was trained to a) detect the target lesion within the segmented prostate, b) classify PCa and benign lesions and c) to justify its predictions with PI-RADS imaging features. A receiver operating characteristic area under the curve (AUC) of the model was determined using a hold-out test set comprising 15% of all lesions.*Results The DLS reliably detected the target lesion using a voxel-wise prediction score generating a colormap-overlay in the T2w axial sequence. In classifying PCa and benign lesions, the explainable DLS achieved an accuracy of 85%, sensitivity (Sn) of 81%, and specificity (Sp) of 87% with an AUC of 90% indicative of a very good performance. Furthermore, the DLS demonstrated good performance in identifying 11 PI-RADS imaging features with an average accuracy of 84%, Sn 81% and Sp of 76%. Specifically, intensity-based features achieved a better accuracy and Sn (85% and 88%) compared to structural imaging features (82% and 72%), while the Sp were almost identical (75% and 76%).*Conclusions This study introduces a novel comprehensive explainable DLS that reliably detects and classifies suspicious prostatic lesions on bpMRI. Thereby, it overcomes the traditional black box design of previous deep neural networks by explaining and visualizing its decision-making using PI-RADS imaging features in a custom interface.*Clinical Relevance/Application This explainable DLS approach for prostate MRI provides a transparent decision support tool for radiologists, which can potentially enhance the acceptance and facilitate the translation of artificial intelligence into the clinical routine.

RESULTS

The DLS reliably detected the target lesion using a voxel-wise prediction score generating a colormap-overlay in the T2w axial sequence. In classifying PCa and benign lesions, the explainable DLS achieved an accuracy of 85%, sensitivity (Sn) of 81%, and specificity (Sp) of 87% with an AUC of 90% indicative of a very good performance. Furthermore, the DLS demonstrated good performance in identifying 11 PI-RADS imaging features with an average accuracy of 84%, Sn 81% and Sp of 76%. Specifically, intensity-based features achieved a better accuracy and Sn (85% and 88%) compared to structural imaging features (82% and 72%), while the Sp were almost identical (75% and 76%).

CLINICAL RELEVANCE/APPLICATION

This explainable DLS approach for prostate MRI provides a transparent decision support tool for radiologists, which can potentially enhance the acceptance and facilitate the translation of artificial intelligence into the clinical routine.

SSGU05-6   Comprehensive Analysis Of MR-Based Imaging Characteristics Of Prostate Lesions Against PIRADS Assessment Guideline And Correlations With Gleason Scores

Participants
Marwan Sati, PhD, Mississauga, Ontario (*Presenter*) Employee, IBM Corporation

PURPOSE

To cross validate appearance of prostate lesions in magnetic resonance (MR) images against PIRADS guideline and investigate correlations with pathological findings.*Methods and Materials Our dataset comprises of 1381 lesions identified in bi- or multi-parametric MR images of 930 patients collected from 6 centers in 4 countries using 23 different MR machines (1.5T and 3T) and variety of acquisition parameters (ex. slice/pixel spacing, repetition time, echo time, etc.). We employed single-read protocol and asked 4 experienced radiologists to use dense contours for annotating each lesion in every sequence (T2w, DWI, and DCE if available) and follow PIRADS v2.1 guideline strictly, for assigning labels. Radiologists had an option to not annotate PIRADS 1&2 and especially BPH lesions. The labels comprise of PIRADS score, zone, morphology (focal (F), encapsulated (E), round (R), linear/wedge (L), focal+round (FR), focal+round+encapsulated (FRE)), homogeneity (homogeneous (H), inhomogeneous (I)), intensity (hyper-(HPER) and hypo-intense (HPO), moderately hyper- (MHPER) and hypo-intense (MHPO)), and margin (circumscribed (C), non-circumscribed (NC)). In addition, the Gleason scores for 369 lesions from 272 patients were assigned using pathology reports driven from either targeted biopsy or prostatectomy. The pathology reports were not accessible by radiologists during annotations to ensure unbiased PIRADS scoring. Once they were revealed, the radiologists could not change the PIRADS scores or any other labels.*Results Our results demonstrate good correlation between PIRADS and Gleason scores through lesion imaging characteristics intensity as shown in table, which substantiates effectiveness of PIRADS guidelines for identifying prostate clinically significant lesions. In particular, the correlation is found to be significant when malignant lesions are considered to be given PIRADS 4&5 and Gleason>=4+3 scores. As recommended by PIRADS v.2.1 guideline, focality and intensity are the most discriminative imaging features for lesion detection and malignancy assessment, which are corroborated in our pathological findings.*Conclusions Strictness of adherence to PIRADS v.2.1 criteria ensures good agreement with Gleason scores and performance reproducibility across different MR scanners, protocols, and readers.*Clinical Relevance/Application Since advanced artificial intelligence (AI) algorithms and especially deep learning models are viable solutions for learning and strictly applying PIRAD criteria, it is expected that AI could play a major role in prostate cancer assessment.

RESULTS

Our results demonstrate good correlation between PIRADS and Gleason scores through lesion imaging characteristics intensity as shown in table, which substantiates effectiveness of PIRADS guidelines for identifying prostate clinically significant lesions. In particular, the correlation is found to be significant when malignant lesions are considered to be given PIRADS 4&5 and Gleason>=4+3 scores. As recommended by PIRADS v.2.1 guideline, focality and intensity are the most discriminative imaging features for lesion detection and malignancy assessment, which are corroborated in our pathological findings.

CLINICAL RELEVANCE/APPLICATION

Since advanced artificial intelligence (AI) algorithms and especially deep learning models are viable solutions for learning and strictly applying PIRAD criteria, it is expected that AI could play a major role in prostate cancer assessment.

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SSGI04

Gastrointestinal (Esophagus and Stomach)

Participants
Jason A. Pietryga, MD, Warren, Rhode Island (*Moderator*) Consultant, Radiostics LLC
Kevin Chang, MD, Sharon, Massachusetts (*Moderator*) Speaker, Anderson Publishing, Ltd;Speaker, Koninklijke Philips NV;

Sub-Events

SSGI04-1 Comparison Of The Accuracy Of 3.0T MRI And CT In Evaluating Resectability Of Locally Advanced Esophageal Squamous Cell Carcinoma

Participants
Keke Zhao, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

The accuracy of 3.0T MRI and CT in evaluating whether locally advanced ESCC invading aorta, tracheobronchial was compared to determine the resectability of tumor.*Methods and Materials Patients with ESCC pathologically confirmed by biopsy from November 2018 to November 2020 were prospectively enrolled, both MRI and CT were acquired within one week before tracheoscopy or surgery. The MRI scanning sequences included BLADE-TSE-T2WI,DWI and post-contrast enhanced Star-VIBE. Two readers evaluated whether the aorta, tracheobronchial were invaded by MRI and CT images using double-blind method independently. The inter-reader agreement between two readers were calculated using Kappa test. Combined intra-reader observation and post-operative pathological or fiberobronchoscopy as the gold standard, the sensitivity, specificity and accuracy of MRI and CT evaluated ESCC invaded aorta, tracheobronchial were calculated respectively and analyzed by Fisher's exact test.*Results A total of 37 patients were enrolled, the inter-reader agreement of the results by two readers were excellent (Kappa=0.87, p<0.05), the accuracy of MRI evaluated ESCC invading aorta, tracheobronchial were 90.0%, 83.3 %, respectively, and the CT results were 40.0%, 23.3%, respectively. The difference between two techniques was statistically significant (p<0.05).*Conclusions The accuracy of MRI in determining whether ESCC invading aorta, tracheobronchial is significantly higher than CT, which could better judge the resectability of the tumor.*Clinical Relevance/Application The study suggests that preoperative MRI examination can better judge whether locally advanced ESCC invading aorta, tracheobronchial, therefore, MRI can better guide the selection of clinical treatment methods for locally advanced ESCC.

RESULTS

A total of 37 patients were enrolled, the inter-reader agreement of the results by two readers were excellent (Kappa=0.87, p<0.05), the accuracy of MRI evaluated ESCC invading aorta, tracheobronchial were 90.0%, 83.3 %, respectively, and the CT results were 40.0%, 23.3%, respectively. The difference between two techniques was statistically significant (p<0.05).

CLINICAL RELEVANCE/APPLICATION

The study suggests that preoperative MRI examination can better judge whether locally advanced ESCC invading aorta, tracheobronchial, therefore, MRI can better guide the selection of clinical treatment methods for locally advanced ESCC.

SSGI04-2 Accuracy Of CT For Metastatic Lymph Nodes Detection In Gastric Adenocarcinoma

Participants
Chiara Zanon, MD,MS, Padova, Italy (*Presenter*) Nothing to Disclose

PURPOSE

to investigate which is the most accurate Computed Tomography (CT) measurement technique for metastatic lymph node (LN) detection in patients affected by gastric adenocarcinoma.*Methods and Materials 107 patients (F=38, median age: 74,5; M= 69, median age 76,7; range 35 - 98 years) affected by gastric adenocarcinoma were retrospectively enrolled. 443 nodal groups were harvested during surgery and subsequently analyzed at histopathology. Contrast-enhanced CTs at diagnosis were jointly reviewed by two expert radiologists, including only loco-regional LNs with a short axis (SA) = 5 mm.In each node group, largest lymph node's SA, volume and SA/long axis (LA) ratio, together with SAs sum and SAs/LAs average ratio were plotted in ROC curves, comparing as control the presence/absence of metastasis at histopathology. SAs sum of all LNs per group and the sum of SAs, volumes and SA/LA of the largest LNs per group were also plotted with ROC curve.*Results 173/443 of the nodal groups proved to be metastatic at histopathology. 64/107 patients had at least one metastatic nodal group. On a nodal group-basis the sum of the SAs showed the best AUC (0.721; 95% CI: 0.677-0.762) with sensitivity of 62.4% and a specificity of 72.6% at Youden's index analysis with a >8 mm cut-off. In the per patient analysis the sum of the SAs of all the LNs in the nodal groups showed the best AUC (0.787; 95% CI: 0.697-0.860) with a sensitivity of 65.6% and a specificity of 83.7% at Youden's index analysis with a >39 mm cut-off.*Conclusions the sum of the SAs of the LNs is the best predictor both of metastatic invasion of the nodal group and of the presence of metastatic LNs in the patient.*Clinical Relevance/Application This paper highlights the important role of CT in predicting lymph nodes metastasis in patient with gastric adenocarcinoma. The SAs sum of the loco regional LNs is the most accurate predictor.

RESULTS

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On a nodal group-basis the sum of the SAs showed the best AUC (0.721; 95% CI: 0.677-0.762) with sensitivity of 62.4% and a specificity of 72.6% at Youden's index analysis with a >8 mm cut-off. In the per patient analysis the sum of the SAs of all the LNs in the nodal groups showed the best AUC (0.787; 95% CI: 0.697-0.860) with a sensitivity of 65.6% and a specificity of 83.7% at Youden's index analysis with a >39 mm cut-off.

CLINICAL RELEVANCE/APPLICATION

This paper highlights the important role of CT in predicting lymph nodes metastasis in patient with gastric adenocarcinoma. The SAs sum of the loco regional LNs is the most accurate predictor.

SSGI04-3   The Value Of DWI And DCE-MRI Quantitive Parameters In Predicting HER2 Status Of Gastric Cancer

Participants
Xiao Zhang JR, BMedSc, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the value of the quantitive parameters of difusion weighted imaging (DWI) and dynamic contrast enhancement MRI (DCE-MRI) in evaluating the status of HER2 in gastric.*Methods and Materials The clinical and imaging data of 67 patients with gastric cancer confirmed by pathology were retrospectively analyzed. The DWI and DCE-MRI images before surgery were analyzed. Quantitative paremeters including the mean, minimum and maximum of ADC (ADCmean, ADCmin, ADCmax) of DWI and Ktrans, Kep and Ve of DCE-MRI were obtained. According to the results of HER2 immunohistochemistry (IHC) and fluorescence in situ hybridization (FISH), the patients were divided into HER2 negative group (IHC0 or IHC1+ or IHC2+/FISH-positive) and HER2 positive group (IHC3+ or IHC2+/FISH-negative). Mann-Whitney U test was used to compare the quantitative parameters between the two groups. The efficacy of identifying HER2 status was determined by receiver operating characteristic (ROC) curves.*Results There were 49 patients in the HER2 negative group and 18 patients in the HER2 positive group. The values of ADCmean, ADCmax, Ktrans and Kep in the HER2 positive group were significantly higher than those in the HER2 negative group (P < 0.05). ROC curves showed that the area under the curve (AUC) of Ktrans was the largest (AUC=0.870), followed by ADCmax (AUC=0.849). The diagnostic efficiency of Ktrans combined with ADCmax was higher than that of Ktrans or ADCmax alone. The AUC was 0.940 and sensitivity and specificity were 94.4% and 89.8%, respectively.*Conclusions Quantitative parameters of DWI and DCE-MRI are benifical to evaluate the status of HER2 in gastric cancer. Ktrans shows the highest diagnostic efficacy and the combination of Ktrans and ADCmax can improve the predictive efficacy.*Clinical Relevance/Application HER2 is one of the most interesting biomarkers for targeted therapy of gastric cancer. HER2 status should be repeatedly detected after tumor recurrence or metastasis and before second-line HER2-targeted therapy due to HER2 status may change during the treatment. However, it is not feasible in clinical practice to reassess the HER2 status through tissue biopsies. Therefore, a non-invasive method is needed to monitor HER2 status.

RESULTS

There were 49 patients in the HER2 negative group and 18 patients in the HER2 positive group. The values of ADCmean, ADCmax, Ktrans and Kep in the HER2 positive group were significantly higher than those in the HER2 negative group (P < 0.05). ROC curves showed that the area under the curve (AUC) of Ktrans was the largest (AUC=0.870), followed by ADCmax (AUC=0.849). The diagnostic efficiency of Ktrans combined with ADCmax was higher than that of Ktrans or ADCmax alone. The AUC was 0.940 and sensitivity and specificity were 94.4% and 89.8%, respectively.

CLINICAL RELEVANCE/APPLICATION

HER2 is one of the most interesting biomarkers for targeted therapy of gastric cancer. HER2 status should be repeatedly detected after tumor recurrence or metastasis and before second-line HER2-targeted therapy due to HER2 status may change during the treatment. However, it is not feasible in clinical practice to reassess the HER2 status through tissue biopsies. Therefore, a non-invasive method is needed to monitor HER2 status.

SSGI04-4   Body Composition, Treatment Tolerance, And Mortality In Patients With Esophageal And Gastric Adenocarcinoma

Participants
Mariana Defreitas, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To assess the relationship between patient features, body composition imaging features, tumor features, and clinical outcomes (including neoadjuvant treatment tolerance and mortality) in patients with esophageal and gastric adenocarcinoma.*Methods and Materials 142 patients were retrospectively identified with biopsy-proven esophageal or gastric adenocarcinoma and available pretreatment CT scans who had received neoadjuvant treatment. Electronic medical records were reviewed to obtain: patient specific data (age, gender, body mass index, and mortality), tumor specific data (location and stage), and neoadjuvant chemotherapy strategy (low, medium, and high toxicity). Staging CTs were analyzed for body composition using a deep learning semantic segmentation algorithm based on the nnU-Net framework. Cross-sectional areas of muscle, visceral adipose tissue, and subcutaneous adipose tissue were measured at the level of the L3 vertebral body. Skeletal muscle index (SMI) was calculated as muscle area/height2. Univariate analyses (t-tests for continuous variables and chi-squared tests for categorical variables) were performed between the clinical and imaging features and the following outcomes: neoadjuvant therapy breaks and dose reductions, early termination of neoadjuvant therapy, hospitalization and emergency department visits during neoadjuvant therapy, surgical candidacy after neoadjuvant therapy, and all-cause mortality. The Bonferroni-Holm method was used to correct for multiple comparisons.*Results The 142 patients included 30 females and 112 males. Average age at diagnosis was 64 years (range 21-88), and average body mass index was 27.8 kg/m2 (range 16-48). Cancer stages at the time of diagnosis varied from stage I through stage IV, with the majority of cases being stage III (94 patients). After correction for multiple comparisons, higher age was associated with more neoadjuvant therapy breaks (p=0.04) and decreased likelihood of surgical candidacy (p=0.001). Lower muscle area was associated with more neoadjuvant therapy breaks (p=0.05). Lower SMI was associated with more chemotherapy breaks (p=0.04) and decreased survival (p=0.03).*Conclusions CT-based measures of skeletal muscle index may be independent predictors of chemotherapy tolerance and mortality in patients with esophageal or gastric adenocarcinoma.*Clinical Relevance/Application Current methods for treatment planning for esophageal and gastric adenocarcinoma take into consideration subjective clinical assessments of functional status. Establishing the relationship of other patient specific factors, such as body composition, and adverse clinical outcomes (including poor neoadjuvant chemotherapy tolerance) can supplement these methods.

RESULTS

The 142 patients included 30 females and 112 males. Average age at diagnosis was 64 years (range 21-88), and average body

mass index was 27.8 kg/m2 (range 16-48). Cancer stages at the time of diagnosis varied from stage I through stage IV, with the majority of cases being stage III (94 patients). After correction for multiple comparisons, higher age was associated with more neoadjuvant therapy breaks (p=0.04) and decreased likelihood of surgical candidacy (p=0.001). Lower muscle area was associated with more neoadjuvant therapy breaks (p=0.05). Lower SMI was associated with more chemotherapy breaks (p=0.04) and decreased survival (p=0.03).

CLINICAL RELEVANCE/APPLICATION

Current methods for treatment planning for esophageal and gastric adenocarcinoma take into consideration subjective clinical assessments of functional status. Establishing the relationship of other patient specific factors, such as body composition, and adverse clinical outcomes (including poor neoadjuvant chemotherapy tolerance) can supplement these methods.

Abstract Archives of the RSNA, 2021

Participants
James Lee, MD, Lexington, Kentucky (*Moderator*) Nothing to Disclose
Margarita Revzin, MD, Wilton, Connecticut (*Moderator*) Nothing to Disclose

Sub-Events

SSMS05-1   Lung Nodule Detection In Whole Body Trauma CT: Is AI Leading The Way Out Of A Diagnostic Dilemma?

Participants
Thorsten Fleiter, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Whole body computer tomography (WBCT) is the standard imaging tool for the assessment of poly-trauma patients. The indications for WBCT broadened with the availability of faster and dose efficient CT scanners challenging the radiologists to generate a final report in 15-20 min - increasing the risk to miss incidental findings like lung nodule. AI algorithms for lung nodules detection within this time window became recently available. The purpose of the study is therefore to compare AI lung nodule detection with nodules reported by trauma radiologists.*Methods and Materials 150 WBCT of acute trauma patients (Age 77-86) were analyzed using a two-step AI system with initial nodule candidate generation and consecutive false positive reduction (Siemens, Princeton, NJ). Only non-calcified nodules >=4mm were included. The AI algorithm reviewed the exact same images as the radiologist. The algorithm returned location and size (2D+3D recist) of the detected nodules. The results were compared to the final radiologist reports. Time of the report and the radiologist ID were recorded. All AI results were reviewed and verified by trauma radiologists with > 10 year experience. Standard statistical tests were applied.*Results The radiologists reported 14 lung nodules versus 76 detected and verified by the AI system (p<0.001) The radiologist reports were correct for 77 of the performed WBCT versus 114 for the AI system (correct positive and negative for lung nodules) (P<0.001). There was no correlation between the time of the WBCT (day/night), reading radiologists and the number of missed lung nodules. There was no significant difference regarding location and size of missed nodules. The largest diameter of nodules not mentioned in the radiologist report was (2D recist) 2.9 cm in the apex of the right upper lobe, 3.7 cm in the right hilum, 2.3 cm in the left upper lobe and 2.7 cm in the left lower lobe. 3 false negative findings for the AI system included 2x6mm solid nodules and a 1.2 cm ground glass lesion in the left upper lobe. There were positive findings for the algorithm due to scars (4), contusions (2), exostosis/fracture of ribs (5) + sternum (2), and the diaphragm (1).*Conclusions The AI driven algorithm detected a significant number of additional actionable lung nodules that were not mentioned in the original WBCT reports revealing the under-reporting of this incidental finding in standard trauma imaging. There was no correlation between the reading radiologists and the number of missed lung nodules - indicating that missing lung nodules in acute trauma scans is likely a systematic issue.*Clinical Relevance/Application Fast AI algorithms have the potential to significantly improve the detection of lung nodules as incidental finding in whole body trauma CT

RESULTS

The radiologists reported 14 lung nodules versus 76 detected and verified by the AI system (p<0.001) The radiologist reports were correct for 77 of the performed WBCT versus 114 for the AI system (correct positive and negative for lung nodules) (P<0.001). There was no correlation between the time of the WBCT (day/night), reading radiologists and the number of missed lung nodules. There was no significant difference regarding location and size of missed nodules. The largest diameter of nodules not mentioned in the radiologist report was (2D recist) 2.9 cm in the apex of the right upper lobe, 3.7 cm in the right hilum, 2.3 cm in the left upper lobe and 2.7 cm in the left lower lobe. 3 false negative findings for the AI system included 2x6mm solid nodules and a 1.2 cm ground glass lesion in the left upper lobe. There were positive findings for the algorithm due to scars (4), contusions (2), exostosis/fracture of ribs (5) + sternum (2), and the diaphragm (1).

CLINICAL RELEVANCE/APPLICATION

Fast AI algorithms have the potential to significantly improve the detection of lung nodules as incidental finding in whole body trauma CT

SSMS05-2   Correlation Of Body Mass Index With Cervical Prevertebral Soft Tissue Thickness

Participants
John Schilling, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Radiologists rely on normative values including upper limits of normal for cervical prevertebral soft tissue thickness (PSTT) to aid in detection of osseous or soft tissue injuries in the setting of neck trauma. Given the epidemic increase in obesity rates over multiple decades, evaluation of the effect of body habitus as measured by body mass index (BMI) on these normative values is needed to assess their reliability in obese patients.*Methods and Materials PSTT measurements were made retrospectively at C1, C2, C3, C6, and C7 in 166 patients who underwent computed tomography of the neck, after excluding patients with known or suspected pathology affecting PSTT. Mean PSTT was calculated within clinical BMI categories (normal, overweight, obese, and morbidly obese) and compared to normative values from the literature at each cervical level. A multiple linear regression analysis was

performed using BMI, age, and gender as predictive variables for PSTT.*Results The morbidly obese group had significantly increased mean PSTT compared to normative mean values from the literature at all measured cervical levels (p < 0.001 at C1, C2, C3, and C6; p < 0.05 at C7), and were near or above described upper limits of normal at C1, C2, and C3. Mean PSTT was also increased in the overweight group at C2 and C6 (p < 0.05) and obese group at C1, C2, and C3 (p < 0.001). Multiple linear regression found BMI was significantly associated with increased PSTT at all cervical levels (p < 0.001 at C1, C2, C3, and C6; p < 0.05 at C7). Male gender was also associated with increased PSTT at all levels except C3 (p < 0.001). BMI was the strongest predictor of PSTT in the regression model at all cervical levels when comparing standardized beta coefficients. PSTT was estimated to increase by approximately 1 mm for every increase of 10 in BMI.*Conclusions Increased BMI is associated with increased PSTT and is the strongest predictor of PSTT compared to age or gender. Established PSTT normative values may be unreliable in overweight and obese patients and are likely to produce increased false-positive results, particularly in the upper cervical spine and in morbidly obese patients. This unreliability is expected to worsen as obesity rates continue to increase. Further study is needed to assess whether BMI-corrected models improve the reliability and accuracy of these normative PSTT values.*Clinical Relevance/Application Cervical PSTT is an important indicator of osseous or soft tissue injury in the setting of trauma. The current study shows a significant effect of BMI on PSTT. Established normative PSTT values may not be reliable to assess obese patients who make up an increasingly larger percentage of the population.

RESULTS

The morbidly obese group had significantly increased mean PSTT compared to normative mean values from the literature at all measured cervical levels (p < 0.001 at C1, C2, C3, and C6; p < 0.05 at C7), and were near or above described upper limits of normal at C1, C2, and C3. Mean PSTT was also increased in the overweight group at C2 and C6 (p < 0.05) and obese group at C1, C2, and C3 (p < 0.001). Multiple linear regression found BMI was significantly associated with increased PSTT at all cervical levels (p < 0.001 at C1, C2, C3, and C6; p < 0.05 at C7). Male gender was also associated with increased PSTT at all levels except C3 (p < 0.001). BMI was the strongest predictor of PSTT in the regression model at all cervical levels when comparing standardized beta coefficients. PSTT was estimated to increase by approximately 1 mm for every increase of 10 in BMI.

CLINICAL RELEVANCE/APPLICATION

Cervical PSTT is an important indicator of osseous or soft tissue injury in the setting of trauma. The current study shows a significant effect of BMI on PSTT. Established normative PSTT values may not be reliable to assess obese patients who make up an increasingly larger percentage of the population.

SSMS05-3   Interpretable Identification Of Various Diseases In The Emergency Brain CTs Using Anomaly Detection With A Deep Neural Network Trained Only With Normal Brain CTs

Participants
Seungjun Lee, BS, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate an anomaly detection algorithm using a deep neural network trained only with normal brain CTs for classifying emergency brain CTs with various diseases.*Methods and Materials We developed a Style-based Generative Adversarial Networks (StyleGAN2)-based model with a training set of 34,080 normal brain CTs collected from Asan Medical Center between January 1, 2000, and August 31, 2018. This model learns to reconstruct a 2D query image into a normal "style" image, then the reconstruction error quantifies the anomaly score to evaluate the severity of the query image, which also provides attention to lesions. 534 consecutive brain CTs comprised the internal validation set, collected from the emergency department of Asan Medical Center between February 1, 2019, and February 28, 2019. 1760 consecutive brain CTs comprised the external validation set, collected from Gangneung Asan Hospital between January 1, 2019, and May 31, 2019. The label of the severity of emergency brain CT scans was defined to request rapid or urgent interventions to the patients or not. Per-patient classification of the algorithm was assessed with the area under the receiver operating characteristic curve (AUC) and its results were analyzed according to the various diseases including tumor, acute infarction, intracranial hemorrhage, hydrocephalus, and others.*Results The AUC, sensitivity, specificity, and accuracy of this algorithm were 0.85, 0.84, 0.72, and 0.74, respectively in the internal validation, and 0.83, 0.78, 0.74, and 0.75, respectively in the external validation. According to the disease subgroups, AUCs of brain tumors, acute infarction, intracranial hemorrhage, hydrocephalus, and others were 0,92, 0.92, 0.80, 0.90, and 0.86, respectively in the internal validation, and 0.92, 0.89, 0.85, 0.90, and 0.78, respectively in the external validation.*Conclusions The anomaly detection with StyleGAN2-based deep learning algorithm could classify the emergency brain CTs with various diseases by learning only normal data distribution and showed more than moderate performance, which could be more robust in the actual clinical situation.*Clinical Relevance/Application The anomaly detection model could be useful for screening and triaging emergency patients with various diseases by detecting emergency anomalies on brain CTs.

RESULTS

The AUC, sensitivity, specificity, and accuracy of this algorithm were 0.85, 0.84, 0.72, and 0.74, respectively in the internal validation, and 0.83, 0.78, 0.74, and 0.75, respectively in the external validation. According to the disease subgroups, AUCs of brain tumors, acute infarction, intracranial hemorrhage, hydrocephalus, and others were 0,92, 0.92, 0.80, 0.90, and 0.86, respectively in the internal validation, and 0.92, 0.89, 0.85, 0.90, and 0.78, respectively in the external validation.

CLINICAL RELEVANCE/APPLICATION

The anomaly detection model could be useful for screening and triaging emergency patients with various diseases by detecting emergency anomalies on brain CTs.

SSMS05-4   Blunt Splenic Trauma: Volumetric Measurements Of Hemoperitoneum Predict Failure Of Non-operative Management In Patients Followed With CT

Participants
Theresa Yu, BA, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Follow-up CT may be used to monitor hemodynamically stable patients selected for non-operative management (NOM) along with serial hemoglobin (Hgb). Prior work has shown that changes on follow-up CT may warrant splenectomy, with emphasis on subjective hemoperitoneum grading. We assess quantitative measurements of hemoperitoneum (HPvol), subcapsular hematoma (SCHvol), and splenic laceration (LACvol) for the outcome of splenic salvage vs splenectomy.*Methods and Materials All adult patients who underwent a trial of non-operative management with at least one follow-up CT between 2017-2019 were included (n=60).

Splenectomy was performed in 7 pts. Voxelwise measurements of HPvol, SCHvol, and LACvol were derived from PVP images of initial and follow-up scans using 3D slicer. ? in volume/day, final volume, new or persistent pseudoaneurysm (PSA), and change in Hgb were assessed. Independent predictors of decision to perform splenectomy were determined with logistic regression.*Results Univariate predictors (p<0.05) included final HPvol, final SCHvol, and new/persistent PSA. Independent predictors in logistic regression were final HPvol (ß= 0.003—units of the regression coefficient: ? in log odds of splenectomy/mL hemoperitoneum, p= 0.012) and PSA (p= 0.018). With PSA held constant, increases in follow-up hemoperitoneum volume of 200, 400, 800, and 1200 mL increased the odds of splenectomy by 82%, 232%, 1002%, and 3560% respectively. New or persistent PSA was present on follow-up in 5/7 splenectomy patients, but also present in 17/60 patients with splenic salvage. AUC of hemoperitoneum, PSA, and the model incorporating both variables was 0.87, 0.74, and 0.90.*Conclusions Hemoperitoneum volume (in mL) on follow-up CT was the most important predictor of splenectomy. New or persistent PSA was also significant but was present in 17 of 60 (28%) of patients with successful splenic salvage and is not an absolute determinant of need for splenectomy.*Clinical Relevance/Application HP volume complements identification of new or persistent PSA as an objective granular quantitative imaging biomarker for predicting splenectomy versus salvage on follow-up CTs in patients trialed with NOM.

RESULTS

Univariate predictors (p<0.05) included final HPvol, final SCHvol, and new/persistent PSA. Independent predictors in logistic regression were final HPvol (ß= 0.003—units of the regression coefficient: ? in log odds of splenectomy/mL hemoperitoneum, p= 0.012) and PSA (p= 0.018). With PSA held constant, increases in follow-up hemoperitoneum volume of 200, 400, 800, and 1200 mL increased the odds of splenectomy by 82%, 232%, 1002%, and 3560% respectively. New or persistent PSA was present on follow-up in 5/7 splenectomy patients, but also present in 17/60 patients with splenic salvage. AUC of hemoperitoneum, PSA, and the model incorporating both variables was 0.87, 0.74, and 0.90.

CLINICAL RELEVANCE/APPLICATION

HP volume complements identification of new or persistent PSA as an objective granular quantitative imaging biomarker for predicting splenectomy versus salvage on follow-up CTs in patients trialed with NOM.

SSMS05-5 COVID-19 Resource Utilization Prediction Using Fusion AI Model

Participants
Imon Banerjee, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

Strain on healthcare resources brought forth by recent COVID-19 pandemic has highlighted the need for efficient planning and allocation through prediction of future consumption. Machine learning can predict resource utilization such as the need for hospitalization based on past medical data stored in electronic medical records (EMR).*Methods and Materials We conducted this study on 3194 patients (46% male with mean age 56.7 (+/-16.8), 56% African American, 7% Hispanic) flagged as COVID-19 positive cases in 12 centers under Emory Healthcare network from February 2020 to September 2020. We designed our fusion learning experiments to be able to predict whether a patient who is COVID-19 positive will need hospitalization after testing positive for COVID-19. Past medical information prior to COVID-19 testing was used as features for predictive modeling which includes demographic, medication, past medical procedures, comorbidities, and laboratory results. Models were evaluated in terms of precision, recall, F1-score (within 95% confidence interval).*Results Fusion models (late, middle and early) predict whether a patient will need hospitalization at some point after infection, with early fusion being the most effective with 84% overall F1-score [CI 82.1-86.1] and 0.92 AUROC. The predictive performance of the model drops by 6 % when clinical data only from the recent past is used, omitting the long-term medical history. Feature importance analysis indicates that history of cardiovascular disease, emergency room visits in the past year prior to testing, and demographic factors are predictive of disease trajectory of COVID-19 patients.*Conclusions With fusion predictive modeling, past medical history and current treatment data can be used to efficiently forecast the need for hospitalization for patients infected with COVID-19 at the time of RT-PCR test which shows that the medical history can predict whether a patient will be asymptomatic or require hospitalization after COVID-19 infection.*Clinical Relevance/Application Fusion based AI models that combine comprehensive information from various types of data available in the electronic medical record (EMR) such as demographic, past medication and procedures, comorbidities and laboratory results, can predict future events like the need for hospitalization for patients infected with COVID-19. In contrast with other published works, our models solely rely on historical information generated before RT-PCR testing. Moreover, our investigation of feature importance of such models reveals important factors that determine patient response to SARS-CoV-2 virus.

RESULTS

Fusion models (late, middle and early) predict whether a patient will need hospitalization at some point after infection, with early fusion being the most effective with 84% overall F1-score [CI 82.1-86.1] and 0.92 AUROC. The predictive performance of the model drops by 6 % when clinical data only from the recent past is used, omitting the long-term medical history. Feature importance analysis indicates that history of cardiovascular disease, emergency room visits in the past year prior to testing, and demographic factors are predictive of disease trajectory of COVID-19 patients.

CLINICAL RELEVANCE/APPLICATION

Fusion based AI models that combine comprehensive information from various types of data available in the electronic medical record (EMR) such as demographic, past medication and procedures, comorbidities and laboratory results, can predict future events like the need for hospitalization for patients infected with COVID-19. In contrast with other published works, our models solely rely on historical information generated before RT-PCR testing. Moreover, our investigation of feature importance of such models reveals important factors that determine patient response to SARS-CoV-2 virus.

SSMS05-6 Can Dual-Energy Marrow Imaging And Cinematic Rendering Improve Pelvic Fracture Severity Grading?

Participants
Theresa Yu, BA, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Instability grading after pelvic fractures is challenging, and instability is further obscured by pelvic binders. Dual energy CT (DECT) marrow imaging and cinematic rendering can provide MRI-like ancillary information regarding osteoligamentous integrity, however, the added utility for classifying pelvic fracture severity for these post-processing tools remain unknown. We compare performance of conventional CT imaging (group 1), CT + marrow imaging (group 2), and CT + marrow imaging + cinematic rendering (CR) (group

3) for classification of pelvic instability in a cohort of patients with pelvic binders.*Methods and Materials 54 consecutive adult patients with pelvic binders scanned in dual energy mode using a 128-section Siemens SOMATOM Force scanner were included. Young-Burgess (YB) grading by orthopedists served as the reference standard. Two radiologists performed blinded consensus review in three reading sessions as above, spaced one month apart. LC-1 and APC-1 injuries were considered stable, LC-2 and APC-2 rotationally unstable, and LC-3, APC-3, and VS vertically/globally unstable. Diagnostic performance for predicting rotational and vertical instability was assessed.*Results AUC under the ROC curve for instability grading overall was 'poor' with conventional CT (0.67). AUC increased to 'fair' (0.75) with the addition of marrow imaging, and to 'good' (0.82) with further addition of CR. Vertical instability (VI) was associated with decision to perform pelvic packing and angioembolization and subanalysis of presence/absence of VI is emphasized. AUC for VI increased from 0.80 (group 1), to 0.91 (group 2), to 0.95 (group 3) (p = 0.037 for marrow + CR vs CT only). Sensitivity increased from 67% to 87% to 93%. Specificity increased from 92% to 95%, to 97%. +LR (36.4) and -LR (0.07) were in the strong/conclusive range. Weighted kappa between radiologist and orthopedist grade increased from 0.44 to 0.64 to 0.76.*Conclusions The combined use of marrow imaging and CR improved instability assessment over conventional CT. In the future, these tools may potentially improve triage to angioembolization and pelvic packing.*Clinical Relevance/Application DECT marrow imaging and cinematic rendering improves instability grading of pelvic fractures obscured by pelvic binders when compared to conventional CT.

RESULTS

AUC under the ROC curve for instability grading overall was 'poor' with conventional CT (0.67). AUC increased to 'fair' (0.75) with the addition of marrow imaging, and to 'good' (0.82) with further addition of CR. Vertical instability (VI) was associated with decision to perform pelvic packing and angioembolization and subanalysis of presence/absence of VI is emphasized. AUC for VI increased from 0.80 (group 1), to 0.91 (group 2), to 0.95 (group 3) (p = 0.037 for marrow + CR vs CT only). Sensitivity increased from 67% to 87% to 93%. Specificity increased from 92% to 95%, to 97%. +LR (36.4) and -LR (0.07) were in the strong/conclusive range. Weighted kappa between radiologist and orthopedist grade increased from 0.44 to 0.64 to 0.76.

CLINICAL RELEVANCE/APPLICATION

DECT marrow imaging and cinematic rendering improves instability grading of pelvic fractures obscured by pelvic binders when compared to conventional CT.

SSMS05-7　A Systematic Review Of The Incidence Of Hypersensitivity Reactions And Post-contrast Acute Kidney Injury After Intravenous Administration Of Ioversol In More Than 57,000 Patients

Participants
Aart J. van der Molen, MD, Bennebroek, Netherlands (*Presenter*) Consultant, Guerbet SA;Author with royalties, Thieme Medical Publishers, Inc

PURPOSE

The aim of this systematic review was to evaluate the incidence of adverse drug reactions (ADRs), including hypersensitivity reactions (HSRs) and post-contrast acute kidney injury (PC-AKI), after intravenous (IV) administration of ioversol, and to position its safety profile among different iodinated contrast media (ICM).*Methods and Materials A systematic literature search was performed (1989-2021) and studies documenting IV use of ioversol and presence or absence of ADRs, HSRs or PC-AKI were selected. Key information including patients' characteristics, indication and dose of ioversol, safety outcome incidence, intensity and seriousness were extracted. When available, data on other ICM from comparative studies were also extracted.*Results Fifteen studies were selected, including two on pediatric patients, with more than 57000 patients (including 13419 pediatric patients). The reported incidences were 0.13%-0.28% for ADRs (3 studies), 0.20-0.66% for HSRs (2 studies), 0.23-1.80% for acute events (4 studies). Severe reactions were rare (0-0.02%), and none were reported amongst pediatric patients. Incidence of ADRs and HSRs with ioversol, especially those of severe intensity, was among the lowest compared to other ICM of the same class. PC-AKI incidence was variable (1-42% in 5 studies), depending on study population and definition of PC-AKI used. Ioversol exposure per se did not increase PC-AKI incidence.*Conclusions When administered by IV route, ioversol has a low incidence of severe / serious ADRs overall, and particularly HSRs. In patients receiving ioversol IV, PC-AKI incidence does not seem to be increased compared to patients who did not receive ioversol.*Clinical Relevance/Application When appropriately used, ioversol has a good safety profile comparable to other ICM within the same class

RESULTS

Fifteen studies were selected, including two on pediatric patients, with more than 57000 patients (including 13419 pediatric patients). The reported incidences were 0.13%-0.28% for ADRs (3 studies), 0.20-0.66% for HSRs (2 studies), 0.23-1.80% for acute events (4 studies). Severe reactions were rare (0-0.02%), and none were reported amongst pediatric patients. Incidence of ADRs and HSRs with ioversol, especially those of severe intensity, was among the lowest compared to other ICM of the same class. PC-AKI incidence was variable (1-42% in 5 studies), depending on study population and definition of PC-AKI used. Ioversol exposure per se did not increase PC-AKI incidence.

CLINICAL RELEVANCE/APPLICATION

When appropriately used, ioversol has a good safety profile comparable to other ICM within the same class

Abstract Archives of the RSNA, 2021

Participants

Luca Maria Sconfienza, MD, PhD, Milano, Italy (*Moderator*) Travel support, Bracco GroupTravel support, Esaote SpASpeakers Bureau, Esaote SpATravel support, ABIOGEN PHARMA SpASpeakers Bureau, P&R HoldingSpeakers Bureau, Pfizer Inc Fees for lectures, Novartis AGFees for lectures, Merck SeronoFees for lectures, MSDF
Leon Lenchik, MD, Winston-salem, North Carolina (*Moderator*) Nothing to Disclose

Sub-Events

SSMK09-1 A Fully Automated Pipeline For Multi-vertebral Level Quantification And Characterization Of Muscle And Adipose Tissue On Chest Computed Tomography

Participants

Christopher Bridge, Boston, Massachusetts (*Presenter*) Institutional support, NVIDIA Corporation;Institutional support, General Electric Company;Institutional support, Nuance Communications, Inc

PURPOSE

To broaden the applicability of automated body composition analysis to chest imaging by developing and validating a fully automated analysis pipeline for multi-vertebral level quantification and characterization of muscle and adipose tissue on routine chest CT.*Methods and Materials We developed a slice-selection network (DenseNet) to identify single axial images at the level of the 5th, 8th, and 10th thoracic vertebral bodies and a segmentation network (U-Net) to identify pixels representing muscle and adipose tissue on these images. Training used ground truth from radiologist-guided manual level selection and segmentation. Our dataset consisted of 629 chest CT scans from 629 patients (55% female, mean±SD age 67±10 years) with lung cancer at three institutions obtained between 2014 and 2017. 471 scans were used for training, 63 for validation, and 94 for testing. 87% of patients had early-stage lung cancer and mean±SD body mass index was 27±5kg/m2. 37 different scanners from 4 manufacturers were represented in the dataset; 56% with intravenous contrast; slice thickness range 1.25mm-5mm; peak tube voltage range 80kV-140kV. We tested each network individually and the full pipeline (slice-selection + segmentation networks). We assessed predictive performance of cross-sectional area (CSA, in cm2) and attenuation in Hounsfield units (HU) for all combinations of tissue, vertebral body level, measurement, and network. We performed root cause analysis for outliers identified with the two-sided Grubbs test.*Results In the full pipeline, median absolute error, and intra-class correlation coefficients (ICCs) for both tissues were 3.6% (IQR 1.3-7.0%) and 0.959-0.998 for CSA, and 1.0 HU (IQR 0.0- 2.0HU) and 0.95-0.99 for median attenuation. The performance of the segmentation network on the ground-truth slice was higher than on the automatically-selected slice, with ICCs>0.99 for CSA and attenuation. In the slice selection network, median absolute error was 7.5mm (IQR 3.3-12.6mm). All outliers of the full pipeline were due to slice selection.*Conclusions We demonstrate accurate and reliable fully automated quantification and characterization of muscle and adipose tissue at multiple thoracic levels on routine chest CT.*Clinical Relevance/Application Recent work has demonstrated that body composition analysis of routine chest CT can inform pre-operative risk assessment in patients with lung cancer. Automation makes clinical translation feasible.

RESULTS

In the full pipeline, median absolute error, and intra-class correlation coefficients (ICCs) for both tissues were 3.6% (IQR 1.3-7.0%) and 0.959-0.998 for CSA, and 1.0 HU (IQR 0.0- 2.0HU) and 0.95-0.99 for median attenuation. The performance of the segmentation network on the ground-truth slice was higher than on the automatically-selected slice, with ICCs>0.99 for CSA and attenuation. In the slice selection network, median absolute error was 7.5mm (IQR 3.3-12.6mm). All outliers of the full pipeline were due to slice selection.

CLINICAL RELEVANCE/APPLICATION

Recent work has demonstrated that body composition analysis of routine chest CT can inform pre-operative risk assessment in patients with lung cancer. Automation makes clinical translation feasible.

SSMK09-2 Opportunistic CT Assessment Of Biological Aging: Comparing 2D Versus 3D Metrics For Muscle And Adipose Tissue

Participants

Robert Boutin, MD, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

Fully-automated tissue segmentation is transitioning to clinical use, but there is a paucity of work comparing 2D vs 3D analysis of muscle and adipose tissue. Our objective was to compare standard cross-sectional (2D) and new volumetric (3D) segmentation methods for muscle and adipose tissue.*Methods and Materials An IRB-approved multi-institutional retrospective study of 110 oncology patients undergoing abdominopelvic CT was performed using a commercially available, CNN-based, fully-automated segmentation software (DAFS 3.0, Voronoi Health Analytics). 2D metrics obtained using a single axial image at the mid L3 level were muscle area (MA) and density (MD-2D), visceral adipose tissue area (VATA) and density (VATD-2D), and subcutaneous adipose tissue area (SATA) and density (SATD-2D). 3D metrics from the mid L1 to mid L5 level were muscle volume (MV) and density (MD-3D), visceral adipose tissue volume (VATV) and density (VATD-3D), and subcutaneous adipose tissue volume (SATV) and density

(SATD-3D). 18 cases were excluded due to CT image artifacts or segmentations errors based on independent review by two musculoskeletal radiologists. In the remaining 92 patients (57% M, 43% F; mean age, 63.2 years; mean BMI, 29.3), 2D and 3D metrics were compared using Pearson correlation coefficients (r) and mean absolute percent errors (%).*Results 2D tissue mean (SD) areas were MA = 128.7 cm2 (33.9), VATA = 184.2 cm2 (118.9), SATA = 231.7 cm2 (124.6); corresponding 3D mean (SD) volumes were MV = 40.0 cm3 (17.5), VATV = 62.4 cm3 (46.9), SATV = 75.4 cm3 (54.2). 2D tissue mean (SD) densities were MD-2D = 37.7 HU (10.3), VATD-2D = -89.9 HU (9.9), SATD-2D = -99.9 HU (6.9); corresponding 3D mean (SD) densities were MD-3D = 38.5 HU (10.1), VATD-3D = -87.2 HU (10.7), SATD-3D = -99.2 HU (6.9). All 2D metrics were highly correlated with corresponding 3D metrics, each at p < 0.001: MA vs MV, r=0.99; MD-2D vs MD-3D, r=0.98; VATA vs VATV, r=0.99; VATD-2D vs VATD-3D, r=0.98; SATA vs SATV, r=0.99; SATD-2D vs SATD-3D, r=0.98. Comparing 2D to 3D, the mean absolute percent errors were: MA vs MV, 3.1%; MD-2D vs MD-3D, 4.8%; VATA vs VATV, 9.5%; VATD-2D vs VATD-3D, 3.4%; SATA vs SATV, 4.9%; SATD-2D vs SATD-3D, 1.1%.*Conclusions 3D volumetric segmentations of muscle and adipose tissue are highly correlated with standard 2D areal segmentations. The least conserved metrics between 2D and 3D analyses are visceral adipose tissue area and volume. Further work is needed to determine if fully-automated 3D segmentations add value over 2D segmentations in predicting clinical outcomes.*Clinical Relevance/Application Fully-automated 3D segmentations of muscle and adipose tissue on CT are increasingly feasible, and provide another dimension for opportunistic biomarker measurements associated with biological aging.

RESULTS

2D tissue mean (SD) areas were MA = 128.7 cm2 (33.9), VATA = 184.2 cm2 (118.9), SATA = 231.7 cm2 (124.6); corresponding 3D mean (SD) volumes were MV = 40.0 cm3 (17.5), VATV = 62.4 cm3 (46.9), SATV = 75.4 cm3 (54.2). 2D tissue mean (SD) densities were MD-2D = 37.7 HU (10.3), VATD-2D = -89.9 HU (9.9), SATD-2D = -99.9 HU (6.9); corresponding 3D mean (SD) densities were MD-3D = 38.5 HU (10.1), VATD-3D = -87.2 HU (10.7), SATD-3D = -99.2 HU (6.9). All 2D metrics were highly correlated with corresponding 3D metrics, each at p < 0.001: MA vs MV, r=0.99; MD-2D vs MD-3D, r=0.98; VATA vs VATV, r=0.99; VATD-2D vs VATD-3D, r=0.98; SATA vs SATV, r=0.99; SATD-2D vs SATD-3D, r=0.98. Comparing 2D to 3D, the mean absolute percent errors were: MA vs MV, 3.1%; MD-2D vs MD-3D, 4.8%; VATA vs VATV, 9.5%; VATD-2D vs VATD-3D, 3.4%; SATA vs SATV, 4.9%; SATD-2D vs SATD-3D, 1.1%.

CLINICAL RELEVANCE/APPLICATION

Fully-automated 3D segmentations of muscle and adipose tissue on CT are increasingly feasible, and provide another dimension for opportunistic biomarker measurements associated with biological aging.

SSMK09-3   Diagnostic Accuracy Of Quantitative Dual-energy CT-based Volumetric Bone Mineral Density Assessment For The Prediction Of Osteoporosis-associated Fractures

Participants
Leon Gruenewald, Frankfurt am Main, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the predictive value of volumetric phantomless trabecular bone mineral density (BMD) assessment of the lumbar spine derived from dual-energy computed tomography (DECT)-based material decomposition as an indicator for the 2-year occurrence risk of osteoporosis-associated fractures.*Methods and Materials Lumbar vertebrae of 92 patients (46 men, 46 women; mean age, 64 years; range, 19-103 years) who had undergone third-generation dual-source DECT between January 2016 and December 2018 were retrospectively analyzed. For phantomless trabecular BMD assessment, dedicated DECT postprocessing software using material decomposition was applied. Digital files of all patients were sighted for 2 years following DECT to obtain the incidence of osteoporotic fractures. Receiver-operating characteristic (ROC) analysis was used to calculate cut-off values, and logistic regression models were applied to determine associations of BMD, sex and age with the occurrence of osteoporotic fractures.*Results A DECT-derived BMD cut-off value of 93.70 mg/cm³ yielded 85.45% sensitivity and 89.19% specificity for the prediction to sustain one or more osteoporosis-associated fractures within 2 years after BMD measurement. DECT-derived BMD was significantly associated with the occurrence of new fractures (Odds ratio of 0.8710, 95% CI, 0.091-0.9375, p < .001), indicating a protective effect of increased DECT-derived BMD values. Overall AUC was 0.9373 (CI, 0.867-0.977, p < .001) for the differentiation of patients that sustained osteoporosis-associated fractures within 2 years of BMD assessment. The regression model was statistically significant (p < .001) and showed high goodness of fit (ROC derived AUC = 0.962, CI, 0.900-0.991).*Conclusions Retrospective DECT-based volumetric trabecular BMD assessment of the lumbar spine can accurately predict the 2-year risk to sustain an osteoporosis-associated fracture in at risk patients without requiring a calibration phantom. Lower DECT-based BMD values are strongly associated with increased risk to sustain fragility fractures.*Clinical Relevance/Application Phantomless opportunistic DECT-based BMD assessment may reduce the social and economic burdens associated with osteoporosis by early identification of patients at risk to sustain an osteoporosis-associated fracture.

RESULTS

A DECT-derived BMD cut-off value of 93.70 mg/cm³ yielded 85.45% sensitivity and 89.19% specificity for the prediction to sustain one or more osteoporosis-associated fractures within 2 years after BMD measurement. DECT-derived BMD was significantly associated with the occurrence of new fractures (Odds ratio of 0.8710, 95% CI, 0.091-0.9375, p < .001), indicating a protective effect of increased DECT-derived BMD values. Overall AUC was 0.9373 (CI, 0.867-0.977, p < .001) for the differentiation of patients that sustained osteoporosis-associated fractures within 2 years of BMD assessment. The regression model was statistically significant (p < .001) and showed high goodness of fit (ROC derived AUC = 0.962, CI, 0.900-0.991).

CLINICAL RELEVANCE/APPLICATION

Phantomless opportunistic DECT-based BMD assessment may reduce the social and economic burdens associated with osteoporosis by early identification of patients at risk to sustain an osteoporosis-associated fracture.

SSMK09-4   Evaluation Of Deep-learning Reconstructed High-resolution 3D Lumbar Spine MRI To Improve Image Quality

Participants
Simon Sun, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To compare interobserver agreement and image quality assessment of 3D T2-weighted fast spin echo (T2w-FSE) lumbar spine (L-spine) MRI, with and without deep learning (DLRecon) reconstructions, as well as standard-of-care (SOC) 2D T2w-FSE MRI. We hypothesized that while decreasing acquisition time, DLRecon 3D T2w-FSE would also allow for similar interobserver agreement and

improved image quality compared to both standard 3D and SOC 2D T2w-FSE.*Methods and Materials Under IRB-approval, imaging from 15 patients who underwent routine 3T L-spine MRI, with both SOC 2D and isotropic 3D T2w-FSE sequences, were retrospectively reviewed. Sequences included 3D T2w-FSE, 2D T2w-FSE sagittal and axial (parallel to L4-5 disc space). A 2D DLRecon algorithm (AIR Recon DL), with denoising and sharpening properties, was retrained for 3D image reconstruction. 3D SOC, 3D DLRecon, and 2D SOC images were obtained, anonymized, and randomized for evaluation by 3 radiologists. Images were evaluated for motion artifact, image quality, central/foraminal stenosis, disc degeneration, annular fissure, presence of facet cysts and disc herniations using a grading scale validated by current literature. Inter-rater agreement for each graded variable was evaluated using Conger's kappa (K) as well as unadjusted percent agreement.*Results Preliminary interobserver agreement for major imaging variables of interest was overall similar between all 3 sequences with K for foraminal stenosis ranging from 0.62-0.88 for DLRecon 3D T2w-FSE, 0.57-0.82 for SOC 3D T2w-FSE and 0.62-0.88 for SOC 2D FSE. Similarly, K for central stenosis at L4-5 was 0.85, 0.82 and 0.90 respectively, ranged from 0.54-0.84, 0.51-0.87, 0.27-0.84 respectively for disc herniation (L3-4 and L4-5) and ranged from 0.47-0.65, 0.55-0.82 and 0.59-0.84 respectively for disc degeneration (L3-4 to L5-S1). Evaluation of image quality showed that 3D DLRecon images were more often graded as of excellent quality (17/44) when compared to SOC 3D T2w-FSE (4/44), 2D axial (5/44) and 2D sagittal (1/44) sequences. Additionally, DLRecon 3D T2w-FSE cases were most often devoid of motion artifact (33/44) compared to SOC 3D T2w-FSE (20/44), 2D axial (16/44) and 2D sagittal (9/44) sequences. Final evaluation will evaluate 35 cases per observer, based on a pre-study power analysis.*Conclusions DLRecon 3D T2w-FSE L-spine MRI demonstrated a similar interobserver agreement for graded variables of interest when compared to 2D imaging and was also more often graded as having excellent image quality.*Clinical Relevance/Application DL Recon 3D T2w-FSE L-spine MRI can facilitate substantial time savings and the ability to reformat sequences freely without compromising interobserver agreement for evaluation of clinically relevant pathology.

RESULTS

Preliminary interobserver agreement for major imaging variables of interest was overall similar between all 3 sequences with K for foraminal stenosis ranging from 0.62-0.88 for DLRecon 3D T2w-FSE, 0.57-0.82 for SOC 3D T2w-FSE and 0.62-0.88 for SOC 2D FSE. Similarly, K for central stenosis at L4-5 was 0.85, 0.82 and 0.90 respectively, ranged from 0.54-0.84, 0.51-0.87, 0.27-0.84 respectively for disc herniation (L3-4 and L4-5) and ranged from 0.47-0.65, 0.55-0.82 and 0.59-0.84 respectively for disc degeneration (L3-4 to L5-S1). Evaluation of image quality showed that 3D DLRecon images were more often graded as of excellent quality (17/44) when compared to SOC 3D T2w-FSE (4/44), 2D axial (5/44) and 2D sagittal (1/44) sequences. Additionally, DLRecon 3D T2w-FSE cases were most often devoid of motion artifact (33/44) compared to SOC 3D T2w-FSE (20/44), 2D axial (16/44) and 2D sagittal (9/44) sequences. Final evaluation will evaluate 35 cases per observer, based on a pre-study power analysis.

CLINICAL RELEVANCE/APPLICATION

DL Recon 3D T2w-FSE L-spine MRI can facilitate substantial time savings and the ability to reformat sequences freely without compromising interobserver agreement for evaluation of clinically relevant pathology.

SSMK09-5 Evaluation Of Adipose Tissue And Muscle CT Attenuation As Quantitative Biomarkers In Predicting Outcomes In Patient With Multiple Myeloma

Participants
Iclal Erdem Toslak, MD, Antalya, Turkey (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate radiologic measures of visceral and subcutaneous adiposity using CT images in predicting patient outcomes in patients with multiple myeloma.*Methods and Materials From January 2014 to through December 2018, 86 patients with a diagnosis of multiple myeloma who underwent FDG-PET/CT were included in this retrospective study. Electronically recorded non-contrast CT images were transferred to a workstation, and cross-sectional areas and attenuation (Hounsfield Unit) of abdominal subcutaneous and visceral adipose tissue (SAT and VAT, respectively) and attenuation of psoas muscle were measured. Clinical information was acquired from patient medical records. Patients were classified into stages (22 stage 1, 30 stage2, and 34 stage 3) based on clinical data. Clinical response to treatment and recurrence were noted. Statistical analyses were performed to calculate clinical associations between radiological measures.*Results Higher SAT and SAT/VAT area values as well as lower subcutaneous and visceral attenuation values were found in those with lower stages of the disease (p<0.05). No statistically significant association was detected between disease stage and psoas muscle attenuation. VAT area values were significantly decreased and visceral attenuation values were significantly increased in patients with lytic bone lesions. On the other hand SAT, VAT, SAT/VAT area and psoas muscle attenuation values were not associated with therapy response and recurrence of the disease.*Conclusions SAT, SAT/VAT area values were strongly associated with the stage of disease in patients with multiple myeloma. Patients with lytic bone lesions had significantly lower VAT area values and higher visceral adipose tissue attenuation values. Quantitative measures of visceral or subcutaneous adipose tissue were not useful in predicting therapy response and recurrence of the disease but can predict the severity of the disease.*Clinical Relevance/Application CT quantification of adipose tissue and muscle can help improve patient management and outcomes in multiple myeloma

RESULTS

Higher SAT and SAT/VAT area values as well as lower subcutaneous and visceral attenuation values were found in those with lower stages of the disease (p<0.05). No statistically significant association was detected between disease stage and psoas muscle attenuation. VAT area values were significantly decreased and visceral attenuation values were significantly increased in patients with lytic bone lesions. On the other hand SAT, VAT, SAT/VAT area and psoas muscle attenuation values were not associated with therapy response and recurrence of the disease.

CLINICAL RELEVANCE/APPLICATION

CT quantification of adipose tissue and muscle can help improve patient management and outcomes in multiple myeloma

SSMK09-6 Novel Deep Learning-based T1- And T2-weighted Imaging Of The Spine: Significant Acceleration Of Image Acquisition With Preservation Of Excellent Image Quality And Diagnostic Confidence

Participants
Judith Herrmann, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning (DL) image reconstruction could potentially disrupt the realm of MRI by significantly accelerating image acquisition. The goal of this study is to introduce a novel deep learning-based T1 and T2 weighted turbo spine echo reconstructions (TSEDL) in

spine MRI and investigate its impact on examination time, image quality and diagnostic confidence in comparison to standard T1 and T2 weighted turbo spin echo imaging (TSE).*Methods and Materials A total of 37 patients with various spinal pathologies were prospectively enrolled in this institutional review board-approved study. Very recently, the novel deep learning-based sagittal T1- and T2-weighted TSE sequence (TSEDL) was developed and trained on 10,000 high resolution slices from 1.5T and 3T scanners. After acquisition of standard T1 and T2 TSE images, the T1 and T2 TSEDL were applied. Parallel imaging acceleration factor of 3 and 4 for T1 and T2 TSEDL were utilized, respectively. Image evaluation was performed by two radiologists in a blinded and a randomized manner using a Likert scale ranging from 1-4, 4 being the best. Outcome measures were: sharpness of anatomical structures: (intervertebral discs, spinal canal, facet joints and neuroforamina), artifacts, noise, overall image quality, diagnostic confidence and acquisition time. Finally, interrater agreement was analyzed.*Results Mean patient age was 46±19 years (range 18-87 years, 39% females). A total of 28 exams were performed at 1.5 T and 9 exams at 3T. A total of 29 MRI exams of the lumbar spine, 5 of the thoracic spine 4 of the cervical spine were performed. All images were reconstructed successfully. TSEDL enabled 60% to 75% reduction of acquisition time for sagittal T1 (TSE: 2:13 min vs, TSEDL: 0:52 min) and sagittal T2 (TSE: 2:29 min vs TSEDL: 0:40 min)) weighted images. For TSEDL image noise was rated significantly superior by both readers (all $p < 0.01$). There was no statistically significant difference between TSE and TSEDL regarding overall image quality, diagnostic confidence or sharpness of intervertebral discs, spinal canal, facet joints or neuroforamina. Interreater reliability was high (K> 0.7)*Conclusions The data-driven deep learning-based T1- and T2-weighted TSE imaging of the spine is feasible enabling a significant improvement of image noise and allowing an acquisition time reduction of up to 75 % while preserving excellent image quality and diagnostic confidence. Consequently, the DL technique might set the stage for ultra-fast spine MRI.*Clinical Relevance/Application Reducing scan time up to 75% without compromising image quality could set the stage for ultra-fast spine MRI, which has numerous benefits in the context of an aging population and increased workload.

RESULTS

Mean patient age was 46±19 years (range 18-87 years, 39% females). A total of 28 exams were performed at 1.5 T and 9 exams at 3T. A total of 29 MRI exams of the lumbar spine, 5 of the thoracic spine 4 of the cervical spine were performed. All images were reconstructed successfully. TSEDL enabled 60% to 75% reduction of acquisition time for sagittal T1 (TSE: 2:13 min vs, TSEDL: 0:52 min) and sagittal T2 (TSE: 2:29 min vs TSEDL: 0:40 min)) weighted images. For TSEDL image noise was rated significantly superior by both readers (all $p < 0.01$). There was no statistically significant difference between TSE and TSEDL regarding overall image quality, diagnostic confidence or sharpness of intervertebral discs, spinal canal, facet joints or neuroforamina. Interreater reliability was high (K> 0.7)

CLINICAL RELEVANCE/APPLICATION

Reducing scan time up to 75% without compromising image quality could set the stage for ultra-fast spine MRI, which has numerous benefits in the context of an aging population and increased workload.

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Sub-Events

SPR-RI-1   Diagnostic Performance Of ACR O-RADS Ultrasound Risk Stratification In Average Risk US Women

Participants
Priyanka Jha, MBBS, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

1. Evaluate applicability of Ovarian-Adnexal Reporting and Data System (O-RADS) risk stratification scoring system to a multi-institutional, non-selected, average risk population in US, obtain risk of malignancy in each O-RADS category & assess concordance with malignancy risk proposed by current O-RADS risk stratification system.2. Assess risk of cancer & O-RADS performance with menopausal status of the patient.*Methods and Materials This retrospective multi-center, IRB-approved study included a non-selected, average risk women presenting to US radiology departments for routine pelvic US. All US exams were reviewed by study radiologists blinded to final diagnosis. The following O-RADS defined findings were excluded: follicles, corpus luteal cysts and cystic lesions <1cm (in postmenopausal women). All other adnexal lesions were assessed using O-RADS. Medical records were reviewed for surgical pathology, minimum 2 years of imaging and/or clinical follow-up as reference standard. Distribution of lesions and frequency of cancer in O-RADS 2-5 categories was calculated.Considering O-RADS 2 & 3 as benign & O-RADS 4 and 5 malignant, descriptive statistics were performed. Univariate & multivariate analyses were also performed.*Results 913 women with 1014 adnexal lesions were included. Average age was 42.4 years(+13.9 years).Frequency of lesion distribution per O-RADS category was:O-RADS 2:64.8%(657/1014), O-RADS 3: 11.2%(114/1014), O-RADS 4: 16.9%(171/1014) & O-RADS 5:7.1%(72/1014).Frequency of malignancy per O-RADS category was: O-RADS 2:0.5% (3/657), O-RADS 3:4.4%(5/114), O-RADS 4:14.6%(25/171) & O-RADS 5:61.1%(43/72). O-RADS 4 lesions with solid components have higher risk of malignancy 20.7%(25/121) compared to the lesions without solid components 0% (0/50),(p<0.01).O-RADS sensitivity & specificity for malignancy diagnosis are 96.1% & 70.0%, with PPV of 20.6% and NPV of 99.5%.Rate of cancer was higher in postmenopausal women 13.4% (32/238), compared to 4.15% (28/675) in premenopausal women (p<0.01).*Conclusions 1. Calculated frequency of malignancy for each O-RADS category in our study falls within the range as reported by the O-RADS algorithm.2. The frequency of malignancy in O-RADS 4 was concordant with the proposed risk, however, it was on the lower range. O-RADS 4 lesions with solid components have higher risk of malignancy compared to lesions without solid components.3. Rate of cancer per O-RADS category is higher in postmenopausal compared to premenopausal women.*Clinical Relevance/Application 1. O-RADS risk stratification is applicable to general non-selected US population. The system has a high NPV but a low PPV for malignancy.2. O-RADS 4 category may be modified to improve specificity and PPV for malignancy.

RESULTS

913 women with 1014 adnexal lesions were included. Average age was 42.4 years(+13.9 years).Frequency of lesion distribution per O-RADS category was:O-RADS 2:64.8%(657/1014), O-RADS 3: 11.2%(114/1014), O-RADS 4: 16.9%(171/1014) & O-RADS 5:7.1% (72/1014).Frequency of malignancy per O-RADS category was: O-RADS 2:0.5% (3/657), O-RADS 3:4.4%(5/114), O-RADS 4:14.6% (25/171) & O-RADS 5:61.1%(43/72). O-RADS 4 lesions with solid components have higher risk of malignancy 20.7%(25/121) compared to the lesions without solid components 0% (0/50),(p<0.01).O-RADS sensitivity & specificity for malignancy diagnosis are 96.1% & 70.0%, with PPV of 20.6% and NPV of 99.5%.Rate of cancer was higher in postmenopausal women 13.4% (32/238), compared to 4.15% (28/675) in premenopausal women (p<0.01).

CLINICAL RELEVANCE/APPLICATION

1. O-RADS risk stratification is applicable to general non-selected US population. The system has a high NPV but a low PPV for malignancy.2. O-RADS 4 category may be modified to improve specificity and PPV for malignancy.

SPR-RI-10   External Validation Of Orads Ultrasound Risk Stratification System To Discriminate Benign And Malignancy Adnexal Masses Diagnosis

Participants
Kalesha Hack, MD, FRCPC, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

The objective of this study was to externally validate the performance of the Ovarian-Adnexal Reporting and Data System (ORADS) Ultrasound Risk Stratification System to distinguish benign and malignant adnexal masses.*Methods and Materials This was a retrospective diagnostic accuracy study of 227 consecutive patients with 262 adnexal lesions who underwent pelvic transvaginal ultrasound at a single-site radiology department within a tertiary care oncology center between August 2015 and April 2017. Adnexal masses were assessed by two independent readers using the ORADS lexicon and assigned ORADS risk category score of 2-5. Readers were blinded to the clinical outcome and histopathologic diagnosis. Descriptors and clinical indices for the IOTA ADNEX model were also assessed used to determine the ADNEX overall risk of malignancy. The reference standard was histopathology or minimum 2-year follow up imaging. Receiver-operating characteristics (ROC) curve analysis was used to assess the performance of the ORADS model and to compare the ORADS and ADNEX models.*Results Of the 262 adnexal lesions, 188 (72%) were benign (88 histopathology, 100 conservative follow up) and 74 were malignant (72 histopathology, 2 interval growth at follow up). All ORADS 2 lesions were benign. Frequency of malignant outcome by ORADS category was 3% (1/32) for ORADS 3, 35% (22/63) for ORADS 4

and 77.3% (51/66) for ORADS 5. Interrater agreement for ORADS category was 99% (260/262). The AUC for ORADS was 0.91 (95% CI 0.92-0.97) and for ADNEX was 0.95 (95% CI 0.92-0.97) which was statistically significant (p<0.05). Adding acoustic shadowing as an independent variable to the ORADS model increased the AUC to 0.94 (CI 0.91-0.96) with no statistically significant difference compared to ADNEX. The optimal cut-off point was ORADS 4 with sensitivity of 99% (95% CI 0.96-1.0) and specificity of 70% (95% CI 0.64-0.77). At this cut-off, negative predictive value is 0.99 and positive predictive value 0.57. Using ORADS 3 as a cut-off improves sensitivity to 100%, however, with corresponding decrease in specificity to 53% (95% CI 0.46-0.61).*Conclusions The ORADS Ultrasound Risk Stratification System can discriminate between benign and malignant adnexal masses with high diagnostic accuracy. The IOTA-ADNEX model showed a small but statistically significant better performance, however, when acoustic shadowing was added to the ORADS model, there was no statistically significant difference between the two.*Clinical Relevance/Application This is the first North American external validation study of the ORADS system to our knowledge. It is also the first study evaluating modified ORADS with addition of acoustic shadowing.

RESULTS

Of the 262 adnexal lesions, 188 (72%) were benign (88 histopathology, 100 conservative follow up) and 74 were malignant (72 histopathology, 2 interval growth at follow up). All ORADS 2 lesions were benign. Frequency of malignant outcome by ORADS category was 3% (1/32) for ORADS 3, 35% (22/63) for ORADS 4 and 77.3% (51/66) for ORADS 5. Interrater agreement for ORADS category was 99% (260/262). The AUC for ORADS was 0.91 (95% CI 0.92-0.97) and for ADNEX was 0.95 (95% CI 0.92-0.97) which was statistically significant (p<0.05). Adding acoustic shadowing as an independent variable to the ORADS model increased the AUC to 0.94 (CI 0.91-0.96) with no statistically significant difference compared to ADNEX. The optimal cut-off point was ORADS 4 with sensitivity of 99% (95% CI 0.96-1.0) and specificity of 70% (95% CI 0.64-0.77). At this cut-off, negative predictive value is 0.99 and positive predictive value 0.57. Using ORADS 3 as a cut-off improves sensitivity to 100%, however, with corresponding decrease in specificity to 53% (95% CI 0.46-0.61).

CLINICAL RELEVANCE/APPLICATION

This is the first North American external validation study of the ORADS system to our knowledge. It is also the first study evaluating modified ORADS with addition of acoustic shadowing.

SPR-RI-11   Challenges Of O-RADS US And MRI In The Assessment Of Complex Ovarian-adnexal Cysts >= 5 Cm

Participants
Yang Guo, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To assess inter-reader agreement and diagnostic performance of O-RADS ultrasound (US) and MRI for characterization of complex adnexal cysts = 5 cm, and to assess concordance between US and MRI risk stratification of these lesions.*Methods and Materials This IRB-approved HIPAA-compliant retrospective study was performed at a large academic center. From our ultrasound electronic reporting database, we identified all patients with a pelvic US from 7/1/2017 to 6/30/2020 in whom "complex cyst(s)" = 5 cm were reported on US and pelvic MRI was performed within one year of the US without intervening procedures or treatment. In patients with more than one US, the one closest to the MRI was used. Two blinded US subspecialists independently reviewed the US images and assigned O-RADS US category, and third served as adjudicator for discrepancies. Three different abdominal radiologists reviewed the MRI in similar fashion as US (two readers, one adjudicator). The final lesion outcome was recorded based on pathology or follow-up imaging. Inter-reader agreement between two primary readers were assessed for US and MRI by Cohen's kappa test. The associated cancer risk for each O-RADS US and MRI category was calculated. The concordance between the US and MRI reads was assessed.*Results Among 1,003 pelvic sonograms that reported at least one 5 cm or larger complex cyst, 80 patients underwent pelvic MRI within one-year. A total of 69 lesions were assigned an O-RADS US category and 74 lesions assigned an O-RADS MR category. We identified 58 lesions seen both on US and MRI in 54 women (mean age 40 years, SD 12.4, 7 post-menopausal) that comprised the final cohort. Mean maximal dimension of the lesions was 9.1 cm (SD 3.2) on US and 8.5 cm (SD 3.6) on MR (p=0.17). Inter-reader agreement between two primary readers was fair for US (weighted kappa=0.31) and moderate for MRI (weighted kappa=0.43). Forty-eight lesions were benign, nine malignant and one with unknown outcome. For O-RADS US 2, 3, 4, and 5 categories, the rate of malignancy was 3%, 10%, 27% and 80%, while for O-RADS MRI 2, 3, 4, and 5, the rate of malignancy was 3%, 0%, 80% and 100%, respectively. The agreement between US and MR risk categorization was moderate (weighted kappa=0.58).*Conclusions There was significant interobserver variability in risk-stratification of = 5 cm complex adnexal cysts using both O-RADS US and MRI. There was moderate concordance between risk categorization between O-RADS US and MRI. The rate of malignancy for O-RADS 4 and 5 lesions was high for both US and MRI.*Clinical Relevance/Application Our study demonstrates significant inter-reader variability in O-RADS US and MRI in the assessment of complex ovarian and adnexal cysts. Further radiologist training may increase inter-reader agreement.

RESULTS

Among 1,003 pelvic sonograms that reported at least one 5 cm or larger complex cyst, 80 patients underwent pelvic MRI within one-year. A total of 69 lesions were assigned an O-RADS US category and 74 lesions assigned an O-RADS MR category. We identified 58 lesions seen both on US and MRI in 54 women (mean age 40 years, SD 12.4, 7 post-menopausal) that comprised the final cohort. Mean maximal dimension of the lesions was 9.1 cm (SD 3.2) on US and 8.5 cm (SD 3.6) on MR (p=0.17). Inter-reader agreement between two primary readers was fair for US (weighted kappa=0.31) and moderate for MRI (weighted kappa=0.43). Forty-eight lesions were benign, nine malignant and one with unknown outcome. For O-RADS US 2, 3, 4, and 5 categories, the rate of malignancy was 3%, 10%, 27% and 80%, while for O-RADS MRI 2, 3, 4, and 5, the rate of malignancy was 3%, 0%, 80% and 100%, respectively. The agreement between US and MR risk categorization was moderate (weighted kappa=0.58).

CLINICAL RELEVANCE/APPLICATION

Our study demonstrates significant inter-reader variability in O-RADS US and MRI in the assessment of complex ovarian and adnexal cysts. Further radiologist training may increase inter-reader agreement.

SPR-RI-2   The Texture Model Of "Coronal And Sagittal" Planes On T2wi Could Accurately Predict Placenta Accreta Spectrum

Participants
Hainan Ren, BMedSc, Sendai, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Prenatal differentiation between normal placenta and placenta accreta spectrum (PAS) is necessary to perform safe delivery. We

performed visual and texture analysis on the axial, coronal, and sagittal planes of T2-weighted images (T2WI) separately and identified the optimal method in differentiating between normal placenta and PAS.*Methods and Materials The Institutional Review Board approved this retrospective study and the requirement for informed consent was waived. Between May 2010 and August 2019, eighty consecutive patients (normal group (n=50) and PAS (n=30)) underwent preoperative magnetic resonance imaging (MRI). A scoring system (0-2) was used to evaluate the abnormality in visual analysis (bulging, abnormal vascularity, heterogeneity, T2 dark band) on T2WI. Manual segmentations of placenta were performed on the axial, coronal, and sagittal planes of T2WI separately to obtain texture features. Seven combinations were obtained from the three planes as follows: axial, coronal, sagittal, axial and coronal, axial and sagittal, coronal and sagittal, as well as axial and coronal and sagittal. Feature selection by least absolute shrinkage and selection operator (LASSO) method and model construction by support vector machine (SVM) algorithm with k-fold cross-validation were performed. Area under the curve (AUC) of receiver operating characteristic (ROC) curve analysis was used to compare the diagnostic performance between visual and texture analysis.*Results The AUC of visual analysis was 0.75. The model "coronal and sagittal" had highest AUC of 0.98 among seven combinations. The 5-fold cross-validation for model "coronal and sagittal" showed AUCs of 0.85 and 0.97 in training and validation sets. Using the model "coronal and sagittal" for all subjects, AUC of the model was significantly higher than that of visual analysis (0.98 vs. 0.75, p<.0001).*Conclusions The texture analysis composed of features from "coronal and sagittal" planes of T2WI was selected as optimal for differentiating between normal placenta and PAS. The diagnostic performance of texture analysis was higher than that of visual analysis.*Clinical Relevance/Application Texture analysis on coronal and sagittal T2-weighted images outperformed the visual analysis in differentiating between normal placenta and placenta accreta spectrum.

RESULTS

The AUC of visual analysis was 0.75. The model "coronal and sagittal" had highest AUC of 0.98 among seven combinations. The 5-fold cross-validation for model "coronal and sagittal" showed AUCs of 0.85 and 0.97 in training and validation sets. Using the model "coronal and sagittal" for all subjects, AUC of the model was significantly higher than that of visual analysis (0.98 vs. 0.75, p<.0001).

CLINICAL RELEVANCE/APPLICATION

Texture analysis on coronal and sagittal T2-weighted images outperformed the visual analysis in differentiating between normal placenta and placenta accreta spectrum.

SPR-RI-3   Noninvasive Magnetic Resonance Imaging-derived Radiomics Analysis Improves Pretreatment Identification Of Multimodality Therapy Candidates In Early-stage Cervical Cancer

Participants
Jing Ren, MD,MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate a clinical-radiomics model that incorporates the radiomics signature and pretreatment clinicopathological parameters for identification of multimodality therapy candidates in early-stage cervical cancer.*Methods and Materials From January 2017 to February 2021, a total of 235 patients with IB1-IIA1 cervical cancer who underwent radical hysterectomy were enrolled and divided into a training set (n = 194, training: validation = 8:2) and a testing set (n = 41) according to the surgical time. Radiomics features of each patient were extracted from preoperative sagittal T2-weighted images. Significance testing, Pearson's correlation analysis, and Least absolute shrinkage and selection operator was applied to select radiomic features associated with the administration of multimodality therapy. A clinical-radiomics model incorporating radiomics signature, age, FIGO stage, menopausal status, and preoperative biopsy histological type was developed to identify multimodality therapy candidates. Nomogram and decision curve analysis were developed to facilitate ease of clinical application.*Results The clinical-radiomics model showed excellent predictive performance, with an area under the curve, sensitivity and specificity of 0.885 (95% CI: 0.781-0.989), 78.9% and 81.8% in the testing set. Decision curve analysis demonstrated that when the threshold probability was >20%, the clinical-radiomics model/nomogram could could bring more net benefit than the treat-all or treat-none strategies.*Conclusions The clinical-radiomics model is of great potential for pretreatment identification of multimodality therapy candidates in early-stage cervical cancer.*Clinical Relevance/Application Clinical-radiomics model for pretreatment identification of multimodality therapy candidates helps to select optimal primary treatment (radical surgery or definitive radiotherapy) for early-stage cervical cancer

RESULTS

The clinical-radiomics model showed excellent predictive performance, with an area under the curve, sensitivity and specificity of 0.885 (95% CI: 0.781-0.989), 78.9% and 81.8% in the testing set. Decision curve analysis demonstrated that when the threshold probability was >20%, the clinical-radiomics model/nomogram could could bring more net benefit than the treat-all or treat-none strategies.

CLINICAL RELEVANCE/APPLICATION

Clinical-radiomics model for pretreatment identification of multimodality therapy candidates helps to select optimal primary treatment (radical surgery or definitive radiotherapy) for early-stage cervical cancer

SPR-RI-4   High-resolution Diffusion-weighted Imaging In Endometrial Cancer Staging: A Comparison Of Multiplexed Sensitivity Encoding Versus Reduced Field-of-view Techniques

Participants
Takashi Ota, MD,PhD, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To compare the image quality and diagnostic performance of high-resolution diffusion-weighted imaging using multiplexed sensitivity encoding (MUSE-DWI) versus reduced field-of-view imaging (rFOV-DWI) in endometrial cancer.*Methods and Materials MUSE-DWI and rFOV-DWI were obtained preoperatively in 44 women with endometrial cancer. For both techniques, two radiologists qualitatively assessed the image qualities and measured apparent diffusion coefficient (ADC) and signal-to-noise ratio (SNR) of the endometrial cancer and myometrium, as well as contrast-to-noise ratio (CNR) between them. Three independent radiologists assessed superficial (SMI) and deep myometrial invasion (DMI) using both techniques separately. Qualitative scores and quantitative parameters were compared using Wilcoxon signed-rank test and paired t-test, respectively. Diagnostic performances of both techniques were compared using McNemar's test and receiver operating characteristic analysis.*Results Artifacts, sharpness, and overall image quality were significantly better with MUSE-DWI compared to rFOV-DWI in both readers (p< .05). Tumor and myometrial ADC values did not differ significantly. SNR on rFOV-DWI was significantly higher than that on MUSE-DWI (p= .012 and <

.001 for the tumors and the myometrium, respectively), whereas CNR did not differ statistically. Regarding SMI assessment, mean accuracies and area under the curve (AUC) were 67.4% and 0.80, respectively with MUSE-DWI, and 75% and 0.80, respectively with rFOV-DWI. In DMI assessment, mean accuracies and AUC were 86.4% and 0.92, respectively with MUSE-DWI, and 83.3% and 0.87, respectively with rFOV-DWI. Although there were no significant differences in the diagnostic performances between the two techniques in all three readers, SMI assessment was superior with rFOV-DWI in all three readers while DMI assessment was more accurate with MUSE-DWI in two readers.*Conclusions MUSE-DWI had higher image quality than rFOV-DWI. Although not significant, SMI assessment tended to be accurate with rFOV-DWI while DMI assessment tended to be accurate with MUSE-DWI.*Clinical Relevance/Application MUSE-DWI yields high image quality and may be a preferred choice in routine endometrial cancer staging while rFOV-DWI may be a reliable option in patient selection for fertility sparing treatment.

RESULTS

Artifacts, sharpness, and overall image quality were significantly better with MUSE-DWI compared to rFOV-DWI in both readers (p< .05). Tumor and myometrial ADC values did not differ significantly. SNR on rFOV-DWI was significantly higher than that on MUSE-DWI (p= .012 and < .001 for the tumors and the myometrium, respectively), whereas CNR did not differ statistically. Regarding SMI assessment, mean accuracies and area under the curve (AUC) were 67.4% and 0.80, respectively with MUSE-DWI, and 75% and 0.80, respectively with rFOV-DWI. In DMI assessment, mean accuracies and AUC were 86.4% and 0.92, respectively with MUSE-DWI, and 83.3% and 0.87, respectively with rFOV-DWI. Although there were no significant differences in the diagnostic performances between the two techniques in all three readers, SMI assessment was superior with rFOV-DWI in all three readers while DMI assessment was more accurate with MUSE-DWI in two readers.

CLINICAL RELEVANCE/APPLICATION

MUSE-DWI yields high image quality and may be a preferred choice in routine endometrial cancer staging while rFOV-DWI may be a reliable option in patient selection for fertility sparing treatment.

SPR-RI-5   Superb Microvascular Imaging: Preliminary Results In Assessment The Response To Chemoradiotherapy In Locally Advanced Cervical Cancer

Participants
Yi Zhu, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

The place of ultrasound in the diagnostics and monitoring of cervical cancer remains controversial. Superb microvascular imaging (SMI) is a new ultrasound image processing technique. SMI can extract and visualize flow signals from vessels through advanced clutter suppression technology, especially the very small vascular which were previously invisible without the use of a contrast agent. In this work, we aim to analyze the usefulness of SMI in the diagnosis of cervical cancer and the possibility of evaluating the effect of chemoradiotherapy in patients with locally advanced cervical cancer.*Methods and Materials Patients with locally advanced cervical cancer were underwent SMI examinations with an Aplio i800 ultrasound system (Toshiba Medical Systems, Tokyo, Japan) before, during and after chemoradiotherapy. Cervical lesions volume and vascularity index (VI) via SMI were obtained using a linear 3 - 11 MHz endovaginal transducer. For continuous variables, the means VI of the cervical area at different treatment timepoint were compared by using analysis of variance (ANOVA).*Results The study included 56 patients with locally advanced cervical cancer based on histological diagnosis. Of these, 23 were newly diagnosed and untreated, 13 were receiving chemoradiotherapy, and 20 have completed treatment with normal ultrasound and cervical cytology findings. In most of the patients, SMI achieved the excellent visualization of microvascular structures, revealing abnormal vasculature in 23 out of 23 (100%) examinations of the untreated patients, 11/13 (84.6%) examination of the patients who were during the treatment. SMI was superior to doppler imaging for depicting the microvascular structures. The untreated patients with cervical cancer had significantly higher median VI (41.1 ± 3.2 %) compared to that of patients during or after treatment (24.8 ± 5.8 %, 4.1 ± 1.4 %, respectively). The VI showed a significant downward trend with the course of treatment (P < 0.01).*Conclusions SMI is especially useful for depicting the microvascular flow and quantitative assessment based on a novel parameter such as VI for locally advanced cervical cancer.*Clinical Relevance/Application Quantitative assessment based on VI visa SMI can aid in the diagnosis and treatment monitoring for patients with locally advanced cervical cancer.

RESULTS

The study included 56 patients with locally advanced cervical cancer based on histological diagnosis. Of these, 23 were newly diagnosed and untreated, 13 were receiving chemoradiotherapy, and 20 have completed treatment with normal ultrasound and cervical cytology findings. In most of the patients, SMI achieved the excellent visualization of microvascular structures, revealing abnormal vasculature in 23 out of 23 (100%) examinations of the untreated patients, 11/13 (84.6%) examination of the patients who were during the treatment. SMI was superior to doppler imaging for depicting the microvascular structures. The untreated patients with cervical cancer had significantly higher median VI (41.1 ± 3.2 %) compared to that of patients during or after treatment (24.8 ± 5.8 %, 4.1 ± 1.4 %, respectively). The VI showed a significant downward trend with the course of treatment (P < 0.01).

CLINICAL RELEVANCE/APPLICATION

Quantitative assessment based on VI visa SMI can aid in the diagnosis and treatment monitoring for patients with locally advanced cervical cancer.

SPR-RI-6   Comparison Of 2D Multi-slice And 3D Compressed Sensing Accelerated High Resolution T2 Weighted Imaging In Detection Of Endometriosis

Participants
Xulun Lu, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

we compare the performance of compressed sensing (CS) accelerated 3D high-resolution and conventional 2D multi-slice T2-SPAIR images on visualization of pelvic ectopic lesions. Results indicate that 3D-CS-HR imaging can be more reliable for discovery of DIE lesions.*Methods and Materials 15 DIE patient were scanned using a 3.0 T MR scanner (Ingenia CX, Philips Healthcare, the Netherlands) . The MR protocol included 2D multi-slice T2-SPAIR, 3D-CS-HR-T2WI and dynamic contrast enhanced scans with parameters listed in Table 1. 3D-CS-HR-T2WI images were reconstructed along directions of the broad ligament and the central direction of the bottom of uterus. Two imaging physicians read the images independently to determine whether the common endometriosis in the original and reconstructed images were affected. The evaluated locations included: ovary , broad ligament,

sacral ligament, round ligament, rectovaginal pouch or rectum adhesion and abdominal wall. Except for ovarian lesions, other locations were compared with enhanced images to see if they were (diffuse or focal) ligament thickening and enhanced in enhanced image, and intraoperative records were compared to determine whether the detected lesions were involved areas. The interobserver reliability on qualitative evaluation was assessed via Cohen's kappa test. The kappa test was also used to evaluated the consistency of T2-SPAIR and 3D pelvis view results with the surgical records, respectively. The kappa values, sensitivity and specificity were compared to see the performance of 2D T2WI and 3D pelvis view for the diagnosis of DIE.*Results Measurement consistency between the two observers was good (kappa value > 0.75). 3D-CS-HR-T2WI shows better detection performance (Table 2). In this set of data, the sensitivity and specificity of T2WI and 3D-CS-HR-T2WI for the detection of lesions at ovary, broad ligament, sacral ligament, round ligament, rectovaginal pouch or rectum and abdominal wall are:100% and 100%, 100% and 77.8%, 100% and 77.8%, 100% and 88.3%, 100% and 25.0%, 100% and 100%. The specificity of 3D-CS-HR-T2WI for the detection of lesions at ovary, broad ligament, sacral ligament, round ligament, rectovaginal pouch or rectum and abdominal wall are:100% and 100%, 100% and 85.7%, 100% and 85.7%, 100% and 100%,100% and 30.0%, 100% and 100%(Figure 1 and 2).The specificity of 3D-CS-HR-T2WI were higher than T2WI in detect of endometriosis located in road ligament, sacral ligament, round ligament, rectovaginal pouch or rectum.*Conclusions 3D-CS-HR-T2WI is potentially a promising and valuable non-invasive method in detection of DIE.*Clinical Relevance/Application indicate that the 3D T2WI imaging were reliable in finding ectopic lesions in each ligament of the pelvic floor.

RESULTS

Measurement consistency between the two observers was good (kappa value > 0.75). 3D-CS-HR-T2WI shows better detection performance (Table 2). In this set of data, the sensitivity and specificity of T2WI and 3D-CS-HR-T2WI for the detection of lesions at ovary, broad ligament, sacral ligament, round ligament, rectovaginal pouch or rectum and abdominal wall are:100% and 100%, 100% and 77.8%, 100% and 77.8%, 100% and 88.3%, 100% and 25.0%, 100% and 100%. The specificity of 3D-CS-HR-T2WI for the detection of lesions at ovary, broad ligament, sacral ligament, round ligament, rectovaginal pouch or rectum and abdominal wall are:100% and 100%, 100% and 85.7%, 100% and 85.7%, 100% and 100%,100% and 30.0%, 100% and 100%(Figure 1 and 2).The specificity of 3D-CS-HR-T2WI were higher than T2WI in detect of endometriosis located in road ligament, sacral ligament, round ligament, rectovaginal pouch or rectum.

CLINICAL RELEVANCE/APPLICATION

indicate that the 3D T2WI imaging were reliable in finding ectopic lesions in each ligament of the pelvic floor.

SPR-RI-7   3.0T Versus 1.5T MRI For The Evaluation Of Placenta Accreta Spectrum Disorders: A Matched Case-Control Study

Participants
Charis Bourgioti, MD, Athens, Greece (*Presenter*) Nothing to Disclose

PURPOSE

To investigate differences between 1.5T and 3.0T MRI for prediction of Placenta Accreta Spectrum (PAS) and extrauterine placental spread.*Methods and Materials Between 3/2016 and 9/2020, 189 pregnant women at high risk for PAS underwent dedicated prenatal MRI for placental evaluation with 1.5T and 3.0T units. All women underwent C-section within 6 weeks from MRI. Prospectively collected data were evaluated by two experienced genitourinary radiologists for presence and extent of PAS. A matched case-control study was designed to investigate differences in predictive ability between 1.5T and 3.0T MRI groups. Sensitivity (SE), specificity (SP), negative and positive prognostic values relative to intraoperative/histological findings, were computed for both groups. Sensitivity and specificity between groups were compared using chi-square tests.*Results Ninety-three/189 gravid women (49.2%) were evaluated with 1.5T (mean age:35years, mean gestational age:32.5weeks) and 96/189 (50.8%) with 3.0T MRI (mean age: 34.9years; mean gestational age:32.1weeks). Patient characteristics were similar for both groups (p>.05). 1.5T MRI exhibited 95.7% SE and 83.3% SP and 3.0T MRI 92.9% SE and 83.3%SP for PAS identification, without significant differences between the two groups (p=0.514 and p>0.999, respectively). MRI showed excellent predictive ability for detecting extrauterine placental spread with 100% SE, 96.7% SP for 1.5T and 97%, 96.8% SP for 3.0T, without significant differences between the two groups (p>0.999). Prominent intraplacental fetal vessels was the most frequently detected MRI sign for both 1.5T and 3.0T groups.*Conclusions 3.0T imaging is not superior to 1.5T for imaging PAS disorders.*Clinical Relevance/Application Prenatal placental MRI for PAS can be reliably performed with 1.5T MR units, overcoming availability issues and safety considerations related to higher field strengths.

RESULTS

Ninety-three/189 gravid women (49.2%) were evaluated with 1.5T (mean age:35years, mean gestational age:32.5weeks) and 96/189 (50.8%) with 3.0T MRI (mean age: 34.9years; mean gestational age:32.1weeks). Patient characteristics were similar for both groups (p>.05). 1.5T MRI exhibited 95.7% SE and 83.3% SP and 3.0T MRI 92.9% SE and 83.3%SP for PAS identification, without significant differences between the two groups (p=0.514 and p>0.999, respectively). MRI showed excellent predictive ability for detecting extrauterine placental spread with 100% SE, 96.7% SP for 1.5T and 97%, 96.8% SP for 3.0T, without significant differences between the two groups (p>0.999). Prominent intraplacental fetal vessels was the most frequently detected MRI sign for both 1.5T and 3.0T groups.

CLINICAL RELEVANCE/APPLICATION

Prenatal placental MRI for PAS can be reliably performed with 1.5T MR units, overcoming availability issues and safety considerations related to higher field strengths.

SPR-RI-9   Predicting Tumor Recurrence In Cervical Cancer Treated With Chemoradiotherapy - Additional Value Of Intravoxel Incoherent Motion Diffusion-weighted Imaging

Participants
Qi Zhang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether intravoxel incoherent motion (IVIM) DWI derived parameters may improve the prediction of tumor recurrence for locally advanced cervical cancer (LACC) patients following concurrent chemoradiotherapy (CCRT) after integrating into clinical variables.*Methods and Materials Between March 2014 and November 2019, 86 consecutive LACC were prospectively enrolled and underwent pelvic MRI examinations with IVIM sequence before treatment. The primary outcome was disease-free survival (DFS). IVIM-derived parameters (true diffusion coefficient,D; pseudo-diffusion coefficient, D* and perfusion fraction,f), conventional

imaging features (tumor maximum size, lymph node metastasis[LNM], primary tumor infiltration) and clinical prognosis variables (age, FIGO2018 staging system, tumor subtype, serum levels of squamous cell carcinoma antigen[SCC-Ag] and hemoglobin) were collected. Univariate and multivariate Cox hazard regression analyses were performed to evaluate these parameters in predicting DFS. The independent and prognosis-interested predictors were combined to build a prediction model, which was compared with clinical FIGO2018 staging system by using the time-dependent ROC curves (tROC). Survive curves were generated using the Kaplan-Meier method and compared with the log-rank test.*Results The median follow-up was 700.5 days for all patients. f, LNM and SCC-Ag were independently associated with tumor recurrence (HR: < 0.001, 4.553, 1.036; P = 0.018, <0.001, 0.046) . The combined prognostic model based on f, tumor maximum size, LNM and SCC-Ag demonstrated a moderate predictive capability in identifying LACC with a high risk of tumor recurrence; the model was more accurate than FIGO2018 staging system alone (c-index: 0.753 vs. 0.618) and the combination of the FIGO2018 staging system, SCC-Ag and f (c-index: 0.753 vs. 0.712).The AUC of the combined prognostic model for predicting 2-year DFS (0.810, 95%CI: 0.701 - 0.920) was significantly superior compared with the FIGO 2018 staging system (0.709, 95% CI: 0.582-0.837; P = 0.029). Moreover, patients were grouped into low-, medial- and high-risk levels based on tumor maximum size, positive LNM, SCC-Ag > 6ng/ml and f < 0.115, with which the 2-year DFS was significantly stratified (P < 0.001).*Conclusions f value could be used as a useful and accurate biomarker to predict DFS in CCRT treated LACC patients as an assistant of clinical prognosis variables.*Clinical Relevance/Application The prognostic prediction model based on the integration of tumor maximum size, f, LNM and SCC-Ag, might provide a more effective prediction of tumor recurrence for LACC patients following CCRT, which might help make therapeutic decisions and tailor follow-up strategies based on individual risk.

RESULTS

The median follow-up was 700.5 days for all patients. f, LNM and SCC-Ag were independently associated with tumor recurrence (HR: < 0.001, 4.553, 1.036; P = 0.018, <0.001, 0.046) . The combined prognostic model based on f, tumor maximum size, LNM and SCC-Ag demonstrated a moderate predictive capability in identifying LACC with a high risk of tumor recurrence; the model was more accurate than FIGO2018 staging system alone (c-index: 0.753 vs. 0.618) and the combination of the FIGO2018 staging system, SCC-Ag and f (c-index: 0.753 vs. 0.712).The AUC of the combined prognostic model for predicting 2-year DFS (0.810, 95%CI: 0.701 - 0.920) was significantly superior compared with the FIGO 2018 staging system (0.709, 95% CI: 0.582-0.837; P = 0.029). Moreover, patients were grouped into low-, medial- and high-risk levels based on tumor maximum size, positive LNM, SCC-Ag > 6ng/ml and f < 0.115, with which the 2-year DFS was significantly stratified (P < 0.001).

CLINICAL RELEVANCE/APPLICATION

The prognostic prediction model based on the integration of tumor maximum size, f, LNM and SCC-Ag, might provide a more effective prediction of tumor recurrence for LACC patients following CCRT, which might help make therapeutic decisions and tailor follow-up strategies based on individual risk.

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Abstract Archives of the RSNA, 2021

Sub-Events

SPR-VA-10 **Quiescent-interval Slice-selective (QISS) MRA Accurately Estimates Intravascular Stent Dimensions Prior To Intervention In Patients With Peripheral Artery Disease**

Participants
Josua Decker, MD, Charleston, South Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of non-contrast quiescent-interval slice-selective (QISS) magnetic resonance angiography (MRA) for the prediction of intravascular stent dimensions in patients with peripheral artery disease (PAD), compared to computed tomography angiography (CTA), and the true stent dimensions used for intervention at digital subtraction angiography (DSA) as reference standard.*Methods and Materials PAD patients (n=33, 68±9 years, 18 men) who had previously undergone QISS MRA, CTA, and DSA of the lower extremity run-off in a prospective research study were included in this retrospective analysis. Stenotic lesion length and diameter were quantified to estimate the dimensions of the stent necessary to reinstate blood flow in the respective arteries. Measured dimensions were corrected for the closest stent size available. Estimated dimensions were compared between QISS MRA and CTA, and validated against the stent size used for intervention. The Friedman test with subsequent pairwise paired Wilcoxon signed-rank test was used for analysis.*Results No significant difference was observed between estimated stent diameter in QISS MRA, CTA and DSA with 8.9 ± 2.9, 8.8 ± 3.0 and 8.8 ± 3.8 mm respectively (Friedman ?²=1.45, p=0.483). There was slight underestimation in estimation of stent length for both QISS MRA and CTA, compared to DSA with lengths of 45.8 ± 27.8, 46.4 ± 29.3 and 50.4 ± 34.0 mm respectively (Friedman ?²=11.96, p=0.003) which could be corrected when measurements were adjusted to the next available stent's length (Friedman ?²=2.38, p=0.303).*Conclusions QISS MRA is a reliable method for pre-procedural intervention planning in PAD patients and represents an alternative in patients with contraindications to contrast administration.*Clinical Relevance/Application The evaluated non-contrast QISS MRA sequence represents a reliable pre-procedural imaging option for PAD patients with contraindications to intravenous contrast administration.

RESULTS

No significant difference was observed between estimated stent diameter in QISS MRA, CTA and DSA with 8.9 ± 2.9, 8.8 ± 3.0 and 8.8 ± 3.8 mm respectively (Friedman ?²=1.45, p=0.483). There was slight underestimation in estimation of stent length for both QISS MRA and CTA, compared to DSA with lengths of 45.8 ± 27.8, 46.4 ± 29.3 and 50.4 ± 34.0 mm respectively (Friedman ?²=11.96, p=0.003) which could be corrected when measurements were adjusted to the next available stent's length (Friedman ?²=2.38, p=0.303).

CLINICAL RELEVANCE/APPLICATION

The evaluated non-contrast QISS MRA sequence represents a reliable pre-procedural imaging option for PAD patients with contraindications to intravenous contrast administration.

SPR-VA-11 **Advanced Non-contrast Fresh Blood Imaging (FBI) MRA: Three-station Peripheral Runoffs With Less Than 6 Minutes**

Participants
Vadim Malis, PhD, La Jolla, California (*Presenter*) Nothing to Disclose

PURPOSE

To advance fresh blood imaging (FBI)1,2 in peripheral non-contrast MR angiography (NC-MRA) using a new centric ky-kz trajectory3 and an exponential flop angle scheme to shorten scan time and yet increase contrast-to-noise ratio (CNR).*Methods and Materials FBI utilizes a physiological signal difference between systolic and diastolic triggered images. The centric ky-kz trajectory is implemented in FBI (cFBI), acquiring multiple slice-encodings (SEs) and phase-encodings (PEs) per TR, whereas standard FBI acquires one SE per TR. By applying exponential flop angle (eFA), cFBI enables reduction of SAR. The design of eFA has high flop angles (Hflop) at the center of k space for bright blood imaging and exponentially decreasing flop angles at periphery of k space. Imaging of cFBI was performed maintaining Hflop and varying low flop angles (Lflop), Hflop/Lflop of 180/180, 180/90, 180/60, 180/30 and 180/2 deg. Simulation of blood signal using eFA with various Lflop angles is also performed. All experiments were performed using a 3T clinical system on healthy volunteers (5 males, 24-68 yo). Parameters used in this experiment were TEeff of 60 ms (TEeff of 30 ms for iliac), 1NAQ, 368x336 matrix, 120 1.8-mm slices, FOV of 46-50x40 cm, parallel imaging of 4, and resolution of 0.68(PE)x0.60(RO)x 0.9(SE) mm after interpolation. CNR of each major vessel was calculated using C=|Sa -Sb|/d0 where Sa is the diastolic signal intensity, Sb is the systolic signal intensity, and d0 is the standard deviation (SD) of the systolic signal.*Results All CNR of major arteries at the iliac, femoral, and popliteal stations were improved using Lflop around 2 and 30 degrees. Figure 1 shows the result of the cFBI using Lflop of 2 deg and standard FBI of three stations. Note that scan time in cFBI is less than half of standard FBI. As lowering the LFlop angle, both signals of blood and background are returned to the +Mz longitudinal magnetization that improved the CNR.*Conclusions The cFBI with eFA permits faster recovery of longitudinal magnetization and improvement in CNR. The scan time reduction of three station run-offs was achieved to less than 6 minutes.References: 1. Miyazaki M, Sugiura S, Tateishi F, et al. J. Magn Reson Imaging 2000;12:776-783.2. Miyazaki M, Takai H, Sugiura S, et al. Radiology 2003;227:890-896. 3. Busse RF, Brau ACS, Vu A, et al. Magn Reson in Med 2008;60:640-649.*Clinical Relevance/Application Advanced cFBI with

appropriate eFA allows tremendous reduction of scan time in three runoffs stations. This shortening of scan time is essential in patients with peripheral artery disease.

RESULTS

All CNR of major arteries at the iliac, femoral, and popliteal stations were improved using Lflop around 2 and 30 degrees. Figure 1 shows the result of the cFBI using Lflop of 2 deg and standard FBI of three stations. Note that scan time in cFBI is less than half of standard FBI. As lowering the LFlop angle, both signals of blood and background are returned to the +Mz longitudinal magnetization that improved the CNR.

CLINICAL RELEVANCE/APPLICATION

Advanced cFBI with appropriate eFA allows tremendous reduction of scan time in three runoffs stations. This shortening of scan time is essential in patients with peripheral artery disease.

SPR-VA-12 Classification Of Dermal Back Flow Patterns In Photoacoustic Lymphangiography: Comparison With Near-infrared Fluorescence Lymphangiography In Lymphedema Patients

Participants
Yushi Suzuki, Tokyo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Lymphedema is a disease in which lymphatic flow is obstructed due to lymphatic hypoplasia or lymph node dissection during cancer treatment. We used a novel technology, photoacoustic lymphangiography (PAL), to assess the lymphatic system and compared the results with those of near-infrared fluorescence (NIRF) imaging in patients with lymphedema. Lymphedema limb shows various findings in NIRF imaging correlating with their clinical stage. By comparing NIRF and PAL, we reveal the feasibility of PAL in lymphedema diagnosis and surgical treatment.*Methods and Materials Patients with lower extremity secondary lymphedema after gynecologic cancer surgery were enrolled. First, NIRF was performed by injecting 5.0 mg/mL of indocyanine green subcutaneously in the first and fourth interdigital spaces in the foot and lateral malleolus . PAL examination was performed following the NIRF procedure, and the findings from each method were compared.*Results Seventeen patients with secondary lymphedema were enrolled. The patients' mean age was 61 ± 11 years. Eleven patients had left lower extremity imaging, five patients had right lower extremity imaging, and one patient had bilateral imaging. The imaging sites were the medial lower leg in 15 patients, the posterior lower leg in nine patients, the lateral lower leg in seven patients, the medial knee in four patients, and other areas in three patients. A total of 38 pictures were taken. Five distinct lymphatic patterns were observed using PAL over the entire sample: straight, winding, spiderweb, nebulous, and black-out. These patterns correlate with four classifications of lymphedema dermal backflow patterns in NIRF which are widely used in lymphedema surgery: linear, splash, stardust, and diffuse patterns.*Conclusions NIRF is a common examination method used in lymphedema and can provide a sensitive diagnosis. The correlation between PAL and NIRF indicates that PAL may play an important role in lymphedema treatment.*Clinical Relevance/Application NIRF findings are widely used, and there are strong correlations between the findings and the surgical result. PAL can visualize the lymphatic vessel more clearly than the previous modality. Expectations regarding the future performance of this system are high.Acknowledgment: This research was funded by a grant from The Japan Agency for Medical Research and Development (AMED) 20he2302002h0502.

RESULTS

Seventeen patients with secondary lymphedema were enrolled. The patients' mean age was 61 ± 11 years. Eleven patients had left lower extremity imaging, five patients had right lower extremity imaging, and one patient had bilateral imaging. The imaging sites were the medial lower leg in 15 patients, the posterior lower leg in nine patients, the lateral lower leg in seven patients, the medial knee in four patients, and other areas in three patients. A total of 38 pictures were taken. Five distinct lymphatic patterns were observed using PAL over the entire sample: straight, winding, spiderweb, nebulous, and black-out. These patterns correlate with four classifications of lymphedema dermal backflow patterns in NIRF which are widely used in lymphedema surgery: linear, splash, stardust, and diffuse patterns.

CLINICAL RELEVANCE/APPLICATION

NIRF findings are widely used, and there are strong correlations between the findings and the surgical result. PAL can visualize the lymphatic vessel more clearly than the previous modality. Expectations regarding the future performance of this system are high.Acknowledgment: This research was funded by a grant from The Japan Agency for Medical Research and Development (AMED) 20he2302002h0502.

SPR-VA-2 Yolov4 Neural Network Based Carotid Plaque Recognition From Ultrasound Dynamic Videos

Participants
Yao Wei, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To establish an automatic recognition system for carotid plaque via deep learning based on the YOLOv4 neural network and achieve real-time and synchronous diagnosis during ultrasound examination.*Methods and Materials A total of 445 subjects (aged 40-80 years) with ultrasound (US) carotid examination were enrolled in our study. The carotid cross-sectional US dynamic videos of each subjects were segmented automatically by the algorithm. Each carotid cross-sectional image was labeled as "negative" or "positive" with the plaque annotated in the image manually by experienced ultrasound doctors. The carotid plaque parameters were extracted and saved for comparison with the automatic method.*Results 3259 carotid cross-sectional images were collected and labeled manually. In the 554 testing dataset images, YOLOv4 and manual method are consistent in diagnosis of carotid plaque (Kappa = 0.967,P < 0.001). The YOLOv4 yielded an accuracy of 98.4%, a sensitivity of 98.3% and a specificity of 98.5%. Comparison of the YOLOv4 performance among the different equipment-sourced images suggested that there were no significant differences in sensitivity, specificity and accuracy (P = 0.339, P = 0.493, P = 0.545, respectively). The mean average precision (mAP) of our method was 91.5%, and the recognition speed based on NVIDIA Tesla V100 graphics processing units (GPU) was 39 frames per second (FPS).*Conclusions Compared with the diagnosis of experienced US doctors, the YOLOv4 has comparable performance for the recognition of carotid plaque. The recognition performance in different equipment-sourced images were compatible. The experimental results demonstrate that YOLOv4 has an advantage in accuracy and speed that can achieve the effect of real-time recognition.*Clinical Relevance/Application The study established an automatic recognition system for carotid plaque via deep learning based on the YOLOv4 neural network and achieve real-time and synchronous diagnosis during US examination to help sonographers in screening and assessing the burden of carotid plaque.

RESULTS

3259 carotid cross-sectional images were collected and labeled manually. In the 554 testing dataset images, YOLOv4 and manual method are consistent in diagnosis of carotid plaque (Kappa = 0.967,P < 0.001). The YOLOv4 yielded an accuracy of 98.4%, a sensitivity of 98.3% and a specificity of 98.5%. Comparison of the YOLOv4 performance among the different equipment-sourced images suggested that there were no significant differences in sensitivity, specificity and accuracy (P = 0.339, P = 0.493, P = 0.545, respectively). The mean average precision (mAP) of our method was 91.5%, and the recognition speed based on NVIDIA Tesla V100 graphics processing units (GPU) was 39 frames per second (FPS).

CLINICAL RELEVANCE/APPLICATION

The study established an automatic recognition system for carotid plaque via deep learning based on the YOLOv4 neural network and achieve real-time and synchronous diagnosis during US examination to help sonographers in screening and assessing the burden of carotid plaque.

SPR-VA-3   Contrast-enhanced Perfusion Patterns, Risk Factors And Serum Lipid Signatures Specific Of Vulnerable Plaque In Predicting Stroke: A Cohort Study Of Carotid Stenosis In Chinese Patients

Participants
Huang Qian, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the correlation between Contrast-enhanced Ultrasound (CEUS) perfusion patterns , Risk factors and Serum lipid signatures specific of carotid artery vulnerable plaque with the degree of carotid stenosis, which provide the basis for early diagnosis of cerebral ischemic stroke.*Methods and Materials From March to June in 2018 years, we screened 2039 patients with plaque of the carotid arteries for routine ultrasound of the carotid arteries. We asked participants to complete questionnaires to obtain information about demographics and Risk factors. Physical examination was performed prior to the Ultrasound examination, including the measurements of BMI and blood pressure. Finally, 80 patients completed CEUS baseline study were analyzed (exclusion criteria were age < 18 or > 85 years, plaque thickness less than 1.5 mm, patients disagrees with the CEUS examination, have a history of myocardial infarction in two weeks, participants who refuse filling out questionnaires, who not underwent CTA or DSA within 1 week after CEUS and participants with poor image quality). All subjects underwent contrast-enhanced ultrasound, CTA or DSA, and Serum lipid testing. The appearance of enhancement in plaques were observed and the enhancement level of the plaques was divided into I-IV grades according to enhanced ultrasound findings of carotid plaques.*Results The CEUS perfusion pattern with patients were divided into plaque base entering mode (52 cases) and plaque surface entering mode (28 cases) when the contrast agent entering plaque. The contrast agent enhancement levels and the CEUS perfusion patterns in plaque were significantly associated with the degree of carotid stenosis (P<0.05), Serum free fatty acid was significantly associated with the different contrast agent enhancement level (P<0.05). Hypertension and APOE were significantly associated with the CEUS perfusion pattern of carotid plaque (P<0.05).*Conclusions The contrast agent mainly infuses from the surface to the interior of the plaque on CEUS and increased serum FFA levels are indicative of vulnerable carotid plaques, we speculate the appearance of hypertension, APOE and FFA may cause the variation of the Contrast-enhanced perfusion patterns. Together these factors may provide evidence of vulnerable plaques in those with carotid artery stenosis, which may be useful for the prediction of stroke in patients with carotid artery disease.*Clinical Relevance/Application To establish a diagnostic model for Contrast-enhanced perfusion patterns, Risk factors and Serum lipid signatures specific of vulnerable plaques, in order to reduce the incidence of cardiovascular accidents in the whole population.

RESULTS

The CEUS perfusion pattern with patients were divided into plaque base entering mode (52 cases) and plaque surface entering mode (28 cases) when the contrast agent entering plaque. The contrast agent enhancement levels and the CEUS perfusion patterns in plaque were significantly associated with the degree of carotid stenosis (P<0.05), Serum free fatty acid was significantly associated with the different contrast agent enhancement level (P<0.05). Hypertension and APOE were significantly associated with the CEUS perfusion pattern of carotid plaque (P<0.05).

CLINICAL RELEVANCE/APPLICATION

To establish a diagnostic model for Contrast-enhanced perfusion patterns, Risk factors and Serum lipid signatures specific of vulnerable plaques, in order to reduce the incidence of cardiovascular accidents in the whole population.

SPR-VA-4   A Novel Subtraction Method (s-mar) To Reduce Metal Artifacts Of Cerebral Aneurysm Embolism Coils Using Dual-layer Spectral CT.

Participants
Hanpei Zheng, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to initially investigate the feasibility of a novel subtraction method, the combination of O-MAR and subtraction algorithms (S-MAR) by subtracting VMIMAR from VNC images to remove the metal artifacts of coils after endovascular embolotherapy of intracranial aneurysms.*Methods and Materials In this retrospective study, 29 patients with 38 coils after endovascular embolotherapy of intracranial aneurysms who underwent cerebral CT using a dual-layer detector spectral CT were included. Conventional CT images (CI), VMI (range: 40-200 KeV), and Virtual Non-enhanced Images (VNC) were reconstructed. These images were then postprocessed to CIMAR, VMIMAR and VNCMAR with O-MAR (Metal Artifact Reduction for Orthopedic Implants) to reduce the metal artifact of coils. The novel subtraction method (S-MAR) was used to get subtraction imaging between VNCMAR and VMIMAR. Contrast-to-noise (CNR) and Noise (Background) of CI, CIMAR, VMI and VMIMAR were calculated. The coil artifacts score (CA score) of these images were determined by two radiologists separately. Differences of the CNR, Noise (Background) and CA score among all sets of images were analyzed using the paired-samples t-test. A P value <0.001 indicated a statistically significant difference.*Results Significant differences were found in the CNR, Noise (Background), and CA score (P < 0.001) between CI and CIMAR, as well as between VMI and VMIMAR of 50 KeV, indicating that O-MAR could effectively remove metal artifacts and enhance image quality. S-MAR showed significantly better performance compared with CI, CIMAR, VMI, and VMIMAR in reducing metal coil artifacts according to the CA score (1.34 ± 0.48 vs 4.71 ± 0.65, 3.08 ± 0.88, 4.65 ± 0.67, and 3.05 ± 0.80) (P < 0.001). S-MAR was an effective method for reducing metal coil artifacts and showed good performance for depicting cerebral vessel visualization even in coils of relatively large size (diameter > 5mm).*Conclusions In conclusion, S-MAR provides significant advantages for reducing metal coil artifact reduction and elevating visualization of cerebral vessels adjacent to coils

compared to conventional images and traditional MAR and VMI methods. S-MAR proved to be a promising method in elevating the performance of CTA for the evaluating of post-coil embolization compared with O-MAR alone.*Clinical Relevance/Application This study was a first trial of investigating S-MAR, as a novel method which combines metal artifact reduction algorithm (MAR), virtual monochromatic imaging (VMI) and subtraction algorithm to remove metal coil artifacts and enhance the vessel visualization.

RESULTS

Significant differences were found in the CNR, Noise (Background), and CA score (P < 0.001) between CI and CIMAR, as well as between VMI and VMIMAR of 50 KeV, indicating that O-MAR could effectively remove metal artifacts and enhance image quality. S-MAR showed significantly better performance compared with CI, CIMAR, VMI, and VMIMAR in reducing metal coil artifacts according to the CA score (1.34 ± 0.48 vs 4.71 ± 0.65, 3.08 ± 0.88, 4.65 ± 0.67, and 3.05 ± 0.80) (P < 0.001). S-MAR was an effective method for reducing metal coil artifacts and showed good performance for depicting cerebral vessel visualization even in coils of relatively large size (diameter > 5mm).

CLINICAL RELEVANCE/APPLICATION

This study was a first trial of investigating S-MAR, as a novel method which combines metal artifact reduction algorithm (MAR), virtual monochromatic imaging (VMI) and subtraction algorithm to remove metal coil artifacts and enhance the vessel visualization.

SPR-VA-5   The Feasibility And Performance Evaluation Of Artificial Intelligence-based Technology For Fast And Accurate Bolus-tracking Process In Aortic Abdominal Artery CT Angiography Compared With Manual Operation By Technicians

Participants
Ya Li I, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to research performance of AI-based technology for fast and accurate bolus-tracking process in aortic abdominal artery CT angiography compared with manual operation by technicians.*Methods and Materials Thirty patients were enrolled in this study underwent the contrast-enhanced aortic abdominal artery CTA using the SmartPrep triggering technique on GE Revolution CT. The study was approved by our institutional review board and the informed consent with all patients were waived. The image acquisitions were performed from the thoracic aperture to the below symphysis pubis. The scanning parameters were as follows: tube voltage 100kVp, automatic mAs, pitch~1, helical acquisition mode, matrix size 512×512, slice thickness and slice interval 1.25mm. Manually placing the ROI in descending aorta for dynamic contrast-enhancement monitoring, and triggering the CTA scans after reaching the threshold. Simultaneously recording the scan time between the appearance of monitoring location and the start time of CTA. The results of the group were recorded as the control group. The scout scans and time-resolved images were then imported into the SmartPlan software to automatically determine the monitoring location in terms of placing ROI and generating TDC curve, and the results were recorded as the experimental group. The consistency and time consuming of the location selection and the peak value of TDC curve triggering the scan between the experimental and control groups were analyzed using paired sample t-test. P < 0.05 was considered statistically significant.*Results There was significant difference in monitoring location between the experimental group (-116.89±60.32mm) and control group (-119.74±65.56mm, P<0.05). However, monitoring locations differences were found no real clinical impact due to the variation of technicians' personal judgement. There was significant difference in the peak value of TDC curves between the experimental group (211.80±18.28 HU) and the control group (192.19±23.28, P=0.001). The average time consuming were found significant decreased in the experimental group compared with the control group (600ms vs 18.18±1.17s, P<0.05).*Conclusions The above technique has great performance and clinical feasibility in AAA CTA compared with manual operation by technicians.*Clinical Relevance/Application This technique can improve the diagnostic confidence and enhance the disease detectability, especially important for an emergency scan for abdominal aneurism or aortic artery dissection patients, and optimize the workflow, improve the operative technology utilization, it can reduce the heavy workload for CT technicians, especially for new technicians.

RESULTS

There was significant difference in monitoring location between the experimental group (-116.89±60.32mm) and control group (-119.74±65.56mm, P<0.05). However, monitoring locations differences were found no real clinical impact due to the variation of technicians' personal judgement. There was significant difference in the peak value of TDC curves between the experimental group (211.80±18.28 HU) and the control group (192.19±23.28, P=0.001). The average time consuming were found significant decreased in the experimental group compared with the control group (600ms vs 18.18±1.17s, P<0.05).

CLINICAL RELEVANCE/APPLICATION

This technique can improve the diagnostic confidence and enhance the disease detectability, especially important for an emergency scan for abdominal aneurism or aortic artery dissection patients, and optimize the workflow, improve the operative technology utilization, it can reduce the heavy workload for CT technicians, especially for new technicians.

SPR-VA-7   Achieving Consistent Diagnostic Accuracy Fordifferent Segments Oflower Extremity Arteries Inct Angiography With Dual-energy Spectral Imagingmode

Participants
Qian Tian, Xi'an, China (*Presenter*) Nothing to Disclose

PURPOSE

Investigate the application of using low energy images in dual-energy spectral CT angiography (CTA) for consistently achieving high diagnostic accuracy for different segments of lower extremity arteries.*Methods and Materials 110 patients (88 males, mean age, 67.32±10.17 years) underwent lower extremity artery CTA with spectral imaging mode were continuously collected (, and the 50keV image was used for analyzing the diagnostic accuracy using the results of digital subtraction angiography (DSA) as the gold standard. The lower extremity arteries were divided into three segments: abdominal iliac segment (AIS), femoral popliteal segment (FPS) and lower knee segment (LKS). The CT value and standard deviation of a total of 11 arterial vessels were measured to calculate the signal to noise ratio (SNR) and contrast noise ratio (CNR) of each segment. The subjective image quality of each segment was evaluated using 4-point evaluation criteria. The subjective and objective quality and diagnostic accuracy of lower extremity artery images among different segments were compared.*Results In AIS, FPS and LKS, the CT values were 670.60±118.91HU, 640.05±115.10HU and 544.91±106.37HU, SNR values were 43.62±11.43, 42.85±13.80, 19.92±9.39, CNR values were 55.78±18.29, 55.64±21.57 and 45.60±16.61, respectively, with values adequate for diagnosis. The subjective scores were

3.40±0.65, 3.47±0.57 and 3.41±0.65 for the three segments with no statistically significant difference (P>0.05) The diagnostic accuracies were 98.18%, 96.14%, 95.91% for the =50% stenoses, and 98.48%, 97.05%, 94.32% for the occlusive patients in AIS, FPS and LKS, respectively. There was no statistical difference in the diagnostic accuracy among AIS, FPS and LKS (P>0.05).*Conclusions The use of low energy (50keV) images in the dual-energy spectral CTA significantly improves the vascular display and increases diagnostic confidence for distal vessels, which is especially useful for maintaining the consistency of diagnostic accuracy of all segments of the lower knee arteries.*Clinical Relevance/Application The low energy images in spectral CTA provides high diagnostic accuracy for lower extremity arteries, especially the lower knee segment arteries.

RESULTS

In AIS, FPS and LKS, the CT values were 670.60±118.91HU, 640.05±115.10HU and 544.91±106.37HU, SNR values were 43.62±11.43, 42.85±13.80, 19.92±9.39, CNR values were 55.78±18.29, 55.64±21.57 and 45.60±16.61, respectively, with values adequate for diagnosis. The subjective scores were 3.40±0.65, 3.47±0.57 and 3.41±0.65 for the three segments with no statistically significant difference (P>0.05) The diagnostic accuracies were 98.18%, 96.14%, 95.91% for the =50% stenoses, and 98.48%, 97.05%, 94.32% for the occlusive patients in AIS, FPS and LKS, respectively. There was no statistical difference in the diagnostic accuracy among AIS, FPS and LKS (P>0.05).

CLINICAL RELEVANCE/APPLICATION

The low energy images in spectral CTA provides high diagnostic accuracy for lower extremity arteries, especially the lower knee segment arteries.

SSNPM02
Noninterpretive (Education and Practice Management)

Participants

Lilja Solnes, MD, Baltimore, Maryland (*Moderator*) Consultant, Lantheus Holdings;Research funded, Novartis AG;Research funded, Precision Molecular Imaging;Royalties, Reed Elsevier

Vinay Prabhu, MD, Brooklyn, New York (*Moderator*) Nothing to Disclose

Sub-Events

SSNPM02-1 Top Five Most Missed Pediatric Cases: An Emergency Radiology Simulation Analysis

Participants

Priya Sharma, MD, Gainesville, Florida (*Presenter*) Nothing to Disclose

PURPOSE

The Wisdom in Diagnostic Imaging SIMulation (WIDI SIM) is a strategically designed computer aided simulation of an emergency imaging shift that has been rigorously tested and proven to be a reliable means for assessing resident preparedness to competently and independently cover radiology call. This has been utilized as a call-readiness simulation for radiology residents from all over the country. Pediatric patients can often be the most challenging population, not only for the emergency physician but also for the radiologist with non-specific complaints and challenging or subtle imaging findings. The purpose of this study was to identify the five most missed pediatric radiology cases in the past nearly 10 years of simulation testing.*Methods and Materials During each simulation examination, consisting of an 8-hour simulated call shift, radiology residents were provided with a total of 65 cases across multiple modalities and areas of specialty for interpretation. These cases were of varying difficulty, including normal studies. A quarter of the test cases included were pediatric cases. The residents responded using free text, which was then scored by radiology faculty members utilizing a robust grading rubric with a 10 -point scale. A score below 3 was considered a "missed" case.*Results Over 1200 residents have participated in UF WIDI SIM program since its inception in 2012. Resident participants include all years of diagnostic radiology residency with the predominant group being R1 and R2. During the past 9 years of simulation testing residents have been tested on a wide variety of pediatric pathologies utilizing all imaging modalities. Analysis of data revealed that the five most missed pediatric case pathologies varied in system and modality. Pathologies that were missed the most in pediatric radiology included: non-accidental trauma, pancreatic laceration and suppurative adenitis.*Conclusions Residents may need more teaching in order to recognize imaging findings of certain pediatric pathologies encountered in the emergency call setting prior to taking independent call. It is important for radiology educators to identify those pathologies that might require careful teaching especially in the pediatric setting. Furthermore, identifying which cases are "more difficult" allows for careful tailoring of the residency curriculum.*Clinical Relevance/Application Emergency clinicians rely upon the radiologists to help recognize pertinent findings that can significantly affect management. This has great implications for programs where a radiology attending is not present as it raises the concern that certain pediatric emergencies may be missed by residents taking call.

RESULTS

Over 1200 residents have participated in UF WIDI SIM program since its inception in 2012. Resident participants include all years of diagnostic radiology residency with the predominant group being R1 and R2. During the past 9 years of simulation testing residents have been tested on a wide variety of pediatric pathologies utilizing all imaging modalities. Analysis of data revealed that the five most missed pediatric case pathologies varied in system and modality. Pathologies that were missed the most in pediatric radiology included: non-accidental trauma, pancreatic laceration and suppurative adenitis.

CLINICAL RELEVANCE/APPLICATION

Emergency clinicians rely upon the radiologists to help recognize pertinent findings that can significantly affect management. This has great implications for programs where a radiology attending is not present as it raises the concern that certain pediatric emergencies may be missed by residents taking call.

SSNPM02-2 Comparison Of Oncologic Imaging Usage Between Telemedicine And In-Person Clinic Visits During The COVID-19 Recovery

Participants

Joseph Erinjeri, MD,PhD, New York, New York (*Presenter*) Advisory Board, AstraZeneca PLC;Consultant, Canon Medical Systems Corporation;

PURPOSE

To compare oncologic imaging usage of patients who had telemedicine vs in-person visits during the COVID-19 recovery.*Methods and Materials This retrospective study examined records of 1,020,753 outpatient ambulatory clinic visits and 412,614 radiology exams (CT, MRI, PET, US, CR - computed radiography, BI - breast imaging, NM - nuclear medicine, and IR) at a cancer center from 1/12/2020 to 4/10/21. Data were collected during three periods: 1) pre-surge, 2) COVID-19 surge (3/15-5/30), and 3) recovery. During the recovery, visits were categorized by type (telemedicine vs. in-person) and exams by imaging modality. An exam performed within +/-14 days of a visit was associated with that visit. Imaging usage was computed as exams per clinic visit (expressed as percentages) and compared using two sample t-tests.*Results During the COVID-19 recovery, the aggregate usage of cross-sectional modalities (CT/MR/PET) was 15% higher for telemedicine vs. in-person visits (0.218 vs 0.189, p<0.001).

Telemedicine visits were associated with significantly higher imaging usage than in-person visits for CT (+20%), MR (+6%), PET (+17%) and IR (+28%). Telemedicine visits were associated with significantly lower imaging usage than in-person visits for US (-24%), CR (-17%) BI (-63%), NM (-28%) and IR (-28%).*Conclusions Telemedicine clinic visits were associated with higher cross-sectional imaging and IR usage than in-person clinic visits during the COVID-19 recovery.*Clinical Relevance/Application Higher usage rates of imaging with telemedicine clinic visits should be considered during resource planning.

RESULTS

During the COVID-19 recovery, the aggregate usage of cross-sectional modalities (CT/MR/PET) was 15% higher for telemedicine vs. in-person visits (0.218 vs 0.189, p<0.001). Telemedicine visits were associated with significantly higher imaging usage than in-person visits for CT (+20%), MR (+6%), PET (+17%) and IR (+28%). Telemedicine visits were associated with significantly lower imaging usage than in-person visits for US (-24%), CR (-17%) BI (-63%), NM (-28%) and IR (-28%).

CLINICAL RELEVANCE/APPLICATION

Higher usage rates of imaging with telemedicine clinic visits should be considered during resource planning.

SSNPM02-4 The Impact Of Emerging Technologies On Residency Selection By Medical Students: 2017 Vs. 2021

Participants
Michael K. Atalay, MD, PhD, Providence, Rhode Island (*Presenter*) Nothing to Disclose

PURPOSE

Artificial intelligence (AI) and other technologies promise to change the way medicine is practiced. How medical students anticipate these changes may affect their career choices. Our objective was to determine the perceived impact of AI on various specialties by medical students and how this might affect their residency selections.*Methods and Materials We conducted an anonymous online survey of all medical students (MS1-4) at a single institution in November 2017 and January 2021. Survey questions were designed to measure the perceived effect that AI will have on future job prospects for each specialty. Data were analyzed using generalized linear modeling.*Results Response rates were 72% (384/532) and 54% (321/598) for 2017 and 2021, respectively. Figure 1A illustrates students perceived AI would reduce job prospects for pathology, radiology, and anesthesiology, but they perceived AI would enhance job prospects for all other specialties (p<.01) except dermatology. These results did not significantly change between 2017 and 2021, except that pathology became more extreme. These perceptions may affect behavior: asked if there were any specialties they were NOT considering because AI would render these specialties obsolete, 23% said radiology for both 2017 and 2021, higher than all other specialties (p<.01), followed by pathology and anesthesiology. In comparison, students selected most other specialties under 5% in both surveys. When comparing MS1 students in 2017 with MS4 in 2021 (same cohort), 49.5% (51/103) said AI would "reduce" job prospects for radiology in 2017, increasing to 70.8% (63/89) in 2021, p<.01. In 2017, 20% (21/103) of MS1 said they explicitly would not consider radiology because of AI; 3 years later as MS4, 23% (20/89) said the same.*Conclusions Current perceptions of AI likely affect residency selection for medical students, which may impact the future of various specialties, especially diagnostic radiology.*Clinical Relevance/Application A large proportion of medical students will reportedly not consider radiology owing to the anticipated impact of AI. Faculty should engage both students and the curriculum to improve and modify these perceptions.

RESULTS

Response rates were 72% (384/532) and 54% (321/598) for 2017 and 2021, respectively. Figure 1A illustrates students perceived AI would reduce job prospects for pathology, radiology, and anesthesiology, but they perceived AI would enhance job prospects for all other specialties (p<.01) except dermatology. These results did not significantly change between 2017 and 2021, except that pathology became more extreme. These perceptions may affect behavior: asked if there were any specialties they were NOT considering because AI would render these specialties obsolete, 23% said radiology for both 2017 and 2021, higher than all other specialties (p<.01), followed by pathology and anesthesiology. In comparison, students selected most other specialties under 5% in both surveys. When comparing MS1 students in 2017 with MS4 in 2021 (same cohort), 49.5% (51/103) said AI would "reduce" job prospects for radiology in 2017, increasing to 70.8% (63/89) in 2021, p<.01. In 2017, 20% (21/103) of MS1 said they explicitly would not consider radiology because of AI; 3 years later as MS4, 23% (20/89) said the same.

CLINICAL RELEVANCE/APPLICATION

A large proportion of medical students will reportedly not consider radiology owing to the anticipated impact of AI. Faculty should engage both students and the curriculum to improve and modify these perceptions.

SSNPM02-5 How COVID-19 Kick-started Online Learning In Medical Education - Results Of An International, Multicenter Study

Participants
Fabian Stoehr, Mainz, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The coronavirus disease 2019 (COVID-19) pandemic led to far-reaching restrictions of social and professional life, affecting societies all over the world. To contain the virus, medical schools had to restructure their curriculum by switching to online learning. However, only few medical schools had implemented such novel learning concepts. We aimed to evaluate students' attitudes to online learning to provide a broad scientific basis to guide future development of medical education.*Methods and Materials Overall, 3286 medical students from 12 different countries participated in this cross-sectional study investigating various aspects of online learning in medical education. On a 7-point Likert scale, participants rated the online learning situation during the pandemic at their medical schools, technical and social aspects, and the current and future role of online learning in medical education.*Results The majority of medical schools managed the rapid switch to online learning (78%) and most students were satisfied with the quantity (67%) and quality (62%) of the courses. Online learning provided greater flexibility (84%) and led to unchanged or even higher attendance of courses (70%). Possible downsides included motivational problems (42%), insufficient possibilities for interaction with fellow students (67%) and thus the risk of social isolation (64%). The vast majority felt comfortable using the software solutions (80%). Most were convinced that medical education lags behind current capabilities regarding online learning (78%) and estimated the proportion of online learning before the pandemic at only 14%. For the future, they wished for a more prominent role, involving around 42% of online learning compared to on-site teaching (Figure 1).*Conclusions This study demonstrates the positive attitude of medical students towards online learning. Furthermore, it reveals a considerable discrepancy between what students demand and what the curriculum offers.*Clinical Relevance/Application We believe that the lessons learned from the pandemic might work as a catalyst for a new "online era" in medical education. The future challenge will be to sustainably integrate innovative teaching

concepts into the current curriculum.

RESULTS

The majority of medical schools managed the rapid switch to online learning (78%) and most students were satisfied with the quantity (67%) and quality (62%) of the courses. Online learning provided greater flexibility (84%) and led to unchanged or even higher attendance of courses (70%). Possible downsides included motivational problems (42%), insufficient possibilities for interaction with fellow students (67%) and thus the risk of social isolation (64%). The vast majority felt comfortable using the software solutions (80%). Most were convinced that medical education lags behind current capabilities regarding online learning (78%) and estimated the proportion of online learning before the pandemic at only 14%. For the future, they wished for a more prominent role, involving around 42% of online learning compared to on-site teaching (Figure 1).

CLINICAL RELEVANCE/APPLICATION

We believe that the lessons learned from the pandemic might work as a catalyst for a new "online era" in medical education. The future challenge will be to sustainably integrate innovative teaching concepts into the current curriculum.

SSNPM02-6 Development And Pilot Randomized Study Of A Patient Decision Aid For Small Renal Mass Management

Participants
Shailin Thomas, BS, Stamford, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

To develop a patient decision aid (DA) about small renal masses (SRMs) and conduct a pilot trial on DA effectiveness in improving knowledge and preparation to discuss current guideline-recognized options of active surveillance, percutaneous ablation, and surgery.*Methods and Materials We conducted a rapid qualitative assessment on informational needs using 3 focus groups and 10 semi-structured interviews of patients, urologists, and radiologists. A printed DA was designed and followed the International Patient Decision Aid Standards on content accessibility and clarity to address these needs. The design committee included two urologists, an internist, interventional radiologist, diagnostic radiologist, and experimental psychologist. Usability assessment with 10 patients in urology clinic informed iterative revisions. A pilot randomized study was conducted in 2 clinics with 30 patients deciding on SRM management. Patients were randomized to receive the DA or an existing prose institutional pamphlet on SRM treatment options. After viewing the pamphlet or DA, patients answered pre-visit questionnaires on demographic information, knowledge items, and preference for shared decisions. After the visit, patients completed a questionnaire on 16 validated decision satisfaction and shared decision making items. Proportions between arms were compared using Chi-Square and decision measures were compared with Mann-Whitney tests.*Results Patient informational needs included the risk of tumor spread during active surveillance and ablation, significance of comorbidities including chronic kidney disease, and the recovery period after ablation and surgery. In the pilot study, 100% completed viewing of information in both arms. DA use significantly improved patient knowledge about SRM risks and treatment options ([63% correct items for DA vs. 20% for pamphlet], p<0.001). DA use increased the proportion of patients discussing ablation with their doctors, trending toward significance (p=0.05), while no difference was found for surveillance or surgery; shared decisions increased, but not significantly (scale effect size 0.6, p=0.09). Decision satisfaction measures were similar (4.37 vs. 4.34 for DA and pamphlet; p=0.55).*Conclusions Patients receiving evidence-based risk communication and educational information in a DA are more likely to be sufficiently knowledgeable and prepared to discuss all treatment options. DA use in clinic is feasible and will be evaluated in a larger trial for impact on decision making.*Clinical Relevance/Application As renal mass ablation, surgery, and surveillance are increasingly recognized options for small renal tumors in society guidelines, a decision aid likely enables informed, better quality decisions.

RESULTS

Patient informational needs included the risk of tumor spread during active surveillance and ablation, significance of comorbidities including chronic kidney disease, and the recovery period after ablation and surgery. In the pilot study, 100% completed viewing of information in both arms. DA use significantly improved patient knowledge about SRM risks and treatment options ([63% correct items for DA vs. 20% for pamphlet], p<0.001). DA use increased the proportion of patients discussing ablation with their doctors, trending toward significance (p=0.05), while no difference was found for surveillance or surgery; shared decisions increased, but not significantly (scale effect size 0.6, p=0.09). Decision satisfaction measures were similar (4.37 vs. 4.34 for DA and pamphlet; p=0.55).

CLINICAL RELEVANCE/APPLICATION

As renal mass ablation, surgery, and surveillance are increasingly recognized options for small renal tumors in society guidelines, a decision aid likely enables informed, better quality decisions.

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Abstract Archives of the RSNA, 2021

Participants
Tarita Thomas, MD,PhD, Chicago, Illinois (*Moderator*) Nothing to Disclose
Simon Lo, MD, Seattle, Washington (*Moderator*) Committee member, Elekta AB

Sub-Events

SSRO04-2   Did Patients With Cancer Receive Priority COVID-19 Vaccination?

Participants
Rahul Prasad, MD, Columbus, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Cancer patients are particularly vulnerable to serious COVID-19 related morbidity and mortality due to a combination of disease and therapy-related effects. Available vaccines are highly effective, but initial supply limitations forced difficult patient prioritization decisions. Advisory Committee on Immunization Practices guidelines recommended that states prioritize patients from 65-74 and patients from 16-64 with high risk-conditions (including cancer) in phase 1c. However, this group encompassed 129 million people nationally forcing many states to sub-prioritize. The proportion of states that elected to follow phase 1c recommendations and include all 16+ patients with a cancer diagnosis (vaccine-eligible age) in the same tier as patients over 65 is unknown.*Methods and Materials In late February 2021, we identified every states' COVID vaccination webpage through keyword-based internet search and attempted to identify information about vaccination for cancer patients. The primary endpoint was the proportion of states simultaneously vaccinating patients with cancer and patients over the age of 65. Secondary endpoints included the proportion of states identifying a cancer diagnosis as a criteria for vaccination and the proportion specifically defining a qualifying cancer diagnosis. Descriptive statistics including proportions and frequency counts were performed.*Results 43 states included cancer as a criteria for vaccination with 8 precisely defining a qualifying cancer diagnosis and 17 giving patients with cancer and patients aged 65-74 the same immunization priority. There was no relationship between per capita cancer prevalence and vaccine prioritization decisions. Finding detailed vaccination information required significant computer literacy, as it routinely required navigation through multiple webpage subdomains.*Conclusions Although the majority of states included cancer as a criteria for vaccination, during the supply-constrained vaccination phase, over four-fifths did not clearly define a cancer diagnosis meeting criteria and nearly two-thirds did not give the recommended equal priority to cancer patients and patients aged 65 to 74. Policy interventions in future waves requiring boosters, or in other pandemics, should ensure timely vaccination of vulnerable populations to better mitigate disparities.*Clinical Relevance/Application Nearly 2/3 of states did not follow guidelines to prioritize vaccinating patients with cancer risking unnecessary morbidity and mortality, as this population is particularly vulnerable to COVID-19. Policy interventions in future waves requiring boosters, or in other pandemics, should ensure timely vaccination of vulnerable populations to better mitigate disparities.

RESULTS

43 states included cancer as a criteria for vaccination with 8 precisely defining a qualifying cancer diagnosis and 17 giving patients with cancer and patients aged 65-74 the same immunization priority. There was no relationship between per capita cancer prevalence and vaccine prioritization decisions. Finding detailed vaccination information required significant computer literacy, as it routinely required navigation through multiple webpage subdomains.

CLINICAL RELEVANCE/APPLICATION

Nearly 2/3 of states did not follow guidelines to prioritize vaccinating patients with cancer risking unnecessary morbidity and mortality, as this population is particularly vulnerable to COVID-19. Policy interventions in future waves requiring boosters, or in other pandemics, should ensure timely vaccination of vulnerable populations to better mitigate disparities.

SSRO04-3   Dosimetric Comparison In Risk-adapted Robotic SBRT For Ultra-central Lung Tumors Between Monte Carlo And Ray Trace Dose Calculations: A Preliminary Study In 16 Patients

Participants
Hong Xiang, PhD, Lancaster, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

SBRT for ultra-central lung tumors (UCLTs) has been an area of caution in clinical practices where several risk-adapted fractionation schemes are used to mitigate the high risk from severe toxicity to fatal complications. The accuracy of dose calculation and reporting may have a more direct impact on the outcome and toxicity. This study focuses on UCLTs cases exclusively with organs-at-risk (OARs) either in direct contact or overlap with the target volumes. Key dosimetric differences between Monte Carlo (MC) and Ray Trace (RAT) dose calculations are characterized.*Methods and Materials Risk-adapted SBRT plans for 16 patients with ultra-central lung tumors are generated in CyberKnife Precision TPS system either by reducing the dose per fraction for a 5-fraction SBRT per RTOG-0813 or by two alternative SBRT schemes of 750cGyx8 and 400cGyx15. Each plan is optimized using RAT algorithm to cover 95% or higher of the PTV with priority given to meeting the OAR constraints. All plans are re-calculated with MC algorithm under the same number of beams, beam directions and number of monitor units. Dosimetric comparisons are made between the two dose calculations, including D95% for PTV, mean and minimum dose for PTV and IGTV.

DVHs values of D0.03 cc and D xx cc for OARs are also compared, including the primary bronchial trees, esophagus, heart, aorta-great-vessels.*Results Comparing to MC, RAT is observed to overestimate the dose to the target volumes of PTV and IGTV, and in most of the cases also overestimates the dose to the OARs. The D95% for PTV is 10.6% (median) higher (range 2.8% to 22.2%). The mean and minimum dose to the PTV are 10.1% (median) higher (range 3.2% to 26.2%) and 8.3% (median) higher (range -7.7% to 20.8%). The mean and minimum dose to the IGTV are 8.3% (median) higher (range 2.3% to 16.9%) and 7.3% (median) higher (range 0.4 to 16.6%). The D0.03cc and D4cc (or D10cc) for the bronchi are 7.1% (median) higher (range 6.2% to 9.1%) and 6.6% (median) higher (range -20.4% to 12.3%). The differences in D0.03cc (other than bronchi), D5cc (esophagus), D10cc-or-15cc (heart) and D10cc (aorta-great-vessel) are around 3-5% (median) and range -0.8% to 13.9%.*Conclusions In risk-adapted robotic SBRT plans for ultra-central lung tumors, we observed significant differences in reported dose to target volumes and organs-at-risk, especially for the bronchi, between Monte Carlo and Ray-Trace dose calculations. Such differences provide critical inputs in evaluating case-specific risk and benefit associated with the current SBRT fractionation schemes.*Clinical Relevance/Application Dose calculation accuracy is most critical in SBRT for ultra-central lung tumors, which have not been explicitly addressed in the RTOG 0813 publications and CyberKnife-based lung SBRT literature to date.

RESULTS

Comparing to MC, RAT is observed to overestimate the dose to the target volumes of PTV and IGTV, and in most of the cases also overestimates the dose to the OARs. The D95% for PTV is 10.6% (median) higher (range 2.8% to 22.2%). The mean and minimum dose to the PTV are 10.1% (median) higher (range 3.2% to 26.2%) and 8.3% (median) higher (range -7.7% to 20.8%). The mean and minimum dose to the IGTV are 8.3% (median) higher (range 2.3% to 16.9%) and 7.3% (median) higher (range 0.4 to 16.6%). The D0.03cc and D4cc (or D10cc) for the bronchi are 7.1% (median) higher (range 6.2% to 9.1%) and 6.6% (median) higher (range -20.4% to 12.3%). The differences in D0.03cc (other than bronchi), D5cc (esophagus), D10cc-or-15cc (heart) and D10cc (aorta-great-vessel) are around 3-5% (median) and range -0.8% to 13.9%.

CLINICAL RELEVANCE/APPLICATION

Dose calculation accuracy is most critical in SBRT for ultra-central lung tumors, which have not been explicitly addressed in the RTOG 0813 publications and CyberKnife-based lung SBRT literature to date.

SSRO04-4 Association Of Non-Cancerous Features On Radiotherapy Planning CT Scans With Overall Survival In Patients With Stage I Non-Small Cell Lung Cancer

Participants
Ismail Tahir, MBBCh, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To explore the association between non-cancerous features on CT scans obtained for radiation therapy planning and overall survival (OS) in patients with lung cancer. We hypothesized that Agatston score, pulmonary artery to aorta (PA:Ao) ratio, and sarcopenia are associated with OS.*Methods and Materials This retrospective single-center study included consecutive patients with stage I non-small cell lung cancer treated with stereotactic body radiotherapy from 2009-2017. Two independent analysts measured Agatston score, PA:Ao ratio, and skeletal muscle cross-sectional area by threshold-based segmentation at the level of the T10 vertebral body on axial 2.5 mm thick CT images (140kV, 21-139 mA, 99% without intravenous contrast). Sarcopenia was defined using sex-specific cut-offs for cross-sectional muscle area divided by height2 that were established in an independent cohort. Associations with OS were measured using univariate (unadjusted hazard ratio, uHR) and multivariate Cox proportional hazards regression (adjusted HR, aHR) adjusted for age and Eastern Cooperative Oncology Group (ECOG) status.*Results Of 206 patients [121 females (58.7%), mean age 74.2±9.2 years], most were ECOG status 1 [n = 96 (46.6%); ECOG status =2 n = 67 (32.5%)], respectively]. 83 patients died after a median clinical follow-up of 39.7 months (IQR 27.2-53.5); median survival was 59.7 months (95%CI 55.7-68.6). The median Agatston score was 199 (IQR 9.0-711.5) and the mean PA:Ao ratio was 0.81±0.12. 62 patients (30.1%) met criteria for sarcopenia. PA:Ao ratio per 1-SD increase (uHR 1.18, p=0.097; aHR=1.35, p=0.007) and ECOG status =2 (uHR=2.06, p=0.027; aHR=2.13, p=0.027) were most strongly associated with worse OS. Sarcopenia was only borderline significant in the multivariate analysis (uHR=1.44, p=0.11; aHR =1.62, p=0.046). Agatston score 10-400 (uHR=1.50, p=0.14; aHR=1.54, p=0.15) and >400 (uHR=1.35, p=0.30; aHR=1.31, p=0.38) was not associated with OS, as was age (uHR=1.01, p=0.29; aHR=1.01, p=0.31).*Conclusions Following radiation therapy, higher PA:Ao ratio on RT-planning CT scans is associated with worse OS in patients with stage I non-small cell lung cancer, independent of age, ECOG status, Agatston score, and sarcopenia.*Clinical Relevance/Application The PA:Ao ratio is readily quantifiable on radiation planning images and may improve clinical decision-making for patients with stage I non-small lung cancer.

RESULTS

Of 206 patients [121 females (58.7%), mean age 74.2±9.2 years], most were ECOG status 1 [n = 96 (46.6%); ECOG status =2 n = 67 (32.5%)], respectively]. 83 patients died after a median clinical follow-up of 39.7 months (IQR 27.2-53.5); median survival was 59.7 months (95%CI 55.7-68.6). The median Agatston score was 199 (IQR 9.0-711.5) and the mean PA:Ao ratio was 0.81±0.12. 62 patients (30.1%) met criteria for sarcopenia. PA:Ao ratio per 1-SD increase (uHR 1.18, p=0.097; aHR=1.35, p=0.007) and ECOG status =2 (uHR=2.06, p=0.027; aHR=2.13, p=0.027) were most strongly associated with worse OS. Sarcopenia was only borderline significant in the multivariate analysis (uHR=1.44, p=0.11; aHR =1.62, p=0.046). Agatston score 10-400 (uHR=1.50, p=0.14; aHR=1.54, p=0.15) and >400 (uHR=1.35, p=0.30; aHR=1.31, p=0.38) was not associated with OS, as was age (uHR=1.01, p=0.29; aHR=1.01, p=0.31).

CLINICAL RELEVANCE/APPLICATION

The PA:Ao ratio is readily quantifiable on radiation planning images and may improve clinical decision-making for patients with stage I non-small lung cancer.

SSRO04-5 Advanced MRI For Characterizing Myocardial Contractility Pattern In Small-animal Model Of Radiation Induced Cardiotoxicity

Participants
El-Sayed Ibrahim, PhD, Milwaukee, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the capability of advanced MRI parameters of heart mechanics for early detection of radiation therapy (RT)-induced cardiotoxicity in a rat model of lung cancer RT, with end goal to help with risk stratification and treatment management to avoid cardiovascular complications.*Methods and Materials Adult salt-sensitive (SS) rats received whole-heart radiation (24Gy; 1

fraction) and were imaged with MRI at 8wk and 10wk post-RT and the results compared to sham treated rats (n=18). The MRI images were analyzed to measure regional peak systolic strain, based on which the percentage of normally contracting myocardium (%Contractility) was determined based on AHA 17-segment model, where a myocardial segment is considered normally contracting if its peak systolic strain exceeds the average value from all studied segments. %Contractility measurements were compared to ejection fraction (EF) and peak strain in different rat groups. Furthermore, ventricular torsion, diastolic strain rate, and mechanical dyssynchrony were measured.*Results EF and myocardial mass paradoxically increased post-RT. However, peak systolic strain and %Contractility significantly decreased post-RT. Specifically, %Contractility showed continuous decrease post-RT. This can be explained by the nonlinear inverse relationship between EF and %Contractility, in which %Contractility spanned a wide range of measurements between 20% and 100% for rats in different groups despite normal EF (>55%) for all rats. When comparing %Contractility to corresponding peak strain values in different rats, %Contractility showed more reduction post-RT than did the strain values. Furthermore, %Contractility showed more significant reduction post-RT than other MRI parameters, including ventricular torsion, early-diastolic strain rate, and mechanical dyssynchrony.*Conclusions %Contractility is a sensitive marker for early detection of RT-induced subclinical cardiac dysfunction before global function is affected and is more sensitive than peak systolic strain and other MRI cardiac biomarkers. The increase in EF and mass post-RT could be explained by undergoing ventricular remodeling during sub/acute phase of cardiotoxicity.*Clinical Relevance/Application %Contractility is sensitive marker for early detection of RT-induced cardiotoxicity which would help with risk stratification and treatment management to avoid cardiac complications and heart failure.

RESULTS

EF and myocardial mass paradoxically increased post-RT. However, peak systolic strain and %Contractility significantly decreased post-RT. Specifically, %Contractility showed continuous decrease post-RT. This can be explained by the nonlinear inverse relationship between EF and %Contractility, in which %Contractility spanned a wide range of measurements between 20% and 100% for rats in different groups despite normal EF (>55%) for all rats. When comparing %Contractility to corresponding peak strain values in different rats, %Contractility showed more reduction post-RT than did the strain values. Furthermore, %Contractility showed more significant reduction post-RT than other MRI parameters, including ventricular torsion, early-diastolic strain rate, and mechanical dyssynchrony.

CLINICAL RELEVANCE/APPLICATION

%Contractility is sensitive marker for early detection of RT-induced cardiotoxicity which would help with risk stratification and treatment management to avoid cardiac complications and heart failure.

SSRO04-6 A Prognostic Radiomic Model For NSCLC Patients At An Early Stage Treated With SBRT

Participants
Marco Bertolini, Reggio Emilia, Italy (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to evaluate the prognostic role of a radiomic model by using healthy and tumour tissues in a multimodal imaging cohort of early stage non-small cell lung cancer (NCSLC) patients treated with Stereotactic Radiation Therapy (SRT).*Methods and Materials We selected a set of NSCLC 65 lesions in two retrospective early stage patients' cohorts treated in two institutions with SRT, analyzed on an IEC-approved protocol. Gross Tumor Volume (GTV) was separately delineated on the available images (simulation CT, 18F-FDG PET/CT) by two experienced radiation oncologists. For each GTV, thirteen healthy control volumes (HCVs) were created by locating and shifting duplicated GTV volumes in the contralateral lung. 1502 features were extracted using pyradiomics for each region of interest (ROI). Our novel harmonization process was computed from the difference between GTV and mean HCV features divided by its standard deviation. Least absolute shrinkage and selection operator (LASSO) regression was used for feature selection. Receiver operating characteristic (ROC) curves were used to test the predictive performance of the resulting model using 5-fold cross-validation. The main endpoint of the study was 2-year local progression-free survival (LPFS).*Results Cohort patients' median age was 76 year (51-87 years). Median PFS was 21.0 months (2.0-107.8). Through LASSO selection, 5 image-filtered features were used to build a linear SVM model using the original features and our harmonized values, respectively showing an AUC of 0.78 (CI 0.69-0.87) and 0.89 (CI 0.77-0.95). Original features model failed to stratify the population in 2 distinct groups with 2-years PFS of 44.6% (CI 30.6%-65.0%) and 60.0% (CI 50.9%-90.8%) (log-rank test p-value=0.063), while our harmonized features model stratified the population in two groups with 2-years PFS of 26.2% (CI 13.7%-50.0%) and 81.9% (CI 68.7%-97.7%) (log-rank test p-value=0.00028), as shown in the figure.*Conclusions This study showed that the model based on our new proposed feature harmonization could increase the prognostic ability of radiomic studies.*Clinical Relevance/Application Local relapse disease risk stratification in patients with early stage NSCLC is still an unsolved clinical question. Our radiomic model could help the physician in this task.

RESULTS

Cohort patients' median age was 76 year (51-87 years). Median PFS was 21.0 months (2.0-107.8). Through LASSO selection, 5 image-filtered features were used to build a linear SVM model using the original features and our harmonized values, respectively showing an AUC of 0.78 (CI 0.69-0.87) and 0.89 (CI 0.77-0.95). Original features model failed to stratify the population in 2 distinct groups with 2-years PFS of 44.6% (CI 30.6%-65.0%) and 60.0% (CI 50.9%-90.8%) (log-rank test p-value=0.063), while our harmonized features model stratified the population in two groups with 2-years PFS of 26.2% (CI 13.7%-50.0%) and 81.9% (CI 68.7%-97.7%) (log-rank test p-value=0.00028), as shown in the figure.

CLINICAL RELEVANCE/APPLICATION

Local relapse disease risk stratification in patients with early stage NSCLC is still an unsolved clinical question. Our radiomic model could help the physician in this task.

Abstract Archives of the RSNA, 2021

Participants
Karen Ordovas, MD, Seattle, Washington (*Moderator*) Nothing to Disclose

Sub-Events

SSCA05   Keynote Speaker

Participants
David Bluemke, MD,PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

SSCA05-3   Hepatosteatosis And Atherosclerotic Plaque On Coronary Computed Tomography Angiography

Participants
Michelle Williams, MBCHB, BSC, Kelso, United Kingdom (*Presenter*) Speaker bureau for Canon Medical Systems and Siemens Healthineers.

PURPOSE

Cardiovascular mortality is common among patients with non-alcoholic fatty liver disease (NAFLD), but the underlying mechanisms for this association are uncertain. This study assesses the association between NAFLD and quantitative atherosclerotic plaque burden on CT.*Methods and Materials In this post-hoc analysis of computed tomography (CT) performed in the Scottish COmputed Tomography of the HEART (SCOT-HEART) trial, hepatosteatosis (<40 Hounsfield units) and coronary artery calcium score were measured on non-contrast CT. Coronary artery stenoses were subsequently assessed on coronary computed tomography angiography (CCTA) and classified as normal, non-obstructive or obstructive disease. Quantitative plaque burden (plaque to vessel volume, %) was assessed for total plaque, non-calcified plaque, calcified plaque and low-attenuation plaque.*Results Images from 1726 patients (mean age 58 ± 9 years, 56% male) were suitable for analysis. Patients with hepatosteatosis (n=155, 9%) had a higher body-mass index, were more likely to have hypertension or diabetes mellitus, and had higher cardiovascular risk scores (p<0.001 for all). They had increased coronary artery calcium scores (43 [interquartile interval 0 to 273] Agatston units versus 19 [0 to 225] AU, p=0.046), prevalence of non-obstructive disease (48% versus 37%, p=0.02) and low-attenuation plaque burden (5.11 [0.00 to 7.16]% versus 4.07 [0 to 6.84]%, p=0.035). However, these associations were not independent of established cardiovascular risk factors. Over a median of 4.7 years, there was no difference in the occurrence of myocardial infarction between those with and without hepatosteatosis (2% versus 2%, p=0.706).*Conclusions Hepatosteatosis on CT is associated with an increased prevalence of cardiovascular risk factors but does not independently affect coronary artery disease on CT or the frequency of subsequent myocardial infarction.*Clinical Relevance/Application Hepatosteatosis is a common finding on CT and is associated with other cardiovascular risk factors. However, its presence in patients with symptoms of coronary artery disease should not influence management.

RESULTS

Images from 1726 patients (mean age 58 ± 9 years, 56% male) were suitable for analysis. Patients with hepatosteatosis (n=155, 9%) had a higher body-mass index, were more likely to have hypertension or diabetes mellitus, and had higher cardiovascular risk scores (p<0.001 for all). They had increased coronary artery calcium scores (43 [interquartile interval 0 to 273] Agatston units versus 19 [0 to 225] AU, p=0.046), prevalence of non-obstructive disease (48% versus 37%, p=0.02) and low-attenuation plaque burden (5.11 [0.00 to 7.16]% versus 4.07 [0 to 6.84]%, p=0.035). However, these associations were not independent of established cardiovascular risk factors. Over a median of 4.7 years, there was no difference in the occurrence of myocardial infarction between those with and without hepatosteatosis (2% versus 2%, p=0.706).

CLINICAL RELEVANCE/APPLICATION

Hepatosteatosis is a common finding on CT and is associated with other cardiovascular risk factors. However, its presence in patients with symptoms of coronary artery disease should not influence management.

SSCA05-6   Prediction Of Acute Coronary Syndrome Based On Myocardial Mass At-risk Using Coronary Computed Tomography Angiography

Participants
Shant Malkasian, BS, Irvine, California (*Presenter*) Nothing to Disclose

PURPOSE

This study assessed the relationship of myocardial mass at-risk (MMAR) to coronary artery lesions of differing angiographic stenosis, composition, and remodeling.*Methods and Materials From the multicenter, international ICONIC study, 62 patients suspected of coronary artery disease (CAD) underwent coronary CT angiography imaging (CCTA) and follow-up for acute coronary syndrome (ACS), comprising 31 patients who would experience future ACS matched to 31 patients who would not experience future ACS by propensity scoring of age, gender, CAD risk factors. MMAR was calculated distal to each lesion using the minimum-cost path technique, as the percent of left ventricle myocardium subtended by a lesion. Left ventricle myocardial segmentation and coronary centerlines were used to calculate MMAR distal to all identifiable coronary lesions. Coronary artery lesions were classified as

obstructive (>50% stenosis) and high-risk (2 or more of the following: remodeling index = 1.1, intra-plaque intensity <30 HU, or intra-plaque calcification < 3.3 mm3).*Results Mean MMAR was 68.5±24.3%, 18.7±24.0%, and 11.6±20.6%, for all lesions, lesions with high-risk plaque (HRP), and lesions with diameter stenosis >50% (DS50). Mean MMAR of all lesions was 62.3±24.3% in patients not experiencing ACS and 74.6±23.0% in patients experiencing ACS ACS (p=0.04). Mean MMAR of HRP lesions was 11.4±18.2% in patients not experiencing ACS and 26.0±27.1% in patients experiencing ACS (p=0.02). Mean aggregated MMAR of obstructive lesions were 7.3±19.2% in patients not experiencing ACS and 15.9±21.3% experiencing ACS (p=0.10). Time-restriction survival analysis was performed for occurrence of ACS within 2 years following CCTA imaging, with cutoffs for survival of 82.03%, 7.02%, and 27.01% for MMAR distal to all, high-risk, and obstructive lesions, respectively. The difference in survival time was 0.50 years (p=0.02), 0.40 years (p=0.02), and 0.62 years (p=0.13) for MMAR distal to all, high-risk, and obstructive CAD lesions, respectively.*Conclusions MMAR distal to HRP lesions was significantly larger in patients with ACS, while MMAR distal to obstructive lesions was not clinically significant.*Clinical Relevance/Application MMAR may provide clinically important assessment of CAD burden and improve risk stratification of patients for occurrence of ACS.

RESULTS

Mean MMAR was 68.5±24.3%, 18.7±24.0%, and 11.6±20.6%, for all lesions, lesions with high-risk plaque (HRP), and lesions with diameter stenosis >50% (DS50). Mean MMAR of all lesions was 62.3±24.3% in patients not experiencing ACS and 74.6±23.0% in patients experiencing ACS ACS (p=0.04). Mean MMAR of HRP lesions was 11.4±18.2% in patients not experiencing ACS and 26.0±27.1% in patients experiencing ACS (p=0.02). Mean aggregated MMAR of obstructive lesions were 7.3±19.2% in patients not experiencing ACS and 15.9±21.3% experiencing ACS (p=0.10). Time-restriction survival analysis was performed for occurrence of ACS within 2 years following CCTA imaging, with cutoffs for survival of 82.03%, 7.02%, and 27.01% for MMAR distal to all, high-risk, and obstructive lesions, respectively. The difference in survival time was 0.50 years (p=0.02), 0.40 years (p=0.02), and 0.62 years (p=0.13) for MMAR distal to all, high-risk, and obstructive CAD lesions, respectively.

CLINICAL RELEVANCE/APPLICATION

MMAR may provide clinically important assessment of CAD burden and improve risk stratification of patients for occurrence of ACS.

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Participants
David Kim, MD, Madison, Wisconsin (*Moderator*) Shareholder, Cellectar Biosciences, Inc;Shareholder, Elucent Medical;
Thomas G. Mang, MD, Vienna, Austria (*Moderator*) Nothing to Disclose

Sub-Events

SSGI01-1   **Development And External Validation Of A Combined Model Using Radiomics And Radiologist Assessment For Predicting Rectal Cancer Treatment Response On MRI**

Participants
Natally Horvat, MD, PhD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To develop and externally validate a combined model using magnetic resonance imaging (MRI)-based radiomics combined with radiologist subjective semantic assessment on restaging rectal MRI in predicting pathological complete response (pCR) in patients with locally advanced rectal cancer (LARC) after neoadjuvant treatment.*Methods and Materials In this IRB-approved study consecutive patients with LARC who underwent neoadjuvant therapy were retrospectively included from two institutions from different countries. Two radiologists (R1 and R2), from each institution, evaluated restaging MRI and classified patients as showing clinical complete or partial response in consensus. A texture classifier (n=33 features) was trained (internal dataset) and validated (external dataset) and also combined with radiological semantic assessment. MRI harmonization using histogram standardization was performed.*Results 114 patients from Institution 1 (41% female; median age=55 years) and 50 from Institution 2 (52% female; median age=64.5) were included. Homogeneity (135°, 1.414) and energy of Gabor (180°, 1.414) were among the top predictive features. In the testing set, accuracy for R1 assessment combined with the texture classifier was 88% (95% CI: 0.76-1.00), and for R2 combined with radiomics features, 85% (95% CI: 0.71-0.99), which were significantly improved over individual reader assessment (68% and 70%, and P=0.01 and 0.04, respectively). MRI harmonization did not reduce the variability of specific features.*Conclusions The combined radiomics texture classifier and radiologist qualitative assessment model was accurate in predicting pCR in patients with LARC after neoadjuvant therapy.*Clinical Relevance/Application Few radiomics algorithm were externally validated, none of them using post-treatment rectal MRI features combined with qualitative radiologist assessment and also none of them with patients from different countries. There is a multidisciplinary effort to improve the accuracy of clinical complete response diagnosis after neoadjuvant treatment, because those patients may be eligible for a non-surgical watch-and-wait approach.

RESULTS

114 patients from Institution 1 (41% female; median age=55 years) and 50 from Institution 2 (52% female; median age=64.5) were included. Homogeneity (135°, 1.414) and energy of Gabor (180°, 1.414) were among the top predictive features. In the testing set, accuracy for R1 assessment combined with the texture classifier was 88% (95% CI: 0.76-1.00), and for R2 combined with radiomics features, 85% (95% CI: 0.71-0.99), which were significantly improved over individual reader assessment (68% and 70%, and P=0.01 and 0.04, respectively). MRI harmonization did not reduce the variability of specific features.

CLINICAL RELEVANCE/APPLICATION

Few radiomics algorithm were externally validated, none of them using post-treatment rectal MRI features combined with qualitative radiologist assessment and also none of them with patients from different countries. There is a multidisciplinary effort to improve the accuracy of clinical complete response diagnosis after neoadjuvant treatment, because those patients may be eligible for a non-surgical watch-and-wait approach.

SSGI01-2   **Diagnostic Accuracy Of MRI For Detecting Tumor Deposits In Staging Of Primary Rectal Cancer**

Participants
Agatha Stanek, MD, Montreal, Quebec (*Presenter*) Nothing to Disclose

PURPOSE

Tumor deposits (TD) are an adverse prognostic indicator in rectal cancer. This study aimed to assess accuracy of MRI in differentiating TD from lymph nodes (LN).*Methods and Materials Following IRB approval, pathologically proven rectal MRI's between 2014-2020 were evaluated (n=394). An expert reader randomized cases into a blinded database with individually marked TD and LN. Four readers, all with less than 5 years' experience individually assessed these labeled structures. Variables assessed included: short and long axis size (mm); T2 signal characteristic, signal on DWI and ADC, contours (irregular or smooth), shape (irregular, ovoid, round), disruption of a vein, whether the structure ran along/tapered/ neither by a vein; distance from the tumor; distance to the MRF; involvement of the MRF; and if the structure was a TD or LN.*Results 105 sessions were created with 46 TD structures and 56 LN structures for individual assessment (n=420). The intraclass correlation coefficient (ICC) demonstrated substantial agreement for long axis dimension (0.87, 95% CI 0.83-0.90), short axis dimension (0.89, 95% CI 0.85 - 0.92), distance from the tumor (0.74, 95% CI 0.66-0.80), and distance to the MRF (0.63, 95% CI 0.51-0.74), (all p&lt0.001). The Kappa estimates showed moderate to substantial agreement for structure discontinuity from the tumor (0.61, 95% CI 0.54-0.69), structure interrupting the course of a vein (0.40, 95% CI 0.33-0.48), contour (0.55, 95% CI 0.47-0.63), and TD/ LN identification (0.57, 95% CI 0.49 - 0.65),

(all p&lt0.001). TD were discontinuous from the primary tumor in 79% of cases and continuous in 21% of cases, whereas LN were discontinuous in 98% of cases and continuous in 1.6% of cases. TD tapering into the vein was identified in 60% of cases and interrupted the course of a vein in 76% of cases. TD were correctly identified in 80% of cases and LN were correctly identified in 69.3% of cases.*Conclusions Tumor deposits demonstrate distinct MRI features including their continuity with the primary tumor, direct tapering, and interruption of nearby veins. These morphologic features can be used in the identification of TD on MRI, which have prognostic implications.*Clinical Relevance/Application Morphologic MRI features of tumor deposits are not adequately delineated in the current TNM staging system for rectal cancer despite their prognostic implications. This study confirms the use of specific morphological characteristics on MRI in the correct identification of tumor deposits versus lymph nodes.

RESULTS

105 sessions were created with 46 TD structures and 56 LN structures for individual assessment (n=420). The intraclass correlation coefficient (ICC) demonstrated substantial agreement for long axis dimension (0.87, 95% CI 0.83-0.90), short axis dimension (0.89, 95% CI 0.85 - 0.92), distance from the tumor (0.74, 95% CI 0.66-0.80), and distance to the MRF (0.63, 95% CI 0.51-0.74), (all p&lt0.001). The Kappa estimates showed moderate to substantial agreement for structure discontinuity from the tumor (0.61, 95% CI 0.54-0.69), structure interrupting the course of a vein (0.40, 95% CI 0.33-0.48), contour (0.55, 95% CI 0.47-0.63), and TD/ LN identification (0.57, 95% CI 0.49 - 0.65), (all p&lt0.001). TD were discontinuous from the primary tumor in 79% of cases and continuous in 21% of cases, whereas LN were discontinuous in 98% of cases and continuous in 1.6% of cases. TD tapering into the vein was identified in 60% of cases and interrupted the course of a vein in 76% of cases. TD were correctly identified in 80% of cases and LN were correctly identified in 69.3% of cases.

CLINICAL RELEVANCE/APPLICATION

Morphologic MRI features of tumor deposits are not adequately delineated in the current TNM staging system for rectal cancer despite their prognostic implications. This study confirms the use of specific morphological characteristics on MRI in the correct identification of tumor deposits versus lymph nodes.

SSGI01-3   Can Radiologic Features Predict Hepatocellular Carcinoma Genetic Subtypes Relevant To Prognosis And Treatment Response?

Participants
Xiaoyang Liu, MD, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To correlate MRI features with genetic mutations of hepatocellular carcinoma (HCC) that have implications for prognosis and treatment in patients with and without cirrhosis.*Methods and Materials Next generation sequencing of 447 HCC implicated genes was performed on 52 pathology-proven HCC tumors from patients with (n=32) or without (n=20) cirrhosis. 38 patients underwent pre-biopsy/resection multiphase contrast enhanced MRI, which were retrospectively reviewed by two abdominal radiologists for features including tumor size, margin definition, arterial hyperenhancement, washout, capsule, peritumoral enhancement (focal/patchy parenchymal blush contiguous or within 1 cm of the tumor and persisting in venous phases), intra-tumoral fat, and tumor-in-vein. Diagnostic performance was calculated. Fisher's exact test was used to correlate genetic subtypes with imaging features and cirrhotic status.*Results CTNNB1 mutation was more likely to occur in HCC tumors from cirrhotic livers (16/32, 50%) than in non-cirrhotic livers (4/20, 20%) (p=.0419). The CTNNB1 mutation was strongly correlated with peritumoral enhancement on MRI (p=.0026), with substantial inter-reader agreement (kappa=.72) for this imaging feature. The accuracy of peritumoral enhancement for predicting CTNNB1 mutation was 79% (sensitivity 62%, specificity 88%). TP53 mutation was correlated with a poorly defined tumor margin on MRI (p=.0258). The accuracy of poorly defined tumor margin for predicting TP53 mutation was 74% (sensitivity 58%, specificity 81%). Intra-tumoral fat was more commonly associated with HCC in non-cirrhotic than in cirrhotic livers (p=.0086).*Conclusions Peritumoral enhancement on MRI strongly correlated with CTNNB1 mutation of HCC tumors. A poorly defined tumor margin on MRI correlated with TP53 mutation. These imaging features were accurate in predicting these genetic subtypes of HCC. The incidence of these mutations differed for HCC tumors in cirrhotic versus non-cirrhotic livers.*Clinical Relevance/Application TP53 and CTNNB1 are common and mutually exclusive mutations in HCC. CTNNB1 mutation favors well-differentiated histology, better prognosis, but worse response to immunotherapy; the TP53 mutation favors better response to immunotherapy, but worse response to tyrosine kinase inhibitor therapy. This study links specific MRI features to these genetic subtypes of HCC. If validated by further study, these MRI features may be useful in predicting genetic subtypes and guiding treatment decisions for patients with HCC.

RESULTS

CTNNB1 mutation was more likely to occur in HCC tumors from cirrhotic livers (16/32, 50%) than in non-cirrhotic livers (4/20, 20%) (p=.0419). The CTNNB1 mutation was strongly correlated with peritumoral enhancement on MRI (p=.0026), with substantial inter-reader agreement (kappa=.72) for this imaging feature. The accuracy of peritumoral enhancement for predicting CTNNB1 mutation was 79% (sensitivity 62%, specificity 88%). TP53 mutation was correlated with a poorly defined tumor margin on MRI (p=.0258). The accuracy of poorly defined tumor margin for predicting TP53 mutation was 74% (sensitivity 58%, specificity 81%). Intra-tumoral fat was more commonly associated with HCC in non-cirrhotic than in cirrhotic livers (p=.0086).

CLINICAL RELEVANCE/APPLICATION

TP53 and CTNNB1 are common and mutually exclusive mutations in HCC. CTNNB1 mutation favors well-differentiated histology, better prognosis, but worse response to immunotherapy; the TP53 mutation favors better response to immunotherapy, but worse response to tyrosine kinase inhibitor therapy. This study links specific MRI features to these genetic subtypes of HCC. If validated by further study, these MRI features may be useful in predicting genetic subtypes and guiding treatment decisions for patients with HCC.

SSGI01-4   Convolutional Neural Networks For The Differentiation Of Benign And Premalignant Colorectal Polyps Detected By CT Colonography

Participants
Sergio Grosu, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Machine learning-based differentiation of premalignant and benign colorectal polyps detected by CT colonography (CTC) using convolutional neural networks (CNN).*Methods and Materials In this retrospective analysis of an average risk colorectal cancer screening sample, polyps of all size categories and morphologies were manually segmented on stool tagged supine and prone CTC

images and classified as benign (hyperplastic polyp or regular mucosa) or premalignant (adenoma) according to histopathology. Two CNN-based models were trained to predict the polyp class (benign vs premalignant). Model SEG was trained on 3D CTC image subvolumes covering individual polyps and additionally polyp segmentation masks. Model noSEG was solely trained on the CTC subvolumes. Diagnostic performance of both models for the determination of premalignant from benign was then validated in an external multicenter test sample (The Cancer Imaging Archive). The operating point for both models was selected individually to maximize the respective Youden-Index.*Results The training set consisted of 107 colorectal polyps in 63 patients (mean age: 63±8 years, 40 men) comprising 169 polyp segmentations. The external test set included 77 polyps in 59 patients comprising 118 polyp segmentations. Model SEG achieved a ROC-AUC of 0.83, sensitivity of 66%, and specificity of 92% on the external test set for determination of premalignant from benign polyps. Model noSEG yielded a ROC-AUC of 0.75, sensitivity of 65%, and specificity of 79% on the external test set.*Conclusions In this proof-of-concept study, CNN-based image analysis allowed for the differentiation of premalignant and benign colorectal polyps with CTC. As this method did not necessarily require manual polyp segmentation it has the potential to facilitate the identification of high-risk polyps as an automated second reader.*Clinical Relevance/Application CNN potentially improve the diagnostic accuracy of CTC in colorectal cancer screening by allowing for a more precise selection of patients who would benefit from endoscopic polypectomy.

RESULTS

The training set consisted of 107 colorectal polyps in 63 patients (mean age: 63±8 years, 40 men) comprising 169 polyp segmentations. The external test set included 77 polyps in 59 patients comprising 118 polyp segmentations. Model SEG achieved a ROC-AUC of 0.83, sensitivity of 66%, and specificity of 92% on the external test set for determination of premalignant from benign polyps. Model noSEG yielded a ROC-AUC of 0.75, sensitivity of 65%, and specificity of 79% on the external test set.

CLINICAL RELEVANCE/APPLICATION

CNN potentially improve the diagnostic accuracy of CTC in colorectal cancer screening by allowing for a more precise selection of patients who would benefit from endoscopic polypectomy.

SSGI01-5   Added Value Of Multiparametric PET/MRI In Staging Of Rectal Cancer

Participants
Alexander Herold, MD, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

Positron emission tomography/magnetic resonance imaging (PET/MRI) has emerged as a ,,one-stop shop" examination in staging of colon and rectal cancer (RC) and various other neoplastic disorders. The purpose of this study was to determine, whether multiparametric PET/MRI can improve locoregional staging of untreated rectal cancer.*Methods and Materials In this retrospective study, 48 patients with primary RC were included, who underwent multiparametric 2-Deoxy-2-[18F] fluoroglucose (FDG) PET/MRI, followed by surgical resection and no further pretreatment. T and N staging was performed on standard T2w- sequences by two readers. Various parameters were extracted from the multiparametric protocol, consisting of diffusion-weighted (DWI), perfusion imaging and PET sequences, and were compared to the histopathological and radiological staging.Statistical analysis (median, mean, 90th percentile and interquartile range [IQR] of parametric data), ROC curve analysis and multivariate regression analysis was performed for correlation with clinical and histological parameters such as pT, pN-Staging, lymph node ratio (LNR) and lymphatic invasion (L).*Results Locally advanced tumors (T3N+ and higher) exhibited significantly higher metabolic tumor volume (MTV, T3N+: AUC= 0.796, p=0.001) and total lesion glycolysis (TLG). Rate constant (kep) was associated with increased lymph node ratio (AUC=0.780, p=0.043) as well as with lymphatic invasion (AUC=0.765, p= 0.01). In the multivariate regression analysis, a combination of MTV and kep best predicted locally advanced RC (HR=1.053, p=0.009), with a sensitivity and accuracy of 78.6% and 72.3% respectively, which was superior to standard anatomical assessment.*Conclusions Multiparametric PET-MRI including dynamic contrast-enhanced MR Perfusion provides additional information on RC tumor biology and tumor involvement of the lymphatic system. This can improve identification of locally advanced tumors and hence help in treatment stratification.*Clinical Relevance/Application Improvement of locoregional staging in untreated rectal cancer and thus possibly impacting treatment decisions regarding neoadjuvant therapy.

RESULTS

Locally advanced tumors (T3N+ and higher) exhibited significantly higher metabolic tumor volume (MTV, T3N+: AUC= 0.796, p=0.001) and total lesion glycolysis (TLG). Rate constant (kep) was associated with increased lymph node ratio (AUC=0.780, p=0.043) as well as with lymphatic invasion (AUC=0.765, p= 0.01). In the multivariate regression analysis, a combination of MTV and kep best predicted locally advanced RC (HR=1.053, p=0.009), with a sensitivity and accuracy of 78.6% and 72.3% respectively, which was superior to standard anatomical assessment.

CLINICAL RELEVANCE/APPLICATION

Improvement of locoregional staging in untreated rectal cancer and thus possibly impacting treatment decisions regarding neoadjuvant therapy.

SSGI01-6   A New Proposal For Secondary Surveillance Following Local Ablative Therapy Of HCC: Alternating MRI And CEUS

Participants
Stephanie Wilson, MD, Calgary, Alberta (*Presenter*) Equipment support, Koninklijke Philips NV;Equipment support, Siemens AG;Equipment support, Samsung Electronics Co, Ltd;Research support, Samsung Electronics Co, Ltd;

PURPOSE

A high recurrence rate following ablative therapy of hepatocellular carcinoma (HCC) necessitates routine follow-up imaging (secondary surveillance) to facilitate early re-treatment. We evaluate our unique secondary surveillance algorithm (with use of alternating MRI and CEUS) by assessment of the relative diagnostic accuracy of MRI and CEUS in detection of residual/recurrent tumor. Potential benefits of alternating surveillance are compared to the use of MRI alone.*Methods and Materials This prospective observational IRB approved study included 231 patients with 354 treated tumors between January 2017 and June 2020. Treated lesions underwent secondary surveillance for a minimum of 7 months and up to 3 years, median follow-up 14 months. Secondary surveillance involved MRI performed at 1 month after treatment, followed by CEUS and MRI at alternate 3 month intervals (i.e., CEUS at month 4, MRI at month 7, etc.), for a total of 2 years. An equivocal finding on one imaging modality triggered expeditious evaluation with the alternate modality. Arterial phase hyperenhancement and washout comprise the classic features of recurrent tumor on both modalities.*Results A total of 746 MRI and 712 CEUS examinations were performed, and a total of 184 tumor

recurrences detected, MRI (n=82) and CEUS (n=102) (p = 0.19). There was no difference in the sensitivity (71.0-85.0% and 80.9-92.0%), specificity (97.4-99.2% and 98.5-99.9%), and area under the ROC curve (0.85-0.92 and 0.91-0.96) between MRI and CEUS respectively. 23 of 82 recurrent tumors identified on MRI were equivocal and confirmed with expedited CEUS. 9 equivocal cases on MRI were disproved by expedited CEUS. On CEUS, 1 of the 102 recurrent tumors was equivocal and confirmed on MRI, and 2 equivocal CEUS cases were disproved by MRI.*Conclusions MRI and CEUS performed similarly in our secondary surveillance algorithm for HCC in their ability to detect tumor recurrence, and showed no significant difference in their relative diagnostic test accuracy measures. Of greater interest, equivocal results on MRI (typically due to difficulty in distinguishing tumor recurrence from post-treatment change/shunting) were either confirmed or disproven by CEUS in all cases.*Clinical Relevance/Application Secondary surveillance of treated HCC with alternating MRI and CEUS shows equivalent performance of each modality. CEUS resolves equivocal MRI and optimally demonstrates APHE and washout in tumor recurrence.

RESULTS

A total of 746 MRI and 712 CEUS examinations were performed, and a total of 184 tumor recurrences detected, MRI (n=82) and CEUS (n=102) (p = 0.19). There was no difference in the sensitivity (71.0-85.0% and 80.9-92.0%), specificity (97.4-99.2% and 98.5-99.9%), and area under the ROC curve (0.85-0.92 and 0.91-0.96) between MRI and CEUS respectively. 23 of 82 recurrent tumors identified on MRI were equivocal and confirmed with expedited CEUS. 9 equivocal cases on MRI were disproved by expedited CEUS. On CEUS, 1 of the 102 recurrent tumors was equivocal and confirmed on MRI, and 2 equivocal CEUS cases were disproved by MRI.

CLINICAL RELEVANCE/APPLICATION

Secondary surveillance of treated HCC with alternating MRI and CEUS shows equivalent performance of each modality. CEUS resolves equivocal MRI and optimally demonstrates APHE and washout in tumor recurrence.

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Participants

Adam S. Wang, PhD, Stanford, California (*Moderator*) Research support, General Electric Company;Research support, Siemens AG;Research collaboration, Varex Imaging Corporation

Sub-Events

SSPH10-1 Low-energy Virtual Monoenergetic Imaging With The Synergy Of Two Algorithms -prior Knowledge Aware Iterative Denoising And Convolutional Neural Network Based Direct Conversion

Participants
Hao Gong, PhD, Rochester,, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Low keV virtual monoenergetic imaging (VMI) can boost iodine contrast signal and improve the differentiation of soft tissue. Yet, the quality of conventional VMI synthesis (including commercial VMI technique) is largely limited by the amplified image noise and artifacts at low energy levels. In this work, we aim to address these limitations by exploiting the synergistic effects of a CNN based VMI method and a prior knowledge aware iterative denoising (PKAID) technique.*Methods and Materials A CNN-based method was developed to directly convert multi-energy CT images into VMIs. The CNN used an in-house structure with customized inception blocks, and in-house-designed loss functions. The network was trained using the phantom images with tissue mimicking materials and iodine contrast media. Training set was generated using image patches of those phantom materials, paired with the corresponding theoretical CT numbers as labels. Numerical phantom materials with a variety of mass densities were simulated to increase the amount of training data. To further improve the image quality, multi-energy CT images were further denoised using PKAID prior to feed into the trained CNN for VMI synthesis. PKAID achieved noise reduction by exploiting spatial redundancy between high-noise thin-slice images and low-noise thick-slice images. The proposed method was tested on patient images of different types of exams (contrast and non-contrast), body parts (head and abdomen), and multi-energy platforms (a dual-source dual energy CT, DECT; and an investigational photon counting detector CT, PCD-CT). Contrast, noise, and contrast to noise ratio (CNR) were measured and compared to commercial VMIs.*Results Compared to commercial VMI, the CNN (with and without PKAID) substantially reduced image noise, and blooming and beam-hardening artifacts in both non-contrast head and contrast-enhanced abdomen CT exams. Without PKAID, CNN can still yield ~66% lower noise and up to 2.8 fold CNR improvement. The synergistic method consistently achieved further noise reduction and CNR improvement: brain tissue in DECT - noise reduction ~72%, CNR improvement ~50%; abdominal muscle and adipose in PCD-CT - noise reduction ~70%, CNR improvement ~3.4 fold.*Conclusions The presented synergistic method substantially improves the image quality of low keV VMIs through reduction of image noise and artifacts, with a CNR improvement up to 3.4 fold compared to current commercial solution.*Clinical Relevance/Application Conventional low keV VMI has limited quality for diagnostic applications. The presented method has the potential of improving the diagnostic quality and clinical adoption of low keV VMI.

RESULTS

Compared to commercial VMI, the CNN (with and without PKAID) substantially reduced image noise, and blooming and beam-hardening artifacts in both non-contrast head and contrast-enhanced abdomen CT exams. Without PKAID, CNN can still yield ~66% lower noise and up to 2.8 fold CNR improvement. The synergistic method consistently achieved further noise reduction and CNR improvement: brain tissue in DECT - noise reduction ~72%, CNR improvement ~50%; abdominal muscle and adipose in PCD-CT - noise reduction ~70%, CNR improvement ~3.4 fold.

CLINICAL RELEVANCE/APPLICATION

Conventional low keV VMI has limited quality for diagnostic applications. The presented method has the potential of improving the diagnostic quality and clinical adoption of low keV VMI.

SSPH10-2 Extraction Of Spectral CT Information From Single-kV CT Scans By Deep Learning

Participants
Yinsheng Li, PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

There is a long-standing technical limitation associated with conventional single-kV CT imaging: anatomical structures with different material compositions may have the same CT number, thereby limiting the ability to differentiate and classify different tissue types and contrast agents. In this work, an artificial intelligence based method was developed to extract the desired spectral CT information from a conventional single-kV CT acquisition.*Methods and Materials A deep neural network, Deep-En-Chroma, was developed to mine the encoded spectral information in the recorded signals using an energy-integrating detector. A dedicated module in Deep-En-Chroma was developed to extract the corresponding effective energy for each measured datum. This effective energy was then used to guide the decomposition of a conventional CT image into material basis images. To train the model, human subject data acquired from the hardware based dual-energy CT acquisitions were curated to generate 4,043 pairs of training data which consists of the conventional high-kV image and the corresponding material basis images. The trained model was applied to 1,526 individual high-kV image slices to produce the corresponding material basis image for comparison. The results of Deep-En-

Chroma were compared against the corresponding clinical gold standard DECT images. The Bland-Altman statistical analysis method was used to analyze results over 9,100 randomly selected ROIs from 1,526 image slices.*Results 1) Image objects with similar CT numbers in single-kV CT images can be well differentiated using the Deep-En-Chroma material basis images. 2) Quantitative accuracy of the material basis images from Deep-En-Chroma and single-kV acquisition closely match those of the DECT images over the entire test cohort. 3) For iodine basis images, the mean difference between Deep-En-Chroma and DECT is -0.25 with a tight agreement limits of [-0.75 mg/ml, +0.24 mg/ml]. 4) For the water basis images, the mean difference is 0.0 with a tight agreement limits of [-0.01 g/ml, 0.01 g/ml].*Conclusions The Deep-En-Chroma method provides a new way to generate spectral CT imaging from a single-kV scan with high quantitative accuracy.*Clinical Relevance/Application This new paradigm enables conventional CT scanners to be equipped with a spectral-resolving capability for the accurate quantification of material compositions to improve the diagnostic accuracy in modern precision medicine.

RESULTS

1) Image objects with similar CT numbers in single-kV CT images can be well differentiated using the Deep-En-Chroma material basis images. 2) Quantitative accuracy of the material basis images from Deep-En-Chroma and single-kV acquisition closely match those of the DECT images over the entire test cohort. 3) For iodine basis images, the mean difference between Deep-En-Chroma and DECT is -0.25 with a tight agreement limits of [-0.75 mg/ml, +0.24 mg/ml]. 4) For the water basis images, the mean difference is 0.0 with a tight agreement limits of [-0.01 g/ml, 0.01 g/ml].

CLINICAL RELEVANCE/APPLICATION

This new paradigm enables conventional CT scanners to be equipped with a spectral-resolving capability for the accurate quantification of material compositions to improve the diagnostic accuracy in modern precision medicine.

SSPH10-3   Real-time, Personalized Estimation Of CT Organ Dose From Scout Images

Participants
Adam S. Wang, PhD, Stanford, California (*Presenter*) Research support, General Electric Company;Research support, Siemens AG;Research collaboration, Varex Imaging Corporation

PURPOSE

To develop an automated tool for providing accurate and real-time patient-specific, organ-specific CT doses from scout views, which could be used to prospectively guide CT acquisition.*Methods and Materials An end-to-end deep-learning model was designed, namely Scout-Net, to predict the CT dose of organs-of-interest from input frontal and lateral views. The Scout-Net model facilitates joint learning of the dose prediction at six different organs (lung, kidneys, liver, spleen, pancreas, bladder) and patient body through two basic modules: a generic feature learning module and individual dose learning modules. An automated pipeline was also developed to establish reference organ doses leveraging the publicly available MC-GPU (V1.3) and an AutoSeg (context-encoder U-Net). MC-GPU was modified to model a realistic CT system, including bowtie filtration and anode heel effect. The methods were validated using an internal dataset of 112 (80 train and 32 test) adult body scans, acquired from Revolution CT scanners (GE Healthcare), paired with frontal and lateral scouts. The CT scan range, which users select prior to scanning, was also input to the model so that dose is calculated for the relevant range.*Results The best model was saved on a validation set of 5% (4 scans) from the train set and mean relative errors were calculated on the test set after ten runs. Scout-Net predicts patient body dose with 6.26%± 0.03 (0.56mGy± 0.03) error and the six organ doses with 10.25%± 0.4 (0.75mGy± 0.02) error on average. Approximately 9% overall performance gain was observed with the incorporation of scan range, and physically consistent augmentations (vertical flip and Gaussian noise) further improved the model performance (by 14% in body dose). In addition to the accurate estimation of patient body and organ doses, Scout-Net facilitates massive gain in runtime and computing resources. Compared to CT-based retrospective estimation (MC-GPU and AutoSeg) which takes approximately 200 s per scan, only 11 ms with GPU (16 ms in CPU) is required for the prospective dose estimation by the Scout-Net model.*Conclusions A novel deep learning-based CT organ dose estimation method (Scout-Net) was developed which is capable of calculating organ dose distribution prospectively before acquiring the CT exam. Compared with CT-based dose estimation, Scout-Net demonstrates the correct prediction of the prospective dose report at the patient body and six different organs from the scout views, with improved generalization and execution speed.*Clinical Relevance/Application We present a new means of estimating organ doses aimed at improving CT acquisition to potentially facilitate the reduction of radiation dose by guiding the automatic exposure control to balance dose and image quality.

RESULTS

The best model was saved on a validation set of 5% (4 scans) from the train set and mean relative errors were calculated on the test set after ten runs. Scout-Net predicts patient body dose with 6.26%± 0.03 (0.56mGy± 0.03) error and the six organ doses with 10.25%± 0.4 (0.75mGy± 0.02) error on average. Approximately 9% overall performance gain was observed with the incorporation of scan range, and physically consistent augmentations (vertical flip and Gaussian noise) further improved the model performance (by 14% in body dose). In addition to the accurate estimation of patient body and organ doses, Scout-Net facilitates massive gain in runtime and computing resources. Compared to CT-based retrospective estimation (MC-GPU and AutoSeg) which takes approximately 200 s per scan, only 11 ms with GPU (16 ms in CPU) is required for the prospective dose estimation by the Scout-Net model.

CLINICAL RELEVANCE/APPLICATION

We present a new means of estimating organ doses aimed at improving CT acquisition to potentially facilitate the reduction of radiation dose by guiding the automatic exposure control to balance dose and image quality.

SSPH10-4   Simultaneous CT Angiography And CT Venography Using Dual-contrast-agent Multi-energy CT: An Animal Feasibility Study

Participants
Zhongxing Zhou, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To develop a dual-contrast-agent multi-energy CT (MECT) technique to simultaneously image and differentiate arteries and veins in a single scan, and to explore its feasibility in a swine model using a triple-beam MECT system.*Methods and Materials The triple-beam MECT system was implemented on a dual-source CT platform by mounting a z-axis split filter (0.05 mm Au, 0.6 mm Sn) on Tube A. The x-ray beam configuration of 70/Au120/Sn120 kV was used to provide optimal spectral performance for material delineation. A dual-contrast scanning protocol was developed for simultaneously acquiring two phases of vascular enhancement,

with iodine and gadolinium corresponding to the arterial enhancement (CT angiography (CTA)) and venous enhancement (CT venography (CTV)), respectively. The quantification accuracy of iodine and gadolinium was evaluated using a water phantom containing multiple concentrations of iodine and gadolinium contrast agents. A test bolus scan was performed in the swine head/neck region to determine the contrast enhancement profiles in arteries and veins, based on which the injection timing for the two agents was calculated. A gadolinium contrast bolus (Gadavist, 80 mL, 10 mL/s) was intravenously injected, followed 12 s later by an iodine contrast bolus (Omnipaque 350, 40 mL, 5 mL/s). A MECT scan was performed 12 s after initiation of the iodine contrast injection. Material decomposition was performed to separate iodine and gadolinium, which corresponded to CTA and CTV images, respectively.*Results Iodine and gadolinium samples were accurately quantified in the phantom experiment with root-mean-square-error (RMSE) of 1.58 mg/cc for iodine and 1.33 mg/cc for gadolinium. In the swine experiment, common carotid arteries containing iodine and internal/external jugular veins containing gadolinium could be clearly delineated from each other. Fine vessels such as cephalic veins and branches of external jugular veins could be visualized but clarity was impacted by image noise.*Conclusions The feasibility of simultaneous CTA and CTV imaging in MECT using a dual-contrast-agent (iodine and gadolinium) injection protocol was demonstrated in a swine study.*Clinical Relevance/Application A MECT scan using dual-contrast-agent injections provides perfectly registered images of arteries and veins from a single CT scan, providing a more complete description of the vascular system.

RESULTS

Iodine and gadolinium samples were accurately quantified in the phantom experiment with root-mean-square-error (RMSE) of 1.58 mg/cc for iodine and 1.33 mg/cc for gadolinium. In the swine experiment, common carotid arteries containing iodine and internal/external jugular veins containing gadolinium could be clearly delineated from each other. Fine vessels such as cephalic veins and branches of external jugular veins could be visualized but clarity was impacted by image noise.

CLINICAL RELEVANCE/APPLICATION

A MECT scan using dual-contrast-agent injections provides perfectly registered images of arteries and veins from a single CT scan, providing a more complete description of the vascular system.

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Participants
Jae Song, MD, MS, Philadelphia, Pennsylvania (*Moderator*) Nothing to Disclose
Hediyeh Baradaran, MD, Salt Lake City, Utah (*Moderator*) Nothing to Disclose

Sub-Events

SSNR06-1 **External Validation Of The Brain Tumour And Reporting System (BTRADS) Score In Multidisciplinary Management Of Post-treatment Gliomas**

Participants
Kamaxi Trivedi, MD,MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

PURPOSE

BTRADS is a structured reporting system proposed by the Emory neuroradiology group to increase the value of the report to the ordering clinician, and provide greater clarity to patients with brain tumors. This study is an external independent validation of the BTRADS scoring system and mainly addresses interobserver variability and evaluation of its efficacy in correctly predicting the multidisciplinary meeting (MDM) decision.*Methods and Materials Retrospective observational study- IEC approved. Sample size:100 Inclusion criteria: All post-operative patients receiving adjuvant therapy (RT ± TMZ) as per hospital protocol and under routine clinical surveillance. Exclusion criteria: Paediatric (= 18 years) brain tumours. Two independent, dedicated neuro-radiologists (RD1 and RD2) were blinded and analysed the consecutive post-treatment MRIs of 100 patients with post-treatment gliomas and gave a score as per the BTRADS to each patient, at two separate sittings. Patients in whom the allotted scores were different were then resolved by discussion and a final "consensus" score given, These scores were then correlated with the MDM decision.*Results Intraclass correlation coefficients showed low interobserver variabilities of the BTRADS scores between RD1 and RD2 and both with consensus as well. The intraclass correlation coefficients was 0.934 (95% CI: 0.901, 0.956) between RD1 and RD2, 0.981 (95% CI: 0.972, 0.988) between RD1 and consensus, and 0.962 (95% CI: 0.944, 0.975) between RD2 and consensus. The overall agreement rate between RD1 and RD2 was 62.7%, with kappa of 0.67. The agreement rate between the RD1 and consensus was 83.3% with a kappa of 0.85. The agreement rate between RD2 and consensus was 69.3% with a kappa of 0.79. Among radiologists, agreement was highest for score 2 and lowest was for score 3B. The consensus with MDM recommendation linked to each score was 97.9% (in total 94 cases) with only 2.1%(2 cases) showing disagreement. Both of these cases were scored 3A.*Conclusions Our study reveals that the BTRADS system shows low inter-reader variability between radiologists. Overall agreement is good, but variation rates increase with category 3b and 3c patients which may be harder to correctly interpret. This is an expected finding because this category likely represents patients who are either pseudo-progression or true progression. The table of interpretation categories tied to suggested management decisions was also quite effective and showed significant match with decisions taken by our treating oncologists.*Clinical Relevance/Application The BTRADS system is independently and externally validated to have good agreement between reporting radiologists, and the allotted scores can be tied to management recommendations.

RESULTS

Intraclass correlation coefficients showed low interobserver variabilities of the BTRADS scores between RD1 and RD2 and both with consensus as well. The intraclass correlation coefficients was 0.934 (95% CI: 0.901, 0.956) between RD1 and RD2, 0.981 (95% CI: 0.972, 0.988) between RD1 and consensus, and 0.962 (95% CI: 0.944, 0.975) between RD2 and consensus. The overall agreement rate between RD1 and RD2 was 62.7%, with kappa of 0.67. The agreement rate between the RD1 and consensus was 83.3% with a kappa of 0.85. The agreement rate between RD2 and consensus was 69.3% with a kappa of 0.79. Among radiologists, agreement was highest for score 2 and lowest was for score 3B. The consensus with MDM recommendation linked to each score was 97.9% (in total 94 cases) with only 2.1%(2 cases) showing disagreement. Both of these cases were scored 3A.

CLINICAL RELEVANCE/APPLICATION

The BTRADS system is independently and externally validated to have good agreement between reporting radiologists, and the allotted scores can be tied to management recommendations.

SSNR06-2 **Lost To Follow-up: A Nationwide Analysis Of Transient Ischemic Attack Patients Discharged From Emergency Departments With Incomplete Imaging Work-up**

Participants
Vincent M. Timpone, MD, Denver, Colorado (*Presenter*) Research Consultant, iSchemaView, Inc

PURPOSE

Imaging guidelines for Transient Ischemic Attack(TIA) recommend patients receive urgent brain and neurovascular imaging, preferably within 24 hours of symptom onset. It has been previously demonstrated that a majority of TIA patients discharged from the emergency department(ED) without hospital admission do not complete a recommended TIA imaging work-up during their ED encounter. The purpose of this study was to determine the percentage of patients discharged from ED with incomplete imaging work-up that are able to complete recommended imaging following discharge.*Methods and Materials We analyzed 24 months of data of the Medicare 5% database from 2017-2018. Patients diagnosed and discharged from EDs with TIA were identified using ICD-10 codes, and imaging performed was identified using CPT codes. Incomplete imaging work-up was defined as an encounter

without cross-sectional brain, brain-vascular and neck-vascular imaging performed at time of initial ED encounter, or within the subsequent 30-days post ED discharge. A multivariable logistic regression analysis was performed to determine significant associations with incomplete TIA imaging work-up.*Results 4,814 TIA encounters were included in our analysis. 2,802(58.2%) of patients had a complete TIA imaging work-up during their ED encounter. Of the 2,012 of patients discharged from EDs with incomplete imaging, 568(28.2%) had completed imaging during the subsequent 30-days post ED discharge. For TIA imaging work-ups completed post ED discharge, median time to completion was 5 days. Odds of incomplete TIA imaging work up at 30-days post ED discharge were increased in Black patients(OR 3.00[1.86-4.82]), older patients(85+ years; OR 2.61[1.88-3.62]), and large hospitals(400+ beds; OR 2.11[1.36-3.28]).*Conclusions Most patients discharged from EDs with incomplete TIA imaging work-up do not complete recommended imaging within 30 days post discharge. Odds of incomplete imaging are increased in Black patients, older patients, and large hospitals.*Clinical Relevance/Application Future efforts should be directed to improve access to timely imaging of TIA so that modifiable risk factors for future stroke can be identified and treated.

RESULTS

4,814 TIA encounters were included in our analysis. 2,802(58.2%) of patients had a complete TIA imaging work-up during their ED encounter. Of the 2,012 of patients discharged from EDs with incomplete imaging, 568(28.2%) had completed imaging during the subsequent 30-days post ED discharge. For TIA imaging work-ups completed post ED discharge, median time to completion was 5 days. Odds of incomplete TIA imaging work up at 30-days post ED discharge were increased in Black patients(OR 3.00[1.86-4.82]), older patients(85+ years; OR 2.61[1.88-3.62]), and large hospitals(400+ beds; OR 2.11[1.36-3.28]).

CLINICAL RELEVANCE/APPLICATION

Future efforts should be directed to improve access to timely imaging of TIA so that modifiable risk factors for future stroke can be identified and treated.

SSNR06-3 Computed Tomography Texture Analysis Of Carotid Plaque As Predictor Of Unfavorable Outcome After Carotid Artery Stenting: A Preliminary Study

Participants
Davide Colombi, MD, Piacenza, Italy (*Presenter*) Nothing to Disclose

PURPOSE

to test the association between textural features of stenotic plaque at carotid bifurcation derived by using open-source software (3D Slicer software; https://www.slicer.org) on computed tomography angiography (CTA) and unfavorable outcome after carotid artery stenting (CAS)*Methods and Materials The study included patients who underwent CAS from January 2010 to January 2021 for carotid bifurcation or internal carotid artery (ICA) stenotic plaque. Exclusion criteria were as follows: (1) absence of supra-aortic vessels CTA within 6 months before the procedure; (2) unsuccessful CAS; (3) unsuccessful software analysis. The study included 172 patients (men 112/172, 65%; median age, 77 years-old, interquartile range, 70-82 years-old). Carotid stenosis was symptomatic (ipsilateral neurologic ischemic event within 6 months before procedure) in 90/172 (52%) patients. All patients underwent CTA of the supraortic vessels and image datasets were reconstructed axially using medium-soft kernel at 1.5-2 mm slice thickness. Carotid plaques were manually segmented at CTA; mean, standard deviation, kurtosis, and skewness of the carotid plaque were derived by the analysis of the density histogram performed by the Radiomics extension (Computational Imaging & Bioinformatics Lab, Harvard Medical School; Boston, Massachusetts, USA) of the open-source 3D Slicer software.Multiple logistic regression analysis was used to examine the association between potential prognostic variables and unfavorable outcome, defined as occurrence of periprocedural (within 30 days following CAS) death or myocardial infarction and any ipsilateral stroke after CAS. Receiver operating characteristic (ROC) curve analysis and the calculation of the area under the ROC (AUC) were used to assess the performance for predicting unfavorable outcome*Results Patients without unfavorable outcome were similar to the remaining patients for demographics, comorbidities, and anatomic features. Patients with unfavorable outcome showed an higher rate of ulcerated plaque (58% vs 30%, P=0.029) and lower plaque kurtosis (5.37 vs 5.84, P=0.048).Among textural features, kurtosis was an independent predictor of unfavorable outcome (odds ratio 0.77; confidence interval: 0.61-0.96; P=0.021). The predictive model for unfavorable outcome including CTA textural features outperformed the model without textural features (AUC 0.856 vs 0.803, P=0.004)*Conclusions In patients with stenotic plaque at carotid bifurcation, kurtosis of the CTA density histogram is an independent predictor of unfavorable outcome*Clinical Relevance/Application Textural analysis of stenotic carotid plaque at CT could be helpful for the risk stratification of unfavorable outcome after carotid artery stenting

RESULTS

Patients without unfavorable outcome were similar to the remaining patients for demographics, comorbidities, and anatomic features. Patients with unfavorable outcome showed an higher rate of ulcerated plaque (58% vs 30%, P=0.029) and lower plaque kurtosis (5.37 vs 5.84, P=0.048).Among textural features, kurtosis was an independent predictor of unfavorable outcome (odds ratio 0.77; confidence interval: 0.61-0.96; P=0.021). The predictive model for unfavorable outcome including CTA textural features outperformed the model without textural features (AUC 0.856 vs 0.803, P=0.004)

CLINICAL RELEVANCE/APPLICATION

Textural analysis of stenotic carotid plaque at CT could be helpful for the risk stratification of unfavorable outcome after carotid artery stenting

SSNR06-4 Admission CT Radiomic Signatures Are Stronger Predictors Of Long-term Outcome And Baseline Clinical Severity Than Hematoma Volume In Patients With Intracerebral Hemorrhage (ICH)

Participants
Stefan Haider, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Only 40% of ICH patients regain functional independence while there is yet no effective treatment - highlighting the importance of early risk stratification for personalized treatment decisions and enrollment in clinical trials. To date, hematoma volume is the most widely used and strongest imaging predictor of clinical outcome. We investigated the utility of ICH radiomics in predicting the severity of clinical symptoms at admission and long-term functional outcome.*Methods and Materials Utilizing the dataset gathered by the "Antihypertensive Treatment of Acute Cerebral Hemorrhage II" trial, we extracted a set of n=1130 radiomics features reflecting hematoma shape, density and texture from hematoma lesions of n=895 patients on admission non-contrast CT. Subjects were randomly allocated to a discovery (n=448) and independent validation cohort (n=447). Following exclusion of features with low inter- and intra-rater reproducibility and high multicollinearity, we generated separate "radiomics signatures" associated with

admission GCS, admission NIHSS, and 3-month follow-up modified Rankin scale (mRS) scores using LASSO-regularized ordinal logistic regression models in the discovery cohort. Features with non-zero coefficients were linearly combined and weighted by their respective coefficients to devise the signatures. Spearman's correlation (rho) between radiomics signatures and target scores was compared with the correlation between ICH volume and target scores.*Results Radiomics signatures, compared to ICH volume, demonstrated significantly stronger correlation with GCS (rho=0.47 vs 0.44, p=0.008), NIHSS (0.69 vs 0.57, p<0.001), and mRS scores (0.44 vs 0.32, p<0.001) in the discovery cohort. Similarly, in independent validation, the radiomics signatures exhibited significantly stronger association with GCS (0.43 vs 0.41, p=0.02), NIHSS (0.64 vs 0.56, p<0.001), and mRS scores (0.43 vs 0.33, p<0.001). The mRS radiomics signature was an independent predictor of long-term disability in multiple regression analysis adjusted for admission GCS and NIHSS scores with p<0.001 in both cohorts.*Conclusions ICH radiomics signatures derived from admission non-contrast CTs provide stronger imaging correlates for clinical presentation and long-term outcome than the hematoma volume alone.*Clinical Relevance/Application Our results suggest admission CT radiomics signatures may aid risk assessment, treatment triage, and prognostication in ICH patients beyond hematoma volume.

RESULTS

Radiomics signatures, compared to ICH volume, demonstrated significantly stronger correlation with GCS (rho=0.47 vs 0.44, p=0.008), NIHSS (0.69 vs 0.57, p<0.001), and mRS scores (0.44 vs 0.32, p<0.001) in the discovery cohort. Similarly, in independent validation, the radiomics signatures exhibited significantly stronger association with GCS (0.43 vs 0.41, p=0.02), NIHSS (0.64 vs 0.56, p<0.001), and mRS scores (0.43 vs 0.33, p<0.001). The mRS radiomics signature was an independent predictor of long-term disability in multiple regression analysis adjusted for admission GCS and NIHSS scores with p<0.001 in both cohorts.

CLINICAL RELEVANCE/APPLICATION

Our results suggest admission CT radiomics signatures may aid risk assessment, treatment triage, and prognostication in ICH patients beyond hematoma volume.

SSNR06-5   Retrospective Multicenter Study Of The Neuroimaging Incidence Of CNS Complications In Hospitalized COVID-19 Positive Patients

Participants
Scott H. Faro, MD, Collingswood, New Jersey (*Presenter*) Nothing to Disclose

PURPOSE

We sought to determine the incidence of acute neuroimaging (NI) findings in hospitalized Covid-19 infected patients in 6 US and 4 European University hospitals.*Methods and Materials Retrospective multicenter study of Covid-19 positive patients admitted (September 2019-June 2020) in 11 institutions was conducted out of which data from 10 institutions were included. Data analysis from remaining 1 institute is in progress. Inclusion criteria: age>18, confirmed diagnosis of Covid-19 infection, acute neuroimaging findings not attributable to any cause other than Covid-19 on CT or MRI brain. Patients were verified by board certified neuroradiologists. Total incidences were calculated for overall and specific neuroimaging findings in Covid-19 positive patients and in those who underwent NI.*Results 24,315 Covid-19 positive patients were reviewed in 8 centers. Total acute NI incidence in patients who underwent NI was 436/4409 (9.8%) in 10 centers with 279 MRI and 157 CT including 287/3762 (7.62%) in USA and 149/647 (23%) in Europe. Total acute NI positive findings incidence in all Covid-19 positive hospitalized patients was 259/24315 (1.06%) in 8 centers including 0.7% in the US and 2.06% in Europe. Average patient age was 66 ± 12 years across institutions. In those who underwent NI, incidence of ischemic stroke was 6.2% followed by intracranial hemorrhage (3.72%), encephalitis (0.47%), deep sinus thrombosis (0.22%) and, ADEM (0.18%). White matter involvement was seen in 5.8% of NI. The most common distribution was unilateral (5.73%) followed by bilateral asymmetric (3.04%). Most common lobes affected were the frontal (5.35%) and parietal lobes (4.9%). *Conclusions We demonstrated an overall incidence of CNS complications in Covid-19 positive patients who underwent NI to be 9.8% including 7.62% in the US and 23% in Europe. Incidence of all positive NI in all hospitalized Covid-19 patients was 1.06% including 0.7% in the US and 2.06% in Europe. We also defined the incidence in a variety of NI abnormalities in USA and Europe.*Clinical Relevance/Application In a large international multi-institutional cohort, incidence and distribution of acute neuroimaging findings helped to characterize the neurological complications of Covid-19 thereby assisting in understanding the full extent of this disease process.

RESULTS

24,315 Covid-19 positive patients were reviewed in 8 centers. Total acute NI incidence in patients who underwent NI was 436/4409 (9.8%) in 10 centers with 279 MRI and 157 CT including 287/3762 (7.62%) in USA and 149/647 (23%) in Europe. Total acute NI positive findings incidence in all Covid-19 positive hospitalized patients was 259/24315 (1.06%) in 8 centers including 0.7% in the US and 2.06% in Europe. Average patient age was 66 ± 12 years across institutions. In those who underwent NI, incidence of ischemic stroke was 6.2% followed by intracranial hemorrhage (3.72%), encephalitis (0.47%), deep sinus thrombosis (0.22%) and, ADEM (0.18%). White matter involvement was seen in 5.8% of NI. The most common distribution was unilateral (5.73%) followed by bilateral asymmetric (3.04%). Most common lobes affected were the frontal (5.35%) and parietal lobes (4.9%).

CLINICAL RELEVANCE/APPLICATION

In a large international multi-institutional cohort, incidence and distribution of acute neuroimaging findings helped to characterize the neurological complications of Covid-19 thereby assisting in understanding the full extent of this disease process.

SSNR06-6   White Matter Hyperintensities And Silent Brain Infarcts In Aortic Valve Repair: Preliminary Results Of The Pearl Study

Participants
Moreno Zanardo, MSc, San Donato Milanese, Italy (*Presenter*) Nothing to Disclose

PURPOSE

We assessed white matter hyperintensities (WMH) burden, a biomarker of chronic cerebrovascular disease, and quantified ischemic lesions at diffusion-weighted magnetic resonance imaging (DW-MRI) in patients who underwent either surgical aortic valve replacement (SAVR) or transcatheter aortic valve implantation (TAVI). We aimed at enquiring whether an association between chronic cerebrovascular disease and acute ischaemia in aortic valve repair patients could be found.*Methods and Materials In this prospective study, patients underwent a 1.5-T brain MRI within seven days from TAVI or SAVR. We used the semi-quantitative Fazekas scale to classify patients into three classes of severity (low-intermediate-high) of chronic cerebrovascular disease. WMHs and DW-MRI positive lesions were quantified using a semi-automated segmentation method based on local intensity thresholds.*Results Fifteen patients were enrolled (9 SAVR, 6 TAVI). Nine (60%) patients had at least one visible lesion at DW-MRI:

five (83%) in the TAVI group and four (44%) in the SAVR group. TAVI patients had significantly higher volumes of DW-MRI lesions (P = 0.036). Also, TAVI patients had more severe chronic cerebrovascular disease than SAVR patients, albeit not significantly (P = 0.057 for Fazekas grade; P = 0.145 for WMH volume). We found a statistically significant difference in the distribution of volumes of DW-MRI lesions across the three Fazekas severity groups (p=0.027), with patients with higher Fazekas grade having higher DW-MRI lesions volume (Spearman's ? = 0.538; P = 0.039). When considering only patients with at least one lesion at DW-MRI, the association between total WMH volume and DW-MRI lesions volume was also strongly significant (Spearman's ? = 0.476; P = 0.002).*Conclusions Patients with more severe chronic cerebrovascular disease burden had significantly more ischamic lesions after TAVI/SAVR than those with a low WMH burden.*Clinical Relevance/Application The WMH burden may enable risk-stratification of patients who undergo TAVI/SAVR and identify those that would benefit most from the adoption of neuroprotective devices.

RESULTS

Fifteen patients were enrolled (9 SAVR, 6 TAVI). Nine (60%) patients had at least one visible lesion at DW-MRI: five (83%) in the TAVI group and four (44%) in the SAVR group. TAVI patients had significantly higher volumes of DW-MRI lesions (P = 0.036). Also, TAVI patients had more severe chronic cerebrovascular disease than SAVR patients, albeit not significantly (P = 0.057 for Fazekas grade; P = 0.145 for WMH volume). We found a statistically significant difference in the distribution of volumes of DW-MRI lesions across the three Fazekas severity groups (p=0.027), with patients with higher Fazekas grade having higher DW-MRI lesions volume (Spearman's ? = 0.538; P = 0.039). When considering only patients with at least one lesion at DW-MRI, the association between total WMH volume and DW-MRI lesions volume was also strongly significant (Spearman's ? = 0.476; P = 0.002).

CLINICAL RELEVANCE/APPLICATION

The WMH burden may enable risk-stratification of patients who undergo TAVI/SAVR and identify those that would benefit most from the adoption of neuroprotective devices.

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Participants

Christopher Francois, MD, Rochester, Minnesota (*Moderator*) Nothing to Disclose
Nicholas Burris, MD, Ann Arbor, Michigan (*Moderator*) Royalties, ImBio, LLC

Sub-Events

SSVA03-1 Influence Of The Comorbidities On The Dissection And Rupture Rate Of The Thoracic Aortic Aneurysm

Participants
Rokas Liubauskas, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Patients with thoracic aortic aneurysm (TAA) are currently being followed by imaging and treated according to guidelines based primarily on aneurysmal size. Association between comorbidities and aortic diameter, aortic aneurysm rupture (AAR), and/or dissection (AAD) was assessed.*Methods and Materials Single-center IRB-approved study of patients with a TAA who underwent computed tomography between October 4th, 2002, and February 18th, 2021. Demographic and comorbidity data were recorded. For this study, TAA rupture or dissection was defined as an aortic event. Associations between aortic events and the prevalence of coronary artery disease (CAD), chronic kidney disease (CKD), COPD, hyperlipidemia, hypertension, peripheral artery disease (PAD), prediabetes & diabetes mellitus (DM group), obesity, and smoking, and initial aortic diameter were investigated. Chi-squared test was used to assess association of comorbidities with AAR and AAD.*Results 6269 patients were included. 4102 (65%) male, median age 71 (IQR 63 - 80). Prevalence of the comorbidities were: CAD - 21% (1344), CKD - 20% (1223), COPD - 13% (802), hyperlipidemia - 31% (1954), hypertension - 46% (2886), PAD - 8% (474), DM group - 29% (1844), obesity - 26% (1648), smoking - 15% (942). The incidence of aortic events was 4.5% (282/6269). The aortic event rate was higher in every comorbidity group compared to patients without it, statistically significantly in patients with hypertension ($p < 0.0001$), PAD ($p < 0.0001$), CAD ($p=0.002$), CKD ($p < 0.0001$), hyperlipidemia ($p < 0.0001$), DM group ($p=0.0005$), smoking ($p < 0.0001$). The aortic event rate was especially high in patients with hypertension (7% vs 2% in patients without it), PAD (9% vs 4%), and smoking (7% vs 4%). Specificity for an aortic event varied among comorbidities, with the following comorbidities exhibiting specificity > 0.80: CKD (0.81), COPD (0.87), PAD (0.93), smoking (0.85). Assessment of the event rate based on the initial aortic diameter and presence of comorbidities showed that hypertension, PAD, and smoking are significant independent predictors, but there was no significant interaction between comorbidities and the initial diameter. I.e. the association between the aortic event and the comorbidities is similar in patients regardless of the initial aortic diameter.*Conclusions Hypertension, PAD, and smoking history substantially increase the risk for TAA rupture or dissection, as compared to patients without these comorbidities. Comorbidities influence the risk of these events equally, regardless of initial TAA diameter.*Clinical Relevance/Application The presence of certain comorbidities might influence the decision regarding the frequency of imaging follow-up and timing of surgical intervention.

RESULTS

6269 patients were included. 4102 (65%) male, median age 71 (IQR 63 - 80). Prevalence of the comorbidities were: CAD - 21% (1344), CKD - 20% (1223), COPD - 13% (802), hyperlipidemia - 31% (1954), hypertension - 46% (2886), PAD - 8% (474), DM group - 29% (1844), obesity - 26% (1648), smoking - 15% (942). The incidence of aortic events was 4.5% (282/6269). The aortic event rate was higher in every comorbidity group compared to patients without it, statistically significantly in patients with hypertension ($p < 0.0001$), PAD ($p < 0.0001$), CAD ($p=0.002$), CKD ($p < 0.0001$), hyperlipidemia ($p < 0.0001$), DM group ($p=0.0005$), smoking ($p < 0.0001$). The aortic event rate was especially high in patients with hypertension (7% vs 2% in patients without it), PAD (9% vs 4%), and smoking (7% vs 4%). Specificity for an aortic event varied among comorbidities, with the following comorbidities exhibiting specificity > 0.80: CKD (0.81), COPD (0.87), PAD (0.93), smoking (0.85). Assessment of the event rate based on the initial aortic diameter and presence of comorbidities showed that hypertension, PAD, and smoking are significant independent predictors, but there was no significant interaction between comorbidities and the initial diameter. I.e. the association between the aortic event and the comorbidities is similar in patients regardless of the initial aortic diameter.

CLINICAL RELEVANCE/APPLICATION

The presence of certain comorbidities might influence the decision regarding the frequency of imaging follow-up and timing of surgical intervention.

SSVA03-2 Perfusion DSA Of The Abdominal Aorta During EVAR: A Work-in-progress

Participants
Stavros Charalambous, Heraklion Crete, Greece (*Presenter*) Nothing to Disclose

PURPOSE

To present a novel perfusion-based digital subtraction angiography (DSA) technique to assess the perfusion of the aneurysm sac in the presence of an endoleak during endovascular aneurysm repair (EVAR).*Methods and Materials Eight patients (all males; median age 78y) who underwent EVAR for infra-renal abdominal aortic aneurysm (AAA) were examined with perfusion DSA after detection of endoleak with standard DSA. For perfusion DSA (SmartPerfusion; Philips Healthcare), a standardized protocol was used with a 5-

Fr diagnostic catheter placed at the level of supra-renal abdominal aorta. Perfusion images were obtained from the level of renal arteries to the external iliac arteries after injection of 30mL of iodinated contrast media at a flow rate of 15mL/s. Subsequent perfusion images were automatically reconstructed on a dedicate workstation. Eight different perfusion indices were investigated, i.e. arrival time (AT), time to peak (TTP), wash in rate (WiR), wash out rate (WoR), mean transit time (MTT), width (Wid), peak density (PD) and area under curve (AUC). To assess the perfusion of the aneurysm sac, a region of interest (ROI) was placed within the aneurysm sac to determine the time-density curve, reflecting the actual perfusion of the AAA in time.*Results Completion DSA revealed type-II endoleak in all patients and this finding was confirmed by follow-up CT examination. A wide range of perfusion indices was presented to all study participants. In particular, the median value with interquartile range differences of all examined indices were as follow: AT (3.7; 1.3-6.1), TTP (10.35; 4.9-16.9), WiR (35.2; 22.9-73.6), WoR (17.1; 10.1-30.9), MTT (11.5; 6.4-18.7), Wid (11.1; 9.4-13.3), PD (1492.6; 901-2073) and AUC (48558.9; 24503.6-71501.6). The median dose-area-product (DAP) associated with the perfusion DSA study was significant lower than the median total DAP reported by the entire EVAR procedure (69.9 vs 200 Gy.cm2, respectively; p<0.01).*Conclusions Perfusion DSA represents a promising real-time diagnostic tool for the accurate diagnosis, early determination and clinical significance of endoleaks after EVAR.*Clinical Relevance/Application The wide range that was recorded in all perfusion indices may indicate that different endoleaks present variable hemodynamic characteristics, and thus, may be associated with a variable prognosis.

RESULTS

Completion DSA revealed type-II endoleak in all patients and this finding was confirmed by follow-up CT examination. A wide range of perfusion indices was presented to all study participants. In particular, the median value with interquartile range differences of all examined indices were as follow: AT (3.7; 1.3-6.1), TTP (10.35; 4.9-16.9), WiR (35.2; 22.9-73.6), WoR (17.1; 10.1-30.9), MTT (11.5; 6.4-18.7), Wid (11.1; 9.4-13.3), PD (1492.6; 901-2073) and AUC (48558.9; 24503.6-71501.6). The median dose-area-product (DAP) associated with the perfusion DSA study was significant lower than the median total DAP reported by the entire EVAR procedure (69.9 vs 200 Gy.cm2, respectively; p<0.01).

CLINICAL RELEVANCE/APPLICATION

The wide range that was recorded in all perfusion indices may indicate that different endoleaks present variable hemodynamic characteristics, and thus, may be associated with a variable prognosis.

SSVA03-3   BAY1747846: A Novel Tetrameric, Macrocyclic Gadolinium-based Contrast Agent With A High Relaxivity For CE-MRI

Participants
Hubertus Pietsch, PhD, Berlin, Germany (*Presenter*) Employee, Bayer AG

PURPOSE

BAY1747846 is a novel tetrameric, macrocyclic gadolinium (Gd)-based contrast agent (GBCA) exhibiting high stability and high relaxivity, providing the possibility of substantially lowering the Gd dose for CE-MR imaging. This study aims to characterize the key physico-chemical and pharmacokinetic properties as well as features for use in CE-MRI.*Methods and Materials The T1-relaxivity of BAY1747846 was determined at 1.41T. The complex stability was analyzed in human serum over 15 days (pH 7.5, 37°C). Pharmacokinetic studies were performed in rats. MR imaging was investigated in healthy Goettingen minipigs on a clinical 1.5T MR system using routine clinical imaging procedures for MR Angiography (MRA). In time-resolved MRA (TWIST) 2 different doses of BAY1747846 (0.025 and 0.03 mmol Gd/kg) were compared to the clinical standard dose (0.1 mmol Gd/kg) of gadoterate meglumine and gadobutrol.*Results BAY1747846 with its tetrameric structure shows pronounced T1-relaxivity (r1: 47.2 mM-1·s-1 per molecule corresponding to 11.8 mM-1·s-1 per Gd at 1.41T in human plasma). Due to the high kinetic inertness of the chelate no release of Gd was observed during 15 days under physiological conditions. Pharmacokinetics showed fast distribution into extracellular space and essentially complete renal elimination in an unchanged form, as also known for other macrocyclic GBCAs. The evaluation of MRI demonstrated similar signal enhancement profiles for BAY1747846 at approximately 70% reduced Gd dose compared to the approved macrocyclic GBCAs (gadobutrol and gadoterate meglumine) administered at the standard dose.*Conclusions BAY1747846, a next generation, macrocyclic GBCA offers a high relaxivity which allows a substantial reduction of the Gd dose, while ensuring high stability of macrocyclic GBCA. The signal enhancements in 4D-MRA at relevantly reduced Gd dose was similar compared to the marketed GBCAs gadoterate meglumine and gadobutrol at a standard dose.*Clinical Relevance/Application Health authorities recommend the lowest approved dose to be utilized and to limit repeated exposures of GBCAs. BAY1747846 will enable a substantial Gd dose reduction compared to the standard GBCA dose as of today.

RESULTS

BAY1747846 with its tetrameric structure shows pronounced T1-relaxivity (r1: 47.2 mM-1·s-1 per molecule corresponding to 11.8 mM-1·s-1 per Gd at 1.41T in human plasma). Due to the high kinetic inertness of the chelate no release of Gd was observed during 15 days under physiological conditions. Pharmacokinetics showed fast distribution into extracellular space and essentially complete renal elimination in an unchanged form, as also known for other macrocyclic GBCAs. The evaluation of MRI demonstrated similar signal enhancement profiles for BAY1747846 at approximately 70% reduced Gd dose compared to the approved macrocyclic GBCAs (gadobutrol and gadoterate meglumine) administered at the standard dose.

CLINICAL RELEVANCE/APPLICATION

Health authorities recommend the lowest approved dose to be utilized and to limit repeated exposures of GBCAs. BAY1747846 will enable a substantial Gd dose reduction compared to the standard GBCA dose as of today.

SSVA03-4   False Lumen Regurgitant Fraction At Entry Tear Predicts Adverse Aorta-related Events In Type B Aortic Dissection

Participants
Bradley Allen, MD, Chicago, Illinois (*Presenter*) Consultant, Circle Cardiovascular Imaging Inc;Speaker, Medscape, LLC

PURPOSE

Prior studies suggest false lumen (FL) regurgitant fraction (RF) (%flow from FL retrograde to true lumen) at the entry tear (ET) in descending aortic dissection (DAD) correlates with aorta growth, but it is not clear how this relates to patient outcomes. This study compares both 4D flow MRI-derived in vivo FL RF and aorta diameters in DAD patients with and without adverse aorta-related outcomes (AARO - defined as aortic intervention or aorta-related mortality).*Methods and Materials DAD patients were retrospectively identified from a cohort of patients with MRA of the thoracic aorta with 4D flow under an IRB-approved protocol. Patients with prior descending aorta intervention were excluded. 4D flow was evaluated in dedicated clinical software (cvi42, Circle,

Calgary). The ET was identified by a cardiovascular radiologist who was blinded to AARO status. An analysis plane was placed orthogonal to the direction of antegrade flow at the ET and a region of interest encompassing ET flow was manually drawn at each phase. The same radiologist measured the maximal diameter of the descending aorta (DAo) and false lumen (FLD) on the standard MRA. Group-wise differences between morphologic and hemodynamic parameters were compared using Kruskal Wallis test. A combined model of significant parameters was created using multivariate linear regression. ROC analysis was used to compare AARO classification of individual parameters and the combined model.*Results A total of 31 patients met inclusion criteria, including n = 8 AARO patients (26%, 57±6 years-old, 5/3 M/F) and n = 23 non-AARO patients (74%, 62±14 years-old, 14/9 M/F). Follow-up interval for non-AARO was 2.5±2.6 years and time-to-AARO was 0.9±0.7 years. A total of 14 patients had prior type A dissection repair and 6 patients had connective tissue disease. AARO patients had larger DAo (51±6 mm vs. 42±8 mm, p = 0.01), FLD (48±6 mm vs. 39±7 mm, p = 0.004), and FL RF (47±39% vs. 15±20%, p = 0.006). The combined model included DAo, FLD, FL RF (R = 0.55, p = 0.02) and exhibited the highest AUC (0.86) relative to individual parameters alone (DAo: 0.82, FLD: 0.85, FL RF: 0.74).*Conclusions DAo, FLD, and FL RF are increased in DAD patients with AARO. Since most surgery decisions are heavily influenced by aortic diameter, it is difficult to discern the true added value of FL RF in this retrospective study, but our findings support the hypothesis that a combination of hemodynamic and morphologic parameters has the potential to improve prospective risk-stratification.*Clinical Relevance/Application Incorporating in vivo 4D flow MRI entry tear hemodynamics in combination with standard morphologic features (i.e. aortic diameter) may improve risk-stratification and treatment selection in descending aortic dissection patients.

RESULTS

A total of 31 patients met inclusion criteria, including n = 8 AARO patients (26%, 57±6 years-old, 5/3 M/F) and n = 23 non-AARO patients (74%, 62±14 years-old, 14/9 M/F). Follow-up interval for non-AARO was 2.5±2.6 years and time-to-AARO was 0.9±0.7 years. A total of 14 patients had prior type A dissection repair and 6 patients had connective tissue disease. AARO patients had larger DAo (51±6 mm vs. 42±8 mm, p = 0.01), FLD (48±6 mm vs. 39±7 mm, p = 0.004), and FL RF (47±39% vs. 15±20%, p = 0.006). The combined model included DAo, FLD, FL RF (R = 0.55, p = 0.02) and exhibited the highest AUC (0.86) relative to individual parameters alone (DAo: 0.82, FLD: 0.85, FL RF: 0.74).

CLINICAL RELEVANCE/APPLICATION

Incorporating in vivo 4D flow MRI entry tear hemodynamics in combination with standard morphologic features (i.e. aortic diameter) may improve risk-stratification and treatment selection in descending aortic dissection patients.

SSVA03-5 Accuracy Of Non-contrast Magnetic Resonance Angiography Using Inflow-sensitive Inversion Recovery (IFIR) Technique For Upper Abdominal Arterial Vessels Evaluation: Comparison With Contrast-enhanced Magnetic Resonance Angiography And Computed Tomography Angiography

Participants
Marco Porta, MD, Senago, Italy (*Presenter*) Nothing to Disclose

PURPOSE

Inflow-sensitive inversion recovery (IFIR) is a technique recently introduced to perform unenhanced Magnetic Resonance Angiography (MRA). The aim of our study is to retrospectively determine the accuracy of IFIR-MRA in the evaluation of main upper abdominal arteries, compared to Contrast Enhanced-MRA (CE-MRA) and Computed Tomography Angiography (CTA).*Methods and Materials Seventy patients underwent upper abdomen IFIR-MRA in different clinical settings. Qualitative comparison with CE-MRA (65 patients) and CTA (39 patients) was performed by using a 4-point scale. Celiac trunk (CA), common-proper-left-right hepatic artery (C-P-L-R-HA), left gastric artery (LGA), gastroduodenal artery (GA), splenic artery (SA), renal arteries (RA) and superior mesenteric artery (SMA) were assessed.*Results IFIR-MRA images were better rated in comparison with CE-MRA. Particularly, all arteries obtained a statistically significant higher qualitative rating value (all p<0.05). IFIR-MRA and CE-MRA exhibited acceptable intraclass correlation coefficients (ICC) values for CA, C-L-R-HA, and SMA (ICC 0.507, 0.591, 0.615, 0.570, 0.525). IFIR-MRA and CTA showed significant correlations in C-P-L-R-HA (Tau=0.362, 0.261, 0.308, 0.307, respectively; p<0.05) and both RA (Tau=0.279, p<0.05).*Conclusions Compared to CE-MRA, IFIR-MRA demonstrated a higher image quality in the main upper abdomen arterial vessels assessment. In particular LHA and RHA branches could be better visualized with IFIR sequences. This suggests the possibility to routinely integrate non-contrast IFIR-MRA in upper abdomen MR studies, especially in liver transplant patients.*Clinical Relevance/Application IFIR-MRA is a reliable diagnostic tool for the evaluation of abdominal vessels architecture in those patients with contraindication to contrast media injection

RESULTS

IFIR-MRA images were better rated in comparison with CE-MRA. Particularly, all arteries obtained a statistically significant higher qualitative rating value (all p<0.05). IFIR-MRA and CE-MRA exhibited acceptable intraclass correlation coefficients (ICC) values for CA, C-L-R-HA, and SMA (ICC 0.507, 0.591, 0.615, 0.570, 0.525). IFIR-MRA and CTA showed significant correlations in C-P-L-R-HA (Tau=0.362, 0.261, 0.308, 0.307, respectively; p<0.05) and both RA (Tau=0.279, p<0.05).

CLINICAL RELEVANCE/APPLICATION

IFIR-MRA is a reliable diagnostic tool for the evaluation of abdominal vessels architecture in those patients with contraindication to contrast media injection

SSVA03-6 Baseline 4D Flow-derived In Vivo Kinetic Energy Stratifies Descending Aorta Dissection Patients With Enlarging Aortas

Participants
Stanley Chu, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Increasing aorta diameter is associated with increasing morbidity, mortality, and need for surgical or endovascular intervention in patients with descending aorta dissection. Imaging-based risk-stratification has focused on baseline aortic diameter and growth, but aorta hemodynamics (flow and pressure) in both the true and false lumen (TL and FL) may provide additional information. Our study used 4D flow MRI to quantify the in vivo volumetric TL and FL kinetic energy (KE - a marker of dynamic pressure) to determine their relationship with aortic diameter change.*Methods and Materials Using an IRB approved protocol, we retrospectively identified descending aorta (DAo) dissection patients with thoracic aorta MRA including 4D flow MRI and follow-up aorta imaging (MRA or CTA) at least 3 months later. Patients with prior DAo intervention were excluded. The FL and TL were manually segmented

from 4D flow MRI data (Mimics, Materialise, Belgium). Total kinetic energy throughout the cardiac cycle was quantified in MatLab (MathWorks, USA) using the formula KE = 0.5 x ? x dV x v(t)2, with ? the blood density assumed as 1060 kg/m3, dV the unit voxel volume, and v(t) the velocity magnitude, and then summed over the entire volume and cardiac cycle. Maximal DAo diameters of the index MRA and follow-up study were measured by an experienced cardiovascular radiologist. Groups were divided based on growth rate >3 mm/year. Index aortic diameter, TL KE, FL KE, and the KE ratio (FL KE/TL KE) were compared between groups using the Mann-Whitney U test.*Results A total of 17 patients met inclusion criteria (age: 59 ± 11 years, M/F: 12/5, n = 3 with connective tissue disease, n = 9 prior type A repair), with n = 5 in the aortic growth group and n = 12 in the non-growth group. There was no difference in index aortic diameters (p = .08), FL KE (p = .28), or TL KE (p = .38), but the KE ratio was significantly higher (larger ratio FL KE to TL KE) in the aortic growth group (p = 0.04).*Conclusions The ratio of FL KE to TL KE may reflect the relative differences in FL and TL dynamic pressure and was larger in aortic growth patients on index imaging. The baseline aortic diameter, which is commonly used for risk-stratification, was not statistically different between these groups. This result demonstrates the potential role of in vivo hemodynamic assessment for improved risk-stratification of descending aorta dissection.*Clinical Relevance/Application Prospectively identifying descending aorta dissection patients at-risk of adverse aortic remodeling has important treatment implications and in vivo true and false lumen kinetic energy may aid in risk-stratification.

RESULTS

A total of 17 patients met inclusion criteria (age: 59 ± 11 years, M/F: 12/5, n = 3 with connective tissue disease, n = 9 prior type A repair), with n = 5 in the aortic growth group and n = 12 in the non-growth group. There was no difference in index aortic diameters (p = .08), FL KE (p = .28), or TL KE (p = .38), but the KE ratio was significantly higher (larger ratio FL KE to TL KE) in the aortic growth group (p = 0.04).

CLINICAL RELEVANCE/APPLICATION

Prospectively identifying descending aorta dissection patients at-risk of adverse aortic remodeling has important treatment implications and in vivo true and false lumen kinetic energy may aid in risk-stratification.

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SSPH14
Physics (CT Image Quality II)

Participants
Scott Hsieh, Rochester, Minnesota (*Moderator*) Nothing to Disclose

Sub-Events

SSPH14-1 Diagnostic Performance Of Whole-body Ultra-low Dose Computed Tomography For Detection Of Mechanical Ventriculoperitoneal Shunt Complications: A Retrospective Analysis

Participants
Saif Afat, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the diagnostic performance of Whole-Body Ultra Low-Dose computed tomography (WB-ULD-CT) for detecting mechanical ventriculoperitoneal (VP)-Shunt complications.*Methods and Materials This study included 186 patients (median age: 54,8 y; 18-88 y; 101 female) who underwent WB-ULD-CT (100 kVp; reference tube current, 10 mAs). Two radiologists independently reviewed the images for the presence/absence of VP-Shunt complications, overall image quality, and diagnostic confidence. On a five-point Likert scale, readers scored image quality (1= very low, 5= very high) and diagnostic confidence (1= low confidence, 5= very high confidence). Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for WB-ULD-CT compared to final clinical diagnosis as a reference standard. Radiation dose estimation of WB-ULD-CT was calculated and compared to the radiation dose of radiographic shunt series.*Results Thirty-four of the 186 included patients had confirmed mechanical VP-Shunt complications. All positive patients were correctly identified on WB-ULD-CT by both readers. No false positive or false negative cases were recorded by any of the readers, yielding a sensitivity of 100 % (95% CI, 87.3%, 100%), a specificity of 100 % (95% CI, 96.9%, 100%), and a perfect agreement (? = 1). WB-ULD-CT revealed a high PPV and NPV of 100%. Shunt-specific image quality was rated very high (median score, 5 range, 5-5). Diagnostic confidence was rated very high (median score, 5; range, 5-5). Interobserver agreement was substantial for image quality (? = 0.73) and for diagnostic confidence (? = 0.78). The mean radiation dose of WB-ULD-CT was significantly lower than radiation dose of conventional radiographic shunt series (0.67 ± 0.4 mSv vs. 1.57 ± 0.6 mSv, 95% CI: 0.79-1.0, p<0.001)*Conclusions WB-ULD-CT allows detection of VP-Shunt complications with excellent diagnostic accuracy and diagnostic confidence.*Clinical Relevance/Application WB-ULD-CT can potentially replace the radiographic shunt series as a new ''gold standard''

RESULTS

Thirty-four of the 186 included patients had confirmed mechanical VP-Shunt complications. All positive patients were correctly identified on WB-ULD-CT by both readers. No false positive or false negative cases were recorded by any of the readers, yielding a sensitivity of 100 % (95% CI, 87.3%, 100%), a specificity of 100 % (95% CI, 96.9%, 100%), and a perfect agreement (? = 1). WB-ULD-CT revealed a high PPV and NPV of 100%. Shunt-specific image quality was rated very high (median score, 5 range, 5-5). Diagnostic confidence was rated very high (median score, 5; range, 5-5). Interobserver agreement was substantial for image quality (? = 0.73) and for diagnostic confidence (? = 0.78). The mean radiation dose of WB-ULD-CT was significantly lower than radiation dose of conventional radiographic shunt series (0.67 ± 0.4 mSv vs. 1.57 ± 0.6 mSv, 95% CI: 0.79-1.0, p<0.001)

CLINICAL RELEVANCE/APPLICATION

WB-ULD-CT can potentially replace the radiographic shunt series as a new ''gold standard''

SSPH14-2 Creating Individualized Learner Models: Predicting Missed Liver Metastases From CT Images Using Deep Convolutional Neural Networks

Participants
Scott Hsieh, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this work was to use deep convolutional neural networks (CNNs) to predict radiologist performance for detecting hepatic metastases from contrast-enhanced CT images. Individualized prediction of difficult lesions may allow targeted training of idiosyncratic weaknesses.*Methods and Materials 10 subspecialized abdominal radiologists, blinded to clinical and imaging information, marked all suspected metastases in a multi-reader-multi-case study of 102 CT liver scans at multiple radiation dose levels. A reference reader marked metastatic and benign lesions according to predefined reference criteria. 51 of 102 patients had 124 hepatic metastases that were assigned binary labels of "detected" or "missed" by individual readers. These labeled images were used to train CNNs, which included a preprocessing pipeline of up-sampling, data augmentation, transfer learning, and dropout to reduce overfitting. The reader performance data was partitioned into 5 folds for five-fold cross-validation. We compared generalized and individualized prediction of missed lesions. In the generalized prediction, the CNN was trained with labels of "detected" if found by more than 25% of all readers or "missed" otherwise. In the individualized prediction, the CNN was trained with labels derived only from a single radiologist.*Results Reader sensitivity ranged from 67.3% to 93.0%. Individualized CNNs obtained an average area under the receiver operating characteristic curve (AUC) of 0.82 (+/- 0.04) in categorizing lesions as missed or detected by the 10 readers across the test sets for each fold. The generalized CNN obtained an average AUC of 0.74 (+/- 0.04).*Conclusions Deep CNNs may be used to create generalized or individualized learner models to predict which hepatic metastases may be missed by an

individual abdominal radiologist. An individualized CNN provides higher performance than a generalized CNN in predicting reader-specific lesion detectability but requires substantial training data for each reader. In situations where this training data cannot be collected, a generalized CNN may be an efficient method for identifying metastases that could be used for radiologist training.*Clinical Relevance/Application The ability to accurately identify liver metastases missed by many radiologists as well as individual radiologists may be used to improve reader performance and reduce interobserver variability.

RESULTS

Reader sensitivity ranged from 67.3% to 93.0%. Individualized CNNs obtained an average area under the receiver operating characteristic curve (AUC) of 0.82 (+/- 0.04) in categorizing lesions as missed or detected by the 10 readers across the test sets for each fold. The generalized CNN obtained an average AUC of 0.74 (+/- 0.04).

CLINICAL RELEVANCE/APPLICATION

The ability to accurately identify liver metastases missed by many radiologists as well as individual radiologists may be used to improve reader performance and reduce interobserver variability.

SSPH14-3   Impact Of Multiplanar Reformations On CT Image Quality With Model-based Iterative And Deep Learning Reconstructions: A Task-based Phantom Study

Participants
Damien Racine, Lausanne, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

In daily clinical practice, multiplanar CT reformations are routinely used for diagnostic purposes. Recent introduction of deep learning image reconstruction algorithms allowed for a significant dose reduction while preserving the objective image quality in the axial plane. The purpose of this work was to evaluate detailed physical metrics and detectability of simulated cervical spine disc herniations in the coronal and sagittal planes compared with axial images.*Methods and Materials A custom cubic phantom was scanned on the Apex GE CT scanner with a dedicated cervical spine protocol at CTDIvol of 17, 10, 5 and 2.5mGy. Images were reconstructed in the axial, coronal and sagittal planes with a standard kernel using two reconstruction algorithms at several strength levels: model-based iterative (ASiR-V 0%, 50% and 100%) and deep learning image reconstruction (True Fidelity (TF) low, medium and high). Task-based transfer function (TTF) and noise power spectrum (NPS) were computed to estimate spatial resolution and noise properties of the images in all three planes. Detectability indexes of simulated disc herniations (|?HU| = 50) were calculated using the nonprewhitening with eye filter model observer.*Results At all dose levels and with all reconstruction algorithms, spatial resolution decreased in the coronal and sagittal planes compared with axial images. Conversely, noise magnitude increased when switching from axial to coronal or sagittal reformations. Overall, TF outperformed ASiR-V in all image reconstruction planes. For the task of simulated disc herniations, detectability indexes were significantly higher in the axial than in coronal or sagittal planes. Moreover, increasing TF strength level substantially enhanced detectability at any dose level in all three image reconstruction planes.*Conclusions CT images acquired in the same conditions but reconstructed in different planes exhibit differences in spatial resolution and noise power spectrum, ultimately affecting lesion detectability.*Clinical Relevance/Application While clinically useful, multiplanar reformations should be used with caution with model-based iterative and deep learning image reconstructions as lesion detectability is intrinsically reduced.

RESULTS

At all dose levels and with all reconstruction algorithms, spatial resolution decreased in the coronal and sagittal planes compared with axial images. Conversely, noise magnitude increased when switching from axial to coronal or sagittal reformations. Overall, TF outperformed ASiR-V in all image reconstruction planes. For the task of simulated disc herniations, detectability indexes were significantly higher in the axial than in coronal or sagittal planes. Moreover, increasing TF strength level substantially enhanced detectability at any dose level in all three image reconstruction planes.

CLINICAL RELEVANCE/APPLICATION

While clinically useful, multiplanar reformations should be used with caution with model-based iterative and deep learning image reconstructions as lesion detectability is intrinsically reduced.

SSPH14-4   Radiologist, Workstation, And Image Features Affecting Liver Metastasis Detection Performance In Abdominal CT

Participants
Scott Hsieh, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Radiologist readers detect lesions in an imaging dataset by navigating stacks of images - scrolling, windowing, and zooming - while systematically examining the entire volume. We sought to determine if some patterns of navigation were associated with higher performance.*Methods and Materials After IRB approval, 25 readers (9 subspecialized abdominal radiologists, 5 non-abdominal subspecialists, 11 residents/fellows) interpreted 40 portal phase abdominal CT exams selected to contain challenging lesions. Metastases were independently confirmed by histopathology or progression. Radiologists marked suspected liver metastases, rating confidence (1-100). A custom workstation measured scrolling in coronal and axial dimensions, viewing time in coronal and axial dimensions, choice of window width and level, use of zoom, and total interpretation time. Performance was quantified using overall sensitivity as well as the area under the jackknife-adjusted free ROC (JAFROC) curve. A confidence matrix was constructed describing the confidence rating for each reader. This matrix was analyzed using a clustergram, a hierarchical clustering algorithm traditionally applied in genetics, to discover patterns of false negatives.*Results There were 91 metastases (mean size 1.4 cm) in 30 patients. 10 of 40 patients had no metastases. The mean number of reader markings over all 40 exams was 134 (range 73-208) with a mean interpretation time of 6.3 ± 3.1 minutes per case. Mean ± SD JAFROC was 77 ± 3%, 69 ± 7%, 71 ± 3% for abdominal specialists, non-abdominal staff, and trainees, respectively (differences between groups, p < 0.01), with sensitivity being 85 ± 8%, 83 ± 11% and 83 ± 10%, and false positive count being 57 ± 30, 56 ± 18, and 60 ± 25 across all 40 exams. Time in liver windows, time spent looking at coronal images, and total number of marks correlated with improved sensitivity (p < 0.05), but not use of zoom or subspecialized training. The clustering analysis identified groups of metastases that were better or not as well detected by abdominal subspecialists.*Conclusions Subspecialized training and practice correlated with improved JAFROC scores. Abdominal subspecialists appear to be no better at detecting possible liver metastases, but once detected, they exhibited better judgment at rating risk of malignancy.*Clinical Relevance/Application Certain patterns of image navigation are associated with higher sensitivity in the task of liver metastasis detection. Subspecialists are able to attain higher performance through better judgment of

malignancy probability.

RESULTS

There were 91 metastases (mean size 1.4 cm) in 30 patients. 10 of 40 patients had no metastases. The mean number of reader markings over all 40 exams was 134 (range 73-208) with a mean interpretation time of 6.3 ± 3.1 minutes per case. Mean $\pm$ SD JAFROC was $77 \pm 3\%$, $69 \pm 7\%$, $71 \pm 3\%$ for abdominal specialists, non-abdominal staff, and trainees, respectively (differences between groups, $p < 0.01$), with sensitivity being $85 \pm 8\%$, $83 \pm 11\%$ and $83 \pm 10\%$, and false positive count being 57 ± 30, 56 ± 18, and 60 ± 25 across all 40 exams. Time in liver windows, time spent looking at coronal images, and total number of marks correlated with improved sensitivity ($p < 0.05$), but not use of zoom or subspecialized training. The clustering analysis identified groups of metastases that were better or not as well detected by abdominal subspecialists.

CLINICAL RELEVANCE/APPLICATION

Certain patterns of image navigation are associated with higher sensitivity in the task of liver metastasis detection. Subspecialists are able to attain higher performance through better judgment of malignancy probability.

SSPH14-5 CT Image Quality Optimization In The Age Of Deep Learning: A 3-way Tradeoff Among Noise Magnitude, Noise Texture, And Structure Similarity

Participants
Kai Yang, PhD, Boston, Massachusetts (*Presenter*) Research Consultant, Malcova, LLC.

PURPOSE

To evaluate the performance of different quantitative image quality metrics when comparing CT reconstruction algorithms including deep-learning image reconstruction (DLIR, True Fidelity, GE), filtered back-projection (FBP), and iterative reconstruction (ASiR-V).*Methods and Materials Axial CT scans of an anthropomorphic phantom (Kyoto Kagaku CTU-41) were acquired from a GE Revolution scanner using three different protocols: brain routine, abdomen pelvis routine, and chest routine, with four different dose levels ranging from scanner max power, to 100%, 50%, and 25% of protocol default dose. CT slices were reconstructed using two slice thicknesses, five strength levels of ASiR-V (0% for FBP, 10%, 40%, 80%, and 100%) and three levels of DLIR (low, medium, and high). 2D noise power spectrum (NPS) was estimated through Fourier analysis of difference images by subtracting two matching images from two repeated scans. Structure similarity index (SSIM) was determined using the max dose level FBP recon as the ground truth. Noise variance (overall noise magnitude), s2, frequency location of the 1D NPS peak (surrogate of noise texture), fpeak, and the mean SSIM (similarity to the ground truth), SSIMmean, were used as three quantitative metrics to compare image quality, which depended on anatomical region, protocol, algorithm, dose level, and slice thickness.*Results Noise magnitude, s2, had a strong ($R2>0.99$) power law relationship with dose level for all algorithms, with the exponent around -0.65, was reduced by 66% changing from 1.25 mm to 5 mm slice thickness, and by 8% for each 10% of increment of ASiR-V strength and by 24% for each increment of DLIR level from FBP. For abdomen and chest protocol, fpeak gradually shifted from 0.3 (FBP) to 0.15 mm-1 (ASiR-V 100%) with increasing ASiR-V strength, but maintained at about 0.3 mm-1 for different DLIR levels, indicating conservation of spatial resolution. However, fpeak shifted down for the brain protocol with increasing DLIR levels. For the 25% dose scans, 100% ASiR-V had SSIMmean (0.84 for brain and 0.63 for abdomen) values higher than all three levels of DLIR (0.76, 0.79, 0.82 for brain and 0.38, 0.45, 0.55 for abdomen), indicating higher similarity to ground truth.*Conclusions Three quantitative metrics were assessed with CT images of realistic anatomic structures. The unique behavior of DLIR was demonstrated and compared to ASiR-V and FBP.*Clinical Relevance/Application This study demonstrated trade-offs between noise magnitude, noise texture, and structural similarity when evaluating advanced noise-reduction reconstruction algorithms, including DLIR and ASiR-V.

RESULTS

Noise magnitude, s2, had a strong ($R2>0.99$) power law relationship with dose level for all algorithms, with the exponent around -0.65, was reduced by 66% changing from 1.25 mm to 5 mm slice thickness, and by 8% for each 10% of increment of ASiR-V strength and by 24% for each increment of DLIR level from FBP. For abdomen and chest protocol, fpeak gradually shifted from 0.3 (FBP) to 0.15 mm-1 (ASiR-V 100%) with increasing ASiR-V strength, but maintained at about 0.3 mm-1 for different DLIR levels, indicating conservation of spatial resolution. However, fpeak shifted down for the brain protocol with increasing DLIR levels. For the 25% dose scans, 100% ASiR-V had SSIMmean (0.84 for brain and 0.63 for abdomen) values higher than all three levels of DLIR (0.76, 0.79, 0.82 for brain and 0.38, 0.45, 0.55 for abdomen), indicating higher similarity to ground truth.

CLINICAL RELEVANCE/APPLICATION

This study demonstrated trade-offs between noise magnitude, noise texture, and structural similarity when evaluating advanced noise-reduction reconstruction algorithms, including DLIR and ASiR-V.

SSPH14-6 Nonlinear Image Quality Assessment Of Deep Learning Algorithms: Beyond Traditional Image-independent Measures

Participants
Junyuan Li, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

The nonlinear nature of deep learning algorithms has presented challenges to comprehensive evaluation of imaging performance. Traditional image quality metrics have often been evaluated in an image-independent manner and do not adequately capture the various dependencies of deep learning algorithms. In this work, we propose a perturbation response analysis framework to evaluate the nonlinear transfer characteristics of such algorithms.*Methods and Materials The framework was applied to a deep learning denoising algorithm for low dose lung CT. We systematically inserted lesion perturbations of various sizes, contrasts, and shapes into different locations of an example thorax image. Perturbation response was computed as the difference between the mean denoised image over 100 repeats with and without the perturbation. From these responses, we performed a threshold segmentation of lesions and generated radiomics transfer maps of various lesions features including size, contrast, and spiculation index. Furthermore, we evaluated noise transfer using variance and covariance around the perturbations. These transfer characteristics were compared with linear FBP reconstructions.*Results The perturbation response of a spherical lesion in both lung and soft tissue (heart) exhibit nonlinear dependencies on the size and contrast of the perturbation itself. Both visual inspection and the contrast transfer maps confirm a location dependency, with lower contrast recovery in the heart region. Similarly, for spiculated lesions, lesion shape is not faithfully represented for lesions below a certain size and contrast. In noise analysis, FBP shows smoothly varying variance maps while the deep learning algorithm produces high variances around the edges of both anatomy and the lesion perturbations.*Conclusions The perturbation response analysis framework provides a systematic way to probe the performance of

image- and stimuli-dependent deep learning algorithms. The radiomics transfer maps enables quantitative characterization of the various dependencies that determine whether clinically relevant lesion features can be faithfully represented.*Clinical Relevance/Application This work proposes an analysis framework that allows quantitative assessment of deep learning algorithms, forming the basis for algorithm optimization for clinically relevant diagnostic features.

RESULTS

The perturbation response of a spherical lesion in both lung and soft tissue (heart) exhibit nonlinear dependencies on the size and contrast of the perturbation itself. Both visual inspection and the contrast transfer maps confirm a location dependency, with lower contrast recovery in the heart region. Similarly, for spiculated lesions, lesion shape is not faithfully represented for lesions below a certain size and contrast. In noise analysis, FBP shows smoothly varying variance maps while the deep learning algorithm produces high variances around the edges of both anatomy and the lesion perturbations.

CLINICAL RELEVANCE/APPLICATION

This work proposes an analysis framework that allows quantitative assessment of deep learning algorithms, forming the basis for algorithm optimization for clinically relevant diagnostic features.

SSIR01

Interventional Radiology (Translational Research/Basic Science)

Participants

Rafael Duran, MD, Lausanne, Switzerland (*Moderator*) Research Grant, Boston Scientific Corporation;Research Consultant, Boston Scientific Corporation;Research Grant, Guerbet SA;Research Consultant, Guerbet SA
Andrew Gunn, MD, Vestavia Hills, Alabama (*Moderator*) Consultant, Boston Scientific Corporation;Speaker, Boston Scientific Corporation;Research support, Penumbra, Inc;Speaker, Terumo Corporation;Consultant, Varian Medical Systems, Inc;;
Lynn Savic, MD, Berlin, Germany (*Moderator*) Research Grant, Guerbet SA

Sub-Events

SSIR01-1   Non-invasive Molecular Imaging Allows Characterization Of The Immune Response Following Hepatic Radiofrequency Ablation (RFA) In A Mouse Model

Participants
Jessica Santana, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

To establish molecular magnetic resonance imaging (MRI) instruments for non-invasive characterization of the immune response to hepatic RFA in a mouse model.*Methods and Materials 72 C57BL/6 wild type mice underwent a standardized RFA (21G 5mm monopolar RF probe at 70 °C for 5 minutes) to generate a white coagulation zone of 6-7mm in diameter. CD68+ Macrophage infiltration in the transitional zone (TZ) was characterized with immunohistochemistry (IHC) 24 hours, 72 hours, 7 days, and 14 days post-ablation (n = 24). A subsequent ablated set of animals was injected with rhodamine-labeled superparamagnetic iron oxide nanoparticles (SPION) for non-invasive visualization of iron uptake by phagocytes using T2*-weighted imaging in a horizontal-bore 9.4 Tesla MRI scanner. Similarly, a separate group of RF ablated mice received 160Gadolinium (160Gad)-labeled CD68 antibody for longitudinal imaging of M1-macrophages using T1-weighted MR sequence. Radiological-pathological comparison was performed using Prussian-blue staining, immunofluorescence of rhodamine, imaging mass cytometry, and IHC staining of CD68 cell marker. Statistical analysis included two-tailed t test and Bonferroni test.*Results RFA induced periablational infiltration (206.92 μm ± 12.2 in diameter) of CD68+ macrophages (p<0.01) peaking at 7 days post-ablation compared to untreated lobe. T2*-weighted MRI with SPION contrast demonstrated curvilinear T2-signal in the periablational rim (measuring 186 μm ± 16.9). Imaging findings were referenced with histopathology, confirming accumulation of iron-labeled macrophages in the TZ. Similarly, T1-weighted MRI with 160Gad-CD68 antibody showed specific curvilinear signal in the TZ (164 μm ± 3.6 in diameter) corresponding to spatial signal distribution patterns detected by IMC. Quantitative analysis of signal intensity changes on both T2-SPIONs- and T1-160Gad-enhanced MRI showed a progressive loss in relative signal intensity ratio (rSI ratio) observed in the TZ over time*Conclusions Both SPION-enhanced T2*-weighted and 160Gad-enhanced T1-weighted MRI allows for non-invasive monitoring of macrophages, demonstrating the feasibility of this model as an investigational platform for the study of immune cell sub-populations in a locally inflamed part of the liver following RF*Clinical Relevance/Application Reproducible in vivo methods designed to bridge the dynamic nature of macrophage response and RFA therapy outcomes would ultimately allow real-time monitoring and modulation of its clinical side-effect

RESULTS

RFA induced periablational infiltration (206.92 μm ± 12.2 in diameter) of CD68+ macrophages (p<0.01) peaking at 7 days post-ablation compared to untreated lobe. T2*-weighted MRI with SPION contrast demonstrated curvilinear T2-signal in the periablational rim (measuring 186 μm ± 16.9). Imaging findings were referenced with histopathology, confirming accumulation of iron-labeled macrophages in the TZ. Similarly, T1-weighted MRI with 160Gad-CD68 antibody showed specific curvilinear signal in the TZ (164 μm ± 3.6 in diameter) corresponding to spatial signal distribution patterns detected by IMC. Quantitative analysis of signal intensity changes on both T2-SPIONs- and T1-160Gad-enhanced MRI showed a progressive loss in relative signal intensity ratio (rSI ratio) observed in the TZ over time

CLINICAL RELEVANCE/APPLICATION

Reproducible in vivo methods designed to bridge the dynamic nature of macrophage response and RFA therapy outcomes would ultimately allow real-time monitoring and modulation of its clinical side-effect

SSIR01-4   Hepatic Hypertrophy And Molecular Response Following Portal Vein Embolization Using Two Different Embolic Agents: A Comparative Study In Swine With Cirrhotic And Normal Underlying Liver.

Participants
Tom Kuhn, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Portal vein embolization (PVE) is the worldwide standard of care for liver cancer patients with an inadequate future liver remnant (FLR). Till now, there have been no large animal studies ever studying the hypertrophy potential & molecular effects of PVE using embolic agents in a cirrhotic background & comparing them to a normal liver.*Methods and Materials After Institutional Animal Care and Use Committee (IACUC) approval, 14 Yorkshire pigs were separated into a cirrhotic (CG) & non-cirrhotic group (NCG) & then further subgrouped into one using N-butyl cyanoacrylate (NBCA) & the other using microspheres & coils (MC); each subgroup

consisted of three animals & one control for NCG & CG each. The CG received a 3:1 Lipiodol & Ethanol mix intraarterially, developing biopsy-confirmed cirrhosis after four weeks. All animals then received a baseline contrast-Computed tomography (CT), PVE including pre- & post-PVE pressure measurements, and a Cone beam-CT post-procedure. Animals underwent follow-up imaging two & four weeks post-PVE, and manual volumetry was performed. After euthanization, histological liver samples were stained for CD3, CD16, KI67 & Caspase 3. Statistical analyses were performed using t-test comparing means of two groups or one-way-ANOVA analysis for multi-comparisons.*Results Standardized FLR% (sFLR%) two weeks post-PVE was 58.43% (SD:3.66%), 52.24% (SD:0.88%); 46.02% (SD:2.24%), and 47.24% (SD:0.40%) for MC in a normal vs. cirrhotic liver & NBCA in a normal vs. cirrhotic liver, respectively. sFLR% four weeks post-PVE was 60.48% (SD:3.88%), 54.85% (SD:0.83%); 60.35% (SD:3.45%), and 54.15% (SD:0.95%). Absolute sFLR% increase four weeks post-PVE was 18.82% (p<0.01) in the NCG vs. 10.93% (p<0.01) in the CG. Quantified signal intensity for CD3 & CD16 in the NCG vs. CG was 51.07 vs. 61.90 (p<0.01) & 43.70 vs. 53.81 (p<0.01). Signal intensity for KI67 in the embolized vs. non-embolized lobe comparing the NCG vs. CG was 47.55 vs. 70.29 (p<0.01) & 36.38 vs. 44.86 (p<0.01). Signal intensity for Caspase 3 in the embolized vs. non-embolized lobe comparing the NCG vs. CG was 62.10 vs. 52.10 (p<0.01) & 83.68 vs. 63.89 (p<0.01). Technical successful PVE was achieved in all animals.*Conclusions Our study showed that the use of microspheres and coils is preferred to NBCA when a substantial and rapid FLR increase is needed, both in cirrhotic and non-cirrhotic liver.*Clinical Relevance/Application Cirrhotic liver cancer patients, giving their nature of a reduced liver function and decreased regenerative potential, are particularly relying on a rapid and sustained FLR volume increase, giving them the possibility of curative care.

RESULTS

Standardized FLR% (sFLR%) two weeks post-PVE was 58.43% (SD:3.66%), 52.24% (SD:0.88%); 46.02% (SD:2.24%), and 47.24% (SD:0.40%) for MC in a normal vs. cirrhotic liver & NBCA in a normal vs. cirrhotic liver, respectively. sFLR% four weeks post-PVE was 60.48% (SD:3.88%), 54.85% (SD:0.83%); 60.35% (SD:3.45%), and 54.15% (SD:0.95%). Absolute sFLR% increase four weeks post-PVE was 18.82% (p<0.01) in the NCG vs. 10.93% (p<0.01) in the CG. Quantified signal intensity for CD3 & CD16 in the NCG vs. CG was 51.07 vs. 61.90 (p<0.01) & 43.70 vs. 53.81 (p<0.01). Signal intensity for KI67 in the embolized vs. non-embolized lobe comparing the NCG vs. CG was 47.55 vs. 70.29 (p<0.01) & 36.38 vs. 44.86 (p<0.01). Signal intensity for Caspase 3 in the embolized vs. non-embolized lobe comparing the NCG vs. CG was 62.10 vs. 52.10 (p<0.01) & 83.68 vs. 63.89 (p<0.01). Technical successful PVE was achieved in all animals.

CLINICAL RELEVANCE/APPLICATION

Cirrhotic liver cancer patients, giving their nature of a reduced liver function and decreased regenerative potential, are particularly relying on a rapid and sustained FLR volume increase, giving them the possibility of curative care.

SSIR01-5 Functional MRI Directed CT-guided Biopsies Of Focal Bone Lesions Can Improve Diagnostic Yield And Feasibility For Next Generation Tumor Sequencing In Cancer Patients

Participants
Ricardo Donners, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether functional MRI-directed lesion targeting for CT-guided bone biopsies in tumor patients can increase diagnostic and next generation sequencing (NGS) success rates.*Methods and Materials 113 CT-guided bone biopsies were performed by interventional radiologists (3/2013 to 2/2021) at our center. In 64 cases, contemporaneous diffusion-weighted MRI (DWI), apparent diffusion coefficient (ADC) and relative fat-fraction (rFF) images calculated from 2-point T1w Dixon MRI were available and retrospectively evaluated. In each patient, the biopsy tract was delineated on the biopsy CT and the ROI transferred via in-house software to corresponding slices on the ADC and rFF maps to record its mean, median, maximum, minimum, 10th and 90th centile values. On the same image sections, the targeted lesion was delineated on ADC and rFF and histogram parameters as above were exported. The signal intensity (SI) of the biopsied bone was visually classified on DWI and rFF as low or high SI. Chi² and unpaired T-tests were used to compare parameters between tumor positive/negative biopsies and feasible/non-feasible NGS, with p-values <0.05 deemed statistically significant.*Results There was no statistical difference between the ADC or rFF histogram parameters from the biopsy tract ROIs of positive/negative biopsies (each p> 0.068) or in NGS feasibility/non-feasibility (each p >0.433). Lesion analyses revealed lower mean ADC in tumor positive (834 ± 206 µm2/s) compared with negative biopsies (1002 ±305 µm2/s, p =0.031). Maximum rFF was lower in lesions where NGS was feasible (37 ±15%) compared with lesions where it failed (62 ±21%, p =0.008). A 41.5% maximum rFF value distinguished between NGS suitable and unsuitable areas with 73% sensitivity and 100% specificity. Biopsy tracts that were visually low in rFF SI, with high b50 and b900 SI and no T2 shine-through had 97% diagnostic success and 89% NGS feasibility rate (p < 0.001). These characteristics increased the likelihood for a positive biopsy outcome 13.6-fold.*Conclusions Functional MRI using DWI and rFF can help to improve the success of CT-guided bone biopsies and should be considered as part of the interventional workup.*Clinical Relevance/Application Bone metastases are common, but biopsy success rates are relatively poor. Pre-biopsy MRI using DWI and rFF may improve successful diagnosis and tumor NGS analysis.

RESULTS

There was no statistical difference between the ADC or rFF histogram parameters from the biopsy tract ROIs of positive/negative biopsies (each p> 0.068) or in NGS feasibility/non-feasibility (each p >0.433). Lesion analyses revealed lower mean ADC in tumor positive (834 ± 206 µm2/s) compared with negative biopsies (1002 ±305 µm2/s, p =0.031). Maximum rFF was lower in lesions where NGS was feasible (37 ±15%) compared with lesions where it failed (62 ±21%, p =0.008). A 41.5% maximum rFF value distinguished between NGS suitable and unsuitable areas with 73% sensitivity and 100% specificity. Biopsy tracts that were visually low in rFF SI, with high b50 and b900 SI and no T2 shine-through had 97% diagnostic success and 89% NGS feasibility rate (p < 0.001). These characteristics increased the likelihood for a positive biopsy outcome 13.6-fold.

CLINICAL RELEVANCE/APPLICATION

Bone metastases are common, but biopsy success rates are relatively poor. Pre-biopsy MRI using DWI and rFF may improve successful diagnosis and tumor NGS analysis.

SSIR01-6 Feasibility And Accuracy Of A Hands-free Robotic System For CT-guided Percutaneous Needle Insertion And Steering

Participants
Sebastian Flacke, MD, Burlington, Massachusetts (*Presenter*) Consultant, BTG International Ltd;Consultant, Surefire Medical, Inc;Consultant, Koninklijke Philips NV;Consultant, XACT Robotics Ltd

PURPOSE

To assess feasibility and accuracy of CT-guided needle insertion and steering for clinical biopsies using a novel, hands-free robotic system balancing system accuracy with duration of procedure and radiation dose.*Methods and Materials A prospective, multi-center study was conducted upon 60 clinically indicated biopsies of abdominal lesions at two centers (Center 1 n=26; Center 2 n=34). CT datasets were obtained for planning and controlled needle placement (insertion and steering) of 17-19g trocar needles using a patient-mounted, hands-free CT-guided robotic system with 5° freedom. Planning included target selection, skin entry point selection, linear or non-linear trajectory recommendation and predetermined checkpoints where additional imaging was performed to permit stepwise correction of needle trajectory. Success rate of robotic needle insertion and steering, needle tip to target distance, number of checkpoints used, number of trajectory corrections, procedure duration and effective radiation dose were recorded and compared between Centers. Significance level a was set to p=0.05.*Results 54 of 60 procedures (90%) were completed by the robot with positioning the trocar needle successfully on target. In the remaining 6 patients the procedure was manually performed by the operator due to technical failure (n=3) or patient related factors (n=3). Average lesion size was 2.7±1.8cm with a lesion depth from skin level of 8.6±2.6cm without differences between Centers (n.s.). Overall accuracy (needle tip to target distance) was 1.71±1.51 (0.05-7.20) mm with an accuracy of 2.06±1.45 mm at Center 1 and 1.45±1.52 mm at Center 2 (n.s.). Center 1 used a significant higher number of checkpoints (4.8 ±0.8) and performed target adjustments in 14 of 23 (61%) needle placements compared to Center 2 with 1.8±0.6 checkpoints and 8 of 31 target adjustments (26%), (p<0.001). Accordingly, insertion and steering duration from skin entry to target varied between Center 1 and 2 with 13.3min±4.2min and 5.6min±2.7min, respectively (p<0.001). Average DLP for the entire procedure was 1157±825 mGycm with a slightly lower average at Center 2 (1031±724 mGycm) compared to Center 1(1328 ±933 mGycm) (n.s.).*Conclusions Accurate needle targeting within 2mm error can be achieved in patients when using a hands-free CT-guided robotic system. Variation in the number of checkpoints did not affect system accuracy but related to shorter insertion and steering times and may contribute to lower radiation dose.*Clinical Relevance/Application Highly accurate needle insertion and steering using a hands-free CT-guided robotic system may facilitate difficult needle placement and enhance performance of less experienced interventionalists.

RESULTS

54 of 60 procedures (90%) were completed by the robot with positioning the trocar needle successfully on target. In the remaining 6 patients the procedure was manually performed by the operator due to technical failure (n=3) or patient related factors (n=3). Average lesion size was 2.7±1.8cm with a lesion depth from skin level of 8.6±2.6cm without differences between Centers (n.s.). Overall accuracy (needle tip to target distance) was 1.71±1.51 (0.05-7.20) mm with an accuracy of 2.06±1.45 mm at Center 1 and 1.45±1.52 mm at Center 2 (n.s.). Center 1 used a significant higher number of checkpoints (4.8 ±0.8) and performed target adjustments in 14 of 23 (61%) needle placements compared to Center 2 with 1.8±0.6 checkpoints and 8 of 31 target adjustments (26%), (p<0.001). Accordingly, insertion and steering duration from skin entry to target varied between Center 1 and 2 with 13.3min±4.2min and 5.6min±2.7min, respectively (p<0.001). Average DLP for the entire procedure was 1157±825 mGycm with a slightly lower average at Center 2 (1031±724 mGycm) compared to Center 1(1328 ±933 mGycm) (n.s.).

CLINICAL RELEVANCE/APPLICATION

Highly accurate needle insertion and steering using a hands-free CT-guided robotic system may facilitate difficult needle placement and enhance performance of less experienced interventionalists.

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Sub-Events

SPR-NPM-1 **Rad Bootcamp: Radiology, Equity, ; Inclusion - A Longitudinal Program Created Through A Multi-institutional Collaboration Diversifying The Radiology Pipeline And Providing Tools For Success**

Participants
Adlai Grayson, BSC, Kissimmee, Florida (*Presenter*) Nothing to Disclose

PURPOSE

Radiology suffers from low numbers of individuals identifying as underrepresented in medicine (URM). This can affect the cultural competency of the field and its ability to identify, understand, and address health disparities for underserved communities, especially those people that are members of communities of color.*Methods and Materials We present the rationale, design, and implementation of a multi-institutional intervention to increase URMs applying into radiology residencies. Rad Boot Camp: Radiology, Equity, Inclusion, is a free, open-to-all longitudinal program created through a collaboration among Massachusetts General Hospital, Emory Healthcare, and Vanderbilt Health with the support of the Student National Medical Association, Latino Medical Student Association, and Association of Native American Medical Students. The initiative consists of three focused interventions: education, mentorship, and research. Rad Bootcamp is structured as quarterly seminars with representation from diverse radiology leaders to provide information and resources supporting success in radiology. Using an end-user design, students inform seminar topics through surveys and participation on the steering committee. We surveyed students before and after the first seminar in October 2020 to evaluate the impact.*Results 180 medical students from 142 unique medical schools worldwide completed the first pre-seminar survey (20% Black, 17% Latinx, 33% Asian). They represented 21 countries, with the majority (72%) coming from the United States. Regarding exposure, 76.7% previously interacted with either a diagnostic or interventional radiologist. Most students had a Diagnostic Radiology (DR) or Interventional Radiology (IR) clerkships at their home institution, 77% and 48%, respectively. Fewer students had access to virtual DR (26%) or IR rotations (3%). Future topics of interest included research, life skills, global radiology, health disparities, and innovation. 150 students (83.3%) were interested in mentorship. Of the 180 registrants, 32 completed a post-event survey. There was a significant increase in comfort with preparing personal statements, electronic application entries, learning about programs, interviewing virtually, and reaching out to residents and program directors.*Conclusions Multi-institutional diversity efforts provide tools to URM students pursuing Radiology careers, encouraging the diversification of the pipeline.*Clinical Relevance/Application Using virtual educational tools extends our reach to more medical students. This model serves our increasingly diverse society and patient population through multi-institutional collaboration and support of students by diversifying the Radiology workforce.

RESULTS

180 medical students from 142 unique medical schools worldwide completed the first pre-seminar survey (20% Black, 17% Latinx, 33% Asian). They represented 21 countries, with the majority (72%) coming from the United States. Regarding exposure, 76.7% previously interacted with either a diagnostic or interventional radiologist. Most students had a Diagnostic Radiology (DR) or Interventional Radiology (IR) clerkships at their home institution, 77% and 48%, respectively. Fewer students had access to virtual DR (26%) or IR rotations (3%). Future topics of interest included research, life skills, global radiology, health disparities, and innovation. 150 students (83.3%) were interested in mentorship. Of the 180 registrants, 32 completed a post-event survey. There was a significant increase in comfort with preparing personal statements, electronic application entries, learning about programs, interviewing virtually, and reaching out to residents and program directors.

CLINICAL RELEVANCE/APPLICATION

Using virtual educational tools extends our reach to more medical students. This model serves our increasingly diverse society and patient population through multi-institutional collaboration and support of students by diversifying the Radiology workforce.

SPR-NPM-2 **Virtual Waiting Room ; Digitized Pre-procedure Forms: Radiology Workflow Innovations Driven By The COVID-19 Pandemic**

Participants
Vishal Desai, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

The COVID-19 pandemic has required drastic changes at imaging centers, including waiting room adaptations and changes to patient flow. We piloted a new app-based "virtual waiting room" (VWR) and digitized pre-procedure screening forms to meet new safety demands while optimizing patient throughput.*Methods and Materials VWR was piloted at our busiest outpatient imaging center beginning with MRI patients in Jul 2020. This tool enabled SMS reminders, virtual check-in when patients are within a preset radius, and pre-appointment completion of screening forms. After virtual check-in patients are notified when the center is ready and bypass the traditional waiting room. Patients were sent a voluntary survey to evaluate the VWR process. Screening forms for a subset were compared for completeness vs hand-written forms. Analytics were later integrated to assess impact on wait times.*Results 1749 MRI patients utilized VWR for SMS reminders. 226 patients opted for virtual check-in from Oct 2020-Apr 2021, with average virtual check in 23.5 min prior to scheduled appointment time (SD 28; traditional check-in=29.7±25 min; p=.001). Mean wait time until the center was ready to begin the MRI was 5.5 min (SD 13; traditional check-in=10.6±12 min; p=.0003). VWR

patients began their appointment on average 12.6 minutes before the scheduled time (SD 16; traditional check-in=2.7 min after ± 10; p<.0001). Survey results were received from 236 patients. Satisfaction rate was high - 92% would use VWR again and 93% felt communication was clear. 86% utilized VWR to prefill screening forms. No significant difference in responses among each age group. Most patients prefilled 2 forms prior to their appointment. Among the 41 VWR patients who had knee MRI, form completeness on the digital knee questionnaire was 100% for required fields. A control group of 20 knee MRI patients with hand-written forms had 72% completeness of required fields (p=.0004) with illegible responses in 10% of free response fields. *Conclusions Accelerated innovation during the pandemic led to the launch of VWR, which enhances social distancing without sacrificing appointment slots, has reduced wait times, and improves form completion via digitization. The tool was very well-received by survey respondents with a large majority planning to use it for future appointments. Continued analytics and survey review will allow us to optimize appointment time slots, enhance the VWR platform, and roll it out across our enterprise.*Clinical Relevance/Application VWR enhances patient safety, reduces wait times, improves form completion and has high patient satisfaction. Additional appointment time slot optimization and enterprise-wide rollout will allow for improved patient throughput and patient experience.

RESULTS

1749 MRI patients utilized VWR for SMS reminders. 226 patients opted for virtual check-in from Oct 2020-Apr 2021, with average virtual check in 23.5 min prior to scheduled appointment time (SD 28; traditional check-in=29.7±25 min; p=.001). Mean wait time until the center was ready to begin the MRI was 5.5 min (SD 13; traditional check-in=10.6±12 min; p=.0003). VWR patients began their appointment on average 12.6 minutes before the scheduled time (SD 16; traditional check-in=2.7 min after ± 10; p<.0001). Survey results were received from 236 patients. Satisfaction rate was high - 92% would use VWR again and 93% felt communication was clear. 86% utilized VWR to prefill screening forms. No significant difference in responses among each age group. Most patients prefilled 2 forms prior to their appointment. Among the 41 VWR patients who had knee MRI, form completeness on the digital knee questionnaire was 100% for required fields. A control group of 20 knee MRI patients with hand-written forms had 72% completeness of required fields (p=.0004) with illegible responses in 10% of free response fields.

CLINICAL RELEVANCE/APPLICATION

VWR enhances patient safety, reduces wait times, improves form completion and has high patient satisfaction. Additional appointment time slot optimization and enterprise-wide rollout will allow for improved patient throughput and patient experience.

SPR-NPM-3 Utilization Of Supplemental Screening Breast MRI In Diverse High Risk Populations

Participants
Dayna Levin, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Early detection of breast cancer reduces mortality. Breast MRI increases detection in high risk women and is more sensitive than mammography and ultrasound. The ACR endorses annual MRI screening for high risk women. Our study estimates the utilization of screening MRI within high risk populations and determines characteristics associated with high risk screening compliance.*Methods and Materials We conducted a retrospective, IRB compliant, study using patient data from 3 breast imaging centers in our urban based academic practice. Data was extracted form the EHR to determine numbers of patients with elevated Gail scores presenting for mammographic evaluation who had an MRI performed within the following 2-year period (2016 and 2017 study years). A multiple logistic regression model was performed on 2431 patients to assess MRI exam compliance association with income, race and age.*Results In our study, less than 20% of high risk patients received indicated supplemental MRI screening. In the 2 year period following a mammogram in 2016 and 2017, between 2.2% (n=90) and 7.8% (n=102) of high risk black patients and between 0% (n=11) and 33% (n=8) of high risk Hispanic patients received MRI screening. Patients with median income over $150,000 are 27% more likely to utilize MRI (OR: 1.27, 95% CI: (1.01,1.60), whereas patients with median income less than $50,000 are 54% less likely to utilize MRI (OR: 0.46, 95% CI: (0.27,0.74). Asian and Black patients are 88% and 70% less likely to get an MRI compared to non-Hispanic White patients respectively (OR_Asian: 0.12, 95% CI: (0.01,0.55); OR_Black: 0.30, 95% CI: (0.14,0.58). Patients over 50 are 36% less likely to get supplemental screening MRI exams than those under 50 (OR: 0.64, 95% CI: (0.50,0.81).*Conclusions Screening high risk women with mammography plus MRI improves the detection of early breast cancer and overall survival and has been shown to be cost effective. However, our study from three academic breast imaging centers in a large urban/suburban area shows low compliance with recommended MRI screening, particularly among racial and ethnic minority populations and lower income populations. Understanding current adherence to screening guidelines provides an opportunity to improve MRI screening in all high risk patients.*Clinical Relevance/Application Innovative methods can be leverage to improve supplemental screening rates in high risk patients and address a significant health care disparity. These include outreach to primary physicians and high risk patients as well as creating integrated advisories within the EHR. Leveraging behavioral economic principles can provide a useful framework to improve supplemental screening. Finally, radiology based patient centered care clinics could be implemented.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Innovative methods can be leverage to improve supplemental screening rates in high risk patients and address a significant health care disparity. These include outreach to primary physicians and high risk patients as well as creating integrated advisories within the EHR. Leveraging behavioral economic principles can provide a useful framework to improve supplemental screening. Finally, radiology based patient centered care clinics could be implemented.

SPR-NPM-5 Outcomes Of Incidental Lung Nodules With Structured Impressions And Electronic Tracking: Further Needs For Closing The Loop

Participants
Barun Bagga, MBBS, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate factors affecting follow-up for incidental lung nodules (ILN) found on CT, including structured reporting and electronic health record tracking.*Methods and Materials Patients of a large urban health system with ILN before and after implementation of structured Fleischner recommendations and electronic tracking were sampled randomly (from 2014, 2018). Cohorts were compared for appropriate follow-up completion and no follow-up despite indication, within 2 years of the index test. Multivariable logistic regression and competing risks analysis were used to assess appropriate follow-up and loss to follow-up. Independent variables included use of structured recommendations/tracking, age, sex, race, ethnicity, setting of the index test (inpatient, outpatient, Emergency), smoking history, and nodule features.*Results 1,301 patients met final inclusion criteria, including 255 before and 1,046 after structured recommendations/tracking. In univariate analysis, structured reporting was associated with higher rates of appropriate follow-up completion among those who followed up, 75.0% vs. 56.6% (p<0.001), and less frequent loss to follow-up, 29.5 % vs 40% (p=0.002). The largest differences in follow-up were in ILNs =8 mm in the outpatient setting (both variables p<0.001). All non-white races had significantly lower rates of appropriate follow-up than white patients (p=0.009) and mean age of patients completing and not completing appropriate follow-up was 66 years vs. 69 years (p=0.015). Multivariable analysis for the outcome of appropriate follow-up completion showed that age, race, care setting, nodule size, and Fleischner category were independent predictors (p<0.015), but structured reporting was not. Similarly, competing risks analysis for loss to follow-up showed that age, nodule size, test setting were stronger predictors for loss to follow-up than the use of structured recommendations. A model with age <68 years, nodule >8 mm, outpatient setting, race, and recommendation of 3-6 month follow up, biopsy or PET had area-under-the-curve of 0.71 for appropriate follow-up.*Conclusions Loss to follow-up and appropriate follow-up completion are accounted for by age, nodule size, and care setting more so than use of structured recommendations. Further interventions may be needed to improve care. Widespread standardized reporting would decrease selection bias for larger ILNs and establish clearer benchmarks for rates of appropriate follow-up in larger nodules.*Clinical Relevance/Application After accounting for structured ILN recommendations, patient age, race, nodule size and care setting remain strongly associated with follow-up; competing risks should be accounted for in quality measures and targeted interventions.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

After accounting for structured ILN recommendations, patient age, race, nodule size and care setting remain strongly associated with follow-up; competing risks should be accounted for in quality measures and targeted interventions.

SPR-NPM-6   Association Of Diagnostic Accuracy Estimates, Conclusion Positivity, And Completeness Of Abstract Reporting With Acceptance By Radiology Conferences And Journals: A Meta-Research Study.

Participants
Robert Frank, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

Preferential dissemination of 'positive' studies (i.e., publication bias) is documented in imaging diagnostic test accuracy (DTA) literature. We evaluated the contribution of the editorial process to publication bias by determining whether accuracy estimates, conclusion positivity, and completeness of abstract reporting are associated with acceptance of submitted research by radiology conferences and journals.*Methods and Materials We evaluated abstracts and manuscripts submitted to radiology conferences and journals. Primary studies evaluating sensitivity and specificity of an imaging test were included. We extracted Youden's index, abstract conclusion positivity, STARD for Abstracts adherence, and potential confounding variables (prospective/retrospective, sample size, study duration, assessment of inter-observer agreement, subspecialty, modality). Multivariable logistic regression provided adjusted associations (odds ratio [OR]) of Youden's index, conclusion positivity and completeness of abstract reporting, with study acceptance.*Results We included 1000 abstracts (500 ESGAR, 500 ISMRM) and 1000 manuscripts (505 Radiology, 495 JMRI). Abstract acceptance by radiology conferences was not associated with Youden's index (OR=0.97 for YI>0.8; CI=0.70-1.35), conclusion positivity (OR=1.21 for positive conclusions; CI 0.75-1.90) or STARD for Abstracts adherence (OR=0.96 per unit increase in reported items; CI=0.82-1.18). Abstracts with positive conclusions were less likely to be accepted by radiology journals (OR=0.45; CI=0.24-0.86), while YI (OR=0.85; CI=0.56-1.29) and STARD for Abstracts adherence (OR=1.06; CI=0.87-1.30) showed no association. Positive conclusions were present in 87% of submitted conference abstracts and 90% of submitted journal manuscripts.*Conclusions Imaging DTA studies with positive findings are not preferentially accepted by radiology conferences or journals, and most submitted studies have positive conclusions. Therefore, publication bias may be attributable to factors occurring prior to submission, rather than at the editorial level.*Clinical Relevance/Application Preferential publication of 'positive' studies can lead to overestimation of test accuracy and negative clinical outcomes. Interventions should promote submission of all research, regardless of findings, in order to balance the evidence guiding clinical decisions.

RESULTS

We included 1000 abstracts (500 ESGAR, 500 ISMRM) and 1000 manuscripts (505 Radiology, 495 JMRI). Abstract acceptance by radiology conferences was not associated with Youden's index (OR=0.97 for YI>0.8; CI=0.70-1.35), conclusion positivity (OR=1.21 for positive conclusions; CI 0.75-1.90) or STARD for Abstracts adherence (OR=0.96 per unit increase in reported items; CI=0.82-1.18). Abstracts with positive conclusions were less likely to be accepted by radiology journals (OR=0.45; CI=0.24-0.86), while YI (OR=0.85; CI=0.56-1.29) and STARD for Abstracts adherence (OR=1.06; CI=0.87-1.30) showed no association. Positive conclusions were present in 87% of submitted conference abstracts and 90% of submitted journal manuscripts.

CLINICAL RELEVANCE/APPLICATION

Preferential publication of 'positive' studies can lead to overestimation of test accuracy and negative clinical outcomes. Interventions should promote submission of all research, regardless of findings, in order to balance the evidence guiding clinical

decisions.

SPR-NPM-7 Cost-Effectiveness Of Endovascular Thrombectomy In Childhood Stroke: An Analysis From The Save Childs Study

Participants
Wolfgang Kunz, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The Save ChildS Study demonstrated that endovascular thrombectomy (EVT) is a safe treatment option for pediatric stroke patients with large vessel occlusions with high recanalization rates. Our aim was to determine the long-term cost, health consequences and cost-effectiveness of EVT in this patient population.*Methods and Materials A decision-analytic Markov model estimated lifetime costs and quality-adjusted life years (QALY, Figure 1). Early outcome parameters were based on subgroups of successful and unsuccessful recanalization within the Save ChildS Study, as no randomized data exist (Figure 2). For modeling of lifetime estimates, pediatric and adult input parameters were obtained from the current literature (Table 1). The analysis was conducted in a United States setting applying healthcare and societal perspectives. Probabilistic sensitivity analyses were performed. The willingness-to-pay (WTP) threshold was set to $100,000 per QALY.*Results The model results yielded EVT as the dominant (cost-effective as well as cost-saving) strategy for pediatric stroke patients. The incremental effectiveness for the average age of 11.3 years at first stroke in the Save ChildS Study was determined as an additional 4.76 lifetime QALYs, with lifetime cost-savings that amounted to $205,506 from a healthcare perspective and $304,531 when applying a societal perspective (Figure 3). Acceptability rates for EVT were 98.1% and 98.5% for the healthcare and societal perspectives.*Conclusions EVT for pediatric stroke patients with large vessel occlusions resulted in added quality-adjusted life years and reduced lifetime costs. Based on the available data in the Save ChildS Study, EVT is very likely to be a cost-effective treatment strategy for childhood stroke.*Clinical Relevance/Application The EVT infrastructure is available as established for adult stroke. Based on the health and economic potential, investments to develop EVT technique and devices for pediatric stroke are justified.

RESULTS

The model results yielded EVT as the dominant (cost-effective as well as cost-saving) strategy for pediatric stroke patients. The incremental effectiveness for the average age of 11.3 years at first stroke in the Save ChildS Study was determined as an additional 4.76 lifetime QALYs, with lifetime cost-savings that amounted to $205,506 from a healthcare perspective and $304,531 when applying a societal perspective (Figure 3). Acceptability rates for EVT were 98.1% and 98.5% for the healthcare and societal perspectives.

CLINICAL RELEVANCE/APPLICATION

The EVT infrastructure is available as established for adult stroke. Based on the health and economic potential, investments to develop EVT technique and devices for pediatric stroke are justified.

Abstract Archives of the RSNA, 2021

Participants
Stuart Samuels, MD, Miami, Florida (*Moderator*) Nothing to Disclose
Sachin Jhawar, Md, MSc, New Brunswick, New Jersey (*Moderator*) Grant, Varian Medical Systems, Inc
Simon Lo, MD, Seattle, Washington (*Moderator*) Committee member, Elekta AB

Sub-Events

SSRO02-3 Radiosurgery Dose Reduction For Brain Metastases On Immunotherapy (RADREMI): Gamma Knife Versus Linear Accelerator Outcomes From A Multicenter Phase I Trial

Participants
Shearwood McClelland III, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

Symptomatic radiation necrosis occurs in up to 20% of patients treated with immune checkpoint inhibitor (ICI) therapy and concomitant single-fraction stereotactic radiosurgery (SRS) (Martin et al., JAMA Oncology 2018). We present the first prospective comparison of outcomes by SRS modality, derived from the Radiosurgery Dose Reduction for Brain Metastases on Immunotherapy (RADREMI) trial.*Methods and Materials RADREMI is a prospective multicenter single arm Phase I pilot study. Patients of age 18+ receiving ICI with SRS for 1-10 brain metastases on MRI from biopsy-confirmed primary malignancy with disease-specific graded prognostic assessment estimated median survival of at least 6 months and no history of whole brain radiation therapy were eligible. The primary endpoint was six-month symptomatic radiation necrosis (rate of clinical symptomatology requiring steroid administration and/or operative intervention concomitant with imaging findings consistent with radiation necrosis), with secondary endpoints including six-month local control (LC) and six-month radiographic radiation necrosis. LC was defined according to Response Assessment in Neuro-Oncology criteria, and was compared to historical controls of 87-91% six-month LC with RTOG 90-05 SRS dosing. The Fisher's exact test was used for statistical analysis. This trial is registered at clinicaltrials.gov, NCT04047602.*Results Between December 18, 2019 and April 11, 2021, 61 lesions were treated in 20 patients receiving ICI delivered within 30 days before SRS. All patients received RADREMI dosing (18 Gy for lesions 0-2 cm, 14 Gy for lesions 2.1-3 cm, and 12 Gy for lesions 3.1-4 cm). Of the 61 lesions treated, 15 lesions (all on trial protocol) were treated with LINAC SRS, and 46 lesions (35 on protocol, 11 per protocol) were treated with Gamma Knife SRS. Median follow-up was 162 days. There were no significant differences by SRS modality in symptomatic radiation necrosis, radiographic radiation necrosis, or LC rates (p > 0.05).*Conclusions Early analysis from the first prospective trial to investigate dose-reduced SRS with concomitant ICI in treating metastatic brain disease reveals no significant difference in morbidity or efficacy between LINAC or Gamma Knife SRS in this patient population. These findings indicate that despite the inherent dosimetric differences between the two SRS modalities (i.e. isodose lines, hotspots), treating this patient population with reduced-dose SRS via LINAC provides comparable outcomes with lesions treated with Gamma Knife SRS.*Clinical Relevance/Application The SRS treatment modality (LINAC versus Gamma Knife) does not impact the efficacy or morbidity in the treatment of brain metastases for patients receiving concomitant immunotherapy.

RESULTS

Between December 18, 2019 and April 11, 2021, 61 lesions were treated in 20 patients receiving ICI delivered within 30 days before SRS. All patients received RADREMI dosing (18 Gy for lesions 0-2 cm, 14 Gy for lesions 2.1-3 cm, and 12 Gy for lesions 3.1-4 cm). Of the 61 lesions treated, 15 lesions (all on trial protocol) were treated with LINAC SRS, and 46 lesions (35 on protocol, 11 per protocol) were treated with Gamma Knife SRS. Median follow-up was 162 days. There were no significant differences by SRS modality in symptomatic radiation necrosis, radiographic radiation necrosis, or LC rates (p > 0.05).

CLINICAL RELEVANCE/APPLICATION

The SRS treatment modality (LINAC versus Gamma Knife) does not impact the efficacy or morbidity in the treatment of brain metastases for patients receiving concomitant immunotherapy.

SSRO02-4 The Role Of Radiotherapy To The Primary Site In Oropharyngeal Cancer With Limited Metastases - A National Cancer Database (NCDB) Analysis

Participants
Michael Kharouta, MD, Cleveland, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Oligometastatic oropharyngeal cancer (OPC) at presentation is rare. Literature to guide management is limited. Aggressive treatment to the primary site is controversial but may be warranted especially in patients with favorable prognostic features such as HPV-mediated disease. We sought to determine clinicopathologic variables associated with improved survival in these patients.*Methods and Materials We queried the NCDB for patients age 18-90 years with OPC categorized as cM1 with limited metastatic disease defined as metastatic disease to only one distant site, known HPV status, and first-course radiotherapy (RT) to the primary site or no RT. Full-optimal propensity score matching was used for receipt of RT based on clinicopathologic covariates. Overall survival (OS) was estimated using the Kaplan-Meier method and compared using log-rank testing. Multivariate Cox-proportional hazards (CPH) regression was used to identify covariates associated with overall survival, using Schoenfeld residuals to

assess the proportional hazards assumption.*Results 512 patients met study criteria. After matching, CPH regression violated the proportional hazards assumption which was mitigated by stratifying patients by HPV status. After stratification, multivariable CPH regression showed that RT was associated with a benefit to overall survival regardless of HPV status. For HPV+ patients, receipt of RT (HR 0.69, p = 0.02), and younger age were associated with improved OS. For HPV- patients, receipt of RT (HR = 0.67, p =0.018), less than cT4 disease, tumor size, no metastases to bone, no LVSI, and receipt of chemotherapy were associated with improved OS.*Conclusions In patients with OPC with metastatic disease at presentation limited to a single site, radiation to the primary site is associated with improved OS in both HPV+ and HPV- disease. Further study of factors predicting long-term benefit of radiotherapy for OPC in patients with limited metastatic disease at presentation is warranted.*Clinical Relevance/Application This study provides evidence of an association of radiotherapy to the primary site with improved overall survival in patients with oropharynx cancer with limited metastatic disease regardless of HPV status, which remains a strong prognostic factor in this cohort.

RESULTS

512 patients met study criteria. After matching, CPH regression violated the proportional hazards assumption which was mitigated by stratifying patients by HPV status. After stratification, multivariable CPH regression showed that RT was associated with a benefit to overall survival regardless of HPV status. For HPV+ patients, receipt of RT (HR 0.69, p = 0.02), and younger age were associated with improved OS. For HPV- patients, receipt of RT (HR = 0.67, p =0.018), less than cT4 disease, tumor size, no metastases to bone, no LVSI, and receipt of chemotherapy were associated with improved OS.

CLINICAL RELEVANCE/APPLICATION

This study provides evidence of an association of radiotherapy to the primary site with improved overall survival in patients with oropharynx cancer with limited metastatic disease regardless of HPV status, which remains a strong prognostic factor in this cohort.

SSRO02-5   Multiparametric MRI As A Potential Predictor Of Tumor Infiltrating Lymphocytes And Tissue Hypoxia In Head-and-neck Cancer Patients - Post-hoc Analysis Of A Prospective Imaging Trial

Participants
Alexander Ruhle, MD, Freiburg, Germany (*Presenter*) Research Grant, NovoCure Ltd

PURPOSE

Tumor-infiltrating lymphocytes (TILs) and tumor-associated hypoxia influence outcome of head-and-neck squamous cell carcinoma (HNSCC) patients undergoing chemoradiation and are commonly quantified from tumor biopsies. As biopsies do not allow spatial and longitudinal analyses of tumor biology, we aimed to assess if multiparametric MRI (mpMRI) can be used as a non-invasive surrogate for TIL levels and tissue hypoxia.*Methods and Materials T1- and T2-weighted, dynamic contrast-enhanced perfusion and diffusion-weighted MRI was performed prior to chemoradiation, and hypoxic subvolumes (HSVs) within the primary tumor or metastatic lymph nodes were defined using co-registered [18F]FMISO PET/CT imaging. Hematoxylin-eosin stainings and immunohistochemical analyses for CD3, CD34, CAIX and HIF1a were performed to assess TIL levels, microvessel density and tissue hypoxia in pre-therapeutic tumor samples, respectively. Expression of the tissue hypoxia markers was quantified based on staining intensity and percentage of positive cells using the H score. MpMRI parameters within the HSV and the complementary non-HSV were then correlated with the histology data.*Results Twenty-one HNSCC patients receiving definitive chemoradiation for locally advanced HNSCC were enrolled in this prospective imaging trial and received pre-treatment mpMRI and FMISO PET/CT. The extravascular volume parameter (ve) within the HSV of the primary tumor was significantly lower in patients with increased levels of TILs (0.34 versus 0.23, p<0.01, unpaired t-test). Similarly, ADC values within metastatic lymph nodes as a marker for tumor cell density were significantly higher in patients with increased TIL levels (1175 x 10-3 mm2/s versus 976 x 10-3 mm2/s, p<0.05). The prognostic tissue hypoxia marker CAIX was inversely correlated with ve within metastatic lymph nodes (Pearson's r=-0.622, p<0.01), and high ve within the primary tumor was also linked with a reduced density of CD34-positive tumor microvessels (p<0.05). The volume transfer constant ktrans within the primary tumor, both within the HSV and the non-HSV, corresponded with an increased HIF1a expression (r=0.588, p<0.05 for the primary tumor, r=0.661, p<0.05 for the primary tumor's HSV, r=0.574, p<0.05 for the primary tumor's non-HSV).*Conclusions We could show in this post-hoc analysis of a prospective trial that mpMRI signatures may provide information regarding TIL levels and tissue hypoxia.*Clinical Relevance/Application Although these correlations require further validation, mpMRI may provide surrogate information for prognostic biological tumor characteristics in HNSCC patients undergoing chemoradiation and may allow for non-invasive and longitudinal biological monitoring of these patients.

RESULTS

Twenty-one HNSCC patients receiving definitive chemoradiation for locally advanced HNSCC were enrolled in this prospective imaging trial and received pre-treatment mpMRI and FMISO PET/CT. The extravascular volume parameter (ve) within the HSV of the primary tumor was significantly lower in patients with increased levels of TILs (0.34 versus 0.23, p<0.01, unpaired t-test). Similarly, ADC values within metastatic lymph nodes as a marker for tumor cell density were significantly higher in patients with increased TIL levels (1175 x 10-3 mm2/s versus 976 x 10-3 mm2/s, p<0.05). The prognostic tissue hypoxia marker CAIX was inversely correlated with ve within metastatic lymph nodes (Pearson's r=-0.622, p<0.01), and high ve within the primary tumor was also linked with a reduced density of CD34-positive tumor microvessels (p<0.05). The volume transfer constant ktrans within the primary tumor, both within the HSV and the non-HSV, corresponded with an increased HIF1a expression (r=0.588, p<0.05 for the primary tumor, r=0.661, p<0.05 for the primary tumor's HSV, r=0.574, p<0.05 for the primary tumor's non-HSV).

CLINICAL RELEVANCE/APPLICATION

Although these correlations require further validation, mpMRI may provide surrogate information for prognostic biological tumor characteristics in HNSCC patients undergoing chemoradiation and may allow for non-invasive and longitudinal biological monitoring of these patients.

Participants

Patricia Acharya, MD, Monrovia, California (*Moderator*) Nothing to Disclose
Usha D. Nagaraj, MD, Cincinnati, Ohio (*Moderator*) Author with royalties, Reed Elsevier;

Sub-Events

SSPD04-1 Early Effects Of Prenatal Alcohol Exposure On Regional Brain Volumes - An Atlas-Based Fetal MRI Study

Participants
Marlene Stuempflen, MD, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

Postnatal imaging studies have shown structural brain anomalies in patients suffering from Fetal Alcohol Spectrum Disorders, including enlarged and malformed hippocampi.[1,2] This atlas-based fetal MRI study aimed to identify early regional effects of prenatal alcohol exposure (PAE) on human fetal brain development.*Methods and Materials This IRB approved prospective single-center study identified pregnant women referred for fetal MRI with variable amounts of alcohol intake during pregnancy using two standardized questionnaires (PRAMS and TACE).[3,4] Postprocessing was conducted generating superresolution imaging and semiautomated atlas-based segmentations. After visual inspection, assessment of data quality and manual correction, an atlas-based analysis of various fetal brain structures was performed. Linear models were applied with an additional factor to account for varying gestational ages and multiple comparisons were corrected using Benjamini-Yekutieli.[5]*Results After excluding subjects with structural brain anomalies and/or poor superresolution image quality, a total of 27 patients with PAE and 36 controls (gestational age 20-37 weeks, mean 27.2 GW) were included and analyzed. In fetuses exposed to alcohol both hippocampi (left p = 0.035, right p = 0.024) and the corpus callosum (p = 0.035) showed significantly larger volumes (mean volumes ± SD), whereas the periventricular/germinal zone (p = 0.003) showed smaller volumes (mean volumes ± SD) compared to controls.*Conclusions While it is well known that PAE may cause neurodevelopmental deficits, this study systematically documented selective effects on regional brain volumes at prenatal stages. Besides the reduction in size of the germinal matrix, an increased regional growth of the hippocampus and the corpus callosum was found.References(1) Norman AL et al. Dev Disabil Res Rev. 2009;15(3):209-217.(2) Roediger DJ et al. Neurotoxicol Teratol. 2021 Jan-Feb;83:106944.(3) Shulman HB et al. Am J Public Health. 2018 Oct;108(10):1305-1313.(4) Sokol RJ et al. Am J Obstet Gynecol. 1989 Apr;160(4):863-870.(5) Benjamini Y et al. Ann. Statist. 2001 Aug;29(4):1165-1188.*Clinical Relevance/Application Prenatal imaging detection of germinal matrix, hippocampal and callosal abnormalities after embryonal/fetal alcohol exposure emphasizes the socioeconomic importance of prevention, detection and support of affected families.

RESULTS

After excluding subjects with structural brain anomalies and/or poor superresolution image quality, a total of 27 patients with PAE and 36 controls (gestational age 20-37 weeks, mean 27.2 GW) were included and analyzed. In fetuses exposed to alcohol both hippocampi (left p = 0.035, right p = 0.024) and the corpus callosum (p = 0.035) showed significantly larger volumes (mean volumes ± SD), whereas the periventricular/germinal zone (p = 0.003) showed smaller volumes (mean volumes ± SD) compared to controls.

CLINICAL RELEVANCE/APPLICATION

Prenatal imaging detection of germinal matrix, hippocampal and callosal abnormalities after embryonal/fetal alcohol exposure emphasizes the socioeconomic importance of prevention, detection and support of affected families.

SSPD04-2 Three-dimensional Visualization Of Large Vessel Anomalies In Fetal MRI Using Super-resolution MultiVane Technique

Participants
Florian Prayer, MD, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

To assess the feasibility of super-resolution-aided three-dimensional reconstruction of the heart and large vessels in fetal MRI of normal fetuses and fetuses with large vessel anomalies using MultiVane technique.*Methods and Materials The study cohort (n=30) consisted of 15 cases (nine male) with echocardiographically confirmed anomalies of the large vessels, and 15 normal cases (eight male). The pathology group included the following entities: tetralogy of Fallot (n=4), aortic coarctation (3), right descending aorta (2), common arterial trunk (2), persistant left superior vena cava (1), unilateral pulmonary agenesis (1), hypoplastic left heart (1), and heterotaxia syndrome (1). Fetal MRI scans were performed at a mean gestational age of 28+1 gestation weeks (GW) (pathology group) and 29+5 GW (normal group). T2-weighted sequences in three orthogonal planes acquired using MultiVane technique on one 1.5 T scanner (Philips Ingenia) were used to calculate super-resolution datasets. Manual segmentation using free ITK-Snap software was performed to obtain three-dimensional models of the fetal heart and large vessels (aorta, pulmonary arteries, superior and inferior vena cava, umbilical vein, and fetal shunts). T2-weighted images in three orthogonal planes, axial super-resolution images, and three-dimensional models were reviewed for anomalies of the large vessels by two expert fetal radiologists.*Results Super-resolution post-processing based on T2-weighted MultiVane sequences and three-dimensional

reconstruction of the fetal heart and large vessels were feasible in all (30 of 30) cases. Review of T2-weighted MultiVane sequences in three orthogonal planes identified large vessel anomalies in 13 of 15 cases. If super-resolution images and three-dimensional models were available, all (15 of 15) pathologic cases were correctly classified. Vessel anomalies were found in none of the fetuses in the normal group.*Conclusions Fetal MRI-based visualization of large vessel structures using Multivane technique and super-resolution reconstruction is feasible and helpful in the identification of large vessel anomalies during intra-uterine development.*Clinical Relevance/Application Novel MultiVane fetal MRI technique in combination with super-resolution post-processing yields morphologic characterisation of fetal large vessels.

RESULTS

Super-resolution post-processing based on T2-weighted MultiVane sequences and three-dimensional reconstruction of the fetal heart and large vessels were feasible in all (30 of 30) cases. Review of T2-weighted MultiVane sequences in three orthogonal planes identified large vessel anomalies in 13 of 15 cases. If super-resolution images and three-dimensional models were available, all (15 of 15) pathologic cases were correctly classified. Vessel anomalies were found in none of the fetuses in the normal group.

CLINICAL RELEVANCE/APPLICATION

Novel MultiVane fetal MRI technique in combination with super-resolution post-processing yields morphologic characterisation of fetal large vessels.

SSPD04-3 Magnetic Resonance (MR) Imaging Features Of Prenatal Neck Lymphatic Malformations (LM)-correlation With Perinatal Outcomes

Participants
Hasan Habib, BA, Stratford, New Jersey (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate imaging findings on fetal MR that can predict the perinatal course of neck lymphatic malformations (LM), including predictors of complicated delivery and immediate postnatal treatment*Methods and Materials Retrospective study of fetal MR dated 1/1/2000-12/31/2020. Inclusion criteria: neck LM diagnosis with complete postnatal clinical follow up. Features extracted from fetal MR: extension of mass into tongue, mediastinum, airway involvement, lesion margin, midline crossing, hemorrhage, and calcification. Neonatal medical records were reviewed for mode of delivery and immediate perinatal care. A total of 36 fetal MR for 35 fetuses were included. Descriptive statistics and Fisher's exact test were done.*Results Mean gestational age (GA) at fetal MR: 29 ± 5 weeks. Fetal neck lesions extended into the tongue (63 %, 22/35), mediastinum (23 %, 8/35) and other anatomic locations such as face, axilla, upper extremity (29 %, 10/35). Airway deviation: seen in 66 % (23/35); midline crossing in 34 % (12/35). Neck LM had infiltrative margins in 66% (23/35) of cases. Other features included calcification (11%, 4/35) and hemorrhage (31%, 11/35). Neonates were delivered at mean GA of 37 ±1 week, mean weight 3.43 ±0.6 kg via C-section (71%, 25/35), EXIT (11%, 4/35), vaginal delivery (14%, 5/35) and 1 vacuum-assisted delivery. Neonatal resuscitation such as tracheal intubation/nasal intubation, bag-mask positive pressure ventilation, continuous positive airway pressure, or O2 through nasal cannula occurred in 34 % (12/35) of neonates. Treatments/procedures in neonatal period included sirolimus, doxycycline sclerotherapy, airway management, microlaryngoscopy and bronchoscopy with excision or sclerosis, surgical debulking, feeding support (nasogastric tube, G-tube, or total parenteral nutrition) or combination were provided in 68 % (24/35) of patients. Apnea monitoring was done for 71% (25/35) of patients. Mean hospital stay was 64 days (2-362). Mean age at postnatal MR was 4 days (0-58). Lesions that extended into the tongue or mediastinum, had infiltrative margins, crossed the midline or caused airway deviation on fetal MR were statistically significant risk factors for airway intervention during delivery and active neonatal management of the LM (p <0.05 for both outcomes).*Conclusions Fetal MR features of neck LM such as infiltrative margins, extension to tongue or mediastinum, midline crossing, or airway deviation, may serve as important predictors of complex modes of neonatal resuscitation and necessity of perinatal interventions/treatments*Clinical Relevance/Application Detection of these prenatal findings may aid parent counseling and prepare appropriate perinatal care, including delivery and postnatal treatment.

RESULTS

Mean gestational age (GA) at fetal MR: 29 ± 5 weeks. Fetal neck lesions extended into the tongue (63 %, 22/35), mediastinum (23 %, 8/35) and other anatomic locations such as face, axilla, upper extremity (29 %, 10/35). Airway deviation: seen in 66 % (23/35); midline crossing in 34 % (12/35). Neck LM had infiltrative margins in 66% (23/35) of cases. Other features included calcification (11%, 4/35) and hemorrhage (31%, 11/35). Neonates were delivered at mean GA of 37 ±1 week, mean weight 3.43 ±0.6 kg via C-section (71%, 25/35), EXIT (11%, 4/35), vaginal delivery (14%, 5/35) and 1 vacuum-assisted delivery. Neonatal resuscitation such as tracheal intubation/nasal intubation, bag-mask positive pressure ventilation, continuous positive airway pressure, or O2 through nasal cannula occurred in 34 % (12/35) of neonates. Treatments/procedures in neonatal period included sirolimus, doxycycline sclerotherapy, airway management, microlaryngoscopy and bronchoscopy with excision or sclerosis, surgical debulking, feeding support (nasogastric tube, G-tube, or total parenteral nutrition) or combination were provided in 68 % (24/35) of patients. Apnea monitoring was done for 71% (25/35) of patients. Mean hospital stay was 64 days (2-362). Mean age at postnatal MR was 4 days (0-58). Lesions that extended into the tongue or mediastinum, had infiltrative margins, crossed the midline or caused airway deviation on fetal MR were statistically significant risk factors for airway intervention during delivery and active neonatal management of the LM (p <0.05 for both outcomes).

CLINICAL RELEVANCE/APPLICATION

Detection of these prenatal findings may aid parent counseling and prepare appropriate perinatal care, including delivery and postnatal treatment.

SSPD04-5 Prevalence Of Intrarenal Reflux In Pediatric Patients On Contrast Enhanced Voiding Urosonography

Participants
Erica Klein, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Vesicoureteral reflux (VUR) is a common finding on voiding cystourethrogram (VCUG) and contrast enhanced voiding urosonography (CEVUS) studies. Occasionally, VUR can extend into the renal parenchyma, a phenomenon known as intrarenal reflux (IRR) which is thought to be associated with the development of renal scarring. IRR found during fluoroscopic VCUG has been previously studied. The purpose of our study was to determine the prevalence of IRR on the newer, radiation-free modality of CEVUS.*Methods and Materials CEVUS studies performed at our institution between August 2019 and August 2020 with reported VUR (106 studies) were retrospectively reviewed by two pediatric radiologists. The radiologists independently graded the VUR and assessed for the

presence of IRR, noting its location in the kidney and phase of the urinary cycle during which it occurred. Additionally, the presence and location of renal scarring was recorded. Discrepancies were resolved by consensus interpretation.*Results 211 kidneys were evaluated on 106 CEVUS exams. Grade 2 to 5 VUR was detected in 165 kidneys with associated IRR detected in 42 (25.4%). IRR was present in 1 of 40 kidneys (2.5%) with grade 2, 10 of 67 (14.9%) with grade 3, 25 of 47 (53.2%) with grade 4 and 6 of 11 (54.5%) with grade 5 VUR. IRR occurred during the voiding phase of the urinary cycle in 31 of 42 kidneys (73.8%) and was seen most often in the lower pole of the kidney (71.4%) with a significant association between IRR and mid pole renal scarring [OR 3.92; 95% CI (1.49, 10.32); p-value 0.006].*Conclusions Intrarenal reflux was frequently seen on CEVUS, with the highest rate in kidneys with grades 4 and 5 VUR and during voiding phase. Radiologists should have a high index of suspicion for IRR on CEVUS, especially in patients with high grade VUR.*Clinical Relevance/Application Detection of VUR with IRR, which is frequently identified on CEVUS examinations, could influence management with potential early surgical intervention to prevent loss of renal parenchyma.

RESULTS

211 kidneys were evaluated on 106 CEVUS exams. Grade 2 to 5 VUR was detected in 165 kidneys with associated IRR detected in 42 (25.4%). IRR was present in 1 of 40 kidneys (2.5%) with grade 2, 10 of 67 (14.9%) with grade 3, 25 of 47 (53.2%) with grade 4 and 6 of 11 (54.5%) with grade 5 VUR. IRR occurred during the voiding phase of the urinary cycle in 31 of 42 kidneys (73.8%) and was seen most often in the lower pole of the kidney (71.4%) with a significant association between IRR and mid pole renal scarring [OR 3.92; 95% CI (1.49, 10.32); p-value 0.006].

CLINICAL RELEVANCE/APPLICATION

Detection of VUR with IRR, which is frequently identified on CEVUS examinations, could influence management with potential early surgical intervention to prevent loss of renal parenchyma.

SSPD04-6   New Pediatric ADPKD Risk Severity Model Based On 3DUS Volumetry

Participants
Luc Breysem, Leuven, Belgium (*Presenter*) Nothing to Disclose

PURPOSE

A height-adjusted total kidney volume (htTKV) based ADPKD severity model stratifying adult ADPKD (>15 years of age) in five severity groups has been developed in the MAYO clinic. We aimed to evaluate if a similar stratification model to estimate ADPKD progression can be used in a pediatric ADPKD population (<18 years of age) with htTKV based on 3DUS and, if needed, propose a more appropriate model.*Methods and Materials We assessed htTKV based on manual 3DUS contouring in genetically-confirmed PKD1 ADPKD patients between 2015-2020 in a tertiary hospital. Severity group stratification was performed with the MAYO classification model ($y=A*(1+B)^x$, with A=htTKV at age 0 and B=yearly htTKV % increase). First the original model was applied (A=150ml/m and B=1.5, 3, 4.5 and 6%/year), after which the parameters were optimized to our pediatric data.*Results 67 genotyped patients (32 female, 35 male) underwent in total 232 3DUS assessments. Age (mean+/-stdev) at first evaluation was 10.5+/-4.8years (range: 0.2-19.2) and htTKV of 187+/-101mL/m (74-630). Direct extrapolation of the MAYO curves below the age of 15 years strongly underestimated ADPKD severity in children, even with correction for patient height. After optimizing the model's parameters (A=70, 80, 90, 100; B=6, 7.5, 9, 10.5%), the 232 scans were split into five subgroups with 47, 94, 42, 27 and 22 patients respectively, with preferential clustering of the htTKV values in groups with low growth rate below 10 years of age and an accelerated growth after 10 years of age comparing to the expected kidney growth in children. To better match this accelerated growth in the second decade, we proposed a new pediatric ADPKD severity model (formula $y=A*B^{(x^1.6)}$ with A=80, 90, 100, 110 and B=1.01, 1.012, 1.015, 1.018) leading to a more homogeneous distribution of the 232 scans into the five severity categories with 45, 67, 38, 36 and 46 patients (Figure).*Conclusions We provide a new two-parameter model using patients' age and 3DUS-based htTKV for ADPKD risk stratification that better fits the accelerated growth after 10 years of age, which could be useful in future pediatric ADPKD progression assessments.*Clinical Relevance/Application This newly developed risk stratification model in pediatric ADPKD, based on 3DUS volumetry, highlights the potential use of height adjusted TKV as a parameter to predict ADPKD severity from young age.

RESULTS

67 genotyped patients (32 female, 35 male) underwent in total 232 3DUS assessments. Age (mean+/-stdev) at first evaluation was 10.5+/-4.8years (range: 0.2-19.2) and htTKV of 187+/-101mL/m (74-630). Direct extrapolation of the MAYO curves below the age of 15 years strongly underestimated ADPKD severity in children, even with correction for patient height. After optimizing the model's parameters (A=70, 80, 90, 100; B=6, 7.5, 9, 10.5%), the 232 scans were split into five subgroups with 47, 94, 42, 27 and 22 patients respectively, with preferential clustering of the htTKV values in groups with low growth rate below 10 years of age and an accelerated growth after 10 years of age comparing to the expected kidney growth in children. To better match this accelerated growth in the second decade, we proposed a new pediatric ADPKD severity model (formula $y=A*B^{(x^1.6)}$ with A=80, 90, 100, 110 and B=1.01, 1.012, 1.015, 1.018) leading to a more homogeneous distribution of the 232 scans into the five severity categories with 45, 67, 38, 36 and 46 patients (Figure).

CLINICAL RELEVANCE/APPLICATION

This newly developed risk stratification model in pediatric ADPKD, based on 3DUS volumetry, highlights the potential use of height adjusted TKV as a parameter to predict ADPKD severity from young age.

Printed on: 06/28/22

SSCA01

Cardiac (Advanced Imaging in Congenital Heart Disease)

Participants

Gautham Reddy, MD, Seattle, Washington (*Moderator*) Nothing to Disclose

Sub-Events

SSCA01-1　Non-contrast Free-breathing Flow-independent Magnetic Resonance Angiography: Assessment Of Thoracic Vasculature In Congenital Heart Disease

Participants

Alexander Isaak, MD, Bonn, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate a non-contrast respiratory- and electrocardiogram-gated 3D relaxation-enhanced angiography without contrast and triggering (REACT) magnetic resonance angiography (MRA) based on magnetization-prepared Dixon method for the assessment of the thoracic vasculature in congenital heart disease (CHD) patients.*Methods and Materials 70 CHD patients (mean: 28 years, range: 10-65 years) who underwent MRI including REACT and standard MRAs were retrospectively included in this study. Image quality (IQ) of REACT-MRA was compared to non-gated multi-phase first-pass-MRA and respiratory- and electrocardiogram-gated steady-state-MRA. Overall IQ of different vessels of interest was independently assessed by two radiologists on a five-point Likert scale. Measurements of vessel diameters were performed in predefined anatomic landmarks. Friedman test, chi-squared test, and Bland-Altman method were used for statistical analysis.*Results Overall IQ score of REACT-MRA was higher compared to first-pass-MRA (3.5±0.4 vs. 2.7±0.4, P<0.001) and did not differ from steady-state-MRA (3.5±0.4 vs. 3.5±0.6, P=0.99). Non-diagnostic IQ of the defined vessels of interest was observed less frequently on REACT-MRA (1.7%) compared to steady-state- (4.3%; P=0.046) or first-pass-MRA (20.9%; P<0.001). Close agreements in vessel diameter measurements were observed between REACT- and steady-state-MRA (e.g. ascending aorta, bias: 0.38±1.0mm, 95% limits of agreement (LOA): -1.62-2.38mm). REACT-MRA showed high intra- (bias: 0.04±1.0mm, 95% LOA: -1.9-2.0mm) and interobserver (bias: 0.20±1.1mm, 95% LOA: -2.0-2.4mm) agreements regarding vessel diameter measurements. Fat-water separation artifacts were observed in 5/70 (7%) cases on REACT-MRA but did not limit diagnostic utility. Seven vascular abnormalities were detected on REACT-MRA that were not seen on standard contrast-enhanced MRA.*Conclusions Non-contrast-enhanced cardiac-gated REACT-MRA offers a high diagnostic quality for assessment of the thoracic vasculature in CHD patients.*Clinical Relevance/Application REACT-MRA allows for a contrast-free visualization of the thoracic vasculature in CHD patients.

RESULTS

Overall IQ score of REACT-MRA was higher compared to first-pass-MRA (3.5±0.4 vs. 2.7±0.4, P<0.001) and did not differ from steady-state-MRA (3.5±0.4 vs. 3.5±0.6, P=0.99). Non-diagnostic IQ of the defined vessels of interest was observed less frequently on REACT-MRA (1.7%) compared to steady-state- (4.3%; P=0.046) or first-pass-MRA (20.9%; P<0.001). Close agreements in vessel diameter measurements were observed between REACT- and steady-state-MRA (e.g. ascending aorta, bias: 0.38±1.0mm, 95% limits of agreement (LOA): -1.62-2.38mm). REACT-MRA showed high intra- (bias: 0.04±1.0mm, 95% LOA: -1.9-2.0mm) and interobserver (bias: 0.20±1.1mm, 95% LOA: -2.0-2.4mm) agreements regarding vessel diameter measurements. Fat-water separation artifacts were observed in 5/70 (7%) cases on REACT-MRA but did not limit diagnostic utility. Seven vascular abnormalities were detected on REACT-MRA that were not seen on standard contrast-enhanced MRA.

CLINICAL RELEVANCE/APPLICATION

REACT-MRA allows for a contrast-free visualization of the thoracic vasculature in CHD patients.

SSCA01-2　Right-left Ventricular Bloodpool T2 Ratio As An Innovative Screening Tool For The Identification Of Left-to-right Shunts In Patients With Dilated Right Ventricle

Participants

Tilman Emrich, MD, Charleston, South Carolina (*Presenter*) Speaker, Siemens AG;Travel support, Siemens AG

PURPOSE

Left-to-right shunts (L-R-Shunt) lead to volume overload of the right ventricular (RV) system, pulmonary hypertension, as well as alterations of the RV myocardium, resulting in adverse cardiac events. CMR is able to detect L-R-Shunts by comparison of phase-contrast measurements of pulmonary and aortic flow (Qp/Qs-ratio), which is not routinely done in clinical CMR examinations. Since T2 is sensitive to the oxygenation of blood, we hypothesized that T2 mapping is able to detect blood oxygenation differences between the ventricles caused by L-R-Shunts. Therefore, the aim of this study was to evaluate T2 mapping for L-R-Shunt detection in patients with dilated RV compared to healthy volunteers.*Methods and Materials We retrospectively analyzed the T2 ratio of the RV/LV blood pool and Qp/Qs-ratio by phase-contrast-imaging from 18 patients with established relevant L-R-shunts. Healthy volunteers (n=41) and patients with dilated right ventricles without L-R-Shunts (ARVC, pulmonary regurgitation, n=10) were used as control groups. Qp/Qs-ratio was calculated by dedicated measurements of pulmonary and aortic flow. T2 ratio of the LV/RV blood pool was calculated from routinely acquired, mid-ventricular T2-Maps.*Results The Qp/Qs ratios in the L-R-Shunt vs the control groups were 1.9 ± 1.0 and 1.0 ± 0.04, respectively (p<0.001). End-diastolic RV volume was significant higher compared to healthy volunteers (120.6 ± 51.1 and 93.0 ± 15.0, p=0.007), but not in comparison to patients with RV disease (120.6 ± 51.1

and 118.2 ± 34.0, p=1.00). T2 RV/LV-Ratio was significantly increased in patients with L-R-Shunts (0.90 ± 0.09) compared to healthy volunteers (0.74 ± 0.11, p<0.001) and patients with dilated RV (0.73 ± 0.16, p=0.004). A ratio over 0.74 showed a 100% sensitivity and 56% specificity for detection of L-R-Shunts, resulting in a negative predictive value of 100%. T2 differences in the LV vs RV could also be depicted by visual assessment.*Conclusions RV-LV-Bloodpool T2 relaxation time ratio has the potential to become a fast and highly reliable method for screening L-R-Shunts. A ratio below 0.74 excluded the presence of a L-R-Shunt, independent of end-diastolic RV volume.*Clinical Relevance/Application The use of RV/LV bloodpool T2 ratio may indicate when more sophisticated Qp/Qs evaluation is needed in the suspicion of L/R-Shunts.

RESULTS

The Qp/Qs ratios in the L-R-Shunt vs the control groups were 1.9 ± 1.0 and 1.0 ± 0.04, respectively (p<0.001). End-diastolic RV volume was significant higher compared to healthy volunteers (120.6 ± 51.1 and 93.0 ± 15.0, p=0.007), but not in comparison to patients with RV disease (120.6 ± 51.1 and 118.2 ± 34.0, p=1.00). T2 RV/LV-Ratio was significantly increased in patients with L-R-Shunts (0.90 ± 0.09) compared to healthy volunteers (0.74 ± 0.11, p<0.001) and patients with dilated RV (0.73 ± 0.16, p=0.004). A ratio over 0.74 showed a 100% sensitivity and 56% specificity for detection of L-R-Shunts, resulting in a negative predictive value of 100%. T2 differences in the LV vs RV could also be depicted by visual assessment.

CLINICAL RELEVANCE/APPLICATION

The use of RV/LV bloodpool T2 ratio may indicate when more sophisticated Qp/Qs evaluation is needed in the suspicion of L/R-Shunts.

SSCA01-3   Aortic Stenosis And Aortic Regurgitation Mediate Systolic And Diastolic Reverse Flow In BIcuspid Aortic Valve Patients With Aortic Dilation

Participants
Elizabeth Weiss, BS, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Bicuspid aortic valve (BAV) disease increases the risk of aortopathies such as aortic dilation, aneurysm, and dissection. Aortic Regurgitation (AR) and Aortic Stenosis (AS) exacerbate BAV related deranged flow and accelerate the need for surgical intervention. Vorticity has been shown to be associated with the degree of aortic dilation but this is a non-standardized measure that requires dedicated analysis tools and is noise-prone. We instead propose using 4D flow MRI to measure voxel-wise reverse flow, an expected but simpler characteristic of vortex flow. We aimed to evaluate reverse flow as a diagnostic metric to quantify deranged flow in BAV patients with AR and AS and to assess its association with aortic dilation.*Methods and Materials 513 patients with BAV (age = 51±13yrs, 24% female), mid-ascending aorta diameter (MAAD) > 35mm and valid 4D flow scans were analyzed. An age and sex-matched healthy control cohort (n=25, age = 49±12yrs, 24% female) was selected. Each 4D flow scan was preprocessed and segmented. 2D analysis planes were equidistantly placed along an automatically calculated centerline to define the direction of reverse flow to quantify voxel-wise reverse flow along the entire aorta (Fig1c-d). The mean reverse flow in the ascending aorta was measured over the first 300ms (systole) and second 300ms (diastole).*Results There were no differences in age, gender, or BMI between the cohorts. There was no difference in MAAD across the AR groups: none, mild, moderate, severe. BAV resulted in significantly increased reverse flow compared to healthy controls even in the absence of AS or AR. Diastolic reverse flow increased significantly with AR severity but had no difference in systole. Reverse flow increased with AS severity in systole but had little change in diastole. Systolic reverse flow across all AR groups had a correlation coefficient of 0.21 with MAAD (p<0.001).*Conclusions Reverse flow maps, measured from 4D flow, captured BAV mediated deranged flow in patients with AR and AS. As expected, reverse flow increased with AR severity, but this increase was isolated to diastole. This suggests that the elevated systolic reverse flow captured BAV related changes in aortic outflow while excluding the effect of deranged flow due to AR. Contrary to AR, AS severity played a significant role in systolic reverse flow. Additionally, systolic reverse flow was found to increase with aortic dilation severity. Overall, we found that reverse flow captured BAV and valve disease related deranged flow and that reverse flow may be a valuable metric for evaluating disease severity.*Clinical Relevance/Application Voxel-wise reverse flow maps, measured from 4D flow MRI, characterizes deranged flow in patients with BAV, aortic dilation, and mixed AS and AR status.

RESULTS

There were no differences in age, gender, or BMI between the cohorts. There was no difference in MAAD across the AR groups: none, mild, moderate, severe. BAV resulted in significantly increased reverse flow compared to healthy controls even in the absence of AS or AR. Diastolic reverse flow increased significantly with AR severity but had no difference in systole. Reverse flow increased with AS severity in systole but had little change in diastole. Systolic reverse flow across all AR groups had a correlation coefficient of 0.21 with MAAD (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Voxel-wise reverse flow maps, measured from 4D flow MRI, characterizes deranged flow in patients with BAV, aortic dilation, and mixed AS and AR status.

SSCA01-5   Diffuse Myocardial Fibrotic Remodeling In Hereditary Thoracic Aortic Disorders

Participants
Gauri Karur, MBBS, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

A primary cardiomyopathy has been described in some hereditary thoracic aortic disorders (HTAD). Angiotensin-II receptor blockers (ARB) and beta-blockers (BB) are a mainstay of medical treatment of many HTAD patients. The purpose is to evaluate myocardial remodeling using cardiac MRI in adults with HTAD and investigate the potential anti-fibrotic effect of ARB and BB on the myocardium.*Methods and Materials Gene-positive HTAD patients undergoing clinical cardiac MRI were prospectively recruited for assessment of myocardial fibrosis using native T1 mapping (MOLLI) and were compared with a cohort of healthy controls. Exclusion criteria included prior cardiovascular surgery and valvular disease. To allow comparison across 1.5T and 3T scanners, Z-scores were calculated for T1 using scanner-specific local reference values.*Results A total of 32 patients with HTAD were included, 18 Marfan, 7 Loeys Dietz, 6 Ehler Danlos, and 1 arterial tortuosity syndromes (mean age 34±12 years, 39% female, 22% treated with ARB and 34% with BB). There was no significant difference in age or sex between HTAD patients and controls (n=45, 40.4±14 years, p=0.051; 61% female, p=0.81). HTAD patients had normal left and right ventricular (LV, RV) volumes and LV mass. HTAD patients had lower LV and RV ejection fractions (EF) compared to controls (57.8±5.8 vs. 60.9±3.7, p=0.006; 53.8±7.5 vs. 57.5±4.2,

p=0.03). Native T1 was significantly higher in patients with HTAD compared to controls, suggestive of diffuse myocardial fibrosis (Z-score 0.7±1.5 vs. 0.007±1.0, p=0.02). Native T1 did not correlate significantly with biventricular volumes, mass, EF or aortic root diameter. Patients treated with ARB or BB therapy had slightly lower native T1 compared to untreated patients (Z-score 0.2±1.4 vs. 1.2±1.5, p=0.042).*Conclusions Cardiac MRI biomarkers of diffuse myocardial fibrosis are elevated and biventricular function is lower in HTAD. While the prognostic significance of this finding will need to be investigated in larger longitudinal studies, our data suggest that HTAD patients undergo adverse biventricular remodeling. ARB and BB therapy may have an anti-fibrotic effect on the myocardium.*Clinical Relevance/Application Cardiac MRI provides valuable information about myocardial remodeling in HTAD. Further research is required to investigate the myocardial protective potential of ARB and BB therapy.

RESULTS

A total of 32 patients with HTAD were included, 18 Marfan, 7 Loeys Dietz, 6 Ehler Danlos, and 1 arterial tortuosity syndromes (mean age 34±12 years, 39% female, 22% treated with ARB and 34% with BB). There was no significant difference in age or sex between HTAD patients and controls (n=45, 40.4±14 years, p=0.051; 61% female, p=0.81). HTAD patients had normal left and right ventricular (LV, RV) volumes and LV mass. HTAD patients had lower LV and RV ejection fractions (EF) compared to controls (57.8±5.8 vs. 60.9±3.7, p=0.006; 53.8±7.5 vs. 57.5±4.2, p=0.03). Native T1 was significantly higher in patients with HTAD compared to controls, suggestive of diffuse myocardial fibrosis (Z-score 0.7±1.5 vs. 0.007±1.0, p=0.02). Native T1 did not correlate significantly with biventricular volumes, mass, EF or aortic root diameter. Patients treated with ARB or BB therapy had slightly lower native T1 compared to untreated patients (Z-score 0.2±1.4 vs. 1.2±1.5, p=0.042).

CLINICAL RELEVANCE/APPLICATION

Cardiac MRI provides valuable information about myocardial remodeling in HTAD. Further research is required to investigate the myocardial protective potential of ARB and BB therapy.

SSCA01-6   Prevalence Of Veno-venous Shunting And High-output State In Fontan - Quantification With 4D Flow MRI

Participants
Albert Hsiao, MD,PhD, La Jolla, California (*Presenter*) Co-founder, Arterys Inc;Shareholder, Arterys Inc;Research Grant, Bayer AG;Research Grant, General Electric Company

PURPOSE

Patients with Fontan palliation comprise a growing and complex population, consisting of a variety of underlying cardiac morphologies with multiple potential modes of failure. In this population, veno-venous collaterals are a known cause of cyanosis, but generally considered a minor source of shunting. We sought to assess the potential value of 4D Flow MRI to quantify flow volume throughout the Fontan circuit, including the frequency and hemodynamic contribution of systemic-to-pulmonary veno-venous collaterals.*Methods and Materials We retrospectively reviewed our experience with 4D Flow to evaluate the Fontan circulation in 75 patients over 4 years at three institutions. Flow volume measurements were performed at multiple locations along the Fontan circuit. To assess the inter-observer consistency, duplicate measurements were performed in a subset of 20 patients. Statistical analysis included Pearson correlation, Bland-Altman analysis, t-test and F-test. The frequency of veno-venous collaterals and structural defects were tabulated from concurrent MRA and related to Fontan clinical status.*Results Flow volume measurements of aortic output, right pulmonary artery, pulmonary veins and SVC/Glenn showed highest inter-observer agreement (?=0.901-0.959), slightly lower in the left pulmonary artery and IVC/Fontan (?=0.792, 0.798), Calculated shunt volume also showed strong agreement, based on the difference between aortic and pulmonary flow (?=0.882). 38/75 (51%) of patients exhibited shunts exceeding 1.00 L/min, 31/38 (82%) of whom had pulmonary venous or atrial flow volume step-ups and corresponding veno-venous collaterals. 9/75 (12%) exhibited a high output state (>4 L/min/m2), most of whom had veno-venous shunts exceeding 30% of cardiac output.*Conclusions Veno-venous collaterals are common in Fontan patients and can contribute a substantial proportion of cardiac output, especially those in a high-output state, suggesting a role in high-output failure. 4D Flow MRI can reliably quantify Fontan flow, including shunts and concomitant structural defects, providing hemodynamic information valuable for management of Fontan palliation.*Clinical Relevance/Application 4D Flow MRI provides visualization and quantitative flow volume measurements for management of Fontan patients that complements traditional sequences used in cardiac MRI and enables quantification of veno-venous shunts.

RESULTS

Flow volume measurements of aortic output, right pulmonary artery, pulmonary veins and SVC/Glenn showed highest inter-observer agreement (?=0.901-0.959), slightly lower in the left pulmonary artery and IVC/Fontan (?=0.792, 0.798), Calculated shunt volume also showed strong agreement, based on the difference between aortic and pulmonary flow (?=0.882). 38/75 (51%) of patients exhibited shunts exceeding 1.00 L/min, 31/38 (82%) of whom had pulmonary venous or atrial flow volume step-ups and corresponding veno-venous collaterals. 9/75 (12%) exhibited a high output state (>4 L/min/m2), most of whom had veno-venous shunts exceeding 30% of cardiac output.

CLINICAL RELEVANCE/APPLICATION

4D Flow MRI provides visualization and quantitative flow volume measurements for management of Fontan patients that complements traditional sequences used in cardiac MRI and enables quantification of veno-venous shunts.

SPR-PH

Physics Pre-recorded Scientific Papers

Sub-Events

SPR-PH-1   Automatic RECIST Measurement In Longitudinal CT Imaging Studies

Participants
Youbao Tang, PhD, Bethesda, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Monitoring treatment response in longitudinal CT imaging studies by identifying and measuring the corresponding lesions is critical in radiology and oncology workflows. Conducting this procedure manually is labor-intensive, as clinicians must review multiple 3D images, going back and forth among different images for visual comparison. This is usually subject to considerable inter-observer variability. To lower costs, increase turnaround speeds, and improve reliability, we propose a deep learning system to track and measure the lesions in longitudinal studies automatically and accurately.*Methods and Materials Our system consists of two deep convolutional neural networks. The first network is used for key slice selection and RECIST (Response Evaluation Criteria in Solid Tumors) diameter prediction by taking inputs of a CT sequence and a click in the lesion region. The second network is used for lesion tracking to locate the lesion in the follow-up CT sequence. It takes inputs of a baseline CT, the lesion center on the baseline CT, and a follow-up CT. Our system can obtain the RECIST measurement in longitudinal studies automatically by requiring only one click from radiologists. The models were trained on the large-scale NIH DeepLesion dataset consisting of 32,735 lesions labeled with RECIST diameters from 10,594 studies of 4,459 patients. 1,000 lesions were randomly selected from 500 patients and manually delineated as the validation set of the RECIST model, the remaining patient data were used for training. 3,008, 403, and 900 lesion pairs were constructed from the DeepLesion dataset as the training, validation, and testing set of the lesion tracking model.*Results For each lesion pair, we can compute its tumor response class, as complete response (CR), partial response (PR), progressive disease (PD), or stable disease (SD), of the manual RECIST and our automated RECIST assessments, based on RECIST version 1.1. On the 900 test lesion pairs, our system achieved an accuracy of 0.91, a macro-F1 score of 0.81, and a micro-F1 score of 0.91 for the tumor response classification.*Conclusions A deep learning system to automate RECIST measurements in longitudinal CT studies via a simple click achieves comparable accuracies to expert clinicians, but with markedly reduced time and labor efforts.*Clinical Relevance/Application Our system can serve as a reliable tool for clinicians to annotate sequential RECIST measurements with only minimal human effort required to attain efficiency, objectiveness and reproducibility, and may have high positive clinical impacts.

RESULTS

For each lesion pair, we can compute its tumor response class, as complete response (CR), partial response (PR), progressive disease (PD), or stable disease (SD), of the manual RECIST and our automated RECIST assessments, based on RECIST version 1.1. On the 900 test lesion pairs, our system achieved an accuracy of 0.91, a macro-F1 score of 0.81, and a micro-F1 score of 0.91 for the tumor response classification.

CLINICAL RELEVANCE/APPLICATION

Our system can serve as a reliable tool for clinicians to annotate sequential RECIST measurements with only minimal human effort required to attain efficiency, objectiveness and reproducibility, and may have high positive clinical impacts.

SPR-PH-10   Quantification Of Regional Cerebral Blood Flow Using Diffusion Imaging With Phase-contrast (dpc)

Participants
Fumiki Sugita, Kanazawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Although the perfusion-related diffusion coefficient in triexponential analysis is closely correlated with regional cerebral blood flow (rCBF) assessed by arterial spin labeling (ASL), it is only a semiquantitative relative value of rCBF, which makes absolute rCBF quantification challenging. To resolve this problem, we developed a novel diffusion imaging method with phase contrast (DPC), in which the total CBF from phase-contrast (PC)-magnetic resonance imaging (MRI) was used to convert perfusion-related diffusion coefficients in the brain to absolute rCBF.*Methods and Materials Eleven healthy volunteers (nine men and two women; mean age, 23.9 years) participated in this study. 3.0 T, single-shot diffusion echo-planar imaging with multiple b-values in combination with PC-MRI was performed to obtain tCBF from the volumetric flow rate at the main feeding arteries into the cranium. Using tCBF obtained from PC-MRI, we converted the perfusion-related diffusion coefficients in the brain into absolute rCBF. We measured rCBF and its correlations in gray and white matter (GM and WM, respectively) in healthy volunteers using DPC and ASL and assessed the relationship between the two methods.*Results A highly significant positive correlation between DPC and ASL in terms of rCBF was observed in GM (R = 0.9; P < 0.05), whereas the correlation between the methods was poor in WM (R = 0.09; P = 0.8). The rCBF in GM (54.4 ± 11.8 mL/100 g/min) and WM (19.6 ± 4.5 mL/100 g/min) and the GM/WM ratio (2.9 ± 0.7) obtained using DPC were consistent with the literature values assessed using [15O]-water positron emission tomography. The rCBF obtained using DPC was significantly higher in GM and WM than that using ASL (P < 0.05 for both; GM [ASL], 31.9 ± 8.1 mL/100 g/min; WM [ASL], 10.0 ± 3.8 mL/100 g/min).*Conclusions DPC makes it possible to quantitatively evaluate rCBF as well as standard diffusion parameters.*Clinical Relevance/Application Diffusion imaging with phase-contrast (DPC) makes it possible to quantitatively evaluate regional cerebral blood flow as well as standard diffusion parameters.

A highly significant positive correlation between DPC and ASL in terms of rCBF was observed in GM (R = 0.9; P < 0.05), whereas the correlation between the methods was poor in WM (R = 0.09; P = 0.8). The rCBF in GM (54.4 ± 11.8 mL/100 g/min) and WM (19.6 ± 4.5 mL/100 g/min) and the GM/WM ratio (2.9 ± 0.7) obtained using DPC were consistent with the literature values assessed using [15O]-water positron emission tomography. The rCBF obtained using DPC was significantly higher in GM and WM than that using ASL (P < 0.05 for both; GM [ASL], 31.9 ± 8.1 mL/100 g/min; WM [ASL], 10.0 ± 3.8 mL/100 g/min).

CLINICAL RELEVANCE/APPLICATION

Diffusion imaging with phase-contrast (DPC) makes it possible to quantitatively evaluate regional cerebral blood flow as well as standard diffusion parameters.

SPR-PH-11   Of Mice And Men - Spatial Resolution Of A Novel Photon Counting Dual-Source CT Scanner In Routine Clinical Acquisition Modes

Participants
Florian Schwarz, MD, Augsburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The potential benefits of Photon-Counting Detector CT (PCD-CT) include substantially improved spatial resolution, elimination of electronic noise and intrinsic spectral sensitivity. The aim of our study was to examine the spatial resolution of a novel photon counting Dual-Source CT (NAEOTOM Alpha, Siemens Healthineers, Erlangen, Germany) in biological tissue and determine its dose dependency.*Methods and Materials A euthanized mouse was purchased from a pet food store and used as a specimen. It was scanned at two different CT scanners currently in use at our institution with protocols optimized for bone imaging and identical CTDI settings (A: 20-slice MDCT with energy-integrating detector (EID), B: PCD-CT with ultra-high-resolution mode (UHR)). Scans were performed at different CTDI's with a range from 2.2 to 20 mGy*cm. For image noise measurements, all datasets were reconstructed at 1 mm slice thickness using reconstruction algorithms with closest similarity in Modulation Transfer Function (B75h and Hr68). Image noise was quantified as standard deviation of HU-values in a large Volume of Air next to the mouse. For the evaluation of spatial resolution, reconstructions were performed at 0.2 mm slice thickness with 0.1 mm increment (PCD-CT); and with 0.6 mm slice thickness with 0.1 mm increment (EID-CT). The latter were reformatted to 0.2 mm series with 0.1 mm increment by a commercially available postprocessing software. To guarantee a "fair comparison", spatial resolution was also compared using the aforementioned Kernels (B75h and Hr68). Two readers semiquantitatively evaluated two defined regions of the spine (cervical spine and lumbar spine) for the delineation of intervertebral disks on a three point Likert scale. Additional Hr98 reconstructions are provided to visualize the much higher spatial resolution routinely available by UHR PCD-CT acquisitions.*Results For all CTDI values, noise was significantly lower in PCD-CT reconstructions than in EID-CT reconstructions using comparable reconstruction algorithms (p's< 0.01). At EID, delineation of the cervical spine structures required a CTDI = 20 mGy, whereas at PCD-CT this delineation was possible at CTDI values = 4 mGy. Delineation of lumbar vertebrae started at CTDI values = 3 mGy for PCD-CT, whereas clear delineation at EID-CT was only possible with CTDI's = 15 mGy.*Conclusions In this direct comparisons of the subtle bone structures of a young mouse, PCD-CT showed clearly superior delineation of small bone details at much lower CTDI's.*Clinical Relevance/Application This study highlights the increased spatial resolution of PCD-CT systems in comparison to EID-CT systems at routine acquisition protocols. This is particularly relevant for high-contrast structures inside the human body.

RESULTS

For all CTDI values, noise was significantly lower in PCD-CT reconstructions than in EID-CT reconstructions using comparable reconstruction algorithms (p's< 0.01). At EID, delineation of the cervical spine structures required a CTDI = 20 mGy, whereas at PCD-CT this delineation was possible at CTDI values = 4 mGy. Delineation of lumbar vertebrae started at CTDI values = 3 mGy for PCD-CT, whereas clear delineation at EID-CT was only possible with CTDI's = 15 mGy.

CLINICAL RELEVANCE/APPLICATION

This study highlights the increased spatial resolution of PCD-CT systems in comparison to EID-CT systems at routine acquisition protocols. This is particularly relevant for high-contrast structures inside the human body.

SPR-PH-12   Physical Characteristics Of A New Photon-counting Detector CT: Comparison Of The Spatial Resolution With That On Conventional Energy-integrated Detector CT Scans

Participants
Toru Higaki, PhD, Minami-ku, Hiroshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

FUJIFILM Healthcare Corporation developed a photon-counting detector CT (PCD-CT) scanner whose photon sensor was made of CdZnTe. It features two scan modes, multi-energy discrimination (MED) mode where 3x3 detector pixels are bundled [detector pixel pitch (DPP) 0.58x0.63 mm, the same as the conventional energy-integrated detector CT [EID-CT scanner]. It can obtain projection data of four energy bins. The other is the ultra-high resolution (UHR) mode where each detector pixel is used separately; it can yield high spatial resolution images (DPP: 0.19x0.21 mm) with projection data of one energy bin. We compared the spatial resolution obtained with the UHR mode of the PCD-CT with EID-CT results.*Methods and Materials The prototype PCD-CT instrument was built on the platform of a conventional EID-CT scanner (SCENARIA View, FUJIFILM Healthcare Corporation). We created a phantom consisting of a cylindrical water background (diameter 20 cm, 0 Hounsfield units) and a 0.18-mm diameter stainless wire placed 30 mm off-center. The scanning parameters for both scanners were scan field-of-view 42.6 cm, tube voltage 120 kV, tube current time product, 300 mAs, tube focal spot 0.7x0.8 mm, view rate 2880 view/sec, slice thickness,1.25 mm, matrix size 512x512, reconstruction with filtered back projection (kernel: abdominal sharp). The number of energy bin of the PCD-CT was 1. We calculated the modulation transfer function (MTF) using the radial frequency method.*Results With PCD-CT in UHR mode, the 50%, 10%, and 2% MTF was 8.5, 13.6, and 16.5 lp/cm, respectively. For conventional EID-CT these values were 4.9, 8.4, and 10.1 lp/cm, respectively. The MTF in the UHR mode of the PCD-CT scanner was higher than that of the EID-CT scanner in the entire frequency range.*Conclusions The spatial resolution of the new PCD-CT scanner was better than of the conventional EID-CT instrument.*Clinical Relevance/Application As the spatial resolution is higher on scans acquired in the UHR mode of the PCD-CT- than the EID-CT scanner, it may be useful for analyzing the microstructures of the lungs and middle ear.

RESULTS

With PCD-CT in UHR mode, the 50%, 10%, and 2% MTF was 8.5, 13.6, and 16.5 lp/cm, respectively. For conventional EID-CT these

values were 4.9, 8.4, and 10.1 lp/cm, respectively. The MTF in the UHR mode of the PCD-CT scanner was higher than that of the EID-CT scanner in the entire frequency range.

CLINICAL RELEVANCE/APPLICATION

As the spatial resolution is higher on scans acquired in the UHR mode of the PCD-CT- than the EID-CT scanner, it may be useful for analyzing the microstructures of the lungs and middle ear.

SPR-PH-13   Accuracy Of CT Number On Virtual Non-contrast Enhanced Images Generated From Stochastic Material Decomposition

Participants
Toru Higaki, PhD, Minami-ku, Hiroshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Virtual non-contrast enhanced (VNC) CT image is an application derived from dual-energy CT (DECT). Since VNC images can be generated from contrast-enhanced CT (CECT) scans, the radiation exposure may be reduced by eliminating the need for non-contrast CT imaging. VNC images are generally generated by 3-material decomposition (3MD). However, the CT value of VNC scans may be incorrect for tissues that do not meet the material definition. To solve this problem, we developed a novel VNC image-generation method that does not assume a specific tissue and named it "stochastic material decomposition (SMD)". We investigated the accuracy of the CT number on VNC images generated by SMD.*Methods and Materials We used a 320-detector row CT scanner that featured a deep-learning-based rapid kV switching dual-energy mode (Aquilion One, Canon Medical Systems). For image processing, we used NIH ImageJ. To generate VNC images, we reconstructed 50- and 70 keV virtual monochromatic X-ray images (VMI) of patients who had undergone liver dynamic CT studies. Figure 1 shows the algorithm for conventional 3MD. The proposed SMD method uses a tissue probability distribution map (TPDM) (Fig. 2) that was a 2-D histogram of two VMIs generated from previously acquired true non-contrast (TNC) images. Starting at the measurement point on each voxel, we extended a straight line along with the slope coefficient and looked for the point with the highest value on the TPDM. Its CT number was taken as that of the VNC image. We then evaluated the accuracy of the CT number on VNC images generated with 3MD and SMD and recorded the difference in the CT number between VNC- and TNC images of the liver, spleen, and aorta.*Results Figure 3 shows a TNC image of liver dynamic CT scans and VNC images generated from early- and delayed phase images. Compared to the SMD-generated VNC image, 3MD-generated VNC images exhibited a rough texture, and attenuation of the stomach- and spleen density was low. Figure 4 shows the difference (error) in the CT number between VNC- and TNC images. Errors in the liver were similar on 3MD and SMD images; in the spleen and aorta, they were significantly smaller on SMD images.*Conclusions As the proposed SMD method did not require tissue definition for the generation of VNC scans, it facilitates the generation of highly accurate VNC scans of multiple tissues.*Clinical Relevance/Application The proposed SMD method yields accurate VNC images and helps to lower the radiation dose at DECT studies.

RESULTS

Figure 3 shows a TNC image of liver dynamic CT scans and VNC images generated from early- and delayed phase images. Compared to the SMD-generated VNC image, 3MD-generated VNC images exhibited a rough texture, and attenuation of the stomach- and spleen density was low. Figure 4 shows the difference (error) in the CT number between VNC- and TNC images. Errors in the liver were similar on 3MD and SMD images; in the spleen and aorta, they were significantly smaller on SMD images.

CLINICAL RELEVANCE/APPLICATION

The proposed SMD method yields accurate VNC images and helps to lower the radiation dose at DECT studies.

SPR-PH-14   A Comparative Study Of Image Quality And Radiation Dose Of Coronary CT Under Free Breathing And Breath-holding Scanning

Participants
Jingyao Zheng, Shizuishan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the radiation dose of coronary CT angiography (CCTA) under different conditions of free breathing and breath-holding.*Methods and Materials Thirty patients with suspected coronary atherosclerotic heart disease to undergo CCTA examination were collected. 15 cases of group A were scanned by traditional breath-holding method,15 cases in group B were scanned by free breathing. All patients underwent CCTA examination with 256-slice wide-body detector CT (Revolution CT, GE Healthcare). And patients signed an informed consent form before the examination. The 4 groups of images are respectively 20% ASiR-V (group A), 40% ASiR-V (group B), 60% ASiR-V (group C), 80% ASiR-V (group D) for standard image reconstruction. The reconstructed image is transferred to GE AW 4.7 workstation to analyze. Two radiologists with cardiovascular CT diagnosis experience scored the images of coronary artery imaging subjectively and objectively by blind method, and compared the radiation measurement between the two groups.*Results There was no statistically significant difference in the subjective scores of image quality between the two groups (p=0.286,p=0.521,p=205). In the state of free breathing, the excellent blood vessel rates of the right coronary artery (RCA), the left ascending artery (LAD), and the left circumflex artery (LCX) are 37.5% (45/120) ,35.8% (43/120) and 31.6% (38/120). The excellent blood vessel rates of RCA, LAD, and LCx in breath-holding state are 36.6% (44/120), 35.8% (43/120) and 20.8% (25/120). There was no statistically significant difference between the two groups (p>0.05). The SD values of the aortic roots examined by CCTA under free breathing and breath-holding state were 31.62±5.70, 29.62±3.76 HU. There was no statistically significant difference between the two groups (p=0.268). The difference in CT value, SNR and CNR was also not statistically significance (p=0.715, p=308, p=0.327), the ED values of groups A and B were (8.25±1.18) mSv and (8.15±1.15) mSv, respectively, and the difference was not statistically significant (p=0.809).*Conclusions With the same 16cm wide detector CT, the scanning dose of the free breathing method and the traditional breath-hold method CCTA examination are equivalent, and there is no statistical difference in the excellent blood vessel rate between the two methods, so the free-breath method can replace the traditional breath-hold method CCTA examination.*Clinical Relevance/Application Using 16 cm wide detector CT,there is no statistical difference in scanning dose and excellent blood vessel rate between free breathing CCTA and traditional breath-holding CCTA., Therefore, the free breathing method CCTA provides the possibility for a wider range of clinical applications.

RESULTS

There was no statistically significant difference in the subjective scores of image quality between the two groups (p=0.286,p=0.521,p=205). In the state of free breathing, the excellent blood vessel rates of the right coronary artery (RCA), the left ascending artery (LAD), and the left circumflex artery (LCX) are 37.5% (45/120) ,35.8% (43/120) and 31.6% (38/120). The

excellent blood vessel rates of RCA, LAD, and LCx in breath-holding state are 36.6% (44/120), 35.8% (43/120) and 20.8% (25/120). There was no statistically significant difference between the two groups (p>0.05). The SD values of the aortic roots examined by CCTA under free breathing and breath-holding state were 31.62±5.70, 29.62±3.76 HU. There was no statistically significant difference between the two groups (p=0.268). The difference in CT value, SNR and CNR was also not statistically significance (p=0.715, p=308, p=0.327), the ED values of groups A and B were (8.25±1.18) mSv and (8.15±1.15) mSv, respectively, and the difference was not statistically significant (p=0.809).

CLINICAL RELEVANCE/APPLICATION

Using 16 cm wide detector CT,there is no statistical difference in scanning dose and excellent blood vessel rate between free breathing CCTA and traditional breath-holding CCTA., Therefore, the free breathing method CCTA provides the possibility for a wider range of clinical applications.

SPR-PH-15 Performance Evaluation Of A Deep Learning Based Reconstruction Method For Low Dose PET Imaging

Participants
Yan Xing, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to evaluate the performance of a deep progressive learning (DPL) method, (HYPER AiR, United Imaging Healthcare) for PET image reconstructions with simulated low dose PET acquisitions in comparison to the standard ordered-subsets expectation maximization (OSEM) method.*Methods and Materials Nineteen oncological patients undergoing 18F-FDG PET/CT imaging with an acquisition of 120s per bed position were retrospectively included. Images reconstructed with OSEM were used as the standard of reference. Subsequently, 37.5%, 50%, 75% and 100% of the full counts were extracted from the list-mode data to simulate low dose PET imaging and reconstructed by the DPL method. A volume of interest (VOI) with a diameter of 30±3mm was manually drawn in the liver to measure the standard uptake values (SUVs) and standard deviations (SDs). For each patient, a VOI was drawn on the lesion with the highest uptake or a diameter of = 15 mm (with an overall maximum of five lesions per patient) to measure the SUVpeak and SUVmax value. Liver signal-to-noise ratio (SNR) and lesion target-to-background ratio (TBR) were obtained. Paired-samples t-test was performed to compare the parameters between the methods.*Results Compared with the reference, there was no significant difference regarding liver SUVs. DPL images with 50% counts and above revealed significantly larger SNR values than the reference (all p<0.001). DPL images with 37.5% counts showed a slightly higher SNR compared to the reference (p=0.438). Compared with the reference lesion SUVmax, SUVpeak and TBR, DPL images showed significantly larger values for lesions with the highest uptake or a diameter of = 15 mm (all p<0.01).*Conclusions The proposed deep progressive learning method provided a non-inferior image quality even with reduced counts by 62.5%. Moreover, the DPL method yielded significantly higher lesion TBR values compared to the reference method, indicating a better lesion contrast. DPL would play a potentially important role in low-dose PET imaging.*Clinical Relevance/Application The proposed deep progressive learning (DPL) method can provide a non-inferior image quality with reduced counts, indicating its application in low dose PET imaging.

RESULTS

Compared with the reference, there was no significant difference regarding liver SUVs. DPL images with 50% counts and above revealed significantly larger SNR values than the reference (all p<0.001). DPL images with 37.5% counts showed a slightly higher SNR compared to the reference (p=0.438). Compared with the reference lesion SUVmax, SUVpeak and TBR, DPL images showed significantly larger values for lesions with the highest uptake or a diameter of = 15 mm (all p<0.01).

CLINICAL RELEVANCE/APPLICATION

The proposed deep progressive learning (DPL) method can provide a non-inferior image quality with reduced counts, indicating its application in low dose PET imaging.

SPR-PH-16 Characterization Of Spectral CT Image Quality Using Covariance Weighted Contrast-to-noise Ratio

Participants
Jayasai Rajagopal, BA, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To develop a metric for spectral CT image data that is able to account for the signal and noise interrelationship between images in an energy selective dataset and as an analogue to the contrast-to-noise ratio in conventional CT image quality*Methods and Materials A metric was developed to incorporate the covariance between images in spectral CT datasets into the calculation, the covariance-weighted contrast-to-noise ratio (Covar-CNR). This metric relates the contrast in a specific image to the shared noise component between that image and others within the spectral dataset. An investigational photon-counting CT system (Siemens CounT) was used to image an open bore water phantom containing vials of iodine (2, 4, 8 mg/mL). Images were acquired with three different tube voltages (100, 120 and 140 kV) at 150 mAs. The macro mode of the scanner was used with optimally selected threshold values of 25 and 52 keV. Regions of interest were drawn within each vial and used to calculate the conventional and covariance weighted CNRs of both spectral images.*Results Both conventional and covariance weighted CNRs increased as a function of iodine concentration across all three tube voltages. Across tube voltages, both conventional and covariance weighted CNRs decreased for the two highest concentrations of iodine, while they increased slightly for the lowest concentration of iodine. The lower energy image had a 42% higher conventional CNR and 142% lower covariance weighted CNR than the high energy image across all conditions. Covariance weighted CNRs were higher than conventional CNR by 124% and 73% in the low and high energy images respectively, providing a fuller representative picture of the interactions within the spectral dataset.*Conclusions While conventional CNR reflects the noise and contrast within an image, the covariance weighted CNR measures how much that noise and contrast are shared across images within the spectral dataset. Together, they provide a more complete characterization of spectral CT datasets.*Clinical Relevance/Application Modifying image quality metrics to reflect differences in spectral detectors and post-processing tasks in material separation can increase confidence in and promote clinical use of these techniques

RESULTS

Both conventional and covariance weighted CNRs increased as a function of iodine concentration across all three tube voltages. Across tube voltages, both conventional and covariance weighted CNRs decreased for the two highest concentrations of iodine, while they increased slightly for the lowest concentration of iodine. The lower energy image had a 42% higher conventional CNR and 142% lower covariance weighted CNR than the high energy image across all conditions. Covariance weighted CNRs were higher than conventional CNR by 124% and 73% in the low and high energy images respectively, providing a fuller representative picture

of the interactions within the spectral dataset.

CLINICAL RELEVANCE/APPLICATION

Modifying image quality metrics to reflect differences in spectral detectors and post-processing tasks in material separation can increase confidence in and promote clinical use of these techniques

SPR-PH-17   Automatic Liver Lesion Localization Using Large-scale Unlabeled And Sequence-incomplete MR Imaging Data

Participants
Bolin Lai, MENG, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

Early detection of liver lesions can significantly boost patient prognosis. But even with multi-phasic MRI, reported sensitivities are still low, e.g., 47% for < 2cm hepatocellular carcinoma. Computer-aided detection (CADe) solutions may help address this challenge, but current algorithms cannot easily exploit existing sources of large-scale data: they expect fully annotated data and a pre-defined set of MRI sequences. Yet, hospital archives house unlabeled MRI studies whose acquired sequences can vary. We investigate how to leverage unlabeled and sequence-incomplete MRI data to train a highly effective deep learning CADe algorithm.*Methods and Materials We collected 1099 multi-sequence MRI studies (T1, T1 contrast-enhanced arterial and venous phases, T2, and DWI) of patients who had undergone a liver resection or transplantation. Three sub-types are included in the dataset: HCC, ICC and metastasized tumors. For 430 studies with all five sequences, we labelled each present lesion with 3D bounding boxes via visual observation and cross-referencing the histopathological reports. We developed a CADe algorithm with two technical innovations. First, we incorporate hetero-modal learning to exploit studies with missing sequences. Second, we propose a semi-supervised mean teacher workflow tailored for detection. Unlike prior art, it enforces consistency on both detection confidences and bounding box sizes. As well, it uses hetero-modal learning to exert consistency across varying sequence inputs.*Results For evaluation, we utilized five-fold cross validation on the labelled studies. We tested a range of training setups under differing ratios of labeled-to-unlabeled data (5%-30%). Under the 10% setting and using free-response ROC analysis, our CADe system achieves an average sensitivity of 55.2%, which is 13.3% higher than its fully supervised counterpart (41.9%) since more (unlabeled) data is used for training, and 3.5% better than the next best state-of-the-art semi-supervised detection method. Commensurate improvements are also observed under other labeled ratios.*Conclusions We proposed a semi-supervised CADe method and hetero-modal learning strategy that can exploit large-scale unlabeled and sequence-incomplete clinical data. Experiments validated its superiority over fully supervised detectors and other semi-supervised methods.*Clinical Relevance/Application Automatic lesion detection could serve as an end goal to help radiologists discover lesions quickly and precisely, or as a critical step for computer-aided diagnosis and prognosis.

RESULTS

For evaluation, we utilized five-fold cross validation on the labelled studies. We tested a range of training setups under differing ratios of labeled-to-unlabeled data (5%-30%). Under the 10% setting and using free-response ROC analysis, our CADe system achieves an average sensitivity of 55.2%, which is 13.3% higher than its fully supervised counterpart (41.9%) since more (unlabeled) data is used for training, and 3.5% better than the next best state-of-the-art semi-supervised detection method. Commensurate improvements are also observed under other labeled ratios.

CLINICAL RELEVANCE/APPLICATION

Automatic lesion detection could serve as an end goal to help radiologists discover lesions quickly and precisely, or as a critical step for computer-aided diagnosis and prognosis.

SPR-PH-18   A Novel Interpretable Deep Learning Prostate Cancer Detector For Bi-parametric MRI

Participants
Nathan Lay, PhD, Bethesda, Maryland (*Presenter*) Inventor, Abris Capital Partners

PURPOSE

Magnetic resonance imaging (MRI) is useful for targeting prostate lesions for biopsy. Reader experience requirements and complexity of MRI sequences have motivated the development of numerous automated prostate cancer detectors. Some recent cancer detectors employ deep learning which achieves state-of-the-art performance for challenging computer vision tasks. However, deep learning still suffers from lack of model interpretability and prediction explainability.We propose a differentiable decision forest, Hinge Forest, that can efficiently operate in concert with deep learning machinery. We use it for prostate cancer detection and show good preliminary test performance (0.91 AUC) on a large prostate cancer cohort along with an example of model interpretability.*Methods and Materials Our Hinge Forest defines an alternative consistent logic on the real numbers with MIN, MAX being logical AND, OR and TRUE, FALSE being positive, negative real numbers. We further define the comparison operation $X > Y$ to be $ReLU(X-Y)$ to guarantee that a unique decision tree leaf is visited for each example. Using this system of logic, the logical conjunctions represented by decision trees become differentiable and identically preserve their original logical meaning.Our deep neural network is comprised of a single VGG block (3 Conv+ReLU followed by max pool) followed by a linear aggregated Hinge Forest classifier comprised of 100 depth 7 trees. The neural network uses T2 weighted (T2w) and apparent diffusion coefficient (ADC) images and was trained end-to-end on 616 prostate MRI scans (517 in-house, 99 ProstateX), validated on 306 scans (250 in-house, 56 ProstateX), and tested on 309 scans (260 in-house, 49 ProstateX) with no patient overlap. The training objective was the weighted cross entropy loss. We trained for 16 epochs and chose the model state with the best validation area under the curve (AUC).*Results Our method achieved an AUC of 0.91 on the test set. The method can achieve 88% lesion detection rate at 20% false positive rate. As a test of interpretability, we visualized a leaf map of one tree and extracted a rule for cancer from a leaf that describes the cancerous lesion.*Conclusions Our Hinge Forest can operate with deep learning, maintain good performance and provide the interpretability and explainability of decision forests.*Clinical Relevance/Application Hinge Forest shows good preliminary performance for prostate cancer detection while providing some model interpretability and prediction explainability which are important for clinical applications.

RESULTS

Our method achieved an AUC of 0.91 on the test set. The method can achieve 88% lesion detection rate at 20% false positive rate. As a test of interpretability, we visualized a leaf map of one tree and extracted a rule for cancer from a leaf that describes the cancerous lesion.

SPR-PH-19   Transposition Of The European Basic Safety Standards Directive At National Level: Impact On A Pan European Healthcare Provider

Participants
Federica Zanca, PhD, Leuven, Belgium (*Presenter*) Nothing to Disclose

PURPOSE

The European Union (EU) issued the 2013/59/Euratom Basic Safety Standards Directive (BSSD) and set 02/06/2018 as a deadline for Member States to bring into force the laws required to comply with its requirements. The aim of this study was two-fold: 1) to evaluate the status of implementation of the BSSD by the EU member states; 2) to assess medical center level compliance with selected elements, independently of the implementation of the same by member states.*Methods and Materials A questionnaire was distributed between January-March 2021 involving 59 CT diagnostic centers in 11 Member States, where a Dose Management Program (DMP) is implemented. Categories of BSSD legal requirements: procedures and population dose evaluation, responsibilities, and asymptomatic patients. Sanctions for non-compliance were investigated.*Results Out of the 11 members states, in 10 the BSSD was fully implemented. Only 55% of the investigated member states have defined National DRLs or require dose from a CT procedure to be reported. CT optimization projects are required in 64% of the countries. In terms of responsibilities, all countries have a framework specifying the role of a Radiation Protection Expert, a Medical Physics Expert, and a Radiation Protection Officer. In terms of justification of exposure of asymptomatic individuals, 91% of the countries have a framework for mammography. Only 1 country (10%) has a regulation in place for lung cancer screening; 37% is preparing the legislation or running a clinical trial. Sanctions for non-compliance were fines from 2k euro to the withdrawal of license to operate. When looking at compliance at center for procedures and population dose evaluation, all centers had established local DRLs and continuous data collection allowed detection of non-optimized exposures; structured dose reporting and high dose level alerts were also in place. *Conclusions Despite of a lower compliance of the transposed BSSD for CT modality in several Member States, the centers participating in this study showed higher compliance with the key BSSD elements investigated thanks to the implementation of a DMP.*Clinical Relevance/Application This survey revealed a lack of compliance at country level with BSSD RP requirements. The level of compliance is higher at local level, especially for centers where a DMP is in place.

RESULTS

Out of the 11 members states, in 10 the BSSD was fully implemented. Only 55% of the investigated member states have defined National DRLs or require dose from a CT procedure to be reported. CT optimization projects are required in 64% of the countries. In terms of responsibilities, all countries have a framework specifying the role of a Radiation Protection Expert, a Medical Physics Expert, and a Radiation Protection Officer. In terms of justification of exposure of asymptomatic individuals, 91% of the countries have a framework for mammography. Only 1 country (10%) has a regulation in place for lung cancer screening; 37% is preparing the legislation or running a clinical trial. Sanctions for non-compliance were fines from 2k euro to the withdrawal of license to operate. When looking at compliance at center for procedures and population dose evaluation, all centers had established local DRLs and continuous data collection allowed detection of non-optimized exposures; structured dose reporting and high dose level alerts were also in place.

CLINICAL RELEVANCE/APPLICATION

This survey revealed a lack of compliance at country level with BSSD RP requirements. The level of compliance is higher at local level, especially for centers where a DMP is in place.

SPR-PH-2   Diagnostic Reference Levels And Achievable Doses For The 11 Most Commonly Performed Pediatric CT Examinations In The United States As A Function Of Patient Age And Size In The American College Of Radiology CT Dose Index Registry.

Participants
Kalpana M. Kanal, PhD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

To develop diagnostic reference levels (DRLs) and achievable doses (ADs) for the 11 most commonly performed pediatric CT examinations in the United States (USA) as a function of patient age and size using the American College of Radiology (ACR) CT Dose Index Registry.*Methods and Materials Data on the 11 most commonly performed pediatric CT examinations acquired between 2016 - 2020 from 1637 facilities were analyzed. For head, neck and extremity examinations, doses were analyzed based on patient age; for body examinations, doses were analyzed based on both patient age and effective diameter. Data from 1,562,016 examinations provided medians (AD) as well as 75th percentiles (DRL) for CTDIvol, DLP and SSDE. Applicable results were compared with DRLs from other countries.*Results Of all facilities analyzed, 65.2% of the facilities were community hospitals, 16.8% were freestanding centers, 9.5% were academic facilities and only 3.5% were dedicated children's hospitals. Head CT was the most frequently performed examination in the study (56.1%) followed by the abdomen/pelvis CT (28.1%). ADs and DRLs (for both CTDIvol and DLP) for all examinations generally increased as a function of age and patient effective diameter. For head without contrast examinations, the CTDIvol AD and DRL ranged from 19-46 mGy and 23-55 mGy, respectively increasing with age. For abdomen/pelvis without contrast examinations, the CTDIvol ADs and DRLs ranged from 2.1-24 mGy and 2.6-28 mGy, respectively with increasing effective diameter. Although international pediatric DRL methodology and results vary, our results fall within the ranges reported across other countries.*Conclusions DRLs and ADs as a function of patient age and effective diameter were developed from a wide range of USA practice environments for the 11 most common CT pediatric examinations using data from over 1.5 million pediatric examinations. These determinations can serve as practical benchmarks for accountability and for improvement in pediatric CT practice.*Clinical Relevance/Application The results of this study will enable US as well as international facilities to compare their patient dose indices to these benchmarks. Because smaller and younger patients require less radiation to obtain adequate image quality, the new DRLs and ADs will enable facilities to adjust their CT protocols more effectively for the wide range of patient habitus and age commonly seen in the pediatric population.

RESULTS

Of all facilities analyzed, 65.2% of the facilities were community hospitals, 16.8% were freestanding centers, 9.5% were academic facilities and only 3.5% were dedicated children's hospitals. Head CT was the most frequently performed examination in the study

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CLINICAL RELEVANCE/APPLICATION

The results of this study will enable US as well as international facilities to compare their patient dose indices to these benchmarks. Because smaller and younger patients require less radiation to obtain adequate image quality, the new DRLs and ADs will enable facilities to adjust their CT protocols more effectively for the wide range of patient habitus and age commonly seen in the pediatric population.

SPR-PH-21 Machine Learning-based Optimal Radiation Treatment Technique Suggestion Using Dosimetric Parameters

Participants
Dongmin Ryu, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop a model which can suggest the optimal radiation treatment (RT) technique using dosimetric parameters of breast cancer patients.*Methods and Materials Whole dataset was obtained from 400 breast cancer patients who underwent RT after breast-conserving surgery. Each dataset consists of a CT image, a contour map of four organs (breast, left lung, right lung, and heart) from RT-structure file (RS), and dose maps for four RT techniques, 2D tangential beams (2D), forward IMRT (f-IMRT), inverse IMRT (i-IMRT), and VMAT, from each RT-dose file (RD). Whole dataset includes 140, 192, 35, and 33 patients for 2D, f-IMRT, i-IMRT, and VMAT, respectively. Every plan's prescription dose was 4240 cGy (16 fractions with 265 cGy). The dataset was randomly divided into a training set of 350 patients and a test set of 50 patients (20 2D, 20 f-IMRT, 5 i-IMRT, and 5 VMAT) considering a ratio of each plan. To develop a RT technique suggestion model, a total of 36 parameters (9 types of dosimetric parameters for each plan) were calculated. In the training stage, XGBoost, a novel machine-learning algorithm, was implemented and parameter optimization was done using a simple grid search algorithm with 7-fold cross-validation to prevent overfitting. Multi log loss was applied, and model's outputs were probabilities of four RT techniques for each case. To evaluate the optimal RT technique prediction performance of the trained model, a confusion matrix was drawn for four plans. Precision, recall, F1-score for four plans were calculated respectively. To determine the accuracy considering the cases suitable for two or more plans, top-2 accuracy was also calculated along with top-1 accuracy.*Results The trained XGBoost model showed suitable RT technique suggestion results for each plan. Top-1 and top-2 accuracies for the test set were 76.0% and 94.0%, respectively. All three RT techniques except VMAT achieved 100% top-2 accuracy. Model performance could be improved by adding more i-IMRT and VMAT patient cases in the dataset. These results could help radiologist's plan selection in the real clinic by showing two most probable techniques with each technique's probability. Furthermore, by applying deep learning-based multi-organ segmentation and dose map estimation techniques that our group already has, an end-to-end CT to RT technique prediction model could be developed.*Conclusions The proposed machine learning-based framework showed suitable performance and successfully suggested which RT technique is the most appropriate for each patient with probability information.*Clinical Relevance/Application For whole breast RT, the optimal RT technique for each patient can be automatically chosen by using the proposed model, without manual treatment plannings for comparison.

RESULTS

The trained XGBoost model showed suitable RT technique suggestion results for each plan. Top-1 and top-2 accuracies for the test set were 76.0% and 94.0%, respectively. All three RT techniques except VMAT achieved 100% top-2 accuracy. Model performance could be improved by adding more i-IMRT and VMAT patient cases in the dataset. These results could help radiologist's plan selection in the real clinic by showing two most probable techniques with each technique's probability. Furthermore, by applying deep learning-based multi-organ segmentation and dose map estimation techniques that our group already has, an end-to-end CT to RT technique prediction model could be developed.

CLINICAL RELEVANCE/APPLICATION

For whole breast RT, the optimal RT technique for each patient can be automatically chosen by using the proposed model, without manual treatment plannings for comparison.

SPR-PH-22 Noise Properties And Low Contrast False Positive And False Negative Assessment Of A Super Resolution Deep Learning Reconstruction Algorithm Trained With Data From A Commercial High Resolution CT System

Participants
Kirsten Lee Boedeker, PHD, Los Angeles, California (*Presenter*) Employee, Canon Medical Systems Corporation

PURPOSE

To evaluate the noise properties and low contrast false positive and false negative performance of a Super Resolution Deep Learning Reconstruction (SR-DLR) trained to enhance spatial resolution.*Methods and Materials A 20cm Catphan and 32cm water phantom were scanned on a wide volume CT scanner (Canon Aquilion ONE Prism) with a standard cardiac protocol and reconstructed with a prototype SR-DLR which outputs a 1024 matrix and slice width less than the 0.5mm acquisition slice thickness. The raw data was also reconstructed with hybrid iterative reconstruction (AIDR Enhanced) and Filtered Backprojection (FBP). A 160mm FOV was used. The SR-DLR uses high-dose CT data acquired on a commercial high resolution CT system (Aquilion Precision). The Precision CT system used for training acquires data with a 0.25 mm detector element size at isocenter, both in-plane and longitudinal. Simulated low-dose normal resolution data was used as the training input. Both the Noise Power Spectra (NPS) and the statistical distribution properties of the noise were determined, including outlier analysis. The Receiver Operator Characteristic (ROC) curve, plotting true positive fraction vs false positive fraction was determined for low contrast objects using a model observer.*Results SR-DLR yielded equivalent or improved LCD compared to the conventional reconstruction algorithms for the cardiac CT protocol examined. NPS was similar to the current clinical standard of hybrid iterative reconstruction. Some noise outliers were present in the low frequency band, but due to overall reduced noise magnitude SR-DLR resulted in a lower false positive/negative fraction than conventional reconstruction algorithms. The false positive fraction was lower for SR-DLR along the entire length of the ROC curve.*Conclusions SR-DLR has equivalent or improved noise and LCD properties to conventional reconstruction, including false positive and false negative fractions.*Clinical Relevance/Application The work addresses the

robustness of noise properties of a new SR-DLR Cardiac CT reconstruction algorithm, a common clinical concern for adoption of machine learning based technology

RESULTS

SR-DLR yielded equivalent or improved LCD compared to the conventional reconstruction algorithms for the cardiac CT protocol examined. NPS was similar to the current clinical standard of hybrid iterative reconstruction. Some noise outliers were present in the low frequency band, but due to overall reduced noise magnitude SR-DLR resulted in a lower false positive/negative fraction than conventional reconstruction algorithms. The false positive fraction was lower for SR-DLR along the entire length of the ROC curve.

CLINICAL RELEVANCE/APPLICATION

The work addresses the robustness of noise properties of a new SR-DLR Cardiac CT reconstruction algorithm, a common clinical concern for adoption of machine learning based technology

SPR-PH-23 Preliminary Application Value Of T1 Mapping Of Cardiac Magnetic Resonance Imaging And Tissue Tracking Technique In Cardiac Amyloidosis And Hypertrophic Cardiomyopathy.

Participants
Xiaohu Li, MD, Hefei, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the value of magnetic resonance native T1 value and tissue tracking technique(CMR-TT) in differentiating myocardial amyloidosis (CA) from hypertrophic cardiomyopathy (HCM).*Methods and Materials A retrospective analysis of 14 CA patients and 16 HCM patients diagnosed in our hospital, retrieved medical records, cardiac magnetic resonance images, ultrasound reports and other clinical data, and selected the same period 16 healthy subjects whose gender and age matched the CA group and HCM group without organic and functional heart disease underwent 3.0T cardiac magnetic resonance examination. The native T1 value and strain indexes in the differential diagnosis of CA and HCM was evaluated by curve of receiver operating characteristic (ROC).For single factors with high discriminating value, the dual-parameter joint logistic regression model is used to combine the predicted probability, and the backword method combined with ROC is used to obtain the discriminating value.*Results The native T1 value of global, basal, papillary muscle and apical myocardium in CA group (1455.68 ±153.23ms, 1446.97 ±170.53 ms, 1442.31 ±151.92 ms, 1468.31 ±141.83 ms respectively) were higher than those in HCM group (1323.18 ±42.51ms, 1329.45 ±46.14 ms, 1330.04 ±41.49 ms, 1327.41 ±46.55 ms respectively) (P < 0.001),but there was no statistical difference between the HCM group and the healthy control group (1305.97±49.83 ms, 1284.57±57.82 ms, 1303.67±56.45 ms, 1323.99±60.79 ms, respectively). The results of CMR-TT strain analysis showed that 2D GRS(15.75±4.41 vs. 24.75±10.21), 2D GCS(-11.11±2.40vs. -14.85±4.50), 3D GRS(14.08±4.22 vs. 26.87±13.45) and 3D GCS(-13.69±2.50 vs.-17.23±4.76) in CA group were lower than those in HCM group (P < 0.05).The combination of 3D GRS&3D GCS, the predicted probability AUC=0.786, the sensitivity rate and specificity rate are 100%, 68.75%, P=0.0028 The CA patients presented as " slowly up -slowly down-rapidly down" form, the HCM presented as "slowly up-rapidly down" form, and healthy control presented as " rapidly up-rapidly down " form.*Conclusions Evaluating the differences in native T1 value and 3D GRS and 3D GCS is helpful to differentiate CA from HCM patients.*Clinical Relevance/Application Myocardial strain technology and T1mapping technology based on movie sequence imaging have good clinical application value in left ventricular hypertrophic cardiomyopathy

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Myocardial strain technology and T1mapping technology based on movie sequence imaging have good clinical application value in left ventricular hypertrophic cardiomyopathy

SPR-PH-24 Tube Current Modulation Reconstruction From Chest CT Images Using Deep-learning Regression Algorithms

Participants
Marios Myronakis, PhD, Irakleio, Greece (*Presenter*) Nothing to Disclose

PURPOSE

Accurate estimates of patient organ-doses require knowledge of the actual tube-current modulation values applied during CT acquisition. The tube-current information included in CT metadata represents an average of z-axis and angular modulation per CT slice rather than a full description of the actual current modulation values. The actual modulation values were determined either during the localizer scan or in real-time and cannot be retrospectively reproduced using analytical methods. The aim of this work was to reconstruct patient-specific tube-current modulation patterns along the anterior-posterior (AP) and lateral directions using deep-learning algorithms.*Methods and Materials Current modulation tables and CT images from 50 patients undergoing chest CT examinations on a scanner that predetermines angular and z-axis modulation during the localizer scan (GE Revolution GSI) were collected. Patient-specific water-equivalent diameter (WED) was estimated and z-position extracted from each CT slice. WED values were correlated with z-positions and normalized. Normalized WED values from 30 patients were used as features and the corresponding set of tube-current modulation tables as dependent parameters. A long short-term memory (LSTM) deep learning network was trained to predict tube-current modulation pattern for each patient WED values. The remaining 20 patient sets were used to test the model.*Results The validation loss of LSTM algorithm was 0.1 and the root mean squared error was 0.0647. The generated modulation patterns demonstrated a median and average deviation of 0.008% and -0.04% respectively from actual current modulation patterns obtained during localizer scan.*Conclusions Preliminary results with 50 patients demonstrated that the method can accurately reconstruct tube current modulation patterns for patients undergoing chest CT examinations using the

acquired CT images. Additional data are currently collected to extend the training and test sets.*Clinical Relevance/Application The technique can be employed for accurate retrospective estimation of patient organ dose after chest CT examination and chest CT exposure settings optimization for CT scanners from various vendors.This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 755523

RESULTS

The validation loss of LSTM algorithm was 0.1 and the root mean squared error was 0.0647. The generated modulation patterns demonstrated a median and average deviation of 0.008% and -0.04% respectively from actual current modulation patterns obtained during localizer scan.

CLINICAL RELEVANCE/APPLICATION

The technique can be employed for accurate retrospective estimation of patient organ dose after chest CT examination and chest CT exposure settings optimization for CT scanners from various vendors.This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 755523

SPR-PH-25   3d Dose Distribution Estimation For Various Treatment Techniques Using Deep Learning Framework For Radiation Therapy

Participants
Jimin Lee, Ulsan, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop a deep learning model that generates 3D dose distributions of four different radiation treatment (RT) techniques, conventional 2D tangential beams (2D), forward IMRT (f-IMRT), inverse IMRT (i-IMRT), and VMAT, from 3D patient CT images and contour maps of four organs (breast, left lung, right lung, and heart).*Methods and Materials A whole dataset consists of 400 patients' CT images, contour maps, and 3D dose distributions of four RT techniques obtained from RT-dose file. The dataset was randomly divided into 281, 69, and 50 patients for training, validation, and test sets, respectively. To develop a multi-channel 3D dose distribution generation model, a convolutional neural network-based 3D SCNAS-Net which was optimized structure by an auto-ML technique SCNAS (Scalable Neural Architecture Search) was implemented. The model was trained to generate four 3D dose distributions: 2D, f-IMRT, i-IMRT, and VMAT from the two channel input of 3D CT image and its corresponding contour map. During the training, L2 loss was implemented with total variation regularization. To evaluate the trained model quantitatively, Pearson correlation coefficient (PCC), peak signal-to-noise ratio (PSNR), and structural similarity (SSIM) between output and target dose distributions were calculated for each RT technique. Target V90% (percentage of breast volume receiving more than 90% of the prescribed dose, 4240 cGy), target mean dose, and ipsilateral lung V1800cGy (percentage of ipsilateral lung volume receiving more than 1800 cGy) were also calculated for the quantitative analysis.*Results The trained model showed superior dose distribution estimation performance as shown in the figure. Average PCC, PSNR, and SSIM scored 0.947, 28.6, 0.893 for the test set. Metrics for each RT technique are described in the figure. For dosimetric parameters, target V90% of the output dose distributions was 2.9% smaller than that of the target. The target mean dose was 0.3% larger and ipsilateral lung V1800cGy was 1.9% larger.*Conclusions A novel deep learning-based multi-channel 3D dose distribution estimation model was successfully developed, and 3D dose distributions for four types of RT techniques were generated with a small error.*Clinical Relevance/Application The proposed model could help treatment planning and dose prescription by presenting dose distribution and dose-volume histogram in advance without manual treatment plannings to compare each RT technique.

RESULTS

The trained model showed superior dose distribution estimation performance as shown in the figure. Average PCC, PSNR, and SSIM scored 0.947, 28.6, 0.893 for the test set. Metrics for each RT technique are described in the figure. For dosimetric parameters, target V90% of the output dose distributions was 2.9% smaller than that of the target. The target mean dose was 0.3% larger and ipsilateral lung V1800cGy was 1.9% larger.

CLINICAL RELEVANCE/APPLICATION

The proposed model could help treatment planning and dose prescription by presenting dose distribution and dose-volume histogram in advance without manual treatment plannings to compare each RT technique.

SPR-PH-3   Practical Evaluation Of The Dose Per Image Slice In Body CT

Participants
Xinhua Li, PhD, Boston, Massachusetts (*Presenter*) Employee, Constellation Pharmaceuticals

PURPOSE

Size-specific dose estimate (SSDE) was introduced for the average dose to the patient midslice from fixed-mA scans of 15-30 cm (scan length). This study proposes practical evaluation of the dose per image slice (Dslice) for all slices of body CT exams and test the method with Monte Carlo simulation.*Methods and Materials Each image slice was considered a scan range just covering the slice, whose kVp and mA-adjusted CTDIvol (from the DICOM headers) were used to directly calculate a z-axis dose profile for the average dose over the cross section of a water phantom, whose diameter was equal to the patient WED (water equivalent diameter), using the approach to equilibrium function. WED calculation followed AAPM Report No. 220, excluding the patient table. The above was repeated at all slices of a single or multiple scan series. At a z-axis location, Dslice was accumulated from all profiles. As proof of concept, full body CT images and mA values (from the DICOM headers) of a 70-kg male were imported into a previously validated CT simulation program (Geant4) to assess Dslice, alternatively, and the results of two approaches were compared.*Results Dslice largely changed with anatomic location but it was consistent between direct evaluation and simulation, with the 95th percentile difference in magnitude 9.2% for chest exam and 10.5% for abdominopelvic exam. Direct Dslice evaluation was further illustrated with CT-guided interventions, including liver biopsy (male, 60 kg) with 7 series, and aspiration of the right sacroiliac joint (male, 108 kg) with 19 series, including CT fluoroscopy.*Conclusions Direct Dslice evaluation is suited for all image slices of any scan length, specific tube current modulation algorithm and number of scan series, permitting exam-level patient dose monitoring in multiphase studies and CT interventions. Our proposal may assist CT manufacturers and dose index monitoring software in assessing Dslice (IEC publication no. 62985) and the overall energy absorbed in the patient, irrespective of CTDI phantom diameter (16 or 32 cm).*Clinical Relevance/Application Direct evaluation of the dose per image slice is suited for body CT scans from sub-cm to >1 m, any mA profile shapes and multiple scan series, potentially benefits to various parties in patient care.

RESULTS

Dslice largely changed with anatomic location but it was consistent between direct evaluation and simulation, with the 95th percentile difference in magnitude 9.2% for chest exam and 10.5% for abdominopelvic exam. Direct Dslice evaluation was further illustrated with CT-guided interventions, including liver biopsy (male, 60 kg) with 7 series, and aspiration of the right sacroiliac joint (male, 108 kg) with 19 series, including CT fluoroscopy.

CLINICAL RELEVANCE/APPLICATION

Direct evaluation of the dose per image slice is suited for body CT scans from sub-cm to >1 m, any mA profile shapes and multiple scan series, potentially benefits to various parties in patient care.

SPR-PH-5   Radiofrequency-Induced Tissue Heating Adjacent To Metallic Orthopedic Screws For 7 Tesla MRI: A Simulation Study Comparison With Lower Field Strengths

Participants
Andrew Fagan, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

MRI at 7 Tesla has significant benefits over imaging at lower field strengths including increased SNR, increased spatial and spectral resolution, and improved susceptibility-related image contrast. However, uncertainties exist relating to the safety of imaging patients with implanted metallic devices, primarily due to fears of tissue heating adjacent to the implants arising from radiofrequency energy coupling into the implant. Moreover, only a handful of devices have been tested for MR Conditionality status at 7T. The aim of this study was to investigate the potential for radiofrequency-induced tissue heating adjacent to metallic orthopedic screws as a function of MRI magnetic field strength from 3 to 7 Tesla. The hypothesis under test was whether tissue heating invariably increases with field strength.*Methods and Materials Electromagnetic simulations were performed using a finite-difference time-domain solver (Sim4Life, ZMT) from 3 to 7 Tesla using a GPU (Tesla V100, NVIDIA). Orthopedic titanium bone screws of variable length (18 - 183 mm) were placed within a volume of 40x40x20cm3 with assigned dielectric properties of bone tissue at each field strength. The electromagnetic fields were generated using a dipole antenna, chosen to ensure a uniform background electric field at the implant location. The screws were placed 40 mm from the antenna center. Simulations were performed over160x160x160cm3 to avoid boundary effects, resulting in approx. 277 million cells and taking 4 hrs to run. The RF power delivered by the antenna was adjusted such that a B1+ field of 0.45 µT was achieved at the center of the implant in each scenario. The maximum 1g-averaged local SAR (SARmax) for each screw length and field strength was determined from each simulation. The effects of varying the tissue type in which the screw was embedded (bone, brain and muscle) were also investigated.*Results SARmax showed a peak around 4T with a 36% reduction at 7T. The implant length at which the SARmax was measured for all field strengths occurred at approximately one-third of the wavelength. The tissue's electric permittivity and conductivity had a large effect on the simulated SAR values, the peak of which was approximately 60% lower for muscle than bone.*Conclusions The data presented herein demonstrate that RF-induced tissue heating near metallic implants can, in certain circumstances, be lower at higher fields. SAR tissue values at 7T are higher adjacent to screws implanted in bone compared to either brain or muscle.*Clinical Relevance/Application This study dispels conventional wisdom that tissue heating adjacent to metallic implants must increase at 7 Tesla MRI, and will facilitate the wider clinical use of this technology in patients with such implants.

RESULTS

SARmax showed a peak around 4T with a 36% reduction at 7T. The implant length at which the SARmax was measured for all field strengths occurred at approximately one-third of the wavelength. The tissue's electric permittivity and conductivity had a large effect on the simulated SAR values, the peak of which was approximately 60% lower for muscle than bone.

CLINICAL RELEVANCE/APPLICATION

This study dispels conventional wisdom that tissue heating adjacent to metallic implants must increase at 7 Tesla MRI, and will facilitate the wider clinical use of this technology in patients with such implants.

SPR-PH-6   Applications And Benefits Of Using Traceable Phantoms From The NIST/NIBIB Medical Phantom Lending Library To Monitor MRI Scanner Performance

Participants
Stephen Russek, PhD, Boulder, Colorado (*Presenter*) Nothing to Disclose

PURPOSE

NIST has instituted a medical phantom lending library (https://www.nist.gov/programs-projects/nistnibib-medical-imaging-phantom-lending-library) to provide easy access to traceable medical phantoms and analysis software. These phantoms allow a wide variety of quality control (QC) checks and assessment of accuracy of many image-based measurements. Currently MRI system, diffusion, and breast phantoms are available, with more phantoms being added. Here, we show the utility of these phantoms for QC, scanner evaluation, and MRI technician training.*Methods and Materials The MRI system phantom contains a fiducial array for geometric distortion and image uniformity measurement, slice profile and resolution insets, a proton density inset for SNR, and 2 relaxation time arrays to measure accuracy of T1, T2 mapping. The diffusion phantom has 13 cells with 6 different isotropic diffusion coefficients that have well defined mono-exponential signal decay. Both phantoms include MRI readable thermometers to correct for variable bore temperatures. The phantom components were calibrated at NIST with traceability to the international system of units.*Results The fiducial sphere centers are located in a 3D GRE scan to within ±0.1 mm and are used to measure geometric distortion, which for the MRI scanners tested, varied from ±2 mm down to ±0.2 mm over a 200 mm field of view when postprocessing distortion corrections were included. Image uniformity measurements were mapped showing large coil/ scanner specific variations. Measurements of the resolution are made with an ACR-like resolution inset and can identify both protocol dependent resolution due to finite k-space sampling and intrinsic scanner resolution. The slice profile inset has been used to characterize the accuracy of the slice thickness as well as the shape of the slice profile. Large scanner to scanner variation in the slice profile has been observed. Finally, the MR-parameter arrays have been used to assess the accuracy of a variety of T1, T2 mapping protocols. The diffusion phantom has been used to assess the accuracy of ADC-mapping and error due to gradient nonuniformity. Typical measurements at 20C can determine the accuracy of ADC measurements to ±2% over the range of tissue ADC values.*Conclusions The phantoms from the public lending library allow for scanner QC measurements and assessment of the accuracy of MR parameter mapping. The phantoms have the advantage of being freely available and curated by a national metrology institute.*Clinical Relevance/Application Easily accessible curated phantoms will allow medical physicists and MR technicians to better understand and monitor scanner performance and allow radiologists to more precisely evaluate the accuracy of quantitative MR measurements.

RESULTS

The fiducial sphere centers are located in a 3D GRE scan to within ±0.1 mm and are used to measure geometric distortion, which for the MRI scanners tested, varied from ±2 mm down to ±0.2 mm over a 200 mm field of view when postprocessing distortion corrections were included. Image uniformity measurements were mapped showing large coil/ scanner specific variations. Measurements of the resolution are made with an ACR-like resolution inset and can identify both protocol dependent resolution due to finite k-space sampling and intrinsic scanner resolution. The slice profile inset has been used to characterize the accuracy of the slice thickness as well as the shape of the slice profile. Large scanner to scanner variation in the slice profile has been observed. Finally, the MR-parameter arrays have been used to assess the accuracy of a variety of T1, T2 mapping protocols. The diffusion phantom has been used to assess the accuracy of ADC-mapping and error due to gradient nonuniformity. Typical measurements at 20C can determine the accuracy of ADC measurements to ±2% over the range of tissue ADC values.

CLINICAL RELEVANCE/APPLICATION

Easily accessible curated phantoms will allow medical physicists and MR technicians to better understand and monitor scanner performance and allow radiologists to more precisely evaluate the accuracy of quantitative MR measurements.

SPR-PH-7   A Prototype Ultra-high-resolution CT For Extremities With 89-µm Detector Pitch: Design And Performance

Participants
Soei Shimokawa, Kanazawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

We developed a prototype ultra-high-resolution (UHR) CT for extremities using a complementary metal-oxide-semiconductor (CMOS) detector and a dedicated system design for achieving uncompromising UHR with 89-µm detector pitch and clinical availability. Unlike the bench top system with phantom rotation previously reported, the developed system has real gantry capable of scanning of human extremities. This study aims to evaluate the performance of this UHR CT.*Methods and Materials The CMOS detector (1536 channels, 440 rows) equipped with a fiber grid (grid ratio, 12:1; grid density, 64 lines/cm) was located opposite to the compact X-ray tube (focal spot size, 0.8 mm) on a metallic ring rail. The rotation speed of the ring rail was controlled by a high-speed stepping motor. 500 projections of 36 mm z-directional coverage were obtained with a rotation for 5 s. CT images with both pixel pitch and increment of 100 µm were reconstructed by the Feldkamp algorithm. Spatial resolution (modulation transfer function: MTF), and noise (noise power spectrum: NPS) were measured, and these values were compared with those measured using a clinical UHR CT system with 0.25 mm detector (Precision, Canon Medical). Additionally, an anthropomorphic foot phantom including dry bones was imaged to assess the visibilities of three-dimensional (3D) microstructures of trabecular bones.*Results The measured CTDIw was 8.4 mGy. The 5%MTF were 4.0 mm-1, which was notably higher than that of the clinical UHR CT (2.6 mm-1). However, NPS was ~15% higher at low frequencies due to the less sensitivity of the CMOS detector. Even with non-edge-enhanced reconstruction kernels, the trabecular bones of the foot phantom were clearly visualized in 3D voxel data with the 100-µm pitch.*Conclusions The developed CT system provided notably clear UHR images of trabecular bones without the help of edge-enhanced reconstruction kernels. The images were significantly clearer than those of clinical UHR CT. Unlike the bench top system, this system first demonstrated a clinical availability of UHR CT system that can analyze microstructures in extremities.*Clinical Relevance/Application The non-edge-enhanced images of developed CT could provide quantitative analysis of 3D trabecular bone structure in extremities and detect of occult fracture and microhemorrhage in extremities.

RESULTS

The measured CTDIw was 8.4 mGy. The 5%MTF were 4.0 mm-1, which was notably higher than that of the clinical UHR CT (2.6 mm-1). However, NPS was ~15% higher at low frequencies due to the less sensitivity of the CMOS detector. Even with non-edge-enhanced reconstruction kernels, the trabecular bones of the foot phantom were clearly visualized in 3D voxel data with the 100-µm pitch.

CLINICAL RELEVANCE/APPLICATION

The non-edge-enhanced images of developed CT could provide quantitative analysis of 3D trabecular bone structure in extremities and detect of occult fracture and microhemorrhage in extremities.

SPR-PH-8   Multi-organ Universal Lesion Detection In CT Scans: An Independent External Validation

Participants
Lianyan Xu, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Multi-organ universal lesion detection in CT scans has been actively developed since NIH DeepLesion dataset was released in 2018. We aim to evaluate the performance and assess the clinical indications of a latest development via an external user study in a real-world clinical setting.*Methods and Materials Our universal lesion detection system consists of a convolutional neural network (CNN) trained on 80K lesion annotations from 12K CT studies in the DeepLesion dataset and five other public organ-specific datasets. Our external test sets include 164 non-contrasted chest/upper-abdomen CT scans collected from a private external hospital, and 187 low-dose helical CT scans from the National Lung Screening Trial (NLST). The private test set is a successive selection of CT scans stored in this hospital's PACS from Feb to March in 2021. NLST test set consists of randomly selected patients with reported cancer or metastasis. We run our algorithm on these two test sets to output lesion detection. Then, two board-certified radiologists read the CT scans and verify the detection results. Tumor-like lesions at all extrapulmonary organs including the liver, kidney, pancreas, thyroid, lymph nodes, body wall, thoracic spine, etc. at visualized CT images are recorded and measured. One of our goals is detecting and assessing the incidental findings from NLST.*Results In the private dataset, the lesion-level precision and sensitivity of our algorithm are 58% and 66%, respectively. On average, our algorithm detects 2.1 findings per scan, and among them, 0.9 are FPs. We find that our algorithm works well at liver lesions with 79% precision and 93% sensitivity, followed by kidney with 70% precision and 58 % sensitivity. It is also sensitive to contour and density change in pancreas with 50.00% sensitivity and 50.00% precision. Note that our algorithm discovers the only one body wall's lesion in 164 scans. There are still some normal structures misclassified as lesions. In the NLST test set, we obtain 75 % precision and 52% sensitivity despite the relatively high noise level in the soft tissue. The accuracy is relatively higher on liver lesions and thoracic lymph nodes.*Conclusions The performance of multi-organ universal lesion detection on external real-world data has shown good promise on a multiple-purposed CAD system. It is trained on public datasets such as DeepLesion but can generalize well to external validation data, annotated by external clinical sites.*Clinical Relevance/Application Our algorithm is helpful for large-scale CT screening and triage to prioritize patients with

significant lesions for clinicians to read first. It may also reduce their missing rate and workload by pre-selecting suspicious lesions.

RESULTS

In the private dataset, the lesion-level precision and sensitivity of our algorithm are 58% and 66%, respectively. On average, our algorithm detects 2.1 findings per scan, and among them, 0.9 are FPs. We find that our algorithm works well at liver lesions with 79% precision and 93% sensitivity, followed by kidney with 70% precision and 58 % sensitivity. It is also sensitive to contour and density change in pancreas with 50.00% sensitivity and 50.00% precision. Note that our algorithm discovers the only one body wall's lesion in 164 scans. There are still some normal structures misclassified as lesions. In the NLST test set, we obtain 75 % precision and 52% sensitivity despite the relatively high noise level in the soft tissue. The accuracy is relatively higher on liver lesions and thoracic lymph nodes.

CLINICAL RELEVANCE/APPLICATION

Our algorithm is helpful for large-scale CT screening and triage to prioritize patients with significant lesions for clinicians to read first. It may also reduce their missing rate and workload by pre-selecting suspicious lesions.

SPR-PH-9   **Image Characteristics Of Virtual Monochromatic Images With Deep Learning-based Image Reconstruction In Fast-kilovoltage Switching Dual-energy CT In Patients With Pancreatic Ductal Adenocarcinoma**

Participants
Akiyo Fukutomi, MS, RT, Kobe, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Contrast-enhanced CT with high image quality is essential for the diagnosis of pancreatic ductal adenocarcinoma (PDAC). Although virtual monochromatic images (VMI) obtained from dual-energy CT (DECT) can improve tissue contrast, increased image noise at low kiloelectron-volt (keV) may have a concern. To improve image quality, deep learning-based image reconstruction (DLIR) has been recently implemented into fast-kilovoltage (kV) switching DECT. The purpose of this study was to evaluate image characteristics of VMI with DLIR in fast-kV switching DECT in patients with PDAC.*Methods and Materials This retrospective study included 30 patients (21 males; mean age, 70.3 years) with PDAC who underwent contrast-enhanced fast-kV switching DECT (Revolution CT; GE Healthcare). Image data on arterial and portal venous phase were reconstructed with 1.25-mm section thickness using iterative reconstruction (ASiR-V 30% and 50%) and DLIR (True Fidelity medium). Image noise of the paraspinal muscle (PsM) and contrast-to-noise ratio (CNR) of the pancreas, artery, portal vein, and liver were calculated on 70 keV VMI as follows: $CNR_{Object} = (HU_{Object} - HU_{PsM}) / image\ noise$. Pancreas-to-lesion CNR was calculated on VMI at 40-100 keV in 10 keV intervals as follows: $Pancreas\text{-}tumor\ CNR = (HU_{Pancreas} - HU_{Tumor}) / image\ noise$. The calculated values were compared among the three reconstruction algorithms by using one-way repeated measures ANOVA test with Bonferroni correction. In addition to the patient examinations, a phantom experiment using noise power spectra (NPS) generated from a water phantom was performed to examine the variance and spatial frequency characteristics of image noise.*Results The image noise was significantly lower on 70 keV VMI using True Fidelity than that using ASiR-V 30% and 50% (P<.001 for all). The CNRsobject were significantly higher on 70 keV VMI using True Fidelity (P<.001 for all), while CT values were consistent among the three reconstruction algorithms (P=.891-.999). True Fidelity yielded significantly higher pancreas-tumor CNR at each keV VMI compared with ASiR-V 30% (P<.0001) and ASiR-V 50% (P=.015-.046), and these differences were greater as the lower keV VMIs. In the NPS curves, the True Fidelity yielded quantifiable noise reduction across the entire spectrum of spatial frequencies, which was more prominent at lower spatial frequencies.*Conclusions DLIR can improve image quality in fast-kV switching DECT, in which noise reduction characteristics are beneficial for the abdomen. VMI using DLIR can provide higher contrast with less image noise in the diagnosis of PDAC.*Clinical Relevance/Application DLIR contributes to improved image quality in VMI of the abdomen, and lower keV images may yield higher diagnostic performance of PDAC.

RESULTS

The image noise was significantly lower on 70 keV VMI using True Fidelity than that using ASiR-V 30% and 50% (P<.001 for all). The CNRsobject were significantly higher on 70 keV VMI using True Fidelity (P<.001 for all), while CT values were consistent among the three reconstruction algorithms (P=.891-.999). True Fidelity yielded significantly higher pancreas-tumor CNR at each keV VMI compared with ASiR-V 30% (P<.0001) and ASiR-V 50% (P=.015-.046), and these differences were greater as the lower keV VMIs. In the NPS curves, the True Fidelity yielded quantifiable noise reduction across the entire spectrum of spatial frequencies, which was more prominent at lower spatial frequencies.

CLINICAL RELEVANCE/APPLICATION

DLIR contributes to improved image quality in VMI of the abdomen, and lower keV images may yield higher diagnostic performance of PDAC.

SSPH04

Physics (X-ray Imaging/MRI)

Participants
Hilde Bosmans, PhD, Leuven, Belgium (*Moderator*) Stockholder, Qaelum NV
Zhihua Qi, PhD, Detroit, Michigan (*Moderator*) Nothing to Disclose

Sub-Events

SSPH04-1 Evaluation Of Image Quality And Artifact In Deep Learning Reconstruction Method Using An ACR Phantom

Participants
Mo Kadbi, PhD, Irvine, California (*Presenter*) Employee, Canon Medical Systems Corporation;

PURPOSE

In MR imaging using conventional reconstruction (CR), it is required to repeat and average the acquisitions to increase the image Signal-to-Noise Ratio (SNR). Deep Learning Reconstruction (DLR) is an emerging technique that can be utilized to improve the MR image quality by increasing SNR and reducing potential image artifacts without increasing the scan time. In addition, increased SNR can be used to improve spatial resolution without sacrificing image quality. In this study, an ACR phantom was used to evaluate DLR's performance in improving spatial resolution and SNR, preserving image contrast, and reducing imaging artifacts while maintaining image structures and details.*Methods and Materials An ACR phantom was scanned on a 3T scanner using the standard ACR protocol, including axial T1 and T2 sequences. The images were reconstructed using CR with no post-processing filter as well as DLR. The axial T1 scan was repeated with higher resolution and reconstructed using CR and DLR. The resolution was increased from 1x1 mm2 in standard ACR protocol to 0.3x0.3 mm2 in the high-resolution (HR) scan to investigate the impact of DLR on SNR in HR images. Based on ACR guidelines, High-Contrast spatial Resolution (HCR) and Low-Contrast Detectability (LCD) tests were performed on both CR and DLR images. Additionally, SNR and artifacts were investigated for both reconstruction methods.*Results The HCR test of both standard and HR T1 images reconstructed using CR and DLR passed the ACR test, but the ringing artifact was significantly reduced in images with DLR compared to CR. Similarly, both CR and DLR images with standard and HR T1 images passed the LCD test of ACR phantom with similar detectability of low contrast spokes. Reducing noise and ringing artifact in DLR helped to better visualize very small spokes compared to CR. In both standard and high-resolution T1 images, the SNR was measured on the uniform section of the phantom using both CR and DLR. In the standard T1, SNR using the DLR was 12% higher than the CR. In the high-resolution image, the SNR was increased by 173% using DLR. The SNR improvement is more noticeable in high-resolution images as the original images are inherently noisier. This SNR improvement can help to better detect the small details.*Conclusions This study affirms that with the DLR method, the image quality can be improved by increasing the spatial resolution and SNR. Additionally, the DLR can reduce the ringing artifact assisting to detect the small details in the images.*Clinical Relevance/Application Deep learning reconstruction improves SNR and reduces ringing artifact, while preserving image detail and passing the ACR test. It can be also used to increase the spatial resolution without compromising SNR.

RESULTS

The HCR test of both standard and HR T1 images reconstructed using CR and DLR passed the ACR test, but the ringing artifact was significantly reduced in images with DLR compared to CR. Similarly, both CR and DLR images with standard and HR T1 images passed the LCD test of ACR phantom with similar detectability of low contrast spokes. Reducing noise and ringing artifact in DLR helped to better visualize very small spokes compared to CR. In both standard and high-resolution T1 images, the SNR was measured on the uniform section of the phantom using both CR and DLR. In the standard T1, SNR using the DLR was 12% higher than the CR. In the high-resolution image, the SNR was increased by 173% using DLR. The SNR improvement is more noticeable in high-resolution images as the original images are inherently noisier. This SNR improvement can help to better detect the small details.

CLINICAL RELEVANCE/APPLICATION

Deep learning reconstruction improves SNR and reduces ringing artifact, while preserving image detail and passing the ACR test. It can be also used to increase the spatial resolution without compromising SNR.

SSPH04-2 Projection-domain Material Decomposition In A Dual-layer Flat-panel Detector Using Perceptron Neural Networks

Participants
Wenying Wang, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Geometric misalignment between layers and layer-dependent spatial resolution can degrade material decomposition estimates using dual-layer flat-panel detectors (FPDs). We investigate data-driven methods for projection-domain decomposition (PDD) that can compensate for these effects.*Methods and Materials Using a dual-layer FPD simulator with spectral, geometric, and scintillator blur models to emulate a prototype (Varex) detector, we trained two perceptron neural networks for PDD using pixel-wise and 3x3 patch inputs, respectively. Both models employed two hidden layers of 48 neurons each with ELU activation and training with ground-truth iodine line-integrals. The training and testing data were simulated from 1000 procedurally generated water-iodine phantoms - including both ideal projection datasets without the misalignment and blur and a realistic dataset with a complete physical model.

Decomposition accuracy was evaluated by mean absolute errors on a test dataset and in quantitative studies using specialized cylindrical iodine inserts of varying sizes.*Results Compared with traditional polynomial PDD, the perception networks showed significant improvements in quantitative accuracy. Using patch inputs yields significant improvements over pixel-wise input, yielding reconstruction accuracy improvements of 60%. The patch-wise model trained on a realistic dataset outperforms the others in contrast quantification test by 10%. The contrast recovery rate increase with increasing size and is above 88% for cylinders of diameter greater 0.5 mm.*Conclusions Two perceptron neural networks were trained for PDD in a dual-layer FPD. The proposed methods achieve better quantification over traditional methods. Patch inputs allow for better reduction of the bias induced by the geometric mismatch and layer-dependent blur.*Clinical Relevance/Application Dual-layer FPDs permit material decomposition enabling, e.g., high-resolution angiography. The proposed methods maintain accuracy and improve small vessel visualization in the presence of realistic degradations.

RESULTS

Compared with traditional polynomial PDD, the perception networks showed significant improvements in quantitative accuracy. Using patch inputs yields significant improvements over pixel-wise input, yielding reconstruction accuracy improvements of 60%. The patch-wise model trained on a realistic dataset outperforms the others in contrast quantification test by 10%. The contrast recovery rate increase with increasing size and is above 88% for cylinders of diameter greater 0.5 mm.

CLINICAL RELEVANCE/APPLICATION

Dual-layer FPDs permit material decomposition enabling, e.g., high-resolution angiography. The proposed methods maintain accuracy and improve small vessel visualization in the presence of realistic degradations.

SSPH04-3 Estimation Of Local Vascular Velocity Using Contrast Dilution Gradients (CGD) From 1000 Fps High Speed Angiography

Participants
Kyle Williams, BS, Buffalo, New York (*Presenter*) Nothing to Disclose

PURPOSE

Estimation of blood flow velocity from 2D angiography using contrast dilution gradients (CDG), has been limited due to detector temporal resolution restrictions. Recent imaging technology breakthrough allows unprecedented 1000 fps temporal resolution. This work applies a CDG method to recover hemodynamic information from high speed angiography (HSA) in the neurovascular domain using precise in-vitro simulations.*Methods and Materials According to CDG theory, the spatial contrast gradient and the contrast derivative are covariates related by velocity (diffusion negligible). The CDG algorithm used here maps contrast changes in arterial centerline profiles as a function of frame number to obtain a "contrastagram", which allows velocity estimation along the artery as a function of time using temporal and spatial derivatives. We validated the method using noiseless simulations, then tested it with HSA in patient-specific 3D printed phantoms at 1000 fps under constant flow conditions using the Direct Conversion Inc. Actaeon photon-counting detector. Ground truth velocities along the centerline were obtained using Computational Fluid Dynamics (CFD) with boundary conditions obtained from the experiment. CDG velocities were compared with CFD calculations. To assess the dependence of the method on temporal resolution, angiographic sequences at frame rates of 500, 250, 100, 50, 25, and 10 fps were simulated via retrospective temporal binning of 1000 fps acquisitions.*Results For computer-simulated angiograms, the CDG method showed strong agreement with expected velocity values (MSE = 0.00, p = 0.001). For HSA, the best results were obtained at 1000 fps with a percent difference of 1.2% between CDG and CFD. With decreasing frame rate, the percent difference between CDG and CFD increases with a substantial increase to 78% difference when using 100 fps.*Conclusions The results indicate that high speed angiography could be used for accurate estimation of velocity in neurovascular applications at temporal resolutions at or above 250 fps.*Clinical Relevance/Application CDG with HSA can be used to estimate local 2D flow velocities in complex vascular geometries. This data may be used for image guided surgery or to assess vascular lesion severity.

RESULTS

For computer-simulated angiograms, the CDG method showed strong agreement with expected velocity values (MSE = 0.00, p = 0.001). For HSA, the best results were obtained at 1000 fps with a percent difference of 1.2% between CDG and CFD. With decreasing frame rate, the percent difference between CDG and CFD increases with a substantial increase to 78% difference when using 100 fps.

CLINICAL RELEVANCE/APPLICATION

CDG with HSA can be used to estimate local 2D flow velocities in complex vascular geometries. This data may be used for image guided surgery or to assess vascular lesion severity.

SSPH04-4 Automatic Windowing Parameter Estimation For Chest Radiographs: A Deep Learning Approach

Participants
HyunJoon An, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The windowing process is an important preliminary step for handling chest X-ray (CXR) images. However, in rare cases, inappropriate window level (WL) and window width (WW) could be set by CXR devices and/or stored by the readers in PACS. Since these images could lead to critical problems when fed into various downstream processes such as CADe and CADx, we propose and evaluate a deep learning-based regression model to automatically estimate the windowing parameters.*Methods and Materials The dataset consists of 31,466 CXR images with corresponding windowing parameters, WW and WL, stored in DICOM format. The images were collected from several hospitals, scanned with equipment from various manufacturers. If not handled properly, raw pixel data of CXR images would have visually inappropriate contrast by markers attached to the X-ray device or various medical devices implanted in the patient. We trained a model using these raw pixel data as an input variable and the windowing parameters as target variables to adjust the appropriate contrast. Each input and target variables with a scale of 12/16 bits were normalized to a value of 0 to 1 to prevent numerical problems. The EfficientNet-B0 was used as the regression model and was optimized using stochastic gradient descent with mean squared error on two target variables, WL and WW. The model was evaluated on both mean absolute error (MAE) and mean absolute percentage error (MAPE). MAE was calculated at a scale of 8 bits to give more intuitive results, because most medical displays used in industry support 8-bit resolution.*Results The regression model showed MAE of 6.63 and MAPE, a measure irrelevant to the value scale, of 5.78% on 7,866 validation images. Additionally, qualitative evaluation was performed on samples with high MAEs, and these samples were confirmed that the windowing parameters were actually stored inappropriately.*Conclusions We have developed a deep learning-based regression model for windowing parameter estimation and

shown to accurately predict these parameters with only pixel data as input. However, from a practical point of view, estimating windowing parameters using a 2D image-based deep learning model could be a heavy process. Therefore, further studies are required such as converting to 1D signal or using a lighter model.*Clinical Relevance/Application This method of estimating windowing parameters could reduce the process of adjusting WL and WW, which is a process that consumes the reader's time and energy, and provide more appropriate input images to downstream tasks such as CADe or CADx.

RESULTS

The regression model showed MAE of 6.63 and MAPE, a measure irrelevant to the value scale, of 5.78% on 7,866 validation images. Additionally, qualitative evaluation was performed on samples with high MAEs, and these samples were confirmed that the windowing parameters were actually stored inappropriately.

CLINICAL RELEVANCE/APPLICATION

This method of estimating windowing parameters could reduce the process of adjusting WL and WW, which is a process that consumes the reader's time and energy, and provide more appropriate input images to downstream tasks such as CADe or CADx.

SSPH04-5   A Low-dose Multi-contrast Chest X-ray Radiography Prototype System With Single-shot Acquisition In A Single Breath Hold

Participants
Ran Zhang, PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

In conventional chest x-ray radiography (CXR), pulmonary lesions are often blocked by overlapping ribs such that they are difficult to detect due to their relatively low contrast compared to the surrounding lung tissues. In this work, we report a low-dose and multi-contrast CXR imaging system that can provide three mutually complementary images from a single acquisition: the conventional absorption contrast, the differential phase contrast, and the dark field contrast images to jointly enhance the imaging functionality of CXR.*Methods and Materials The constructed multi-contrast CXR system consists of a motorized patient table and a gantry to hold the x-ray tube, the flat-panel detector, and the gratings. During data acquisitions, the patient is scanned in a scanning mode while the table moves along the superior-inferior (SI) direction. The system employs several technical innovations to achieve data acquisition of the entire chest with a coverage of 28 cm along the SI direction within 4 seconds. The initial imaging performance tests were performed using an anthropomorphic chest phantom. To simulate potential lung nodules, a container containing microbubble powder and calcium hydroxyapatite was attached onto the chest phantom. The phantom was scanned at a speed of 7 cm/s. The tube was operated in a pulse-fluoro mode with 70 kVp, 60 mA, and a duty cycle of 40%. The exposure was measured using a 10X6-6 RadCal 6 cc chamber and was converted to air kerma and effective dose.*Results The estimated air kerma and effective dose were 53 uGy and 9.2 uSv, respectively, which is well below the effective dose for a typical CXR (~20 uSv). The quality of the absorption contrast image matches that of conventional CXR. In addition, the dark field image revealed the microbubble and the calcium hydroxyapatite, which was invisible in the absorption image due to anatomical noise. No table translation-induced artifacts were observed in the multi-contrast CXR images.*Conclusions A new prototype multi-contrast CXR system was developed to enable low radiation dose and fast scans of human chest-sized objects within 4 seconds.*Clinical Relevance/Application The new multi-contrast CXR system offers the potential to improve the clinical diagnosis and screening of lung diseases such as screening for lung cancer.

RESULTS

The estimated air kerma and effective dose were 53 uGy and 9.2 uSv, respectively, which is well below the effective dose for a typical CXR (~20 uSv). The quality of the absorption contrast image matches that of conventional CXR. In addition, the dark field image revealed the microbubble and the calcium hydroxyapatite, which was invisible in the absorption image due to anatomical noise. No table translation-induced artifacts were observed in the multi-contrast CXR images.

CLINICAL RELEVANCE/APPLICATION

The new multi-contrast CXR system offers the potential to improve the clinical diagnosis and screening of lung diseases such as screening for lung cancer.

SSPH04-6   In Vivo Relative Dosimetry With Xact Imaging: A Feasibility Study

Participants
Kiana Prather, BS, Oklahoma City, Oklahoma (*Presenter*) Nothing to Disclose

PURPOSE

In the thermoacoustic phenomenon, acoustic waves are generated by objects irradiated by short-pulsed ionizing radiation due to transient local temperature change. The thermoacoustic effect has been increasingly investigated as a novel imaging modality. One of the potential applications capitalizing on this phenomenon is X-ray acoustic computed tomography (XACT), which utilizes acoustic waves generated by X-ray beams that are clinically available. The field of XACT has garnered growing interest as a potential tool for in vivo dosimetry during radiotherapy at no extra radiation. This study aims to investigate the feasibility of using XACT as a relative dosimetry tool without the use of additional marker.*Methods and Materials X-ray acoustic (XA) signals generated from an X-ray beam in water were collected by a single element, broadband ultrasound transducer submerged in water (Fig. 1a). The XA signal was amplified by a 60-dB Olympus preamplifier and acquired on an oscilloscope with 1024 averaging at a 5 MHz sampling rate. The beam was delivered by a Varian TrueBeam system at 10 MV flattening filter free (FFF) and 6 MV FFF energy with a 4 μs pulse duration. To capture the change in X-ray dose with increasing water depth, the height of the transducer was varied from 2.60 cm to 11.00 cm from the water surface at multi-millimeter steps. The peak-to-peak amplitude of the beam edge XA signal was plotted against the transducer depth, and the XACT image was reconstructed in MATLAB using back-projection after 10 kHz high-pass filtering.*Results XA signals from the near and far edges of the X-ray beam corresponding to the field size can be observed (Fig. 1b). As the transducer depth is increased, the signal amplitude decreases, while the signal profile remains largely unchanged (Fig. 2a). Fig. 2b demonstrate the near linear relationship between the near-edge XA signal amplitude and the transducer depth, which is comparable to the percentage depth dose curves of 10 and 6 MV beams within this depth range. A reconstruction of the depth plane of the beam is shown in Fig. 3, with the near and far edges of the beam visible at ~4 cm apart.*Conclusions This study demonstrates the feasibility of relative dosimetry using XACT imaging. While a more robust method to quantify the XA signals is warranted, the results of this study contribute to further advancing utilizing XACT to improve the precision of X-ray based radiotherapy.*Clinical Relevance/Application There currently does not exist an in vivo, direct dosimetry method for radiotherapy. This study demonstrates the feasibility of XACT as a non-invasive and affordable dosimetry method that

can be used during patient treatment with no additional radiation to improve the safety and accuracy of photon-based radiotherapy.

RESULTS

XA signals from the near and far edges of the X-ray beam corresponding to the field size can be observed (Fig. 1b). As the transducer depth is increased, the signal amplitude decreases, while the signal profile remains largely unchanged (Fig. 2a). Fig. 2b demonstrate the near linear relationship between the near-edge XA signal amplitude and the transducer depth, which is comparable to the percentage depth dose curves of 10 and 6 MV beams within this depth range. A reconstruction of the depth plane of the beam is shown in Fig. 3, with the near and far edges of the beam visible at ~4 cm apart.

CLINICAL RELEVANCE/APPLICATION

There currently does not exist an in vivo, direct dosimetry method for radiotherapy. This study demonstrates the feasibility of XACT as a non-invasive and affordable dosimetry method that can be used during patient treatment with no additional radiation to improve the safety and accuracy of photon-based radiotherapy.

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SPR-PD

Pediatric Pre-recorded Scientific Papers

Sub-Events

SPR-PD-1   **Detecting Pediatric Wrist Fractures Using Deep Learning-based Object Detection**

Participants
John Zech, MD,MA, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Buckle fractures of the distal radius are unique to pediatric patients, and may be unrecognized due to their subtle presentation on imaging. We investigated the ability of a deep learning framework to detect acute pediatric wrist fractures and specifically evaluated its ability to detect buckle fractures.*Methods and Materials A sample of 1144 radiographs from 397 examinations of 397 patients under the age of 18 who had wrist radiographs performed between 1/9/2015-11/15/2019 containing at least two orthogonal projections were obtained (mean age 10.1 years, min 0.82, max 17.84; 37.5% female; 64.4% positive for fracture; 29.7% positive for buckle fracture). Only examinations that served as an initial evaluation for fracture were considered for inclusion. The available radiographs were divided into train (n=791 radiographs, 272 examinations) and test (n=353 radiographs, 125 examinations) datasets. The report of the attending radiologist served as ground truth.Bounding boxes containing imaging findings indicative of buckle fracture were manually segmented. For each image containing no pathologic findings, a background bounding box was randomly generated. A Faster R-CNN was trained in PyTorch 1.7.0 [1,2] using the Detectron2 library [3] contributed by Facebook AI Research (1000 epochs, batch size 10, learning rate 0.01). A classification probability of 85% was required to consider a region a positive for pathology. The maximum probability over all regions predicted by the model across images corresponding to a single examination served as the model's overall prediction.*Results The model demonstrated AUC of 93.6%, accuracy of 92.9% (n=117/127), sensitivity of 93.9% (n=77/82), and specificity of 88.9% (n=40/45) in identifying any fracture. It accurately identified 97.5% of buckle fractures (n=39/40).*Conclusions An object detection-based deep learning approach was able to detect pediatric wrist fractures with high accuracy. Of note, the model demonstrated strong ability to detect subtle buckle fractures.*Clinical Relevance/Application This approach may be used to assist in detection of these fractures.References:1. Paszke, A., Gross, S., Massa, F., Lerer, A., Bradbury, J., Chanan, G., et al. PyTorch: An Imperative Style, High-Performance Deep Learning Library. Advances in Neural Information Processing Systems 32. 2019.2. Ren, S., He, K., Girshick, R., Sun, J. Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks. Available at: https://arxiv.org/abs/1506.01497.3. Wu, Y., Kirillov, A., Massa, F., Lo, W.-Y., and Girshick, R. Detectron2. Available at https://github.com/facebookresearch/detectron2. 2019.

RESULTS

The model demonstrated AUC of 93.6%, accuracy of 92.9% (n=117/127), sensitivity of 93.9% (n=77/82), and specificity of 88.9% (n=40/45) in identifying any fracture. It accurately identified 97.5% of buckle fractures (n=39/40).

CLINICAL RELEVANCE/APPLICATION

This approach may be used to assist in detection of these fractures.References:1. Paszke, A., Gross, S., Massa, F., Lerer, A., Bradbury, J., Chanan, G., et al. PyTorch: An Imperative Style, High-Performance Deep Learning Library. Advances in Neural Information Processing Systems 32. 2019.2. Ren, S., He, K., Girshick, R., Sun, J. Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks. Available at: https://arxiv.org/abs/1506.01497.3. Wu, Y., Kirillov, A., Massa, F., Lo, W.-Y., and Girshick, R. Detectron2. Available at https://github.com/facebookresearch/detectron2. 2019.

SPR-PD-10   **Two-dimensional Shear Wave Elastography For The Prediction Of Hepatic Veno-occlusive Disease Following Hematopoietic Stem Cell Transplantation In Pediatric Patients**

Participants
Yoonseong Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Hepatic veno-occlusive disease (VOD) is one of the complications following hematopoietic stem cell transplantation (HSCT). This study aimed to assess the usefulness of two-dimensional shear wave elastography (2D-SWE) for predicting hepatic VOD in pediatric patients who underwent HSCT.*Methods and Materials Pediatric patients who received HSCT between November 2019 and January 2021 were monitored for the presence or absence of sonographic signs of VOD using grayscale, color doppler, and 2D-SWE ultrasound examination once a week for 4-week. Ultrasound parameters were assessed as follows: the craniocaudal length of the liver at the mid-clavicular level, the presence of ascites, gallbladder wall edema, resistance index of hepatic arteries, peak velocity and flow direction of hepatic and portal veins, and median liver stiffness value on 2D-SWE. The clinical diagnosis and assessment were based on the European Society for Blood and Marrow Transplantation (EBMT) pediatric criteria. Each parameter was compared between VOD and non-VOD group using unpaired t-test and Chi-square test. The risk of VOD in an individual in relation to ultrasound parameters which were repeatedly measured was analyzed using the generalized estimating equation.*Results A total of 34 (27 allogenic and 7 autologous) patients were included in our study. The patients' demographics were as follows: the median age of 8 years (range 2-21 years), and 18 boys (52.9%). The grayscale ultrasound of the VOD group revealed gallbladder wall edema, ascites, and hepatomegaly more frequently (p-value<0.001). However, there was no significant difference in the color doppler parameters. The liver stiffness value of the VOD group was higher than the non-VOD group (12.5±5.2 vs. 5.9±2.6 kPa, p-value<0.001). When the liver stiffness value increased by one unit, the risk of VOD occurrence for an individual was 1.703 times

[95%C.I: 1.263, 2.296] (p-value=0.001).*Conclusions Patients who developed VOD had signi&7;cantly increased liver stiffness as measured by 2D-SWE compared to patients who did not develop VOD. Our study results show that changes in 2D-SWE can provide quantitative information for the risk of VOD than current conventional imaging criteria.*Clinical Relevance/Application The 2D-SWE offers the novel potential tool for VOD monitoring to help make early decision-making for therapeutic intervention that may impact the outcome of HSCT.

RESULTS

A total of 34 (27 allogenic and 7 autologous) patients were included in our study. The patients' demographics were as follows: the median age of 8 years (range 2-21 years), and 18 boys (52.9%). The grayscale ultrasound of the VOD group revealed gallbladder wall edema, ascites, and hepatomegaly more frequently (p-value<0.001). However, there was no significant difference in the color doppler parameters. The liver stiffness value of the VOD group was higher than the non-VOD group (12.5±5.2 vs. 5.9±2.6 kPa, p-value<0.001). When the liver stiffness value increased by one unit, the risk of VOD occurrence for an individual was 1.703 times [95%C.I: 1.263, 2.296] (p-value=0.001).

CLINICAL RELEVANCE/APPLICATION

The 2D-SWE offers the novel potential tool for VOD monitoring to help make early decision-making for therapeutic intervention that may impact the outcome of HSCT.

SPR-PD-12 Non-contrast Pulmonary MRI: Long-term Monitoring Of Structural Lung Disease In Patients With Cystic Fibrosis

Participants
Michael Esser, MD, Tuebingen, Germany (Presenter) Nothing to Disclose

PURPOSE

Phenotypic expression and pulmonary impairment vary substantially across cystic fibrosis (CF) patients. The purpose of this study was to evaluate the change in structural lung disease over 6 years assessed by pulmonary MRI (pMRI) and correlated to pulmonary function testing with forced expiratory volume in 1 s (FEV1).*Methods and Materials In this retrospective study CF patients were included with biennial pMRI continuing over at least 6 years and with pulmonary function testing. All pMRIs consisted of the same protocol and were conducted on a 1.5 T scanner (PDw Flash 3D in breath-hold, coronal T2w TSE with double-triggering and functional sagittal PDw Flash 2D sequence in submaximal in- and expiration). Structural lung disease was assessed per lung lobe using the semi-quantitative MR-CF-S scoring system, which comprises bronchiectasis/peribronchial wall thickening, mucus plugging, centrilobular opacities, consolidation, sacculation, and air trapping. For better comparison, z-scores were calculated for each patient`s examination and pulmonary function testing, which were correlated to time.*Results 41 patients (mean age 10.2±5.2 years, 19 males, 22 females) were included. Over a 6 year period, an overall decrease of FEV1 of -0.77 % per year (SD 2.1) was observed with a baseline FEV1 of 91.1% (SD 14.3). Concurrently, the baseline MR-CF-S with an average of 5.6±5.0 showed an increase of 6.4 points (SD 3,69) over the 6 years. There was a significant difference in the z-scores that were correlated to the examination time points: z-FEV1 (-1) showed a slope of 0.03 (p=0.38) and z-MR-CF-S 0.14 (p<0.001). The most significant categorical differences in z-MR-CF-S were seen for bronchiectasis and air trapping.*Conclusions The increase in MR-CF-S over the 6 years showed a significantly swifter disease progression than FEV1, suggesting that the pMRI is more sensitive than pulmonary function testing.*Clinical Relevance/Application CF patients can benefit from biennial pulmonary MRIs. MR-CF-S scoring system is a reliable marker for long-term disease evaluation.

RESULTS

41 patients (mean age 10.2±5.2 years, 19 males, 22 females) were included. Over a 6 year period, an overall decrease of FEV1 of -0.77 % per year (SD 2.1) was observed with a baseline FEV1 of 91.1% (SD 14.3). Concurrently, the baseline MR-CF-S with an average of 5.6±5.0 showed an increase of 6.4 points (SD 3,69) over the 6 years. There was a significant difference in the z-scores that were correlated to the examination time points: z-FEV1 (-1) showed a slope of 0.03 (p=0.38) and z-MR-CF-S 0.14 (p<0.001). The most significant categorical differences in z-MR-CF-S were seen for bronchiectasis and air trapping.

CLINICAL RELEVANCE/APPLICATION

CF patients can benefit from biennial pulmonary MRIs. MR-CF-S scoring system is a reliable marker for long-term disease evaluation.

SPR-PD-13 Postnatal Urinary Tract Dilation Classification System For Assessing Surgical Outcome In Neonates And Young Infants

Participants
Jisun Hwang, MD, Hwaseong-si, Korea, Republic Of (Presenter) Nothing to Disclose

PURPOSE

To validate postnatal urinary tract dilation (UTD) classification system proposed in 2014 by correlating with the need for surgical intervention*Methods and Materials We retrospectively identified young infants (= 3-months-old) who underwent postnatal US for evaluating prenatal hydronephrosis between 2010 and 2017. The children who underwent US within 48 hours after birth, did not undergo a follow-up US at least 30 days later, or were treated by fetal intervention were excluded. The kidney units (KUs; either right, left, or bilateral) were graded using the UTD classification system (P1 [low risk] to P3 [high risk]) based on seven US findings (anterior-posterior renal pelvic diameter, central and peripheral calyceal dilation, renal parenchymal thickness and appearance, bladder abnormalities, and ureteral abnormalities). The P0 (very low risk) was assigned for KUs which did not met the criteria of P1 but showed measurable pelvic dilatation. Kaplan-Meier analysis and log rank test were conducted to compare the need for surgical intervention among the groups. Multivariate Cox regression analysis was performed to determine predictors of surgical intervention among the US parameters of the UTD system.*Results A total of 517 KUs from 335 patients (mean age, 18.38 ± 15.88 days; range, 1 - 94 day; male, 275) who showed UTD on postnatal US were included with median follow-up of 24.2 months. Fifty-eight KUs (0 % [0 of 101 KUs] in P0, 1.0% [2 of 201 KUs] in P1, 15.9% [24 of 151 KUs] in P2, and 62.7% [32 of 51 KUs] in P3) underwent surgical intervention. Significant differences were observed among the Kaplan-Meier curves of the UTD groups by log-rank test (all P=0.001), except P0 vs. P1 (P=0.5). Anterior-posterior renal pelvic diameter (Hazard ratio [HR], 1.09; 95 CI, 1.61-10.95), peripheral calyceal dilation (HR, 8.10;95 CI, 2.39-27.47), ureteral dilation (HR, 4.90; 95 CI, 2.40-10.02), parenchymal thickness abnormality (HR, 4.09; 95 CI, 2.01-8.32), bladder abnormality (HR, 4.46; 95 CI, 1.72-11.56) were significantly associated with the occurrence of surgery (all P=0.001).*Conclusions Postnatal UTD classification system well stratified the risk of clinical outcome in terms of the need for surgical intervention. Peripheral calyceal dilation is the most predictive US sign.*Clinical Relevance/Application Postnatal UTD classification system well stratified the risk of clinical outcome in terms of the need for surgical intervention and it is a useful

system for diagnosis and management of postnatal UTD.

RESULTS

A total of 517 KUs from 335 patients (mean age, 18.38 ± 15.88 days; range, 1 - 94 day; male, 275) who showed UTD on postnatal US were included with median follow-up of 24.2 months. Fifty-eight KUs (0 % [0 of 101 KUs] in P0, 1.0% [2 of 201 KUs] in P1, 15.9% [24 of 151 KUs] in P2, and 62.7% [32 of 51 KUs] in P3) underwent surgical intervention. Significant differences were observed among the Kaplan-Meier curves of the UTD groups by log-rank test (all P=0.001), except P0 vs. P1 (P=0.5). Anterior-posterior renal pelvic diameter (Hazard ratio [HR], 1.09; 95 CI, 1.61-10.95), peripheral calyceal dilation (HR, 8.10;95 CI, 2.39-27.47), ureteral dilation (HR, 4.90; 95 CI, 2.40-10.02), parenchymal thickness abnormality (HR, 4.09; 95 CI, 2.01-8.32), bladder abnormality (HR, 4.46; 95 CI, 1.72-11.56) were significantly associated with the occurrence of surgery (all P=0.001).

CLINICAL RELEVANCE/APPLICATION

Postnatal UTD classification system well stratified the risk of clinical outcome in terms of the need for surgical intervention and it is a useful system for diagnosis and management of postnatal UTD.

SPR-PD-2   Ferumoxytol MRI Detects Joint Infiltration Of Bone Sarcomas In Pediatric Patients

Participants
Ashok Joseph Theruvath, MD, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

The diagnosis of joint infiltration by a malignant bone tumor affects surgical management. The specificity of standard MRI for diagnosing joint infiltration is limited. During our MRI evaluations of pediatric bone sarcomas with ferumoxytol nanoparticles, we observed a surprising marked T1-enhancement of the joint effusion in some patients and not others. The purpose of this study was to evaluate, if nanoparticle extravasation differed between joints with and without tumor infiltration.*Methods and Materials We retrospectively identified 15 pediatric cancer patients and young adults (mean age 16±4 years) with bone sarcomas who underwent 18 MRI scans at 1 hour (n=7) or 24 hours (n=11) after intravenous ferumoxytol infusion. Twelve patients also received a gadolinium(Gd)-enhanced MRI. We determined the presence or absence of tumor invasion into the joint or pleural space, based on imaging findings (n=18) and histology (n=14). We compared the signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) of the joint fluid for tumors with and without joint invasion using a Mann-Whitney test.*Results MRI scans at 24 hours after intravenous ferumoxytol infusion demonstrated a positive T1-enhancement of the effusion in all joints with tumor infiltration and no joint without infiltration. Corresponding SNR (P=0.0043) and CNR values (P=0.0043) were significantly higher for joints with than without tumor infiltration. By contrast, unenhanced MRI, Gd-enhanced MRI and 1 hour postcontrast ferumoxytol-MRI did not show any enhancement of the joint effusion, with or without tumor infiltration.*Conclusions This pilot study suggests that 24 hour postcontrast ferumoxytol-MRI scans can non-invasively differentiate between joints with and without tumor infiltration.*Clinical Relevance/Application Ferumoxytol-MRI can be used to determine joint infiltration status of patients with bone sarcoma and therefore can affect surgical management by stratifying patients towards more or less invasive surgeries.

RESULTS

MRI scans at 24 hours after intravenous ferumoxytol infusion demonstrated a positive T1-enhancement of the effusion in all joints with tumor infiltration and no joint without infiltration. Corresponding SNR (P=0.0043) and CNR values (P=0.0043) were significantly higher for joints with than without tumor infiltration. By contrast, unenhanced MRI, Gd-enhanced MRI and 1 hour postcontrast ferumoxytol-MRI did not show any enhancement of the joint effusion, with or without tumor infiltration.

CLINICAL RELEVANCE/APPLICATION

Ferumoxytol-MRI can be used to determine joint infiltration status of patients with bone sarcoma and therefore can affect surgical management by stratifying patients towards more or less invasive surgeries.

SPR-PD-3   Brain Tissue Relaxation Time And Cerebral Blood Flow In Preterm Neonates: Association With Neurodevelopmental Outcome

Participants
Hyun Gi Kim, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Both relaxation time and cerebral blood flow are known to reflect maturation in neonates' brains. Whether relaxation time or cerebral blood flow of early preterm neonates' brains is associated with later neurodevelopmental outcomes remains unknown. The objective of this study was to find out the association between either relaxation time or cerebral blood flow and later neurodevelopmental outcomes.*Methods and Materials this prospective study, preterm neonates in the intensive care unit were recruited and synthetic MRI and multi-delay arterial spin labeling (ASL) was performed before discharge. These neonates underwent the Bayley Scales of Infant Development test at 18 months of age and both cognitive and motor outcome scores were measured. T1 and T2 relaxation times and cerebral blood flow values in different brain regions were measured. Linear regression was done between 'regional relaxation times and neurodevelopmental outcome scores' and between 'cerebral blood flow values and neurodevelopmental outcome scores'.*Results Forty-nine neonates (median [interquartile range] gestational age, 209 [17] days; range, 169 - 245 days; 28 boys, 21 girls) underwent MRI scan at or near term equivalent age (median [interquartile range] corrected gestational age, 258 [15] days; range, 239 - 321 days). Gestational age at birth showed a positive relationship with cognitive score (P = .018) and was included as a confounding factor. After controlling for gestational age at birth, the frontal white matter T1 relaxation times were significantly associated with the cognitive scores (coefficient, 0.034; 95% confidence interval [CI], 0.005 - 0.063; P = .025). No other regional T1 and T2 relaxation times showed association with cognitive or motor scores. Frontal white matter cerebral blood flow values were significantly associated with the cognitive score after controlling for gestational age at birth (coefficient, -0.949; 95% CI, -1.807- -0.091; P = .031). No other regional cerebral blood flow values showed association with cognitive or motor scores.*Conclusions There were significant associations between 'T1 relaxation times and cerebral blood flow values in frontal white matter' acquired in preterm neonates and their later cognitive outcome.*Clinical Relevance/Application 'T1 and T2 relaxation times' and 'cerebral blood flow values' were measured in preterm neonates using synthetic MRI and multi-delay arterial spine labeling, respectively. Preterm neonate's brain tissue properties and developmental degrees were quantified by T1 and T2 relaxation times and cerebral blood flow values. Higher T1 relaxation times and lower cerebral blood flow values in frontal white matter were associated with better cognitive outcomes at age 18 months.

RESULTS

Forty-nine neonates (median [interquartile range] gestational age, 209 [17] days; range, 169 - 245 days; 28 boys, 21 girls) underwent MRI scan at or near term equivalent age (median [interquartile range] corrected gestational age, 258 [15] days; range, 239 - 321 days). Gestational age at birth showed a positive relationship with cognitive score (P = .018) and was included as a confounding factor. After controlling for gestational age at birth, the frontal white matter T1 relaxation times were significantly associated with the cognitive scores (coefficient, 0.034; 95% confidence interval [CI], 0.005 - 0.063; P = .025). No other regional T1 and T2 relaxation times showed association with cognitive or motor scores. Frontal white matter cerebral blood flow values were significantly associated with the cognitive score after controlling for gestational age at birth (coefficient, -0.949; 95% CI, -1.807--0.091; P = .031). No other regional cerebral blood flow values showed association with cognitive or motor scores.

CLINICAL RELEVANCE/APPLICATION

'T1 and T2 relaxation times' and 'cerebral blood flow values' were measured in preterm neonates using synthetic MRI and multi-delay arterial spine labeling, respectively. Preterm neonate's brain tissue properties and developmental degrees were quantified by T1 and T2 relaxation times and cerebral blood flow values. Higher T1 relaxation times and lower cerebral blood flow values in frontal white matter were associated with better cognitive outcomes at age 18 months.

SPR-PD-4   MRI-based Radiomics And Machine Learning For Ependymoma: An International Study

Participants
Edward Wang, London, British Columbia (*Presenter*) Nothing to Disclose

PURPOSE

Patients with posterior fossa ependymoma (PFE) routinely receive magnetic resonance (MR) imaging for diagnosis and surgical planning. PFEs are divided into two molecular subgroups (A versus B), with subgroup A having worse prognoses. Standard treatment of ependymomas is surgery with adjuvant radiation therapy. In this study, we extracted radiomic features from pre-treatment MR images to develop machine learning models for survival prognosis and tumour molecular classification.*Methods and Materials In the largest machine learning study of ependymoma, imaging and clinical data from 157 children (95M/62F, median age of 87 months) from 11 different international centers were evaluated. We manually isolated tumor volumes on T1-post contrast (T1) and T2-weighted (T2) MR images for high-dimensional feature extraction using PyRadiomics. We extracted 900 features on each image comprising first-order statistics, shape, size, and second-order texture features including Gray Level Co-occurrence Matrix (GLCM), Gray Level Run Length Matrix (GLRLM), Gray Level Size Zone Matrix (GLZM), Neighboring Gray Tone Difference Matrix (NGTDM), and Gray Level Dependence Matrix (GDLM). Proportional hazard Cox models were used for survival prediction, and logistic regression models were used for molecular subgroup classification. Least Absolute Shrinkage and Selection Operator (LASSO) was used to select the optimal features to feed into the model. The models were trained on T1 MR features only, T2 MR features only, and both T1 and T2 MR features. 4-fold nested cross validation was used for feature selection and model training.*Results T1 and T2 MR images were collected for 103 and 90 patients respectively. Molecular subtype information was available for 79 patients (64A/15B). T2 features were more predictive of survival status and T1 features were more predictive of molecular classification. A Cox model trained on T2 features that appeared in all 4 outer-loop folds was able to successfully stratify patients into high and low risk groups (p<0.05). A logistic regression model trained on T1 features was able to achieve an AUC of 0.86 [95% CI: 0.73-0.96]. GLZM features were consistently identified by LASSO for both survival analysis and molecular classification.*Conclusions Our pilot study shows the potential role for MR-based radiomics and machine learning for PFE risk stratification and molecular classification. Additional work is needed to validate the findings on an external dataset.*Clinical Relevance/Application These findings from an international cohort suggests that radiomic imaging features may assist clinicians in risk stratifying children at higher risk of progression to better personalize treatment options.

RESULTS

T1 and T2 MR images were collected for 103 and 90 patients respectively. Molecular subtype information was available for 79 patients (64A/15B). T2 features were more predictive of survival status and T1 features were more predictive of molecular classification. A Cox model trained on T2 features that appeared in all 4 outer-loop folds was able to successfully stratify patients into high and low risk groups (p<0.05). A logistic regression model trained on T1 features was able to achieve an AUC of 0.86 [95% CI: 0.73-0.96]. GLZM features were consistently identified by LASSO for both survival analysis and molecular classification.

CLINICAL RELEVANCE/APPLICATION

These findings from an international cohort suggests that radiomic imaging features may assist clinicians in risk stratifying children at higher risk of progression to better personalize treatment options.

SPR-PD-6   Evaluation Of Treatment Response In Children With Perianal Crohn's Disease Using Transperineal Ultrasonography

Participants
Jae-Hyeop Jung, MD, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To assess the accuracy of transperineal ultrasound (TPUS) for evaluating treatment response, compared with pelvis MRI and colonoscopic examination, in children with perianal CD (PACD).*Methods and Materials Twenty-nine children with PACD who underwent baseline and follow-up TPUS and pelvis MRI were included between January 2016 and February 2020. Perianal fistulae with or without abscesses were identified by their presence and location, and thickness of the fistula and size of the abscess were measured on each modality. The fistulae were classified according to Park's and St. James's University Hospital classifications. Two radiologists assessed the treatment response based on the fistula thickness and the abscess size of each baseline and follow-up examinations in consensus, and classified it into two groups; response and no response. Regarding the treatment response, the agreement between TPUS and MRI and between colonoscopy and MRI were assessed using the weighted Cohen kappa test. Interobserver agreement of perianal fistula thickness was evaluated by calculating the intraclass correlation coefficient (ICC). We evaluated intraobserver correlation of the fistula thickness between TPUS and MRI using the Pearson correlation coefficient.*Results Fifty-six fistulae (six superficial, forty-six intersphincteric, and four transsphincteric) with six-teen abscesses were detected using MRI. On MRI, thirty-nine fistulae (70%) showed a response, and the remaining seventeen fistulae did not show response. We evaluated the treatment response of forty-five and thirty-nine lesions using TPUS and colonoscopic examination, respectively. Thirty-three cases of treatment response on TPUS (accuracy 73.3%), and twenty-four cases of that on the colonoscopic exam (accuracy 61.5%) corresponded with MRI. Concerning evaluation for treatment response, the agreement between TPUS and MRI was moderate (kappa value 0.486), while the agreement between colonoscopy and MRI was slight (kappa value 0.180). The interobserver agreement in the measurement of the fistula thickness was excellent (ICC = 0.890-0.953), and the

fistula thickness between TPUS and MRI among intra-observers showed a strong positive correlation (Pearson correlation coefficient, 0.432-0.484, P < 0.001). Of 12 TPUS-MRI discordances, ten lesions (83%) demonstrated the response in MRI but remained unchanged in TPUS.*Conclusions TPUS is an appropriate, simple, and real-time method for evaluating the treatment response of perianal fistula with or without abscess in children with PACD.*Clinical Relevance/Application TPUS can be alternative to the pelvis MRI to evaluate treatment response in children with PACD compared to the colonoscopic exam.

RESULTS

Fifty-six fistulae (six superficial, forty-six intersphincteric, and four transsphincteric) with six-teen abscesses were detected using MRI. On MRI, thirty-nine fistulae (70%) showed a response, and the remaining seventeen fistulae did not show response. We evaluated the treatment response of forty-five and thirty-nine lesions using TPUS and colonoscopic examination, respectively. Thirty-three cases of treatment response on TPUS (accuracy 73.3%), and twenty-four cases of that on the colonoscopic exam (accuracy 61.5%) corresponded with MRI. Concerning evaluation for treatment response, the agreement between TPUS and MRI was moderate (kappa value 0.486), while the agreement between colonoscopy and MRI was slight (kappa value 0.180). The interobserver agreement in the measurement of the fistula thickness was excellent (ICC = 0.890-0.953), and the fistula thickness between TPUS and MRI among intra-observers showed a strong positive correlation (Pearson correlation coefficient, 0.432-0.484, P < 0.001). Of 12 TPUS-MRI discordances, ten lesions (83%) demonstrated the response in MRI but remained unchanged in TPUS.

CLINICAL RELEVANCE/APPLICATION

TPUS can be alternative to the pelvis MRI to evaluate treatment response in children with PACD compared to the colonoscopic exam.

SPR-PD-7   Simulated Dose Reduction And Snapshot In Total-body 18F-FDG PET/CT In Pediatric Patients Using The UEXPLORER Scanner

Participants
Yu-Mo Zhao, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Pediatric patients due to less tolerance and long lifetime expectance are susceptive to the ionizing radiation and the acquisition time for PET examinations. The purpose of this study was to explore the promising minimum threshold of the acquisition time and administered dose for 18F-fluorodeoxyglucose (18F-FDG) PET imaging in pediatric patients by using the digital PET/CT scanner with 194-cm long axial field-of-view -- uEXPLORER.*Methods and Materials A total of 28 pediatric patients (age 7.6±4.8 years, weight 28.2±17.8 kg) have been enrolled in this study. By truncating the list-mode PET data to reducing statistic count density, a series of simulated low-dose 18F-FDG PET images have been reconstructed with various durations (20 s, 40 s, 1 min, 2 min, 5 min, and 10 min), representing the PET images of 10 min with simulated administered dose (0.12 MBq/kg - 3.7 MBq/kg). The reconstruction method was time-of-flight ordered-subsets expectation maximization with point-spread function (OSEM-TOF-PSF). Dose or time-related image quality has been subjectively and objectively evaluated. For subjective evaluation, we performed Likert 5-point scales with 3 radiologists to assess overall image quality, image noise, and lesion conspicuity. The measurements of standard uptake value (SUV) are used in the objective evaluations, where the SUVmax, SUVmean, and SD at the liver, the SUVmax at lesions, and lesion-to-background ratio (LBR) was recorded.*Results In this study, the feasibility of dose-reduction and snapshot in total-body 18F-FDG PET imaging for pediatric patients has been proved by using the state-of-the-art PET/CT scanner. As the acquisition time or dose decreases, the SUVmax and SD at liver increases due to low statistic count induced noise effect, there is a significant difference among different reconstructed groups (p < 0.05). Nevertheless, the SUVmean at the liver is relatively stable in different groups. Strikingly, the SUVmax at lesions as well as the LBR is relatively fixed (with or without Bonferroni correction, all p > 0.1).*Conclusions By utilizing a 194-cm-long axial FOV PET/CT scanner, pediatric patients could undergo PET/CT examinations with 0.25 MBq/kg for 10 min or 3.7 MBq/kg during 40 s, while the PET image quality was qualitatively and quantitatively acceptable in the clinical diagnosis. Such examinations could be utilized in pediatric patients who are susceptive to ionizing-radiation-induced DNA damage or sedation.*Clinical Relevance/Application The digital PET/CT scanner with a long axial field-of-view has a great potential to reduce the administered dose and the acquisition time for pediatric oncological patients.

RESULTS

In this study, the feasibility of dose-reduction and snapshot in total-body 18F-FDG PET imaging for pediatric patients has been proved by using the state-of-the-art PET/CT scanner. As the acquisition time or dose decreases, the SUVmax and SD at liver increases due to low statistic count induced noise effect, there is a significant difference among different reconstructed groups (p < 0.05). Nevertheless, the SUVmean at the liver is relatively stable in different groups. Strikingly, the SUVmax at lesions as well as the LBR is relatively fixed (with or without Bonferroni correction, all p > 0.1).

CLINICAL RELEVANCE/APPLICATION

The digital PET/CT scanner with a long axial field-of-view has a great potential to reduce the administered dose and the acquisition time for pediatric oncological patients.

SPR-PD-9   Left Ventricular Systolic Dysfunction In Kawasaki Disease With Coronary Artery Dilation Detected By Cardiovascular Magnetic Resonance Tissue Tracking

Participants
Zhongqin Zhou, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

The association between left ventricular (LV) systolic function and coronary artery dilation (CAD) in Kawasaki disease (KD) patients remains unclear. We sought to quantify global and regional LV strain parameters in KD patients using cardiovascular magnetic resonance (CMR) tissue tracking, and assess the association of CAD with LV systolic function.*Methods and Materials Thirty-one KD patients with CAD (26 male, average age 5.82±3.35 years), 22 patients without CAD (13 male, average age 5.57±1.97 years) and 27 age- and sex-matched normal controls (18 men; average age 6.3±2.45 years) underwent CMR examination on a 3.0T clinical MRI scanner. The internal diameter of coronary artery was recorded by ultrasound to calculate Z score. Z score > 2 was defined as CAD. Global LV strain parameters and regional LV strain parameters in basal, middle, and apical level and 16 AHA segmentation including radial, circumferential and longitudinal peak strain (PS), and LV function were measured and compared among groups.*Results There was no difference in LV ejection fraction among controls, KD patients with CAD and patients without CAD (all p>0.05). Global longitudinal peak strain (GLPS) was lower in groups with CAD compared to groups without CAD (-12.55±4.05% vs -14.94±2.60%, p<0.05). There was on difference in radial,circumferential and longitudinal PS at basal, middle, and apical level (all

p<0.05). However, for regional strain, the segments with CAD (n=301) were lower than those in both normal controls (n=416) and segments without CAD (n=547) for regional radial, circumferential and longitudinal PS (all P<0.05). Severity of CAD was positively correlated to GLPS and regional longitudinal PS (r=0.388 and r=0.222; both p<0.05) in patients with KD.*Conclusions CMR tissue tracking could sensitively identify subclinical LV dysfunction in KD patients with CAD. LV systolic dysfunction is associated with severity of CAD and particularly occurs in myocardium dominated by dilated coronary artery.*Clinical Relevance/Application CMR tissue tracking can sensitively detect subclinical LV dysfunction in KD patients with CAD. Early clinical intervention is necessary to KD patients with CAD.

RESULTS

There was no difference in LV ejection fraction among controls, KD patients with CAD and patients without CAD (all p>0.05). Global longitudinal peak strain (GLPS) was lower in groups with CAD compared to groups without CAD (-12.55±4.05% vs -14.94±2.60%, p<0.05). There was on difference in radial,circumferential and longitudinal PS at basal, middle, and apical level (all p<0.05). However, for regional strain, the segments with CAD (n=301) were lower than those in both normal controls (n=416) and segments without CAD (n=547) for regional radial, circumferential and longitudinal PS (all P<0.05). Severity of CAD was positively correlated to GLPS and regional longitudinal PS (r=0.388 and r=0.222; both p<0.05) in patients with KD.

CLINICAL RELEVANCE/APPLICATION

CMR tissue tracking can sensitively detect subclinical LV dysfunction in KD patients with CAD. Early clinical intervention is necessary to KD patients with CAD.

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SSGI14

Gastrointestinal (Colon and Appendix)

Participants
Courtney Moreno, MD, Atlanta, Georgia (*Moderator*) Nothing to Disclose
Jorge Soto, MD, Boston, Massachusetts (*Moderator*) Nothing to Disclose
Michael S. Gee, MD, PhD, Boston, Massachusetts (*Moderator*) Research Grant, Takeda Pharmaceutical Company
Limited;Researcher, General Electric Company ;Researcher, Siemens AG

Sub-Events

SSGI14-1   GI Fluoroscopy 2021: What Are We Still Doing? What The Numbers Reveal And Implications For Trainees

Participants
David Disantis, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

PURPOSE

By analyzing utilization trends for GI fluoroscopy since 2000, we identified which studies are still performed in significant volume as a guide for matching trainee education with current practice.*Methods and Materials Medicare yearly procedure volumes from 2000 through 2019 were compiled for the most common GI fluoroscopy procedures: esophagram, swallowing study, upper GI, small bowel follow-through, and barium enema.Medicare numbers were then extrapolated to estimate nationwide procedure volumes.*Results In the latest reporting year (2019), more than 2.9 million GI fluoroscopy studies were performed in the U.S. Comparing each procedure's peak volume year with 2019, all procedure volumes dropped. The degree of change, however, was extremely disparate. For example, swallowing studies down 4%; esophagrams fell 11%; single contrast upper GIs dropped 65%; double contrast upper GIs fell 77%; single contrast barium enemas plunged 89%, and double contrast barium enemas plummeted 95%.*Conclusions With 2.9 million studies yearly, GI fluoroscopy -- in particular esophagography and swallowing studies -- will remain a part of standard radiology practice for the foreseeable future.*Clinical Relevance/Application These data allow radiology training programs to match fluoroscopy instruction with the real-world clinical demand that their graduates will face.

RESULTS

In the latest reporting year (2019), more than 2.9 million GI fluoroscopy studies were performed in the U.S. Comparing each procedure's peak volume year with 2019, all procedure volumes dropped. The degree of change, however, was extremely disparate. For example, swallowing studies down 4%; esophagrams fell 11%; single contrast upper GIs dropped 65%; double contrast upper GIs fell 77%; single contrast barium enemas plunged 89%, and double contrast barium enemas plummeted 95%.

CLINICAL RELEVANCE/APPLICATION

These data allow radiology training programs to match fluoroscopy instruction with the real-world clinical demand that their graduates will face.

SSGI14-3   Nationwide Estimates Of CT Colonography Utilization: Cross-sectional Survey Results From The 2019 National Health Interview Survey

Participants
Anand Narayan, MD,PhD, Cambridge, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Colon cancer screening reduces deaths from colorectal cancer. CT colonography is a minimally invasive screening test with high sensitivity for colonic polyps (>1 cm). Prior studies have suggested that CT colonography utilization remains low, however there are few studies evaluating recent CT colonography utilization. Our purpose was to estimate recent nationwide CT colonography utilization using 2019 nationally representative cross-sectional survey data.*Methods and Materials Participants between ages 50 and 75 without colorectal cancer history in the 2019 National Health Interview Survey cross-sectional data were included. Proportion of participants reporting utilization of CT colonography was estimated. Logistic regression analyses evaluated predictors of CT colonography, optical colonoscopy, and sigmoidoscopy utilization. All analyses were conducted accounting for complex survey design elements to obtain statistically valid estimates for the civilian, noninstitutionalized US population. *Results Overall, 14,153 respondents between the ages 50 and 75 years old were included. 1.4% of participants reported ever having CT colonography (95% CI 1.2 to 1.7), of whom 39.7% reported undergoing CT colonography within the last year, 18.7% reported within the last two years, 12.6% within the last three years, 8.8% within the last 5 years, 10.9% within the last 10 years, 9.3% underwent CT colonography 10 years ago or more. 60.1% of participants reported ever undergoing optical colonoscopy or sigmoidoscopy. Multiple variable logistic regression analyses revealed that Hispanic (OR 2.73, 95% CI 1.72 to 4.34, p < 0.001) and Black (OR 2.34, 95% CI 1.50 to 3.64, p < 0.001) participants were more likely to undergo CT colonography. Multiple variable logistic regression analyses revealed that Hispanic (OR 0.61, 95% CI 0.52 to 0.72, p < 0.001) and Black (OR 0.49, 95% CI 0.39 to 0.63, p < 0.001) participants were less likely to report optical colonoscopy or sigmoidoscopy.*Conclusions In comparison with prior published reports, survey results suggest that nationwide utilization of CT colonography remains low. Black and Hispanic participants were more likely to report undergoing CT colonography and were less likely to report undergoing optical colonoscopy or sigmoidoscopy.*Clinical Relevance/Application Continued public awareness and health insurance coverage expansion will promote improved CT colonography

utilization and overall colorectal cancer screening rates. Promotion of CT colonography may reduce racial/ethnic disparities in colorectal cancer screening.

RESULTS

Overall, 14,153 respondents between the ages 50 and 75 years old were included. 1.4% of participants reported ever having CT colonography (95% CI 1.2 to 1.7), of whom 39.7% reported undergoing CT colonography within the last year, 18.7% reported within the last two years, 12.6% within the last three years, 8.8% within the last 5 years, 10.9% within the last 10 years, 9.3% underwent CT colonography 10 years ago or more. 60.1% of participants reported ever undergoing optical colonoscopy or sigmoidoscopy. Multiple variable logistic regression analyses revealed that Hispanic (OR 2.73, 95% CI 1.72 to 4.34, p < 0.001) and Black (OR 2.34, 95% CI 1.50 to 3.64, p < 0.001) participants were more likely to undergo CT colonography. Multiple variable logistic regression analyses revealed that Hispanic (OR 0.61, 95% CI 0.52 to 0.72, p < 0.001) and Black (OR 0.49, 95% CI 0.39 to 0.63, p < 0.001) participants were less likely to report optical colonoscopy or sigmoidoscopy.

CLINICAL RELEVANCE/APPLICATION

Continued public awareness and health insurance coverage expansion will promote improved CT colonography utilization and overall colorectal cancer screening rates. Promotion of CT colonography may reduce racial/ethnic disparities in colorectal cancer screening.

SSGI14-6   Final Diagnosis And Patient Disposition Following Equivocal Results On 2-mSv CT Vs. Conventional-dose CT In Adolescents And Young Adults With Suspected Appendicitis: A Post Hoc Analysis Of Large Pragmatic Randomized Trial Data

Participants
Jungheum Cho, MD, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To compare 2-mSv CT and conventional-dose CT (CDCT, typically 7-8 mSv) regarding final diagnosis and patient disposition following equivocal CT results in adolescents and young adults with suspected appendicitis.*Methods and Materials 3,074 patients of 15-44 years (28 ± 9 years, 1672 women) from 20 hospitals were randomized to undergo contrast-enhanced 2-mSv CT (n = 1535) or CDCT (n = 1539) from December 2013 through August 2016. 161 radiologists prospectively rated the likelihood of appendicitis in a Likert scale (i.e., grades 1-5). Final diagnosis was based on CT image, surgical, pathologic, and clinical findings. Post hoc analysis was performed for final diagnosis, surgical procedure, and delay in patient management following equivocal CT results (i.e., grade 3).*Results The prevalence of confirmed appendicitis among patients with equivocal CT results was 49% (18/37) and 36% (19/53) in the 2-mSv CT and CDCT groups, respectively. The 2-mSv CT and CDCT groups were comparable for final diagnosis following equivocal results, including confirmed appendicitis (1.2% [18 patients] vs. 1.2% [19], P > 0.99), negative appendectomy (0.1% [2] vs. 0.3% [4], P = 0.53), and perforated appendicitis (0.1% [1] vs. 0.2% [3], P = 0.53). More patients were confirmed as not having appendicitis following equivocal results in the CDCT group than in the 2-mSv CT group (2.2% [34] vs. 1.0% [16], P = 0.016). The two groups were comparable for the need of appendectomy (1.4% [22] vs. 1.5% [23], P > 0.99), need of additional imaging tests (0.7% [11] vs. 1.1% [17], P = 0.35), and delay in patient management following equivocal CT results.*Conclusions 2-mSv CT is comparable to CDCT regarding final diagnosis and patient disposition following equivocal CT results.*Clinical Relevance/Application Equivocal CT results cause a challenging situation for practitioners in the management of patients with suspected appendicitis. Our results justified the use of low-dose CT instead of CDCT in patients with suspected appendicitis.

RESULTS

The prevalence of confirmed appendicitis among patients with equivocal CT results was 49% (18/37) and 36% (19/53) in the 2-mSv CT and CDCT groups, respectively. The 2-mSv CT and CDCT groups were comparable for final diagnosis following equivocal results, including confirmed appendicitis (1.2% [18 patients] vs. 1.2% [19], P > 0.99), negative appendectomy (0.1% [2] vs. 0.3% [4], P = 0.53), and perforated appendicitis (0.1% [1] vs. 0.2% [3], P = 0.53). More patients were confirmed as not having appendicitis following equivocal results in the CDCT group than in the 2-mSv CT group (2.2% [34] vs. 1.0% [16], P = 0.016). The two groups were comparable for the need of appendectomy (1.4% [22] vs. 1.5% [23], P > 0.99), need of additional imaging tests (0.7% [11] vs. 1.1% [17], P = 0.35), and delay in patient management following equivocal CT results.

CLINICAL RELEVANCE/APPLICATION

Equivocal CT results cause a challenging situation for practitioners in the management of patients with suspected appendicitis. Our results justified the use of low-dose CT instead of CDCT in patients with suspected appendicitis.

Abstract Archives of the RSNA, 2021

Participants
Kristopher W. Cummings, MD, Phoenix, Arizona (*Moderator*) Nothing to Disclose

Sub-Events

SSCH04-2 Development And Validation Of A Novel Deep Learning-based Survival Prediction Algorithm On COPD Patients Utilizing Chest Radiographs

Participants
Ju Nam, MD, Seoul, Korea, Republic Of (*Presenter*) Research grant from VUNO.

PURPOSE

Although prediction of survival is important for management of chronic obstructive pulmonary disease (COPD) patients, pre-existing COPD-specific indices require complex history taking or exercise tests, making their wide utilization impractical. We aimed to develop and validate a deep learning-based survival prediction model on COPD patients (DLSP) utilizing chest radiograph (CXR) and clinical information.*Methods and Materials For development of DLSP, COPD patients who underwent post-bronchodilator spirometry and CXR within 1 month in 2011-2015 were retrospectively collected, and split into training (n= 3,475), tuning (n= 435), and internal validation (n= 315) datasets. First, deep learning algorithm predicting survival from patients' CXR was trained (DLSPCXR), using DenseNet backbone whose last dense layer modified to adopt a negative log likelihood loss function. Afterwards, integration model of DLSPCXR and clinical information, including age, sex, body-mass index (BMI), and diabetes mellitus history, was generated as the final DLSP. For external validation, three independent cohorts were collected from different institutions (n= 337-416). Discrimination performance of DLSP was evaluated and compared with other clinical factors using time-dependent area under the receiver operating characteristic curve (TD-AUROC) for 5-year survival. Using one external validation cohort, DLSP was compared with four COPD-specific clinical indices: BODE, ADO, CAT, and SGRQ. Goodness-of-fit statistics with Hosmer-Lemeshow test was performed for model calibration.*Results DLSP showed TD-AUROC of 0.710-0.814 in predicting 5-year survival of COPD patients, which were significant higher than that of FEV1 (%predicted), age, and BMI in all three external validation cohorts. DLSP also showed higher TD-AUROC than three out of four evaluated clinical indices including BODE (TD-AUROC, 0.860 vs. 0.801; P= .53), CAT (0.927 vs. 0.549; P< .001), and SGRQ (0.848 vs. 0.702; P= .16). DLSP exhibited good calibration on all cohorts (P> .05). On Cox multivariate proportional hazard analysis, DLSP worked as an independent survival predictor from FEV1 in all three cohorts (Ps< .01).*Conclusions DLSP utilizing both CXR and simple clinical information worked as a significant predictor of the survival of COPD patients, surpassing FEV1 and other COPD-specific clinical indices.*Clinical Relevance/Application Independent from FEV1, DLSP may work as an easily accessible and powerful survival predictor for COPD patients, only utilizing CXR and simple clinical information.

RESULTS

DLSP showed TD-AUROC of 0.710-0.814 in predicting 5-year survival of COPD patients, which were significant higher than that of FEV1 (%predicted), age, and BMI in all three external validation cohorts. DLSP also showed higher TD-AUROC than three out of four evaluated clinical indices including BODE (TD-AUROC, 0.860 vs. 0.801; P= .53), CAT (0.927 vs. 0.549; P< .001), and SGRQ (0.848 vs. 0.702; P= .16). DLSP exhibited good calibration on all cohorts (P> .05). On Cox multivariate proportional hazard analysis, DLSP worked as an independent survival predictor from FEV1 in all three cohorts (Ps< .01).

CLINICAL RELEVANCE/APPLICATION

Independent from FEV1, DLSP may work as an easily accessible and powerful survival predictor for COPD patients, only utilizing CXR and simple clinical information.

SSCH04-3 Parametric Response Mapping Correlation With FEV1/FVC In COPD: Influence Of Registration Accuracy And Direction

Participants
Silvia Almeida, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Parametric response mapping (PRM), based on in- and expiratory computed tomography (CT) volumes' registration, phenotypes lung parenchyma voxels as normal, emphysema (PRMEmph) and functional small airway disease (PRMfSAD), in chronic obstructive pulmonary disease (COPD). We investigated the impact of two registration methods and direction on %PRM volumes and their association to forced expiratory volume in 1 second / forced vital capacity (FEV1/FVC), to clarify their roles and to exclude their influence as a source of error.*Methods and Materials Paired in- and expiratory volumetric CT scans from 358 consecutive participants of a COPD cohort study (64 ± 9 years old, COSYCONET) were subject to automated lung segmentation using a specialized software (YACTA). Two algorithms (R1; R2), differing on the similarity metric (sum of squared tissue volume differences; advanced normalized correlation with a bending penalty), and the two possible registration directions (inspiratory to expiratory I/E and the reverse E/I) were tested and fine-tuned. The Dice Similarity Coefficient (DSC) was computed between the lung masks as a measure of registration accuracy. %PRM volumes were compared for each registration method and direction and correlated with FEV1/FVC.*Results R2 showed the best overlap (R1: I/E DSC = 0.91±0.08 and E/I DSC = 0.90±0.09 vs R2: I/E DSC = 0.98±0.01; E/I DSC = 0.99±0.01) and the direction seems not to influence the DSC, for both algorithms. However, I/E shows greater median

DSC difference (R2 - R1) and range: 0.05, 0.00-0.49, comparing to E/I: 0.04, 0.00-0.40. This difference in registration accuracy results in %PRM volumes variation from R1 to R2: mean absolute increment of 1.18% in I/E and 1.59% in E/I for %PRMfSAD; and 0.81% in I/E and 0.86% in E/I for %PRMEmph, with limits of agreement: -3.84 to 3.86 for E/I and -3.13 to 3.16 for I/E. This translates into subtle but noticeable Pearson correlation coefficient changes from I/E to E/I, between FEV1/FVC and %PRMfSAD (-0.47 to -0.49 R1; -0.51 to -0.52 R2) and %PRMEmph (-0.69 to -0.70 R1 and constant -0.70 R2).*Conclusions Both registration methods reach high volumetric overlap (in terms of mean DSC > 0.90), but the remaining difference still results %PRM volumes variability, in particular for fSAD, and their correlation with FEV1/FVC. This effect was larger than the registration direction itself. However, if the registration accuracy is compromised, the direction seems to influence the %PRM, especially for fSAD. Further investigation is warranted to improve the registration process, since it seems to be a key factor to derive PRM.*Clinical Relevance/Application Optimizing registration performance improves the accuracy of %PRM volumes and correlation with FEV1/FVC, regardless of the registration direction.

RESULTS

R2 showed the best overlap (R1: I/E DSC = 0.91±0.08 and E/I DSC = 0.90±0.09 vs R2: I/E DSC = 0.98±0.01; E/I DSC = 0.99±0.01) and the direction seems not to influence the DSC, for both algorithms. However, I/E shows greater median DSC difference (R2 - R1) and range: 0.05, 0.00-0.49, comparing to E/I: 0.04, 0.00-0.40. This difference in registration accuracy results in %PRM volumes variation from R1 to R2: mean absolute increment of 1.18% in I/E and 1.59% in E/I for %PRMfSAD; and 0.81% in I/E and 0.86% in E/I for %PRMEmph, with limits of agreement: -3.84 to 3.86 for E/I and -3.13 to 3.16 for I/E. This translates into subtle but noticeable Pearson correlation coefficient changes from I/E to E/I, between FEV1/FVC and %PRMfSAD (-0.47 to -0.49 R1; -0.51 to -0.52 R2) and %PRMEmph (-0.69 to -0.70 R1 and constant -0.70 R2).

CLINICAL RELEVANCE/APPLICATION

Optimizing registration performance improves the accuracy of %PRM volumes and correlation with FEV1/FVC, regardless of the registration direction.

SSCH04-4   CT Findings And Patterns Of Electronic Cigarette Or Vaping Product Use-associated Lung Injury (evali), A Multicenter Cohort Of 160 Cases

Participants
Seth J. Kligerman, MD, La Jolla, California (*Presenter*) Speakers Bureau, Boehringer Ingelheim GmbH;Author, RELX;Consultant, Riverain Technologies, LLC;Consultant, Bayer AG

PURPOSE

Electronic cigarette and vaping-induced lung injury (EVALI) causes a spectrum of CT lung injury patterns. Relative frequencies and associations with vaping behavior are unknown.*Methods and Materials CT scans of 160 subjects with EVALI from 15 institutions were retrospectively reviewed. CT findings and patterns were defined via consensus. The parenchymal organizing pneumonia (OP) pattern was defined as regional or diffuse GGO +/- consolidation without centrilobular nodules (CN). Airway-centered OP was defined as diffuse CN with little or no GGO; Mixed OP was a combination of the two. Other patterns were diffuse alveolar damage (DAD), acute eosinophilic pneumonia-like (AEP-like), and pulmonary hemorrhage (DAH). Cases were classified as atypical if they did not fit into a pattern. Pattern frequencies and injury severity were correlated with vaping history (substance vaped and frequency), geography and state marijuana (THC) legality. One-way ANOVA, Chi square test, and multivariable analyses (MVA) were used for statistical analysis*Results 160 patients (79.4% male) with mean age of 28.2 yrs (range 15-68) with EVALI underwent CT. 77 (48.1%), 15 (9.4%), and 68 (42.5%) admitted to vaping THC, nicotine, or both, respectively. Common findings include diffuse or lower lobe GGO with subpleural (78.1%), lobular (59.4%) or peribronchovascular (PBV) sparing (40%). Septal thickening (50.6%), lymphadenopathy (63.1%), and CN (36.3%) were common. PBV sparing was associated with younger age (p=0.02). 156 of 160 (97.5%) subjects had 1of 6 defined patterns. Parenchymal, airway-centered, and mixed OP patterns were seen in 89 (55.6%), 14 (8.8%), and 32 (20%) respectively. AEP-like (6/160, 3.8%), DAD (9/160, 5.6%), DAH (6/160, 3.8%), and atypical (4/160, 2.5%) patterns were less common. Increased vaping frequency was associated with more severe injury (p=0.008). MVA showed negative association between vaping for >6 months and DAD pattern (p=0.03). Two subjects (1.25%) with DAD pattern died. There was no relation between pattern and injury severity and geographic location and state legality of THC.*Conclusions EVALI typically causes an OP pattern but exists on a spectrum of acute lung injury (ALI). Vaping habits do not correlate with CT patterns except for negative correlation between vaping >6 months and DAD pattern. PBV sparing, not previously described in ALI, is a common finding.*Clinical Relevance/Application Vaping should be included in the history of all patients with ALI particularly if they are young and otherwise healthy. Some patients demonstrated CT findings less commonly reported in other causes of ALI, including superimposed upper lobe predominant CN and PBV sparing. .

RESULTS

160 patients (79.4% male) with mean age of 28.2 yrs (range 15-68) with EVALI underwent CT. 77 (48.1%), 15 (9.4%), and 68 (42.5%) admitted to vaping THC, nicotine, or both, respectively. Common findings include diffuse or lower lobe GGO with subpleural (78.1%), lobular (59.4%) or peribronchovascular (PBV) sparing (40%). Septal thickening (50.6%), lymphadenopathy (63.1%), and CN (36.3%) were common. PBV sparing was associated with younger age (p=0.02). 156 of 160 (97.5%) subjects had 1of 6 defined patterns. Parenchymal, airway-centered, and mixed OP patterns were seen in 89 (55.6%), 14 (8.8%), and 32 (20%) respectively. AEP-like (6/160, 3.8%), DAD (9/160, 5.6%), DAH (6/160, 3.8%), and atypical (4/160, 2.5%) patterns were less common. Increased vaping frequency was associated with more severe injury (p=0.008). MVA showed negative association between vaping for >6 months and DAD pattern (p=0.03). Two subjects (1.25%) with DAD pattern died. There was no relation between pattern and injury severity and geographic location and state legality of THC.

CLINICAL RELEVANCE/APPLICATION

Vaping should be included in the history of all patients with ALI particularly if they are young and otherwise healthy. Some patients demonstrated CT findings less commonly reported in other causes of ALI, including superimposed upper lobe predominant CN and PBV sparing. .

SSMK10
Musculoskeletal (Image-guided Interventions)

Participants

Jon Jacobson, MD, Ann Arbor, Michigan (*Moderator*) Research Consultant, BioClinica, IncAdvisory Board, Koninklijke Philips NVRoyalties, Reed ElsevierContactor, POCUS PRO

Kenneth Lee, MD, Madison, Wisconsin (*Moderator*) Grant: NFLResearch support, Supersonic ImagineRoyalties, Reed Elsevier

Sub-Events

SSMK10-2 The Role Of 3 Tesla MR Neurography, Diagnostic Accuracy And Therapeutic Effect Of 3T MR Guided Nerve Blocks For Meralgia Paresthetica

Participants

Jan Fritz, MD, New York, New York (*Presenter*) Institutional research support, Siemens AGScientific Advisor, Siemens AGPatent agreement, Siemens AGInstitutional research support, Johnson & JohnsonInstitutional research support, Zimmer Biomet Holdings, IncInstitutional research support, BTG Internation

PURPOSE

Lateral femoral cutaneous nerve (LFCN) blocks are frequently utilized to diagnose meralgia paresthetica (MP). Traditionally these are performed with Ultrasound or CT guidance at or distal to the inguinal ligament. However, the LFCN course has several known variants, which are poorly appreciable on traditional intra-procedural imaging methods, potentially limiting the diagnostic accuracy and efficacy of blocks. We prospectively tested the hypothesis that pre-ligamentous 3Tesla MR neurography-guided (MRNg) LFCN blocks are safe and effective for the diagnosis of MP.*Methods and Materials Our institutional review board approved this prospective study. Informed consent was obtained from all participants. Patients with intractable thigh pain and high clinical suspicion of LFCN neuropathy were included. Diagnostic MRNg LFCN blocks were performed using an anterior approach and clinical wide-bore 3T MRI system targeting the nerve proximal to the inguinal ligament. Outcome variables included technical success, complications, learning curve, pre- and post-procedural numerical visual analog scale (VAS) score (0=no discomfort to 10=worst discomfort), efficacy and patient satisfaction P-values=0.05 were considered statistically significant. Descriptive and binary logistic regression statistical analyses were performed.*Results 123 LFCN blocks were performed in 95 subjects (36 men, 59 women; mean age, 54 years; range, 18-91; mean body mass index (BMI), 30kg/m2, range 17-46kg/m2), all performed with an anterior needle path. Successful drug delivery was achieved in 100% of patients. No complications occurred. Total procedure time was 25 ± 10 minutes (range:6-53) in unilateral blocks; 29 ± 11minutes (range:23-42) in bilateral blocks. Mean pre-procedure VAS score was 5.91 ± 2.1 (range 1-10). Mean post-procedure VAS score was 1.68 ± 1.91 (0-8). LFCN blocks achieved appropriate anesthesia in 77/95 (81%) subjects and symptom relief on subsequent treatment in 75/95 (79%). The majority of patients (>80%) reported immediate pain relief, comfort, acceptable examination time and positioning.*Conclusions Selective pre-ligamentous MRNg LFCN blocks are safe and effective with high technical success and patient satisfaction in patients with MP.*Clinical Relevance/Application High spatial and contrast resolution 3T MRNg LFCN blocks are safe and technically feasible. It permits direct, precise targeting of the retroperitoneal course of the LFCN, proximal to the inguinal ligament maximizing anesthesia in post-operative or variant courses. Due to its safety profile and high patient satisfaction, the procedure can be repeated to optimise individual patient outcomes prior to more invasive treatments such as cryoablation or surgical decompression.

RESULTS

123 LFCN blocks were performed in 95 subjects (36 men, 59 women; mean age, 54 years; range, 18-91; mean body mass index (BMI), 30kg/m2, range 17-46kg/m2), all performed with an anterior needle path. Successful drug delivery was achieved in 100% of patients. No complications occurred. Total procedure time was 25 ± 10 minutes (range:6-53) in unilateral blocks; 29 ± 11minutes (range:23-42) in bilateral blocks. Mean pre-procedure VAS score was 5.91 ± 2.1 (range 1-10). Mean post-procedure VAS score was 1.68 ± 1.91 (0-8). LFCN blocks achieved appropriate anesthesia in 77/95 (81%) subjects and symptom relief on subsequent treatment in 75/95 (79%). The majority of patients (>80%) reported immediate pain relief, comfort, acceptable examination time and positioning.

CLINICAL RELEVANCE/APPLICATION

High spatial and contrast resolution 3T MRNg LFCN blocks are safe and technically feasible. It permits direct, precise targeting of the retroperitoneal course of the LFCN, proximal to the inguinal ligament maximizing anesthesia in post-operative or variant courses. Due to its safety profile and high patient satisfaction, the procedure can be repeated to optimise individual patient outcomes prior to more invasive treatments such as cryoablation or surgical decompression.

SSMK10-3 Long-term Outcome Of CT-guided Microwave Ablation In Patients With Osteoid Osteoma

Participants

Sebastien L. Aubry, MD, PhD, Besancon, France (*Presenter*) Nothing to Disclose

PURPOSE

To assess the long term efficacy of CT-guided microwave ablation (MWA) in the treatment of osteoid osteomas (OOs)*Methods and Materials Twenty-eight consecutive patients with a diagnosis of OO treated by CT-guided MWA between July 2013 to March 2020 were retrospectively included. The ablations were performed with a median power and time of 60W and 1m 30s respectively.

Pain referred to OO was assessed at predefined times using a 0-10 numeric pain rating scale (NRS) : before the procedure, per procedure if no general anesthesia, and post procedure (1 day, 1 week, 1 month, 3 months, 6 months, 1 year, then yearly). Post procedure side effects were reported. At one month, a contrast-enhanced follow-up MRI was performed to evaluate the nidus vascularization and the volume of necrosis induced by MWA. Technical success was defined by necrosis of the nidus on the one-month post-procedure MRI, and early success by the absence of OO-related pain at one month*Results Long term success rate was up to 92.86% (26/28) at the end of the follow-up (median 55.5 months). Early success rate was 96.43% (27/28) and technical success rate was 96.15% (25/26). Three minor complications were reported during the procedure: a transient injury to a sensitive nerve branch of the radial nerve and two skin burns. Only one late failure was observed after a patient had been declared cured at one month but the formal proof of a late recurrence of OO could not be brought. The median volume of MWA induced necrosis was 2.4 ml*Conclusions Clinical and technical success rates are excellent, with no late recurrence after that healing is asserted at one month both clinically and on contrast enhanced MRI*Clinical Relevance/Application CT-guided MWA can treat osteoid osteoma effectively and safely, with an excellent long term efficacy

RESULTS

Long term success rate was up to 92.86% (26/28) at the end of the follow-up (median 55.5 months). Early success rate was 96.43% (27/28) and technical success rate was 96.15% (25/26). Three minor complications were reported during the procedure: a transient injury to a sensitive nerve branch of the radial nerve and two skin burns. Only one late failure was observed after a patient had been declared cured at one month but the formal proof of a late recurrence of OO could not be brought. The median volume of MWA induced necrosis was 2.4 ml

CLINICAL RELEVANCE/APPLICATION

CT-guided MWA can treat osteoid osteoma effectively and safely, with an excellent long term efficacy

SSMK10-5   The Role Of Ultrasound-guided Infiltration Of The Greater Occipital Nerve For Pain Management In Occipital Neuralgia

Participants
Nicolas Ochoa Sambrizzi, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

PURPOSE

Occipital Neuralgia also knowns as Arnold's neuralgia is a rare yet highly debilitating pathology, whose treatment range from the use of various pharmacotherapeutic agents to occipital nerve blockade. The purpose of the study is to show the efficacy of US-guided infiltration of the GON in the treatment of Occipital Neuralgia.*Methods and Materials We present a controlled before and after study of patients diagnosed with Arnold's neuralgia in our center that received ultrasound (US) guided infiltration of the Greater Occipital nerve (GON) in the last year.12 patients received a total of 20 infiltrations of either botulinum toxin or a mixture of corticosteroid and local anesthetic. We compared the visual analogue scale (VSA) and "Neck Disability Index" (NDI) before and after the procedure. Considering the main outcome a statistically significant reduction of the VSA, as well as an improvement of the NDI. A secondary outcome was to compare the efficacy of the use of Botulinum toxin vs corticosteroid in terms of pain reduction and duration of the effect.Statistical analysis was through a t-test for paired samples.*Results All patients completed a minimum of 4 months follow-up period after the procedure.Statistical analysis showed a significant reduction of the VSA score after infiltration as well as a reduction of the NDI scale. There was a significant difference in the average of the VSA scores before and 7 days after the procedure ((p < 0.001)) with an average reduction of 4.9 points (95% CI [3.7, 6.1]), the mean duration of the effect was 3.4 months. There was also an important difference between the averages of NDI before and after the infiltrations (p < 0.001), with an average reduction of 24.5% after the procedure (95% CI [17.4, 31.5]).No statistical difference was found between the use of botulinum toxin or a corticosteroid mixture in terms of pain reduction or duration of the effect.*Conclusions US-guided infiltrations of the GON are a temporary yet effective way to manage cervical pain in patients with occipital neuralgia and should be considered among the therapeutic options when treating these patients.*Clinical Relevance/Application Minimally invasive procedures like US-guided infiltrations should be considered among the basic tools of every radiologist, demonstrating the role of the specialist not only in the diagnosis but also in the treatment of different and sometimes difficult to treat pathologies like Occipital neuralgia.

RESULTS

All patients completed a minimum of 4 months follow-up period after the procedure.Statistical analysis showed a significant reduction of the VSA score after infiltration as well as a reduction of the NDI scale. There was a significant difference in the average of the VSA scores before and 7 days after the procedure ((p < 0.001)) with an average reduction of 4.9 points (95% CI [3.7, 6.1]), the mean duration of the effect was 3.4 months. There was also an important difference between the averages of NDI before and after the infiltrations (p < 0.001), with an average reduction of 24.5% after the procedure (95% CI [17.4, 31.5]).No statistical difference was found between the use of botulinum toxin or a corticosteroid mixture in terms of pain reduction or duration of the effect.

CLINICAL RELEVANCE/APPLICATION

Minimally invasive procedures like US-guided infiltrations should be considered among the basic tools of every radiologist, demonstrating the role of the specialist not only in the diagnosis but also in the treatment of different and sometimes difficult to treat pathologies like Occipital neuralgia.

SSMK10-6   Image-guided Corticosteroid Injections For Musculoskeletal Pain During The Recovery Phases And Incidence Of Symptomatic COVID-19 Infections: A Prospective Observational Study

Participants
Joao Rafael Vicentini, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Prior studies have shown no higher symptomatic COVID-19 infection in patients who received image-guided corticosteroid injections for musculoskeletal pain compared to the general population during the lockdown period. In the initial recovery period, when exposure to the virus is potentially higher, vaccination has not yet become available, and variants are developing, the risk of COVID-19 infection is presumably higher. The purpose of this study was to determine the incidence of symptomatic COVID-19 infection in patients receiving image-guided corticosteroid injections for musculoskeletal pain compared to the general population during the recovery period. We hypothesized that corticosteroid injection would not increase the risk of symptomatic COVID-19 infections.*Methods and Materials In this prospective study, adult patients undergoing image-guided corticosteroid injection for pain management between April 15 and December 26, 2020, were consecutively enrolled. Subjects were followed for a minimum of

28 days after their injection by electronic medical record (EMR), and if no records were available, by direct phone call to the patient, to screen for COVID-19-related symptoms or history of SARS-COV2 RT-PCR testing.*Results A total of 2123 steroid injections were performed in 1885 adult patients. Follow-up was available for 1696 (90%) of the patients, 885 (52%) females, and 811 (48%) males, ages 59 ± 15 (19-97) years. For 1225 (72%), follow-up was performed by EMR search and 471 (28%) by phone survey, performed 99 ± 33 (28-139) days after the injection. Thirty-nine (39/1696, 2.3%; 95% CI 1.6-3.1%) positive cases were identified. During the same period, 262,966 positive cases were documented among the general population in the state (262,966/6,892,503, 3.8%). The incidence of COVID-19 among corticosteroid injection patients was lower than the general population (p=0.0014). A sub-group of 181 patients, which had at least two injections during the study period, had a higher COVID-19 infection rate than the single injection group, but this difference was not statistically significant (p=0.4).*Conclusions Image-guided corticosteroid injections for pain management performed during the recovery period and prior to general vaccination was not associated with increased rates of COVID-19 infection compared to the general population.*Clinical Relevance/Application Musculoskeletal pain can be debilitating for a significant portion of the population, for which image-guided corticosteroid injections are an important treatment option. This study suggests that injections performed during the recovery phases of the COVID-19 pandemic do not carry an increased risk of symptomatic COVID-19 infection and are safe to perform.

RESULTS

A total of 2123 steroid injections were performed in 1885 adult patients. Follow-up was available for 1696 (90%) of the patients, 885 (52%) females, and 811 (48%) males, ages 59 ± 15 (19-97) years. For 1225 (72%), follow-up was performed by EMR search and 471 (28%) by phone survey, performed 99 ± 33 (28-139) days after the injection. Thirty-nine (39/1696, 2.3%; 95% CI 1.6-3.1%) positive cases were identified. During the same period, 262,966 positive cases were documented among the general population in the state (262,966/6,892,503, 3.8%). The incidence of COVID-19 among corticosteroid injection patients was lower than the general population (p=0.0014). A sub-group of 181 patients, which had at least two injections during the study period, had a higher COVID-19 infection rate than the single injection group, but this difference was not statistically significant (p=0.4).

CLINICAL RELEVANCE/APPLICATION

Musculoskeletal pain can be debilitating for a significant portion of the population, for which image-guided corticosteroid injections are an important treatment option. This study suggests that injections performed during the recovery phases of the COVID-19 pandemic do not carry an increased risk of symptomatic COVID-19 infection and are safe to perform.

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Abstract Archives of the RSNA, 2021

Sub-Events

SPR-MK-10   Prediction Of Osteoporosis Using Radiomics Analysis Derived From Single Source Dual Energy CT

Participants
Jinling Wang, Changsha, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate a radiomics model based on the monochromatic imaging of dual-energy CT for osteoporosis prediction.*Methods and Materials 124 patients underwent both single source dual-energy CT and QCT lumbar examination were enrolled in a study cohort including training datasets (n = 86 [44 normal bone mineral density ,19 low bone mineral density and 23 osteoporosis]) and validation datasets (n = 38 [19 normal bone mineral density ,8 low bone mineral density and 11 osteoporosis]). 129 radiomics features were extracted from 70-kev monochromatic CT images. Top important radiomics signatures were built by using the least absolute shrinkage and selection operator method on the basis of reproducible features. A radiomics model was constructed by incorporating the radiomics signatures and significant clinical parameters using multivariate logistic regression analysis. Prediction performance of radiomics analysis was calculated using diagnostic test and comparison of area under the receiver operating characteristic (AUC) curve performed between training and validation cohorts.*Results The 16 selected radiomics signature features showed good performance in both training (AUC, 0.997) and validation (AUC, 0.978) cohorts. The radiomics model, which incorporated the radiomics signatures and two significant clinical predictors (age and BMI), also showed good prediction performance (AUC, 0.999 in training cohort and 0.986 in validation cohort). The prediction performance of the radiomics analysis model to diagnose osteoporosis from normal, low bone mineral density patients in the training and validation cohorts showed high accuracy of 98.8% in the training cohort and 94.7% in the validation cohort.*Conclusions Prediction performance of osteoporosis using radiomics analysis model derived from single source dual energy CT showed high validity with more than 94% accuracy.*Clinical Relevance/Application Our proposed model can serve as a useful tool for osteoporosis prediction and has the potential to be applied in clinical treatment planning in the future.

RESULTS

The 16 selected radiomics signature features showed good performance in both training (AUC, 0.997) and validation (AUC, 0.978) cohorts. The radiomics model, which incorporated the radiomics signatures and two significant clinical predictors (age and BMI), also showed good prediction performance (AUC, 0.999 in training cohort and 0.986 in validation cohort). The prediction performance of the radiomics analysis model to diagnose osteoporosis from normal, low bone mineral density patients in the training and validation cohorts showed high accuracy of 98.8% in the training cohort and 94.7% in the validation cohort.

CLINICAL RELEVANCE/APPLICATION

Our proposed model can serve as a useful tool for osteoporosis prediction and has the potential to be applied in clinical treatment planning in the future.

SPR-MK-11   Deep Learning-based Metal Artifact And Noise Reduction In The Lumbar Spine CT

Participants
Hyoung In Choi, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the performance of deep learning (DL)-based metal artifact reduction (MAR) and denoising technique to enhance the image quality of the postoperative lumbar spine CT.*Methods and Materials The training set consisted of 15800 image pairs from 200 spine CTs without a prosthesis. We simulated images with metal artifacts through sinogram handling. A convolutional neural network (CNN) with an encoder-decoder structure was developed for MAR. We then applied DL-based denoising using U-net-based CNN, trained to generate denoised images from simulated noise-added images. For the test set, we used 50 spine CTs from patients with spinal instrumentation. For quantitative evaluation, the mean attenuation at the most hypodense artifacts, the area of the hyperdense artifacts within the spinal canal, the standard deviation of HU within the dural sac were calculated in the original, MAR for orthopedic implants (O-MAR), and DL images. For qualitative analysis, images were rated with a 5-point scale regarding the visualization of the dural sac, conspicuity of the posterior vertebral cortex, and bone-metal interface.*Results The metal artifacts were the most reduced in DL images, whereas the O-MAR introduced new hyperdense artifacts within the spinal canal. The mean attenuation at the most hypodense artifacts was -337 HU, -71 HU, and 6 HU (P < .001), and the mean area of hyperdense artifacts within the spinal canal was 68 mm2, 97 mm2, and 22 mm2 (P < .001) for original, O-MAR, and DL images, respectively. DL-based images (117 HU) showed a significant reduction of noise than original images (141 HU; P < .001), but there was no significant difference compared with O-MAR (127 HU; P = .23). In qualitative analysis, DL images showed better visualization of the dural sac, posterior vertebral cortex, and bone-metal interface compared to original and O-MAR images (P < .001). O-MAR caused bone deletion in many cases, worsening visualization of cortical bone compared to original and DL images (P < .001).*Conclusions The DL-based technique showed excellent MAR and denoising performance with the improved image quality of the postoperative lumbar spine CT.*Clinical Relevance/Application Deep learning can effectively reduce metal artifacts and noise in the postoperative spine CT, hence enabling its use in the diagnosis of postoperative complications of spinal instrumentation surgery.

RESULTS

The metal artifacts were the most reduced in DL images, whereas the O-MAR introduced new hyperdense artifacts within the spinal canal. The mean attenuation at the most hypodense artifacts was -337 HU, -71 HU, and 6 HU (P < .001), and the mean area of hyperdense artifacts within the spinal canal was 68 mm2, 97 mm2, and 22 mm2 (P < .001) for original, O-MAR, and DL images, respectively. DL-based images (117 HU) showed a significant reduction of noise than original images (141 HU; P < .001), but there was no significant difference compared with O-MAR (127 HU; P = .23). In qualitative analysis, DL images showed better visualization of the dural sac, posterior vertebral cortex, and bone-metal interface compared to original and O-MAR images (P < .001). O-MAR caused bone deletion in many cases, worsening visualization of cortical bone compared to original and DL images (P < .001).

CLINICAL RELEVANCE/APPLICATION

Deep learning can effectively reduce metal artifacts and noise in the postoperative spine CT, hence enabling its use in the diagnosis of postoperative complications of spinal instrumentation surgery.

SPR-MK-12   To Evaluate the Role Of 18f-fdg PET/CT In Determining The Disease Burden And Its Impact On Anti Tuberculous Treatment

Participants
Sikandar Shaikh, DMRD, Hyderabad, India (*Presenter*) Nothing to Disclose

PURPOSE

Tubercular arthritis is one of the most common and important arthritis after osteoarthritis in Indian subcontinent. We evaluated the role of the whole body 18F-FDG PET/CT to evaluate the extent of the disease, disease burden and response to Anti tuberculosis treatment*Methods and Materials We evaluated Forty five patients with diagnosed tubercular arthritis . PET-CT was done in all these patients in pretreatment scenarios .Whole body 18F FDG PET/CT scan was done before and after anti-tubercular treatment, PET/CT scans were before starting anti tuberculous treatment and also done at 2 months and 6 months after starting the antituberculous treatment . Depending on the various stages of the metabolic response to the treatment, PET-CT scans were further categorized into complete metabolic response(CR), partial metabolic response(PR), Stable disease(SD) and Progressive disease(PD). CR was defined as complete disappearance of metabolic activity, PR as disappearance of activity >30% reduction in the SUVmax. Thus Stable Disease means no significant change from the baseline and PD is categorised as appearance of new lesion or >30% increase in the SUVmax.*Results mong 45 patients, median age was 41 (range, 18-63) years, and M:F-1.3:1. Other than pain in the particular joints Whole body 18F FDG PET/CT revealed additional lymph nodes other than the primary diseases in Hip, Knee and upper extremity in all the patients with (average SUVmax- 6.4, size-16mm),24 patients with mediastinal lymph-nodes (average SUVmax- 5.3, size-16mm in size), 16 patients with abdominal lymph-nodes (average SUVmax- 4.3, size-15mm). Overlapping of these regions were seen due to various other pathologies were noted in12 patients, cervico-mediastinal region in 10 patients and mediastinal-abdominal regions in 12 patients. Additional findings such as Potts spine, lung involvement, liver to splenic reversal, bone marrow activation, psoas abscess were also noted. Post treatment Follow up was done after 2nd month of starting anti tubercular treatment(ATT) in 24 patients and 6 month of anti tubercular treatment in 16 out of 45 patients. After 2 months of ATT, 2 patients had CR, 20 had PR, 2 had progression. After 6 months of ATT, 1 patients had CR, 5 PR, 2 PD.*Conclusions Thus 18-F-FDG-PET/CT plays an important role in eliciting actual disease burden in systemic tubercular arthritis.*Clinical Relevance/Application PET-CT plays an important role in the evaluation of tuberculous arthritis.

RESULTS

mong 45 patients, median age was 41 (range, 18-63) years, and M:F-1.3:1. Other than pain in the particular joints Whole body 18F FDG PET/CT revealed additional lymph nodes other than the primary diseases in Hip, Knee and upper extremity in all the patients with (average SUVmax- 6.4, size-16mm),24 patients with mediastinal lymph-nodes (average SUVmax- 5.3, size-16mm in size), 16 patients with abdominal lymph-nodes (average SUVmax- 4.3, size-15mm). Overlapping of these regions were seen due to various other pathologies were noted in12 patients, cervico-mediastinal region in 10 patients and mediastinal-abdominal regions in 12 patients. Additional findings such as Potts spine, lung involvement, liver to splenic reversal, bone marrow activation, psoas abscess were also noted. Post treatment Follow up was done after 2nd month of starting anti tubercular treatment(ATT) in 24 patients and 6 month of anti tubercular treatment in 16 out of 45 patients. After 2 months of ATT, 2 patients had CR, 20 had PR, 2 had progression. After 6 months of ATT, 1 patients had CR, 5 PR, 2 PD.

CLINICAL RELEVANCE/APPLICATION

PET-CT plays an important role in the evaluation of tuberculous arthritis.

SPR-MK-14   3D-UNet For Automatic Volumetric Vertebral Segmentation From Body CT Images For Opportunistic Osteoporosis Screening

Participants
Jiyoung Song, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to develop and validate a deep neural network applicable to body CT images for automatic volumetric segmentation and labeling of individual vertebrae.*Methods and Materials For model development, we retrospectively included CT images of 79 patients who underwent thin-section whole-body or torso 18F-fluorodeoxyglucose PET-CT scans. A radiologist semi-automatically segmented and labeled individual lumbar vertebrae, including body, vertebral arch, and processes. Input data was a bone mask obtained by a priori developed network that automatically segmented bony structures from body CT images with a dice similarity coefficient of 98.1 to 99.2%. 75 cases were used for 3D U-Net training, and 4 cases were used for validation to assess segmentation accuracy. The segmentation model was applied to a community-based cohort comprised of 381 individuals (women n=191, 50.4%; mean age, 60; age range, 40 to 93) who underwent a precontrast abdomen CT scan and dual-energy x-ray absorptiometry (DXA) scan on the same day. The 3D U-Net-driven volume and Hounsfield unit (HU) of individual lumbar vertebrae were clinically validated with average bone mineral density (aBMD) measured on DXA.*Results The 3D U-Net automatically segmented and labeled lumbar vertebrae with an average dice similarity coefficient of 93.4 to 97.0%. The 3D U-Net-driven average HU of lumbar area (L1-4) was 352 ± 71 and 367 ± 53 in women and men, respectively, with the lowest value at L1 and the highest at L4 (354 vs. 362, p<0.001). The annual decline of bone attenuation was 5.2 HU (95% CI, 4.6 to 5.7) in women and 1.7 HU (95% CI, 1.1 to 2.3) in men (p for interaction<0.001). Mean lumbar HU was positively correlated with lumbar aBMD (r=0.79, p<0.001). Thresholds for lumbar HU equivalent to DXA T-score -2.5 in linear regression models were 290 HU (women) and 300 HU (men), with

a sensitivity of 85% and specificity of 91% to detect DXA-based L-spine osteoporosis (T-score=-2.5; n=33, 8.7%). One unit decrease in average lumbar spine HU was associated with 9% elevated odds of DXA-based osteoporosis after adjustment for age, sex, and body mass index (adjusted OR 1.09, 95% CI 1.06 to 1.12, p<0.001).*Conclusions The 3D U-Net provided an automatic volumetric segmentation and labeling of lumbar vertebrae on body CT images. The average lumbar vertebral attenuation was well correlated to aBMD measured on DXA, and detected osteoporosis with high sensitivity and specificity. Further external validation is ongoing for generalizability.*Clinical Relevance/Application A deep neural network enables an automatic volumetric evaluation of lumbar vertebrae, potentially facilitating opportunistic osteoporosis screening on body CT images and adjunctive materialization of segmented vertebrae as virtual reality and 3D printing.

RESULTS

The 3D U-Net automatically segmented and labeled lumbar vertebrae with an average dice similarity coefficient of 93.4 to 97.0%. The 3D U-Net-driven average HU of lumbar area (L1-4) was 352 ± 71 and 367 ± 53 in women and men, respectively, with the lowest value at L1 and the highest at L4 (354 vs. 362, p<0.001). The annual decline of bone attenuation was 5.2 HU (95% CI, 4.6 to 5.7) in women and 1.7 HU (95% CI, 1.1 to 2.3) in men (p for interaction<0.001). Mean lumbar HU was positively correlated with lumbar aBMD (r=0.79, p<0.001). Thresholds for lumbar HU equivalent to DXA T-score -2.5 in linear regression models were 290 HU (women) and 300 HU (men), with a sensitivity of 85% and specificity of 91% to detect DXA-based L-spine osteoporosis (T-score=-2.5; n=33, 8.7%). One unit decrease in average lumbar spine HU was associated with 9% elevated odds of DXA-based osteoporosis after adjustment for age, sex, and body mass index (adjusted OR 1.09, 95% CI 1.06 to 1.12, p<0.001).

CLINICAL RELEVANCE/APPLICATION

A deep neural network enables an automatic volumetric evaluation of lumbar vertebrae, potentially facilitating opportunistic osteoporosis screening on body CT images and adjunctive materialization of segmented vertebrae as virtual reality and 3D printing.

SPR-MK-15 Multiparametric Analysis Of Monoexponential Diffusion-weighted Imaging, Intravoxel Incoherent Motion, And Diffusion Kurtosis Models For Differentiation Of Benign And Malignant Musculoskeletal Tumors

Participants
Sevtap Arslan, Ankara, Turkey (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic performance of monoexponential DWI, IVIM, and DK models and their combinations in differentiating benign and malignant musculoskeletal tumors.*Methods and Materials Fifty patients with benign (n= 22) and malignant (n= 28) musculoskeletal tumors were included in this prospective study. Minimum and volumetric values of ADC, DIVIM, D*, f, DK, and K were measured and compared between all benign and malignant tumors. Mean values of each parameter were measured by drawing VOI (volume of interest) including the whole tumor volume with consensus, whereas minimum values were calculated independently by two observers by calculating the arithmetical mean of measurements on ROIs (region of interest) placed on a solid enhancing area with the lowest diffusivity. Subgroup analysis was performed for non-myxoid non-chondroid, myxoid and/or chondroid tumors as well.*Results ADCmin, DIVIM-min, D*vol, Kvol, and Kmin values showed significant difference between all malignant and benign tumors (P= 0.026, 0.015, 0.045, 0.002, and 0.001, respectively). ADCmin, DIVIM-min, D*vol, Kvol, DK-min, and Kmin values showed significant difference between benign and malignant non-myxoid non-chondroid tumors (P= 0.005, 0.002, 0.013, 0.035, 0.025, and 0.002, respectively). Kmin showed the highest diagnostic performance in differentiating benign and malignant tumors with AUCs of 0.760 and 0.825 (for all tumor groups and non-myxoid non-chondroid tumor groups, respectively). No significant difference was detected in DWI-, IVIM-, and DK-derived parameters for differentiating benign and malignant myxoid and chondroid tumors.*Conclusions ADCmin, DIVIM-min, D*vol, DK-min, Kvol, and Kmin values can be used to differentiate benign and malignant musculoskeletal tumors. Our findings suggest that added value of multiparametric approach in differentiating malignant versus benign tumors is not significant.*Clinical Relevance/Application In addition to well documented contribution of ADCmin, DIVIM-min in differentiation of benign and malignant musculoskeletal tumors, we found in this study comparable diagnostic values for DK-min and Kmin. More significantly, volumetric measurements (D*vol, Kvol) appeared to be promising parameters for specific and overall tumor types, respectively.

RESULTS

ADCmin, DIVIM-min, D*vol, Kvol, and Kmin values showed significant difference between all malignant and benign tumors (P= 0.026, 0.015, 0.045, 0.002, and 0.001, respectively). ADCmin, DIVIM-min, D*vol, Kvol, DK-min, and Kmin values showed significant difference between benign and malignant non-myxoid non-chondroid tumors (P= 0.005, 0.002, 0.013, 0.035, 0.025, and 0.002, respectively). Kmin showed the highest diagnostic performance in differentiating benign and malignant tumors with AUCs of 0.760 and 0.825 (for all tumor groups and non-myxoid non-chondroid tumor groups, respectively). No significant difference was detected in DWI-, IVIM-, and DK-derived parameters for differentiating benign and malignant myxoid and chondroid tumors.

CLINICAL RELEVANCE/APPLICATION

In addition to well documented contribution of ADCmin, DIVIM-min in differentiation of benign and malignant musculoskeletal tumors, we found in this study comparable diagnostic values for DK-min and Kmin. More significantly, volumetric measurements (D*vol, Kvol) appeared to be promising parameters for specific and overall tumor types, respectively.

SPR-MK-16 Imaging Utilization Patterns For The Post-Operative Follow-up Of Extremity Soft Tissue Sarcoma In The United States

Participants
Natalia Gorelik, MD, Montreal, Quebec (*Presenter*) Research Grant, General Electric Company

PURPOSE

No consensus exists on the most appropriate surveillance approach for extremity soft tissue sarcoma, and current follow-up practices have not been characterized nationally. This study aims to define patterns of imaging utilization after resection of extremity soft tissue sarcoma in the U.S., assess for potential disparities, and evaluate temporal trends.*Methods and Materials A retrospective analysis of a national database of private payer claims data was performed to determine the utilization rate of extremity MRI, CT, and ultrasound and chest CT and radiographs in a 5-year post-operative follow-up period for patients with extremity soft tissue sarcoma. 3816 patients (52% males; 48% 65 years and older; mean follow-up of 850 days) surgically treated for extremity soft tissue sarcoma between January 2007 and December 2019 were included. Imaging utilization rates were assessed

according to patient demographics, post-operative year, and calendar year of surgery. Trends were evaluated using Cochran-Armitage and unadjusted linear regression. Generalized linear regression evaluated the effect of calendar year of surgery and patient demographics on weighted imaging rates during follow-up.*Results Weighted mean imaging exams performed in the 365 days after surgery increased from 4.63 in 2007 to 5.29 in 2019 for all chest imaging and from 1.56 to 2.30 over that period for all extremity imaging. There was a significant increasing trend in the proportion of patients with any extremity imaging (p<0.001) and chest imaging (p<0.01) in the first post-operative year during the study period. The increasing trend in chest imaging was driven by an increase in patients with one or more chest CT (p<0.01), whereas there was a decline in the proportion of patients with one or more chest radiograph (p<0.001). Over the study period, there was also a significant increase in the weighted mean number of imaging exams during the first post-operative year and for 5-years for any extremity imaging (p<0.01), and for all individual imaging types (p<0.05), except chest radiograph. Patient age, region of residence, and death during the study period were significantly associated with weighted means for all imaging types during follow-up, whereas sex, race, and year of surgery were not.*Conclusions There has been significant growth in imaging utilization for extremity soft tissue sarcoma surveillance over the course of our study period. Imaging use rates are associated with patient age and region of residence.*Clinical Relevance/Application An initial step toward evaluating the cost-effectiveness of surveillance strategies for extremity soft tissue sarcoma is understanding current trends. The data presented are foundational to future studies that can inform follow-up guidelines.

RESULTS

Weighted mean imaging exams performed in the 365 days after surgery increased from 4.63 in 2007 to 5.29 in 2019 for all chest imaging and from 1.56 to 2.30 over that period for all extremity imaging. There was a significant increasing trend in the proportion of patients with any extremity imaging (p<0.001) and chest imaging (p<0.01) in the first post-operative year during the study period. The increasing trend in chest imaging was driven by an increase in patients with one or more chest CT (p<0.01), whereas there was a decline in the proportion of patients with one or more chest radiograph (p<0.001). Over the study period, there was also a significant increase in the weighted mean number of imaging exams during the first post-operative year and for 5-years for any extremity imaging (p<0.01), and for all individual imaging types (p<0.05), except chest radiograph. Patient age, region of residence, and death during the study period were significantly associated with weighted means for all imaging types during follow-up, whereas sex, race, and year of surgery were not.

CLINICAL RELEVANCE/APPLICATION

An initial step toward evaluating the cost-effectiveness of surveillance strategies for extremity soft tissue sarcoma is understanding current trends. The data presented are foundational to future studies that can inform follow-up guidelines.

SPR-MK-17 Magnetic Resonance Fingerprinting For Multicomponent Imaging In Articular Cartilage Of Knee

Participants
Seung Eun Lee, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of magnetic resonance fingerprinting (MRF)-derived multicomponent mapping to probe temporal change in the composition of articular cartilage of the knee.*Methods and Materials In 23 osteoarthritis patients, sagittal fat-suppressed 3D fast spin-echo (FSE) sequence and 3D MRF-FISP with the hybrid radial-EPI were acquired at baseline (0M), three months (3M), and 12 months (12M). Normal cartilage, damaged cartilage, and synovial fluid were assumed as different components of the cartilage, and their fraction maps were generated with the partial volume MRF method. Total 138 focal regions were evaluated out of 6 divisions. We defined 3 groups according to cartilage changes in serial 3D FSE sequences: progressed (group A), stable abnormal (group B), and stable normal (group C). Group B and C regions were determined by division-matched selection to group A lesions. Averages with standard deviations of normal cartilage fraction (NCF), damaged cartilage fraction (DCF), and synovial fluid fraction (SFF) were obtained by drawing ROI. Two-way repeated measure ANOVA was used to reveal differences in component fractions between groups and between time-points.*Results Nine lesions were assigned to each group. In group A, NCF and DCF were decreased, while SFF was increased between 0M and 12M : NCF, DCF, and SFF - 69.3±20.4, 23.4±19.1, and 7.2±8.9% at 0M; 58.8±21.6, 19.2±19.7, and 21.2±14.8% at 12M. In group B and C, NCF, DCF, and SFF were stable throughout 3 time points. NCF and DCF were significantly higher in group C than group A and group B (P<0.05). SFF was significantly different between groups (p=0.001) and time points (p=0.003). In pairwise comparisons, SFF was different between 0M and 12M (p=0.025) and between group A and C (p=0.001).*Conclusions Multicomponent maps using MRF can demonstrate the fractional changes of normal cartilage, damaged cartilage, and synovial fluid in temporally progressing cartilage lesions.*Clinical Relevance/Application MRF-derived multicomponent maps can be used to probe fractional changes of different cartilage components in the knee.

RESULTS

Nine lesions were assigned to each group. In group A, NCF and DCF were decreased, while SFF was increased between 0M and 12M : NCF, DCF, and SFF - 69.3±20.4, 23.4±19.1, and 7.2±8.9% at 0M; 58.8±21.6, 19.2±19.7, and 21.2±14.8% at 12M. In group B and C, NCF, DCF, and SFF were stable throughout 3 time points. NCF and DCF were significantly higher in group C than group A and group B (P<0.05). SFF was significantly different between groups (p=0.001) and time points (p=0.003). In pairwise comparisons, SFF was different between 0M and 12M (p=0.025) and between group A and C (p=0.001).

CLINICAL RELEVANCE/APPLICATION

MRF-derived multicomponent maps can be used to probe fractional changes of different cartilage components in the knee.

SPR-MK-18 A Pilot Study On AI Based Kellgren-Lawrence Grading For Knee Osteoarthritis

Participants
Heewon Yoon, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To validate the diagnostic performance of an artificial intelligence model for automated Kellgren-Lawrence (KL) grading for knee osteoarthritis in a single institution.*Methods and Materials The model was trained with 54000 radiographs from the open dataset of the Osteoarthritis Initiative (OAI), using a convoluted neural network (CNN). Knee radiographs of 106 subjects (age 65.0 ± 11.8 years, 24/74 male/female, 94/93 right/left [= 187] knee split) who visited our hospital from January to June 2020 were interpreted by a musculoskeletal radiologist with 20 years' experience, serving as the reference standard; and the model's performance outlined by the sensitivity, specificity, precision, f1 score, and accuracy was assessed. Existing KL grading from real clinical practice for these patients were collected; and the model's grading, KL grading noted in real clinical practice, and the reference standard were

all compared.*Results The model achieved testing performance (sensitivity 0.818, specificity 0.938, precision 0.810, f1 score 0.811, accuracy 0.918). KL grading agreement between clinical practice and reference standard was at a kappa value of 0.82 (0.79-0.85) while agreement between the model and the reference standard was 0.93 (0.92-0.94).*Conclusions The results show that classification by this model was comparable to that of models published in the recent studies related to automated KL grading. Furthermore, this fully automated model appears to yield repeatable results at the level of human experts, superior to the KL grading of various human readers for knee osteoarthritis.*Clinical Relevance/Application Model could enhance the diagnostic accuracy and repeatability for knee osteoarthritis grading in clinical practice.

RESULTS

The model achieved testing performance (sensitivity 0.818, specificity 0.938, precision 0.810, f1 score 0.811, accuracy 0.918). KL grading agreement between clinical practice and reference standard was at a kappa value of 0.82 (0.79-0.85) while agreement between the model and the reference standard was 0.93 (0.92-0.94).

CLINICAL RELEVANCE/APPLICATION

Model could enhance the diagnostic accuracy and repeatability for knee osteoarthritis grading in clinical practice.

SPR-MK-19 T2-mapping MRI Evaluation Of Patellofemoral Cartilage In Patients Submitted To Intra-articular Platelet-rich-plasma (PRP) Injections

Participants
Flavia Cobianchi Bellisari, MD, Laquila, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the ability of T2 mapping magnetic resonance imaging (MRI) at 3T, in addition to morphological sequences, to assess efficacy of platelet-rich plasma (PRP) injections, characterizing qualitatively and quantitatively the grade of knee cartilage repair in patients with patellofemoral chondropathy.*Methods and Materials We retrospectively studied 34 patients (22 men, 12 women, mean age 41.8 years) with patellofemoral knee chondropathy, who underwent intra-articular PRP injections and completed a clinical and instrumental follow-up. As control group we evaluated 34 patients, matching pairwise for age, sex, BMI, chondropathy severity, who underwent conservative treatment. All patients were submitted to clinical (using VAS and WOMAC index) and imaging studies at 3T magnetic resonance (MR) including T2 mapping sequences for cartilage analysis at baseline and up to 12 months after treatment.*Results In the study group, mean pre-treatment T2 relaxation time values were 44.2±2.5ms, considering all articular cartilage compartments, with significant reduction at the follow-up (p<0.001). At the index compartment, mean pre-treatment T2 relaxation times values were 47.8±3.6ms, with statistically significant reduction at the follow-up (p<0.001). Evaluation of focal cartilage lesions reported pre-treatment mean T2 values of 70.1±13.0 ms and post-treatment mean values of 59.9±4.6ms (p<0.001). From a clinical point of view, the pre-treatment WOMAC and VAS scores were 18.3±4.5 and 7 (IQR:6-7.2), respectively; the post-treatment values were 7.3±3.2 and 2 (IQR: 1.7-3.0), respectively (p<0.001). In the control group, despite clinical improvement, we didn't find significant T2 values change during the follow-up period.*Conclusions T2 mapping is a valuable indicator for chondropathy and treatment-related changes over time.*Clinical Relevance/Application Our results confirm the positive clinical effect of PRP in patients affected by patellofemoral knee chondropathy. In addition to morphological sequences, 3T MRI with T2 mapping is a valuable tool for the evaluation of cartilage water content and thus PRP injections efficacy. Further, characterization of the cartilage matrix integrity with T2 mapping may help in the prevention of disease progression by enabling the identification of individuals with early osteoarthritis who may benefit from treatment before irreversible morphologic changes occur.

RESULTS

In the study group, mean pre-treatment T2 relaxation time values were 44.2±2.5ms, considering all articular cartilage compartments, with significant reduction at the follow-up (p<0.001). At the index compartment, mean pre-treatment T2 relaxation times values were 47.8±3.6ms, with statistically significant reduction at the follow-up (p<0.001). Evaluation of focal cartilage lesions reported pre-treatment mean T2 values of 70.1±13.0 ms and post-treatment mean values of 59.9±4.6ms (p<0.001). From a clinical point of view, the pre-treatment WOMAC and VAS scores were 18.3±4.5 and 7 (IQR:6-7.2), respectively; the post-treatment values were 7.3±3.2 and 2 (IQR: 1.7-3.0), respectively (p<0.001). In the control group, despite clinical improvement, we didn't find significant T2 values change during the follow-up period.

CLINICAL RELEVANCE/APPLICATION

Our results confirm the positive clinical effect of PRP in patients affected by patellofemoral knee chondropathy. In addition to morphological sequences, 3T MRI with T2 mapping is a valuable tool for the evaluation of cartilage water content and thus PRP injections efficacy. Further, characterization of the cartilage matrix integrity with T2 mapping may help in the prevention of disease progression by enabling the identification of individuals with early osteoarthritis who may benefit from treatment before irreversible morphologic changes occur.

SPR-MK-21 Gender And Age Related Changes In Bone Density, Fat, And Perfusion By DCE-MRI

Participants
Wing Pong Chan, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose

PURPOSE

Older women are at greater risk for osteoporosis and fragility fractures compared to men. There is little information with regards to the bone marrow composition changes that occur in aging men. The present study aims to investigate the differences in vertebral bone mineral density (BMD), fat, and blood perfusion between men and women of different ages.*Methods and Materials We prospectively recruited 120 healthy volunteers with BMI ?30kg/cm2. All participants were grouped by sex and age (20 ~ 34, 35 ~ 49, 50 ~ 64, and ?65). Axial MRI images at the L1 vertebral body level were obtained using a T1-weighted 3D spoiled gradient echo sequence and a gradient-echo fast low angle shot sequence (temporal resolution, 2s; total scan time, 7m 20s). We measured proton density fat fraction (PDFF), enhancement maximum (Emax), Ktrain, Kep, Ve, and Cmax. The data were analyzed using repeated-measures ANOVA. BMD was obtained by Dual-energy X-ray absorptiometry (DXA) scan.*Results Vertebral marrow perfusion (Emax) was highest in the 35-49 age group and was consistently higher in females than in males across all age groups. In women, BMD negatively correlated with PDFF though positively correlated with Emax in four of the age groups. BMD and Emax were significantly lower in the older group (>=65) compared to the two younger groups (20~34 and 35~49) (p<0.0001). PDFF values were also significantly higher in the older group compared to the younger groups. Men across all age groups showed no significant differences in BMD and PDFF (all comparisons yielded p>0.05). Emax, Ve, and Cmax values were however significantly lower in older men compared to men in the two younger groups.*Conclusions In women, BMD decreased with age, while PDFF increased with age.

For both men and women, Emax levels were the lowest in the older group. Older men also showed drops in Ve and Cmax. Therefore, it appears that the aging of bone in women is marked by structural losses and composition changes, while the aging of bone in men is marked more by perfusion abnormalities. Emax is the only measurement that can identify aging bone in both genders.*Clinical Relevance/Application Postmenopausal women are different from men in terms of vertebral marrow perfusion, fat and bone mineral density relationships. Emax is the only measurement that can identify aging bone in both genders.

RESULTS

Vertebral marrow perfusion (Emax) was highest in the 35-49 age group and was consistently higher in females than in males across all age groups. In women, BMD negatively correlated with PDFF though positively correlated with Emax in four of the age groups. BMD and Emax were significantly lower in the older group (>=65) compared to the two younger groups (20~34 and 35~49) (p<0.0001). PDFF values were also significantly higher in the older group compared to the younger groups. Men across all age groups showed no significant differences in BMD and PDFF (all comparisons yielded p>0.05). Emax, Ve, and Cmax values were however significantly lower in older men compared to men in the two younger groups.

CLINICAL RELEVANCE/APPLICATION

Postmenopausal women are different from men in terms of vertebral marrow perfusion, fat and bone mineral density relationships. Emax is the only measurement that can identify aging bone in both genders.

SPR-MK-26 High Contrast Cartilaginous Endplate Imaging Using A 3D Adiabatic Inversion Recovery Prepared Fat Saturated Ultrashort Echo Time (3D IR-FS-UTE) Sequence

Participants
Alecio Lombardi, MD, San Diego, California (*Presenter*) Nothing to Disclose

PURPOSE

To describe a 3D adiabatic inversion recovery fat-saturated ultrashort echo time (3D-IR-FS-UTE) MR sequence to highlight the cartilaginous endplate (CEP) of vertebral bodies.*Methods and Materials The 3D IR-FS-UTE sequence uses an adiabatic inversion pulse (hyperbolic secant type 1, duration = 8.64 ms, bandwidth = 1.15 kHz) centered in a frequency between water and fat to invert the longitudinal magnetization of long T2 tissues like the intervertebral disc (IVD), while only partially inverting the longitudinal magnetization of short T2 tissues like the CEP (1). A FatSat module is used to suppress fat from the bone marrow. After appropriate inversion recovery time (TI) to null long T2 tissues' signals, data acquisition starts detecting short T2 tissues' signals. A train of spokes is used to accelerate the scan. A slab-selective half pulse (Shinnar-Le Roux design, duration = 1132 µs, bandwidth = 16 kHz) with variable-rate selective excitation design (2) is used for signal excitation and a 3D cones trajectory is used to reduce sampling time. To investigate T1 variations among the CEP, annulus fibrosus (AF), and nucleus pulposus (NP), T1 relaxations were measured with the 3D UTE actual flip angle and variable flip angle method (UTE-AFI-VFA) (3) in a human cadaveric spine, that was later fixed and sliced for histology. Six healthy volunteers and three patients with back pain underwent T1w-FSE, T2w-FSE, and 3D IR-FS-UTE spine MRI. Contrast-to-noise ratios (CNR) between the CEP and BF and between the CEP and IVD were calculated as differences in signal divided by background noise.*Results The 3D UTE-AFI-VFA method showed a T1 of 360±12 ms in the CEP, 570±21 ms in the AF, and 870±28 ms in the NP. High CEP contrast was achieved with TIs ranging from 480 to 640 ms. The CEP was detected on the 3D IR-FS-UTE but not on the T1w- or T2w-FSE. A CEP fracture in the spine sample with NP herniation through the focal defect, later confirmed on histology, was only detected on the 3D IR-FS-UTE. CEP abnormalities such as reduced thickness, focal erosions, fractures, and fragmentation were observed among patients. The mean CNRs between the CEP and BF, and between the CEP and IVD for all six volunteers were 18.5±4.9 and 20.3±4.15, respectively.*Conclusions The 3D IR-FS-UTE MRI sequence can image the CEP with high contrast in healthy volunteers and patients with traumatic and degenerative spinal changes.*Clinical Relevance/Application The 3D IR-FS-UTE sequence allows for early detection of CEP abnormalities and can be applied in the study of the mechanisms involved in IVD degeneration and low back pain. 1. Magn Res Med. 2007;58(5):952-61; 2. Magn Res Med. 2004;52(3):590-7; 3 Magn Res Med. 2019;81(3):1634-44.

RESULTS

The 3D UTE-AFI-VFA method showed a T1 of 360±12 ms in the CEP, 570±21 ms in the AF, and 870±28 ms in the NP. High CEP contrast was achieved with TIs ranging from 480 to 640 ms. The CEP was detected on the 3D IR-FS-UTE but not on the T1w- or T2w-FSE. A CEP fracture in the spine sample with NP herniation through the focal defect, later confirmed on histology, was only detected on the 3D IR-FS-UTE. CEP abnormalities such as reduced thickness, focal erosions, fractures, and fragmentation were observed among patients. The mean CNRs between the CEP and BF, and between the CEP and IVD for all six volunteers were 18.5±4.9 and 20.3±4.15, respectively.

CLINICAL RELEVANCE/APPLICATION

The 3D IR-FS-UTE sequence allows for early detection of CEP abnormalities and can be applied in the study of the mechanisms involved in IVD degeneration and low back pain. 1. Magn Res Med. 2007;58(5):952-61; 2. Magn Res Med. 2004;52(3):590-7; 3 Magn Res Med. 2019;81(3):1634-44.

SPR-MK-27 Percutaneous Ultrasound Guided Needle Tenotomy For Treatment Of Chronic Tendinopathy: A Systematic Review And Meta-analysis

Participants
Firoozeh Shomal Zadeh, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

To systematically assess the efficacy of Percutaneous Ultrasound Guided Needle Tenotomy (PUNT) in the treatment of chronic tendinopathy.*Methods and Materials A literature search was conducted with the following search terms: Tendinopathy, Tenotomy, Needling, Tenex, Fasciotomy, Ultrasound guided, Percutaneous. Inclusion criteria consisted of original studies that assessed the pain and disability improvement using Visual Analog Scale (VAS), or Disability of the Arm, Shoulder and Hand (DASH) Index after PUNT. Cochrane Collaboration's tool was used to assess methodological quality assessment. Meta-analyses were performed and compared pain and disability improvement in three different time points.*Results Twenty-one studies with a total of 806 subjects were included in the meta-analysis. According to our meta-analysis, PUNT significantly alleviated pain and disability. Our baseline mean VAS was 6.26 (95% CI: 5.86-6.68) with improvement of 3.8 (95% CI: 3.23 - 4.32; P<0.001), 3.95 (95% CI: 2.98-4.92; P<0.001), and 4.56 (95% CI: 4.06-5.06; P<0.001) points in the first 3 months, 6 months, and long-term follow-up (12.6±1.8 months), respectively. PUNT is also associated with marked reductions in DASH score (24.7 [95% CI: 22.8-26.5; P<0.001]) in long-term follow-up (11.3±1.3 months). The most significant improvement in VAS and DASH scores was through the first 3 months of

follow-up. The mean difference of VAS (1.03 [95% CI: -0.907-2.970; P= 0.29]) and DASH score (3.19 [95% CI: -1.22-7.60; P=0.156]) after this period (3 months) was not significant.*Conclusions PUNT could significantly improve pain and function scores related to chronic resistant tendinopathy. The improvement was more significant during the short-term follow-up. PUNT could be considered as a suitable nonsurgical option for the treatment of chronic tendinopathy. Additionally, the included studies showed overall positive outcome for life quality, patient satisfaction, and sonographic findings.*Clinical Relevance/Application PUNT could be a less invasive and cost-effective substitute for surgical intervention in treatment of resistant chronic tendinopathies.

RESULTS

Twenty-one studies with a total of 806 subjects were included in the meta-analysis. According to our meta-analysis, PUNT significantly alleviated pain and disability. Our baseline mean VAS was 6.26 (95% CI: 5.86-6.68) with improvement of 3.8 (95% CI: 3.23 - 4.32; P<0.001), 3.95 (95% CI: 2.98-4.92; P<0.001), and 4.56 (95% CI: 4.06-5.06; P<0.001) points in the first 3 months, 6 months, and long-term follow-up (12.6±1.8 months), respectively. PUNT is also associated with marked reductions in DASH score (24.7 [95% CI: 22.8-26.5; P<0.001]) in long-term follow-up (11.3±1.3 months). The most significant improvement in VAS and DASH scores was through the first 3 months of follow-up. The mean difference of VAS (1.03 [95% CI: -0.907-2.970; P= 0.29]) and DASH score (3.19 [95% CI: -1.22-7.60; P=0.156]) after this period (3 months) was not significant.

CLINICAL RELEVANCE/APPLICATION

PUNT could be a less invasive and cost-effective substitute for surgical intervention in treatment of resistant chronic tendinopathies.

SPR-MK-3 Enthesis Assessment Using Ultrashort Echo Time Magnetic Resonance Imaging (UTE-MRI) Adiabatic T1 (UTE-Adiab-T1) And Magnetization Transfer (MT) Modeling

Participants
Saeed Jerban, PhD, San Diego, California (Presenter) Nothing to Disclose

PURPOSE

To determine if ultrashort echo time MRI (UTE-MRI) techniques (magnetization transfer (MT) modeling and adiabatic T1? (UTE-Adiab-T1?)) can detect the compositional differences between Achilles tendon and enthesis.*Methods and Materials Eight normal human cadaveric ankle specimens (52±18 years old) were imaged with on a 3T MRI scanner (MR750, GE) employing a T/R birdcage coil on the sagittal plane. An actual variable flip angle (AFI-VFA) sequence (AFI: TE=0.032ms, TRs=20,100ms, FA=45°; VFA: TE=0.032ms, TR=20ms, FAs=5, 10, 20, 30°) was performed to measure T1(1). A 3D-UTE-Cones-MT sequence (pulse power=400, 600, and 800°; frequency offset=2, 5, 10, 20, and 50kHz) was performed for the two-pool MT modeling (2,3). Additionally, a set of 3D UTE-Adiab-T1? sequences with 5 different spin-locking times (TSLs) (TR=500ms, TSL= 0, 12, 24, 36, and 48 ms) were performed (4). Field of view, matrix dimension, pixel size, slice thickness, and total scan time were 11cm, 340×340, 0.8mm, and 100 mins, respectively.For each specimen, average macromolecular proton fraction (MMF) was estimated using MT modeling performed on two sagittal slices 3 mm apart. T1 and UTE-Adiab-T1? values were calculated for each specimen using a single-component exponential fitting model. Measurements were performed within three regions of interest (ROIs) including enthesis, tendon, and the transition region between tendon and enthesis. Student's t-test was used to compare the calculated MRI markers between the three selected ROIs. P-values <0.05 were considered significant. . Data analysis was performed in MATLAB (2018, The Mathworks Inc., MA).*Results Fig.1A shows schematically the representative ROIs selected on a UTE-Adiab-T1? image performed on the sagittal plane. Estimated MMF and T1? values in the studied ROIs are presented in Fig.1B and 1C, respectively. MMF was significantly lower in enthesis compared with Achilles tendon, while T1? was significantly higher in enthesis compared with the tendon. Fig.1D and 1E illustrate representative MMF and T1? pixel maps, respectively, for a 62-year-old female donor.*Conclusions This study highlighted the UTE-MT modeling and UTE-Adiab-T1? technique as useful quantitative methods to assess enthesis and tendon. Significantly lower MMF and higher T1? may suggest lower macromolecular contents (i.e., collagen and proteoglycan) in enthesis compared with the tendon. Future studies will be required to investigate the correlations between our MRI biomarkers and the tissues' mechanical and histological properties.*Clinical Relevance/Application UTE-MRI-based techniques which can distinguish between entheses and tendons, and detect their changes, may help diagnose musculoskeletal diseases sooner and more specifically.

RESULTS

Fig.1A shows schematically the representative ROIs selected on a UTE-Adiab-T1? image performed on the sagittal plane. Estimated MMF and T1? values in the studied ROIs are presented in Fig.1B and 1C, respectively. MMF was significantly lower in enthesis compared with Achilles tendon, while T1? was significantly higher in enthesis compared with the tendon. Fig.1D and 1E illustrate representative MMF and T1? pixel maps, respectively, for a 62-year-old female donor.

CLINICAL RELEVANCE/APPLICATION

UTE-MRI-based techniques which can distinguish between entheses and tendons, and detect their changes, may help diagnose musculoskeletal diseases sooner and more specifically.

SPR-MK-4 Prediction Of Compression Fracture In Multiple Myeloma Patients Using CT Measures Of Muscle Mass And Density

Participants
Sanghee Kim, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose

PURPOSE

To evaluate muscle area and muscle density on abdominal CT as predictors for compression fractures and survival in multiple myeloma patients.*Methods and Materials Patients with multiple myeloma who underwent abdomen CT between 2010 and 2019 were retrospectively included. The muscle area was semi-automatically segmented from an axial CT at the L3 lower endplate level. Muscle density was defined as the mean Hounsfield unit (HU) of segmented muscle mass. Additionally, age, body mass index (BMI), bone density measured on the vertebral body of L1 on CT, and international staging system (ISS) were considered for variables. Compression fracture and death were primary and secondary endpoints, respectively. Univariate survival analysis with Kaplan-Meyer (KM) plots was performed on each variable. Multivariate Cox proportional hazards models using different combinations of variables were developed and compared using the concordance index (C-index).*Results A total of 361 patients were included (mean age ± SD, 65.3 ± 9.49 years; 191 men and 170 women). On analysis of KM plots after each variable dichotomized by z-score, muscle area and muscle density were significant factors for the compression fracture (P=0.003, P<0.001). In contrast, ISS and muscle density were significant factors for the survival (P<0.001, P=0.02). Multivariate Cox proportional hazards models revealed that ISS and

muscle density were independent factors to predict compression fractures (P=0.002, P<0.001), and survival (P=0.001, P<0.001). There were significant differences in C-index between the base model, including age, BMI, bone density, and the models with additional variables (P<0.001) : base model (0.564, 95 % confidence interval (CI): 0.508-0.619), base model+muscle density (0.642, 95 % CI 0.591-0.693), base model+muscle area (0.637, 95 % CI 0.589-0.686), base model+muscle density+muscle area (0.648,95 % CI 0.599-0.697).*Conclusions Muscle density obtained from abdomen CT was an independent predictor for compression fracture and survival in multiple myeloma patients. The models, including muscle density and muscle area, performed better than the base model for predicting compression fracture.*Clinical Relevance/Application Sarcopenia-related parameters on opportunistic abdomen CT are predictors for compression fractures and survival in multiple myeloma patients.

RESULTS

A total of 361 patients were included (mean age ± SD, 65.3 ± 9.49 years; 191 men and 170 women). On analysis of KM plots after each variable dichotomized by z-score, muscle area and muscle density were significant factors for the compression fracture (P=0.003, P<0.001). In contrast, ISS and muscle density were significant factors for the survival (P<0.001, P=0.02). Multivariate Cox proportional hazards models revealed that ISS and muscle density were independent factors to predict compression fractures (P=0.002, P<0.001), and survival (P=0.001, P<0.001). There were significant differences in C-index between the base model, including age, BMI, bone density, and the models with additional variables (P<0.001) : base model (0.564, 95 % confidence interval (CI): 0.508-0.619), base model+muscle density (0.642, 95 % CI 0.591-0.693), base model+muscle area (0.637, 95 % CI 0.589-0.686), base model+muscle density+muscle area (0.648,95 % CI 0.599-0.697).

CLINICAL RELEVANCE/APPLICATION

Sarcopenia-related parameters on opportunistic abdomen CT are predictors for compression fractures and survival in multiple myeloma patients.

SPR-MK-5　Femoral Retroversion: Intra- And Extraarticular Anterior Subspine Hip Impingement During Flexion On 3D-CT Based Impingement Simulation

Participants
Till Lerch, MD, Bern, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

Symptomatic FAI patients have limitations in hip function and sports activity. Some patients report exacerbation of hip pain with sitting or maximal flexion.But the exact location of hip impingement in sitting position is unknown. We aimed to investigate impingement-free maximal flexion, the location of the impingement conflict in maximal flexion and if impingement is located intra- or extraarticular in patients with low femoral version(FV).*Methods and Materials An IRB-approved retrospective study involving 84 hips of 68 participants was performed. Of these, 58 hips of symptomatic patients with anterior FAI were compared with 26 asymptomatic hips with no FAI and normal FV. All patients with FAI were symptomatic and had anterior hip pain and a positive anterior impingement test. They underwent pelvic CT scans to measure FV and for dynamic impingement simulation. McKibbin index was calculated adding FV and acetabular version (AV). All 84 hips were evaluated by use of CT-based 3D models and a validated 3D range of motion and impingement simulation using the equidistant method. Simulation of maximal flexion was evaluated for all patients. Asymptomatic hips were contralateral normal hips of patients undergoing total hip arthroplasty.*Results Hips with FAI had a significantly (p<0.001) lower mean impingement-free flexion of 116° compared with the asymptomatic control group (125°). In a subgroup analysis, hips with decreased McKibbin index had a lower flexion of 113°, while hips with mixed-type FAI combined with decreased McKibbin index had 110° of flexion and hips with pincer-type FAI combined with decreased McKibbin index had 112°. Patients with Low McKibbin index had a significantly higher prevalence (59%) of extraarticular subspine impingement in 125° of flexion compared to the control group (29%). Location of femoral impingement conflict in maximal flexion was anterior between 3 to 5 o clock in 115° of flexion, while in 125° of flexion, it was located anterior-inferior between 4 and 6 o clock of the hips with FAI.*Conclusions For planning hip preservation surgery, the exact location of the hip impingement conflict is essential. Based on this study, impingement conflict in sitting position was located intra- and extraarticular. Patients with Low McKibbin index combined with mixed-type FAI had the lowest impingement-free flexion. Femoral impingement location was anterior inferior in maximal flexion.*Clinical Relevance/Application Exacerbation of hip pain in sitting position is common in FAI patients. This 3D simulation has implications for planning for hip arthroscopy and enables patient-specific treatment of the impingement conflict in maximal flexion.

RESULTS

Hips with FAI had a significantly (p<0.001) lower mean impingement-free flexion of 116° compared with the asymptomatic control group (125°). In a subgroup analysis, hips with decreased McKibbin index had a lower flexion of 113°, while hips with mixed-type FAI combined with decreased McKibbin index had 110° of flexion and hips with pincer-type FAI combined with decreased McKibbin index had 112°. Patients with Low McKibbin index had a significantly higher prevalence (59%) of extraarticular subspine impingement in 125° of flexion compared to the control group (29%). Location of femoral impingement conflict in maximal flexion was anterior between 3 to 5 o clock in 115° of flexion, while in 125° of flexion, it was located anterior-inferior between 4 and 6 o clock of the hips with FAI.

CLINICAL RELEVANCE/APPLICATION

Exacerbation of hip pain in sitting position is common in FAI patients. This 3D simulation has implications for planning for hip arthroscopy and enables patient-specific treatment of the impingement conflict in maximal flexion.

SPR-MK-6　Percutaneous CT-guided Corticosteroid For The Treatment Of Langerhans Cell Histiocytosis: A Retrospective Multi-institutional Study

Participants
Connie Y. Chang, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the safety and effectiveness of CT-guided corticosteroid injection for the treatment of Langerhans Cell Histiocytosis (LCH) in a multi-institutional study.*Methods and Materials This study was IRB-approved and HIPAA-compliant at all three participating institutions. We retrospectively reviewed clinical, procedural, and imaging data for corticosteroid injections performed to treat LCH at the participating institutions. Location of the lesion and lesion maximum dimension and volume, corticosteroid type and dose, and time interval between injection and partial/complete imaging resolution and symptomatic resolution were recorded. Groups were compared using the Kruskal-Wallis and Chi-Square tests. A Generalized Estimating Equation was used to evaluate the association between size of the lesion and steroid dose (accounting for multiple lesions per subject). This analysis was adjusted by

anatomic site. *Results 40 corticosteroid injections were performed in 36 subjects (20 (56%) females, and 16 (44%) males, ages 12 ± 11 (2-57) years). All patients had pathologic confirmation for LCH. All subjects underwent one injection per lesion. If additional injections were performed in the same subject, it was for a new site of disease. Lesion maximum dimension was 3.2±1.7 cm, and volume was 10±17cm3. There were 19 (56%) and 15 (44%) lesions in the appendicular and axial skeleton, respectively. Corticosteroid (methylprednisolone, triamcinolone) dose was 73 ± 24 (40-120) mg. Larger lesions were treated with higher corticosteroid doses (p = 0.02). Imaging and clinical follow-up were available for 22/40 (55%) and 34/40 (85%) of injections, respectively. Times to partial and complete imaging resolution were 13 ± 9 and 32 ± 13 weeks, respectively, and time to pain control was 22 ± 14 weeks. There were no complications.*Conclusions CT-guided corticosteroid injection is a safe and effective treatment for LCH. Pain resolution was achieved in all patients and imaging did not show progressive disease in any of the patients.*Clinical Relevance/Application CT-guided corticosteroid injection may be considered as a first-line therapy for LCH.

RESULTS

40 corticosteroid injections were performed in 36 subjects (20 (56%) females, and 16 (44%) males, ages 12 ± 11 (2-57) years). All patients had pathologic confirmation for LCH. All subjects underwent one injection per lesion. If additional injections were performed in the same subject, it was for a new site of disease. Lesion maximum dimension was 3.2±1.7 cm, and volume was 10±17cm3. There were 19 (56%) and 15 (44%) lesions in the appendicular and axial skeleton, respectively. Corticosteroid (methylprednisolone, triamcinolone) dose was 73 ± 24 (40-120) mg. Larger lesions were treated with higher corticosteroid doses (p = 0.02). Imaging and clinical follow-up were available for 22/40 (55%) and 34/40 (85%) of injections, respectively. Times to partial and complete imaging resolution were 13 ± 9 and 32 ± 13 weeks, respectively, and time to pain control was 22 ± 14 weeks. There were no complications.

CLINICAL RELEVANCE/APPLICATION

CT-guided corticosteroid injection may be considered as a first-line therapy for LCH.

SPR-MK-7   Development And Assessment Of A Robotic Telesonography System For Musculoskeletal Imaging

Participants
Scott Adams, MD, Saskatoon, Saskatchewan (*Presenter*) Nothing to Disclose

PURPOSE

Robotic telesonography systems have been developed to help patients in rural and remote communities overcome barriers to access diagnostic ultrasound. However, most previous robotic telesonography systems have been designed for performing only abdominal and obstetrical exams. The purpose of this study was to develop and assess a robotic telesonography system for performing musculoskeletal (MSK) ultrasound exams.*Methods and Materials We developed a 4-degrees-of-freedom robot to manipulate an ultrasound probe. The robot is remotely controlled by a radiologist operating a joystick at the master site. The robotic telesonography system was used to scan participants' forearms, and all participants were also scanned conventionally for comparison. Participants and radiologists were surveyed regarding their experience. Images from robotic and conventional scanning methods were independently assessed by an MSK radiologist and visualization scores were compared using Fisher's exact test.*Results All 10 ultrasound exams were successfully performed using our developed MSK robotic telesonography system, with no significant delay in movement. The mean (±standard deviation) duration of robotic and conventional exams was 4.6 (±0.9) and 1.4 (±0.5) minutes, respectively (p = 0.039). An MSK radiologist rated quality of real-time ultrasound images transmitted over an internet connection as "very good" for all telesonography exams, and participants rated communication with the radiologist as "very good" or "good" for all exams. Visualization of anatomic structures was similar between robotic and conventional images based on the radiologist's blinded assessment. No statistically significant differences were observed in the proportion of muscles, myotendinous junctions, tendons, neurovascular bundles, and bones which were completely (adequately) documented, partially documented, or not documented based on the representative images.*Conclusions The MSK robotic telesonography system developed in this study is feasible for remotely performing soft tissue ultrasound exams. The advancement of this system may allow MSK ultrasound exams to be performed over long distances, increasing access to ultrasound for patients in rural and remote communities.*Clinical Relevance/Application The remote provision of MSK ultrasound services using robotic telesonography may increase access to specialized ultrasound imaging for patients in underserved rural and remote communities. MSK robotic telesonography may reduce time to diagnosis, improve patient experience and satisfaction, and help improve health equity in rural and remote communities.

RESULTS

All 10 ultrasound exams were successfully performed using our developed MSK robotic telesonography system, with no significant delay in movement. The mean (±standard deviation) duration of robotic and conventional exams was 4.6 (±0.9) and 1.4 (±0.5) minutes, respectively (p = 0.039). An MSK radiologist rated quality of real-time ultrasound images transmitted over an internet connection as "very good" for all telesonography exams, and participants rated communication with the radiologist as "very good" or "good" for all exams. Visualization of anatomic structures was similar between robotic and conventional images based on the radiologist's blinded assessment. No statistically significant differences were observed in the proportion of muscles, myotendinous junctions, tendons, neurovascular bundles, and bones which were completely (adequately) documented, partially documented, or not documented based on the representative images.

CLINICAL RELEVANCE/APPLICATION

The remote provision of MSK ultrasound services using robotic telesonography may increase access to specialized ultrasound imaging for patients in underserved rural and remote communities. MSK robotic telesonography may reduce time to diagnosis, improve patient experience and satisfaction, and help improve health equity in rural and remote communities.

SPR-MK-8   Diagnostic Performance Of Deep Learning Algorithm In Detecting Anterior Cruciate Ligament Tear On Lateral Knee Radiography: Focusing On Lateral Femoral Notch Sign And Joint Effusion

Participants
Jihee Kang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic performance of deep learning algorithm in detecting acute anterior cruciate ligament (ACL) tear on lateral knee radiographs.*Methods and Materials A total of 987 cropped lateral knee radiographs (661 with ACL tear and 326 normal) was divided into training (80%), validation (10%), and test sets (10%). Firstly, a single binary classifier for diagnosing ACL tear was developed (algorithm 1). Secondly, two binary classification models were developed for detecting secondary signs of ACL tears on radiograph: lateral femoral notch sign (algorithm 2) and significant amount of knee joint effusion (anteroposterior diameter

= 5mm; algorithm 3). Finally, an ensemble model using algorithm 2 and 3 to make the diagnosis of ACL tear was developed (algorithm 4). Sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV) were calculated for each algorithm.*Results Sensitivity, specificity, accuracy, PPV, and NPV were 84.85, 66.67, 78.10, 81.16, and 72.22% for algorithm 1, 77.78, 85.51, 82.86, 73.68, and 88.06% for algorithm 2, and 91.07, 77.55, 84.76, 82.26, and 88.37% for algorithm 3. In the case of ensemble model, sensitivity, specificity, accuracy, PPV, and NPV was 86.36, 74.36, 81.90, 85.07, and 76.32%, respectively. Diagnostic performance of the ensemble model was significantly higher compared to the single model (area under the curve 0.902 vs 0.753; p=0.0004).*Conclusions The deep learning algorithm could accurately make the diagnosis of ACL tear on lateral knee radiographs.*Clinical Relevance/Application The proposed deep learning algorithm can be an efficient screening tool for ACL tear, facilitating early diagnosis and timely management. It might be useful especially in the emergency department.

RESULTS

Sensitivity, specificity, accuracy, PPV, and NPV were 84.85, 66.67, 78.10, 81.16, and 72.22% for algorithm 1, 77.78, 85.51, 82.86, 73.68, and 88.06% for algorithm 2, and 91.07, 77.55, 84.76, 82.26, and 88.37% for algorithm 3. In the case of ensemble model, sensitivity, specificity, accuracy, PPV, and NPV was 86.36, 74.36, 81.90, 85.07, and 76.32%, respectively. Diagnostic performance of the ensemble model was significantly higher compared to the single model (area under the curve 0.902 vs 0.753; p=0.0004).

CLINICAL RELEVANCE/APPLICATION

The proposed deep learning algorithm can be an efficient screening tool for ACL tear, facilitating early diagnosis and timely management. It might be useful especially in the emergency department.

SPR-MK-9   A Deep Learning Method Based On Multi-model Weighted Fusion To Distinguish Benign And Malignant Spinal Tumors With Magnetic Resonance Imaging

Participants
Hong Liu, DO, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate a deep learning method (DLM) based on multi-model weighted fusion strategy for identifying benign and malignant spinal tumors with sagittal MRI, and compare with one senior radiologist (D1), one senior orthopedist (D2) and one junior orthopedist (D3).*Methods and Materials The consecutive spinal tumor patients between Jan. 2006 and Dec. 2019 from collaborating hospital were all retrospectively reviewed, especially the sagittal MRI with final pathological diagnosis. This study recruited 585 spinal tumor patients including 270 benign and 315 malignant ones (over 20 histological subtypes). All the spinal tumor patients were randomly divided into training set (n=445; 180 benign, 265 malignant) and testing set (n=140; 90 benign, 50 malignant). MRI sagittal sequences of each patient including T1-weighted image (TIWI), T2WI and fat suppression T2WI were used. A multi-model weighted fusion method including Faster-RCNN and ResNet101 was proposed. Firstly, a tri-class Faster-RCNN model was used to detect benign and malignant lesions in MRI images, and patient-level results were obtained by fusing these region detection results. Then, a two-class sequence classification model based on ResNet101 was applied to classify the former detected lesion regions to get the patient-level result of benign or malignant. Finally, above results of two models were weighted fused to get final diagnosis results. On training set, four-fold cross-validation was applied to train and validate the proposed method DLM, and the proper hyper parameters of deep models and fused weights were selected. Metrics of AUC, ACC, sensitivity, specificity and diagnosis time were used to evaluate our method.*Results On testing set, the AUC (0.787) of DLM was similar to senior radiologist (D1:0.73, p=0.3) and higher than two orthopedic doctors (D2: 0.646, p=0.01, D3: 0.682, p<0.009). The ACC (80.0%, 112 in 140) of DLM was higher than doctors' (D1:75%, D2: 66.4%, D3: 61.4%). For malignant tumor identification, DLM's specificity (83.3%) was higher than doctors' (D1: 80.0%, D2: 71.1%, D3: 44.4%), and DLM's sensitivity (74.0%) was higher than most of doctors' (D1: 66.0%, D2: 58.0%, D3: 92.0%). Although doctor D3 had higher sensitivity (92.0%), he had lower ACC (61.4%) and specificity (44.4%). To diagnose benign or malignant of each patient with MRI sequences, DLM spent average 12.45 seconds and doctor spent average 47.86 seconds.*Conclusions The proposed method is effective to identify benign and malignant spinal tumor on patient MRI dataset with complex histological subtypes, and has higher performance than radiologist and orthopedist.*Clinical Relevance/Application This framework can provide a reference for early spinal tumor assisted diagnosis.

RESULTS

On testing set, the AUC (0.787) of DLM was similar to senior radiologist (D1:0.73, p=0.3) and higher than two orthopedic doctors (D2: 0.646, p=0.01, D3: 0.682, p<0.009). The ACC (80.0%, 112 in 140) of DLM was higher than doctors' (D1:75%, D2: 66.4%, D3: 61.4%). For malignant tumor identification, DLM's specificity (83.3%) was higher than doctors' (D1: 80.0%, D2: 71.1%, D3: 44.4%), and DLM's sensitivity (74.0%) was higher than most of doctors' (D1: 66.0%, D2: 58.0%, D3: 92.0%). Although doctor D3 had higher sensitivity (92.0%), he had lower ACC (61.4%) and specificity (44.4%). To diagnose benign or malignant of each patient with MRI sequences, DLM spent average 12.45 seconds and doctor spent average 47.86 seconds.

CLINICAL RELEVANCE/APPLICATION

This framework can provide a reference for early spinal tumor assisted diagnosis.

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Participants
Grace Gang, PHD, Baltimore, Maryland (*Moderator*) Nothing to Disclose
John Boone, PhD, Sacramento, California (*Moderator*) Board of Directors, Izotropic Corporation;Shareholder, Izotropic Corporation;Co-author with royalties, Wolters Kluwer nv;Patent agreement, The Phantom Laboratory;In-kind support, Canon Medical Systems Corporation

Sub-Events

SSPH03-1 Utility Of A New Phantom For Quantitative Imaging Performance Evaluation Of CT Scanners

Participants
Mahadevappa Mahesh, PHD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Evaluation of advanced multi-detector CT (MDCT) scanners with isotropic resolution and nonlinear image reconstruction presents a challenge to current QA standards. Existing CT phantoms are not designed to quantify contrast-dependent 3D spatial resolution (MTF), noise power spectrum (NPS), or cone-beam effects (Zmod).*Methods and Materials We used a phantom (CorgiTM, The Phantom Lab) previously developed for evaluation of cone-beam CT (CBCT) - extended to 16 cm and 32 cm diameters for diagnostic MDCT - to evaluate 3D spatial resolution (MTF in axial and non-axial planes), NPS, uniformity, linearity, CNR, and cone-beam artifacts. Three MDCT systems were evaluated (Siemens Edge, Canon One, and Canon Precision) using head and body scan protocols in longitudinal studies over a period of 6 months.*Results The phantom provided objective evaluation of imaging performance via automated software and a structured report. Important characteristics were brought to light in the study that would not be captured by existing test phantoms - e.g., the contrast dependence (non-linearity) of the MTF, the (non-) isotropic nature of the 3D MTF for various reconstruction protocols, and the magnitude of cone-beam artifact (Zmod) for fully volumetric scan protocols. For example, the Precision CT exhibited protocols with varying levels of non-isotropic MTF [e.g., f10 = 1.7 mm-1 (axial) and 1.0 mm-1 (at 45o)], 3D NPS showing longitudinal (z) interpolation, high zmod (~75%) for helical protocols, and a high degree of longitudinal constancy in all metrics. By contrast, the Canon One clearly exhibited a drop in zmod from 81% (at z = 0.4 cm) to 36% (at z = 4.4 cm) for volumetric scan protocols.*Conclusions The phantom and automated analysis provide a reliable tool for quantitative evaluation of MDCT imaging performance pertinent to the current and emerging generation of MDCT.*Clinical Relevance/Application Automated, quantitative evaluation of MDCT imaging performance in a manner that is sensitive to important characteristics of modern CT scanners will improve acceptance and QA testing, reduce scanner downtime, and improve quality of care.

RESULTS

The phantom provided objective evaluation of imaging performance via automated software and a structured report. Important characteristics were brought to light in the study that would not be captured by existing test phantoms - e.g., the contrast dependence (non-linearity) of the MTF, the (non-) isotropic nature of the 3D MTF for various reconstruction protocols, and the magnitude of cone-beam artifact (Zmod) for fully volumetric scan protocols. For example, the Precision CT exhibited protocols with varying levels of non-isotropic MTF [e.g., f10 = 1.7 mm-1 (axial) and 1.0 mm-1 (at 45o)], 3D NPS showing longitudinal (z) interpolation, high zmod (~75%) for helical protocols, and a high degree of longitudinal constancy in all metrics. By contrast, the Canon One clearly exhibited a drop in zmod from 81% (at z = 0.4 cm) to 36% (at z = 4.4 cm) for volumetric scan protocols.

CLINICAL RELEVANCE/APPLICATION

Automated, quantitative evaluation of MDCT imaging performance in a manner that is sensitive to important characteristics of modern CT scanners will improve acceptance and QA testing, reduce scanner downtime, and improve quality of care.

SSPH03-2 The American College Of Radiology Fluoroscopy Dose Index Registry Pilot: Dose Indices From Fluoroscopically-Guided Interventional Procedures

Participants
A. Kyle Jones, PhD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

The most recent published dataset of dose indices from U.S. fluoroscopically-guided interventions (FGI) is the RAD-IR study, which collected data 20 years ago and was published in 2003. The ACR Fluoroscopy Dose Index Registry (DIR) is designed to be a living normative dataset for fluoroscopy dose indices.*Methods and Materials During the pilot phase of the ACR Fluoroscopy DIR, dose indices for FGI were collected from 9 pilot sites through the ACR TRIADTM server. Participating sites were academic medical centers and regional hospitals; fluoroscopes from all major manufacturers were included. FGI were mapped to one of over 200 standard procedure descriptions in the ACR Common lexicon. Procedural dose index data were analyzed by individual Common ID. Three rounds of data validation were performed to ensure accurate procedure mapping.*Results Dose indices for 53,626 FGI were collected during the pilot. Fluoroscopy time in min. (FT), cumulative air kerma in mGy (Ka,r), and kerma area product in Gy-cm2 (PKA) are reported here as (N; mean [interquartile range]) for select ACR Common IDs. IVC filter insertion (1675; FT: 2.9 [1.9-4.3]; Ka,r: 57.2 [28.45-124.3]; PKA: 14.6 [7.4-32.85]); IVC filter retrieval (471; FT: 5.2 [3.1-12.0]; Ka,r: 188.3 [73.25-437.9]; PKA:

33.65 [12.8-85.88]); visceral angiography (1488; FT: 15.2 [8.8-26.1]; Ka,r: 789.0 [359.3-1636.4]; PKA: 152.4 [70.80-308.6]); visceral embolization (742; FT: 20.8 [11.7-36.4]; Ka,r: 851.9 [374.8-1679.0]; PKA: 152.7 [72.45-304.8]); nephrostomy placement (1826; FT: 4.6 [2.3-9.2]; Ka,r: 45.95 [16.7-139.2]; PKA: 8.35 [2.9-26.40]); gastrostomy placement (1568; FT: 3.3 [2.1-5.4]; Ka,r: 29.1 [13.5-68.55]; PKA: 7.3 [3.0-18.30]); percutaneous biliary drainage (921; FT: 12.9 [5.3-25.2]; Ka,r: 170.3 [48.9-470.1]; PKA: 23.20 [7.70-69.20]); transjugular intrahepatic portosystemic shunt placement (323; FT: 35.9 [24.2-54.6]; Ka,r: 836.3 [361.7-1530.9]; PKA: 192.2 [93.40-423.2]); CVC placement, tunneled (4426; FT: 0.9 [0.5-1.7]; Ka,r: 2.8 [1.4-6.3]; PKA: 0.7 [0.3-1.5]); central venous catheter (CVC) placement, non-tunneled (3827; FT: 0.9 [0.4-1.6]; Ka,r: 6.3 [2.5-16.6]; PKA: 1.8 [0.7-5.3]).*Conclusions The ACR Fluoroscopy DIR collected dose indices from 9 pilot sites across the country. Data were analyzed by Common ID, allowing similar procedures all sites to be analyzed in aggregate.*Clinical Relevance/Application Quality control of radiation use during FGI requires current and continuously updated normative datasets so sites can benchmark performance against their peers. The ACR Fluoroscopy DIR provides this dataset.

RESULTS

Dose indices for 53,626 FGI were collected during the pilot. Fluoroscopy time in min. (FT), cumulative air kerma in mGy (Ka,r), and kerma area product in Gy-cm2 (PKA) are reported here as (N; mean [interquartile range]) for select ACR Common IDs. IVC filter insertion (1675; FT: 2.9 [1.9-4.3]; Ka,r: 57.2 [28.45-124.3]; PKA: 14.6 [7.4-32.85]); IVC filter retrieval (471; FT: 5.2 [3.1-12.0]; Ka,r: 188.3 [73.25-437.9]; PKA: 33.65 [12.8-85.88]); visceral angiography (1488; FT: 15.2 [8.8-26.1]; Ka,r: 789.0 [359.3-1636.4]; PKA: 152.4 [70.80-308.6]); visceral embolization (742; FT: 20.8 [11.7-36.4]; Ka,r: 851.9 [374.8-1679.0]; PKA: 152.7 [72.45-304.8]); nephrostomy placement (1826; FT: 4.6 [2.3-9.2]; Ka,r: 45.95 [16.7-139.2]; PKA: 8.35 [2.9-26.40]); gastrostomy placement (1568; FT: 3.3 [2.1-5.4]; Ka,r: 29.1 [13.5-68.55]; PKA: 7.3 [3.0-18.30]); percutaneous biliary drainage (921; FT: 12.9 [5.3-25.2]; Ka,r: 170.3 [48.9-470.1]; PKA: 23.20 [7.70-69.20]); transjugular intrahepatic portosystemic shunt placement (323; FT: 35.9 [24.2-54.6]; Ka,r: 836.3 [361.7-1530.9]; PKA: 192.2 [93.40-423.2]); CVC placement, tunneled (4426; FT: 0.9 [0.5-1.7]; Ka,r: 2.8 [1.4-6.3]; PKA: 0.7 [0.3-1.5]); central venous catheter (CVC) placement, non-tunneled (3827; FT: 0.9 [0.4-1.6]; Ka,r: 6.3 [2.5-16.6]; PKA: 1.8 [0.7-5.3]).

CLINICAL RELEVANCE/APPLICATION

Quality control of radiation use during FGI requires current and continuously updated normative datasets so sites can benchmark performance against their peers. The ACR Fluoroscopy DIR provides this dataset.

SSPH03-3   Measurement Of Low-contrast Detectability Using Channelized Hotelling Observer On ACR Accreditation Phantom: Optimization And Repeatability

Participants
Mingdong Fan, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Current CT quality control (QC) for low-contrast detectability relies on visual inspection and measurement of contrast-to-noise ratio, which was demonstrated to be inappropriate for non-linear reconstruction methods. Channelized Hotelling observer (CHO)-based method is promising. However, a large number of repeated scans are typically required to achieve acceptable accuracy and precision, which is not feasible in practice. In this work, we aim to optimize the CHO measurement process for the most widely used ACR accreditation phantom and to evaluate its robustness in a repeatability test.*Methods and Materials For CHO optimization, the ACR low-contrast module was repeatedly scanned 100 times on a 192-slice CT scanner (Force, Siemens), using identical techniques and phantom position. The optimal set of channel filters, number of slices, and number of background regions of interest (ROI) were determined to reduce the required number of repeated scans, using the index of detectability (d') calculated from the 100 repeated scans as the reference standard. To evaluate the robustness of the optimized CHO at reduced number of scans, we scanned the phantom on another scanner for 10 times, each with independent repositioning of the phantom. For each repositioning, a single scan was acquired at 3 dose levels (CTDIvol = 6, 12, and 24 mGy). The optimized CHO method was used to calculate d' for each of the 10 independent measurements, 3 dose levels, and 2 reconstruction methods.*Results With the optimal CHO calculation (4 channel filters, 50 slices per objects, and 2 sets of background ROIs), the bias was within 2.1% and the relative standard deviation was within 9.8% for the 4-, 5-, and 6-mm objects from a single-scan measurement. The d' calculated by 10 independent measurements using this optimal CHO calculation were precise for all object sizes, reconstruction methods, and dose levels. The d' of the 6 mm low-contrast object from the IR reconstruction was 2.92±0.19, range: [2.56, 3.24]; 2.30±0.18, range: [1.95, 2.69]; 1.67±0.20, range: [1.39, 2.01] at 24, 12, and 6 mGy, respectively.*Conclusions A CHO-based method was optimized for routine CT QC of low-contrast detectability using the ACR accreditation phantom. This method was demonstrated to be robust in a repeatability test.*Clinical Relevance/Application The optimized CHO-based method provides an efficient, quantitative, and reproducible approach to routine QC of low-contrast detectability on the most widely used ACR accreditation phantom.

RESULTS

With the optimal CHO calculation (4 channel filters, 50 slices per objects, and 2 sets of background ROIs), the bias was within 2.1% and the relative standard deviation was within 9.8% for the 4-, 5-, and 6-mm objects from a single-scan measurement. The d' calculated by 10 independent measurements using this optimal CHO calculation were precise for all object sizes, reconstruction methods, and dose levels. The d' of the 6 mm low-contrast object from the IR reconstruction was 2.92±0.19, range: [2.56, 3.24]; 2.30±0.18, range: [1.95, 2.69]; 1.67±0.20, range: [1.39, 2.01] at 24, 12, and 6 mGy, respectively.

CLINICAL RELEVANCE/APPLICATION

The optimized CHO-based method provides an efficient, quantitative, and reproducible approach to routine QC of low-contrast detectability on the most widely used ACR accreditation phantom.

SSPH03-4   Quantitative Image Quality Comparison Between Photon Counting And Conventional CT Systems: Noise, Resolution And Quantitative Accuracy

Participants
Richard Thompson, PhD, Hawthorn Woods, Illinois (*Presenter*) Employee, Canon Medical Research, USA

PURPOSE

Recent studies have shown that photon counting CT (PCCT) has the potential to provide better contrast and noise performance compared to conventional CT systems using scintillator-based energy integrating detectors (EID), and enable material decomposition for spectral imaging. In this work, we compare the image quality of a prototype PCCT to EID-CT at comparable scan protocols and analyze the performance in terms of noise, spatial resolution and material quantification accuracy.*Methods and

Materials The prototype PCCT is based on a Canon Aquilion ONE ViSION™ system. The smallest detector pixel size is 342μm, and each pixel can output measurements up to 6 energy bins starting from 20keV. The readout can be configured into various macro-pixel schemes to reconstruct images at different spatial resolutions. The 3x3 macro-pixel mode generates a similar detection pitch as the typical EID-CT, and the resulting images were evaluated here. A 40cm water phantom and a Gammex™ multi-energy phantom were scanned on PCCT with 120kVp, from 50 to 400mA, 1s rotation. Counting images were generated based on total counts per pixel, and spectral images were generated using 5 energy bin counts. For EID-CT, the phantoms were scanned at 120kVp and dual energy mode at dose matched to the PCCT scans. For both systems, images were reconstructed using FBP without noise reduction. Image resolution, noise, and quantitative accuracy were compared between PCCT and EID-CT in both counting and spectral images.*Results Compared to EID-CT, PCCT counting images have reduced noise at low dose levels. The PCCT images have significantly higher MTF than EID-CT. In monoenergetic images, PCCT and EID-CT have similar material quantification accuracy for iodine. PCCT also has similar noise performance with reduced noise at high keV.*Conclusions We compared quantitative image quality between a prototype PCCT and a commercial EID-CT. The results demonstrate that PCCT has potential benefits of reducing noise and improving resolution in both counting and spectral modes.*Clinical Relevance/Application The initial performance of a prototype PCCT system in both counting and spectral imaging modes demonstrates its potential to achieve better diagnostic performance with reduced dose.

RESULTS

Compared to EID-CT, PCCT counting images have reduced noise at low dose levels. The PCCT images have significantly higher MTF than EID-CT. In monoenergetic images, PCCT and EID-CT have similar material quantification accuracy for iodine. PCCT also has similar noise performance with reduced noise at high keV.

CLINICAL RELEVANCE/APPLICATION

The initial performance of a prototype PCCT system in both counting and spectral imaging modes demonstrates its potential to achieve better diagnostic performance with reduced dose.

SSPH03-5   Search, Recognition, And Decision Errors In Liver Metastasis Detection At Contrast-enhanced Abdominal CT

Participants
Scott Hsieh, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

A better understanding of false negative exams (FNs) is needed to reduce interobserver variability and improve patient care. FNs can be characterized as a failure to search for a lesion; a failure to subconsciously recognize a lesion after glancing briefly at it; or a conscious decision error in rejecting the lesion after considering it. We conducted a 25-reader study for the task of liver metastasis detection in abdominal CT using eye tracking technology and characterized the relative frequency of search, recognition, and decision errors.*Methods and Materials In this IRB-approved study, 25 radiologists examined 40 CT exams containing 91 hepatic metastases, marking all suspected liver metastasis. Ground truth was determined using histopathology or progression. An eye tracking device (Eyelink Portable Duo) measured total gaze time within 40 pixels (approximately 25 mm in DICOM coordinates) of each true lesion. Unmarked metastases, or FNs, were categorized by total gaze time as follows: search errors, less than 0.5 seconds; recognition errors, between 0.5 and 2 seconds; decision errors, greater than 2 seconds. Total time gazing within each liver segment, across all cases, was also measured.*Results On average, radiologists missed 15.1 of 91 metastases (range, 6 - 36). Of these FNs, 37% were search, 32% were recognition, and 31% were decision errors. Half of the FNs occurred in 9 of 91 metastases. The errors in the 9 most difficult metastases were different from the remaining metastases (p < 10-5); the 9 most difficult metastases contained more search and recognition errors (45% and 38%, respectively) than the remaining metastases (29% and 27%, respectively). Time spent gazing within individual liver segments were associated with fewer FNs in a univariate analysis (p < 0.05) except for segment VIII (p = 0.14). This association became nonsignificant in a model that included mean interpretation time per case. Of the segments containing metastases, segments II and III had the lowest average gaze time, with a median gaze time of 12 seconds per case in both segments. Readers spending more than 12 seconds in these segments had fewer FNs than those with less than 12 seconds (0.5 vs 2.1 FNs, p = 0.0001).*Conclusions Search, recognition, and decision errors occurred in similar proportion over the entire dataset. Individual lesions showed a tendency towards specific error types. Increased attention in segments II and III was associated with fewer false negatives in these segments.*Clinical Relevance/Application Missed liver metastases can be categorized as search, recognition, and decision errors, with a similar proportion of each type of error. Reduced time gazing in segments II and III was associated with more false negatives in these segments.

RESULTS

On average, radiologists missed 15.1 of 91 metastases (range, 6 - 36). Of these FNs, 37% were search, 32% were recognition, and 31% were decision errors. Half of the FNs occurred in 9 of 91 metastases. The errors in the 9 most difficult metastases were different from the remaining metastases (p < 10-5); the 9 most difficult metastases contained more search and recognition errors (45% and 38%, respectively) than the remaining metastases (29% and 27%, respectively). Time spent gazing within individual liver segments were associated with fewer FNs in a univariate analysis (p < 0.05) except for segment VIII (p = 0.14). This association became nonsignificant in a model that included mean interpretation time per case. Of the segments containing metastases, segments II and III had the lowest average gaze time, with a median gaze time of 12 seconds per case in both segments. Readers spending more than 12 seconds in these segments had fewer FNs than those with less than 12 seconds (0.5 vs 2.1 FNs, p = 0.0001).

CLINICAL RELEVANCE/APPLICATION

Missed liver metastases can be categorized as search, recognition, and decision errors, with a similar proportion of each type of error. Reduced time gazing in segments II and III was associated with more false negatives in these segments.

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Participants

Wendy B. Demartini, MD, Stanford, California (*Moderator*) Advisory Board, Kheiron Medical Technologies Ltd

Sub-Events

SSBR01-2   A Decade Of Digital Breast Tomosynthesis: How Has It Performed?

Participants
Liane E. Philpotts, MD, Madison, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Digital breast tomosynthesis (DBT) was approved for commercial use in February 2011. Many studies have shown superiority of DBT over 2D mammography, particularly in terms of recall and cancer detection rates. With any new technology, long-term performance must be established. The purpose of this study was to assess screening mammography metrics over a 10-year period since adopting DBT.*Methods and Materials Our facility started offering DBT for screening in August 2011 at the main hospital of an academic breast center. Over the next several years we obtained DBT at our 3 satellite offices. We performed DBT screening at no charge to patients resulting in data unbiased by breast density, risk factors, insurance coverage, or other factors. A search of our electronic breast imaging database (PenRad, MN) was performed to identify all screening mammograms performed with DBT during one-year periods (8/1/11 - 7/31/12, 8/1/12 to 7/31/13,? present) and interpreted by dedicated breast radiologists. The recall rate (RR), cancer detection rate (CDR), and false negative rate (FN) (supplemental screening detected and interval cancers) was determined. The metrics were assessed for the entire cohort and sub-group analyzed by breast density (non-dense vs dense).*Results Over the 10 years 207,128 DBT mammograms were performed: 130,114 non-dense and 77,014 dense. The recall rate averaged 7.5% and, other than year 2, fluctuated between 7-8%: 8%,9%,8%,7%,7%,7%,7%, 7%, 7%, 8%. The CDR averaged 5.4 and maintained a stable range of 5-6 cancers (per 1000) for each of 10 years: 6,5,5,5,5,6,5,6,5,6,5. The FN rate (for the first 9 years) averaged 0.8 per 1000: 1.8, 1, 0.5, 0.8, 0.9, 0.7, 0.8, 0.7, 1.2. For non-dense women the RR averaged 6.8% (7,8,7,7,6,6,6,7,7,7) and the CDR 5.2 (4,6,4,6,6,5,6,5,6,4). For dense women the RR averaged 8.1% (8,11,10,8,7,7,7,7,7,9) and the CDR 5.1 (7,4,6,4,6,5,5,5,4,5).*Conclusions DBT screening metrics have held steady throughout the 10 years since the adoption of this new technology with maintained favorable RR, CDR and FN rates. The favorable metrics are noted for both non-dense and dense women.*Clinical Relevance/Application The maintained benefits of DBT support use of this technology for screening.

RESULTS

Over the 10 years 207,128 DBT mammograms were performed: 130,114 non-dense and 77,014 dense. The recall rate averaged 7.5% and, other than year 2, fluctuated between 7-8%: 8%,9%,8%,7%,7%,7%,7%, 7%, 7%, 8%. The CDR averaged 5.4 and maintained a stable range of 5-6 cancers (per 1000) for each of 10 years: 6,5,5,5,5,6,5,6,5,6,5. The FN rate (for the first 9 years) averaged 0.8 per 1000: 1.8, 1, 0.5, 0.8, 0.9, 0.7, 0.8, 0.7, 1.2. For non-dense women the RR averaged 6.8% (7,8,7,7,6,6,6,7,7,7) and the CDR 5.2 (4,6,4,6,6,5,6,5,6,4). For dense women the RR averaged 8.1% (8,11,10,8,7,7,7,7,7,9) and the CDR 5.1 (7,4,6,4,6,5,5,5,4,5).

CLINICAL RELEVANCE/APPLICATION

The maintained benefits of DBT support use of this technology for screening.

SSBR01-3   Follow-up Study Of Lymph Node Response Induced By M-RNA COVID-19 Vaccination

Participants
Alba Cristina Igual Rouilleault, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the imaging presentation and main characteristics of axillary adenopathy response induced by mRNA COVID-19 vaccination.*Methods and Materials Ninety-one volunteer employees from our center were prospectively ruled-out between February to April 2021. The study was conducted with the approval of our IRB and all participants provided written consent to participate. Patients recruited were Pfizer-BioNTech COVID-19 vaccine recipients and each one underwent a total of three axillary ultrasound (US) evaluations of the ipsilateral vaccinated arm. The first axillar US exam was obtained within the week before vaccine administration, the second one the week after the first dose and the last one, the week after the second dose. Findings recorded were: the total number of visible nodes, the maximum measurements of the long-axis size and cortical thickness (mm), Bedi's classification (grade 1 to 6) and color Doppler evaluation (grade 0 to 3, being 0 no color signal and 3 high intense color signal). Finally, data collected were compared using paired-sample Student's t-test for quantitative continuous variables and Wilcoxon rank-sum test for ordinal variables. Variables with a p value < 0.05 were considered statistically significant.*Results Comparative analyses between the basal and the first US control showed a statistically significant augmentation of total visible nodes (mean 2.96 vs 4.77 nodes; p<0.001), maximum long-axis size (mean 15.84 vs 21.34 mm; p<0.001), cortical thickness (mean 1.6 vs 3.7 mm; p<0.001), grade of Bedi's classification and color Doppler signal (p<0.001). In addition, same statistically significant differences were found comparing the first and the second control: total visible nodes (mean 4.77 vs 6.21 nodes), long-axis size (mean 21.1 vs 24.0 mm), cortical thickness (3.7 vs 4.6 mm), grade of Bedi's classification and color Doppler signal (p<0.001).*Conclusions According to our results, both doses of COVID-19 vaccine induced an increase of all axillary lymph node parameters with

statistically significant differences.*Clinical Relevance/Application The main differential diagnosis of unilateral axillary adenopathy is malignancy but, in the setting of recent COVID-19 vaccination, radiologists should consider induced ipsilateral hyperplasic axillary nodes since the first vaccination dose.

RESULTS

Comparative analyses between the basal and the first US control showed a statistically significant augmentation of total visible nodes (mean 2.96 vs 4.77 nodes; p<0.001), maximum long-axis size (mean 15.84 vs 21.34 mm; p<0.001), cortical thickness (mean 1.6 vs 3.7 mm; p<0.001), grade of Bedi's classification and color Doppler signal (p<0.001). In addition, same statistically significant differences were found comparing the first and the second control: total visible nodes (mean 4.77 vs 6.21 nodes), long-axis size (mean 21.1 vs 24.0 mm), cortical thickness (3.7 vs 4.6 mm), grade of Bedi's classification and color Doppler signal (p<0.001).

CLINICAL RELEVANCE/APPLICATION

The main differential diagnosis of unilateral axillary adenopathy is malignancy but, in the setting of recent COVID-19 vaccination, radiologists should consider induced ipsilateral hyperplasic axillary nodes since the first vaccination dose.

SSBR01-4   Optimizing The Pairs Of Radiologists That Double-read Screening Mammograms

Participants
Jessie Gommers, MSc, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

To investigate how radiologist performance characteristics can be leveraged to identify optimal pairs of radiologists for double-reading of screening mammograms.*Methods and Materials We retrospectively analyzed 990,802 screening examinations of women who underwent screening mammography as part of a regional program between 2008 and 2015. In total, 37 radiologists were involved. Any examination that was flagged by any radiologist became subject to consensus discussion. We evaluated sensitivity and specificity for individual radiologists and pairs of radiologists in terms of their flagging of women diagnosed with cancer within 12 months. The individual radiologists were divided into four performance categories involving cancer detection and recall rates, using the group average as cut-off for each metric. Therefore, radiologists were classified into: high sensitivity & high specificity (HH), high sensitivity & low specificity (HL), low sensitivity & high specificity (LH), or low sensitivity & low specificity (LL). We compared random pair performance to specific class-pair performance.*Results A difference in performance was found when individual readers were paired with a specific class of reader vs. with a random reader. Specific class-pairs involving only readers with a high sensitivity, i.e. readers HH and HL, achieved a significantly higher cancer detection rate (CDR), compared to random pairs at the same given recall rate (HH+HH CDR 3.6 vs. 2.7 per 1000 exams, HH+HL CDR 4.5 vs. 3.5 per 1000 exams, HL+HL CDR 4.9 vs. 4.1 per 1000 exams). On the other hand, class-pairs involving only readers with a low sensitivity (LH and LL), performed worse compared to randomly paired readers. Furthermore, low-specificity pairs performed worse than random pairs, unless both readers were highly sensitive.*Conclusions Pairing radiologists based on sensitivity/specificity characteristics, as opposed to randomly, may improve screening performance. Pairs of high-sensitivity readers outperform random pairs, even if low-specificity readers are involved. Depending on what type of readers and how many of them are involved in the double-reading, the feasibility of using performance metrics to pair radiologists may be considered.*Clinical Relevance/Application Optimizing the pairs of radiologists that double-read screening mammograms may improve cancer detection and reduce the number of false-positives, with no new technology or training costs.

RESULTS

A difference in performance was found when individual readers were paired with a specific class of reader vs. with a random reader. Specific class-pairs involving only readers with a high sensitivity, i.e. readers HH and HL, achieved a significantly higher cancer detection rate (CDR), compared to random pairs at the same given recall rate (HH+HH CDR 3.6 vs. 2.7 per 1000 exams, HH+HL CDR 4.5 vs. 3.5 per 1000 exams, HL+HL CDR 4.9 vs. 4.1 per 1000 exams). On the other hand, class-pairs involving only readers with a low sensitivity (LH and LL), performed worse compared to randomly paired readers. Furthermore, low-specificity pairs performed worse than random pairs, unless both readers were highly sensitive.

CLINICAL RELEVANCE/APPLICATION

Optimizing the pairs of radiologists that double-read screening mammograms may improve cancer detection and reduce the number of false-positives, with no new technology or training costs.

SSBR01-6   Digital Breast Tomosynthesis And Digital Mammography Recall Rates And Time Of Day: Was There Improvement During COVID-19?

Participants
Grayson Baird, PhD, Providence, Rhode Island (*Presenter*) Nothing to Disclose

PURPOSE

To determine how Digital Breast Tomosynthesis (DBT) and Digital Mammography (DM) recall and false positive rates varied by time of day of study interpretation before COVID-19 during normal caseload as compared to during COVID-19 with reduced caseload.*Methods and Materials Retrospective review of all 103,065 screening DBT and DM from 3/2019-3/2021 at 13 outpatient centers with 17 radiologists. Screens were batch read. Data were extracted from a tracking database and included: exam type (DBT or DM), interpreting radiologist, time of day of interpretation, BI-RADS, and outcome (false positive [FP], true positive [TP]). All radiologists read DM and DBT during the 2 years. An interrupted time series design was used. Generalized linear mixed modeling was used to model recall and FP over time of day, before vs. during COVID-19, where each radiologist had an intercept and slope.*Results As illustrated in Figure 1, before COVID-19, for every hour increase during the day, the odds of recall increased 5% for DBT (Red) (OR: 1.05, 95% CI[1.01, 1.09], p=0.01) but not for DM (Blue), which increased (insignificantly) 2% for every hour (OR: 1.02, 95% CI[0.99, 1.09], p=0.49). Conversely, during COVID-19, for every hour increase, the odds of recall were 0 (flat) for both DBT and DM (OR: 1.00, 95% CI[0.97, 1.02], p=0.75 and (OR: 1.00, 95% CI[0.95, 1.04], p=0.91, respectively). The mean (flat) recall rates for DBT and DM were 9.8% and 11.3%, respectively, regardless of the time of day, a significant difference of 1.5% (p=.02). The relationship between recall rate and time of day before COVID-19 versus during COVID-19 was significantly different, p<.01, as seen comparing column 1 with 2 in Figure 1. All findings for recall are mirrored for FP. TP before COVID-19 was 5.2 per 1000 for DBT and 3.6 per 1000 for DM; TP during COVID-19 was 5.2 per 1000 for DBT and 5.3 per 1000 for DM, p=.18.*Conclusions Recall and FP rates increased over the course of the day for DBT interpretation before COVID-19. During COVID-19, when caseloads reduced, no relationship was observed for recall and FP and time of day. These results indicate that the time-of-day effect (as the day increased, recall increased perhaps due to fatigue) disappeared after caseloads declined due to COVID-

19.*Clinical Relevance/Application Lower interpretation volumes, as observed during COVID-19, may reduce recall and FP rates in DBT without affecting TP rate.

RESULTS

As illustrated in Figure 1, before COVID-19, for every hour increase during the day, the odds of recall increased 5% for DBT (Red) (OR: 1.05, 95% CI[1.01, 1.09], p=0.01) but not for DM (Blue), which increased (insignificantly) 2% for every hour (OR: 1.02, 95% CI[0.99, 1.09], p=0.49). Conversely, during COVID-19, for every hour increase, the odds of recall were 0 (flat) for both DBT and DM (OR: 1.00, 95% CI[0.97, 1.02], p=0.75 and (OR: 1.00, 95% CI[0.95, 1.04], p=0.91, respectively). The mean (flat) recall rates for DBT and DM were 9.8% and 11.3%, respectively, regardless of the time of day, a significant difference of 1.5% (p=.02). The relationship between recall rate and time of day before COVID-19 versus during COVID-19 was significantly different, p<.01, as seen comparing column 1 with 2 in Figure 1. All findings for recall are mirrored for FP. TP before COVID-19 was 5.2 per 1000 for DBT and 3.6 per 1000 for DM; TP during COVID-19 was 5.2 per 1000 for DBT and 5.3 per 1000 for DM, p=.18.

CLINICAL RELEVANCE/APPLICATION

Lower interpretation volumes, as observed during COVID-19, may reduce recall and FP rates in DBT without affecting TP rate.

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Abstract Archives of the RSNA, 2021

SSCA08

Science Session with Keynote: Cardiac (Cardiac MRI Technical Advancements)

Participants

Karen Ordovas, MD, Seattle, Washington (*Moderator*) Nothing to Disclose
Elsie Nguyen, MD, Toronto, Ontario (*Moderator*) Nothing to Disclose
Tim Leiner, MD, PhD, Rochester, Minnesota (*Moderator*) Speakers Bureau, Koninklijke Philips

Sub-Events

SSCA08   Keynote Speaker

Participants

Michael Markl, PhD, Chicago, Illinois (*Presenter*) Research Support, Siemens AGResearch Grant, Circle Cardiovascular Imaging Inc

SSCA08-2   Multiparametric Cardiac MRI In Acute Myocarditis With Endocardial Myocardial Biopsy: A Verification Of Lake Louise Criteria 2009 And 2018

Participants

Shuang Li, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study was to evaluate the value of the Original Lake Louise Criteria (LLC) and the 2018 LLC for the diagnosis of acute myocarditis at 3 T and provide the cutoff value for cardiac magnetic resonance (CMR) imaging technique.*Methods and Materials Seventy-three patients (32±32 years, 60.5% men) with clinically suspected myocarditis underwent endocardial myocardial biopsy (EMB) and CMR at 3.0 Tesla were enrolled in the study. Patients were divided into two groups according to EMB results. CMR protocol included cine-SSFP, T2 STIR, T2 mapping, early and late gadolinium enhancement and pre- and post-contrast T1 mapping. Their potential diagnostic ability was assessed with receiver operating characteristic (ROC) curves.*Results Myocardial T1 and T2 relaxation times were significantly prolonged in patients with myocarditis than in control group (1252±42ms vs. 1195±43ms, p<0.001; 63.2±6.1ms vs. 54.5±3.7ms, p<0.001).Optimal cutoff value was 1228ms for T1 relaxation times and 58.5ms for T2 relaxation times with sensitivity of 86.0% and 83.7%, specificity of 93.3% and 93.3%, respectively. All the patients diagnosed as myocarditis by the original LLC were correctly identified by 2018 LLC. For the diagnostic accuracy, 2018 LLC was the highest (91.8%) compared with single parameters or those combined parameters, followed with T1 mapping (89.0%) and T2 mapping (87.7%).*Conclusions Emerging technologies such as T1/ T2 mapping have significantly improved the diagnostic performance of CMR for the diagnosis of acute myocarditis. The 2018LLC provides the overall best diagnostic performance in acute myocarditis compared with those single standard CMR parameters or combined parameters.*Clinical Relevance/Application CMR is a promising tool for the diagnosis of patients with myocarditis. With the addition of new parameter imaging technology, the diagnostic efficiency of 2018 LLC has been significantly improved.

RESULTS

Myocardial T1 and T2 relaxation times were significantly prolonged in patients with myocarditis than in control group (1252±42ms vs. 1195±43ms, p<0.001; 63.2±6.1ms vs. 54.5±3.7ms, p<0.001).Optimal cutoff value was 1228ms for T1 relaxation times and 58.5ms for T2 relaxation times with sensitivity of 86.0% and 83.7%, specificity of 93.3% and 93.3%, respectively. All the patients diagnosed as myocarditis by the original LLC were correctly identified by 2018 LLC. For the diagnostic accuracy, 2018 LLC was the highest (91.8%) compared with single parameters or those combined parameters, followed with T1 mapping (89.0%) and T2 mapping (87.7%).

CLINICAL RELEVANCE/APPLICATION

CMR is a promising tool for the diagnosis of patients with myocarditis. With the addition of new parameter imaging technology, the diagnostic efficiency of 2018 LLC has been significantly improved.

SSCA08-3   Free-breathing High Resolution Modified Dixon Steady-state Angiography For The Assessment Of The Thoracic Vasculature In Pediatric Patients With Congenital Heart Disease

Participants

Narine Mesropyan, Bonn, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Magnetic resonance imaging including angiography (MRA) of the thoracic vasculature in small pediatric patients with congenital heart disease (CHD) remains challenging. Thus, the aim of this study was to evaluate the diagnostic utility of a respiratory- and electrocardiogram-gated steady-state MRA with modified Dixon (mDixon) fat suppression in comparison to standard first-pass MRA in sedated pediatric patients with CHD at 3.0 T.*Methods and Materials Pediatric CHD patients, who underwent cardiac MRI with first-pass MRA followed by mDixon steady-state MRA at 3 T were retrospectively analyzed. Image quality was assessed using a Likert grading scale from 5 (excellent) to 1 (non-diagnostic). Additionally, blood-to-tissue ratio, quality of fat suppression as well as quantitative measurements of the thoracic vasculature were assessed. Measurements were performed separately and/or in consensus by two radiologists. Paired t test, Wilcoxon test and Bland-Altman method were used for statistical analysis.*Results 32

patients with CHD (mean age: 3.2±1.6 years, 13 female) were included. Overall image quality of steady-state mDixon MRA was higher compared to first-pass MRA (4.5±0.5 vs. 3.3±0.5; P<0.001). Blood-to-tissue contrast ratio of steady-state mDixon MRA was comparable to first-pass MRA (7.85±4.75 vs. 6.35±2.23; P=0.133). Fat suppression of steady-state mDixon MRA was perfect in 30/32 (93.8 %) cases. First-pass MRA showed significantly greater diameters at all measurement points with the greatest differences at the level pulmonary arteries and veins, e.g. 10.4±2.4 vs. 9.9±2.3 (P<0.001) for right pulmonary artery. Steady-state mDixon MRA had higher interobserver agreements of vessel measurements (e.g. for ascending aorta: bias -0.06±0.2; 95% limits of agreement -0.56 - 0.44). In 4/32 (12.5 %) cases additional vascular abnormalities were detected on steady-state mDixon MRA (e.g. partial anomalous venous return), which could not be depicted in the first-pass MRA.*Conclusions Steady-state mDixon MRA with compressed sensing offers a robust fat suppression and a high image quality for the assessment of the thoracic vasculature in pediatric CHD patients at 3.0 T, insensitive to the magnetic field inhomogeneities.*Clinical Relevance/Application Our study results support the clinical application of described sequence in sedated pediatric patients with CHD at 3.0 T.

RESULTS

32 patients with CHD (mean age: 3.2±1.6 years, 13 female) were included. Overall image quality of steady-state mDixon MRA was higher compared to first-pass MRA (4.5±0.5 vs. 3.3±0.5; P<0.001). Blood-to-tissue contrast ratio of steady-state mDixon MRA was comparable to first-pass MRA (7.85±4.75 vs. 6.35±2.23; P=0.133). Fat suppression of steady-state mDixon MRA was perfect in 30/32 (93.8 %) cases. First-pass MRA showed significantly greater diameters at all measurement points with the greatest differences at the level pulmonary arteries and veins, e.g. 10.4±2.4 vs. 9.9±2.3 (P<0.001) for right pulmonary artery. Steady-state mDixon MRA had higher interobserver agreements of vessel measurements (e.g. for ascending aorta: bias -0.06±0.2; 95% limits of agreement -0.56 - 0.44). In 4/32 (12.5 %) cases additional vascular abnormalities were detected on steady-state mDixon MRA (e.g. partial anomalous venous return), which could not be depicted in the first-pass MRA.

CLINICAL RELEVANCE/APPLICATION

Our study results support the clinical application of described sequence in sedated pediatric patients with CHD at 3.0 T.

SSCA08-4   Noninvasive Left Ventricular Filling Pressure With 4D Flow MRI: Scan-Rescan Reproducibility

Participants
Paul Roos, MSc, Leiden, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Left ventricular (LV) filling pressure represents diastolic function and is often estimated using E/e'. While this is widely used, it is proven unreliable in patients with severe heart failure and mitral valve insufficiency [1]. Intra-LV relative pressure fields can be obtained by combining flow velocity with fluid dynamics. Intra-LV velocity is measured using 4D Flow MRI. Relative pressure is then calculated according to [2].Relative pressure fields can be used to calculate LV filling pressure differences and to assess diastolic function. We have investigated scan-rescan reproducibility of this approach, which could open the door to full noninvasive pressure-volume loop estimation.[1] SF Nagueh et al. J. Am. Soc. Echocardiogr. 2016. [2] T Ebbers et al. J. Biomech. Eng. 2002.*Methods and Materials Cardiovascular MRI was performed twice for ten (N=10) healthy volunteers (age 27?±?3 years). This included multi-slice cine short axis scan for LV endocardial contour segmentation and 4D Flow MRI. Pressure gradients (?p) were calculated from 4D Flow MRI using the Navier-Stokes equation:?p = -? ?V/?t -?V*?V+µ?^2 V+Fwhich was transformed into a pressure Poisson equation and solved iteratively. Density ? = 1060 kg/m3, viscosity µ = 0.004 Ns/m2 and external forces F was neglected.Apex and mitral valve were manually identified. In the sampling locations pressures were averaged within a radius of 3 voxels. The pressure in the apex was then subtracted from the mitral valve pressure to determine pressure difference. This was plotted over time and peak relative filling pressure difference was identified. Reproducibility was tested by Pearson correlation.*Results For all subjects, the curves of the relative pressure difference of the first and second scan showed close agreement. Strong correlation (r=0.83, P=0.003) was found between peak relative filling pressure differences of first and second scan. Paired sample t-test showed no significant difference between scan and rescan (p=0.57) with average absolute error 0.071±0.066 mmHg.*Conclusions Noninvasive measurement of LV peak filling pressure differences derived from 4D flow MRI showed good reproducibility. Accurate segmentation of endocardial contours and careful selection of sampling locations are crucial for accuracy. This technique may prove its use in diastolic function evaluation when E/e' estimation is inaccurate.*Clinical Relevance/Application Noninvasive measurement of LV peak filling pressure differences derived from 4D flow MRI may prove its use in diastolic function evaluation.

RESULTS

For all subjects, the curves of the relative pressure difference of the first and second scan showed close agreement. Strong correlation (r=0.83, P=0.003) was found between peak relative filling pressure differences of first and second scan. Paired sample t-test showed no significant difference between scan and rescan (p=0.57) with average absolute error 0.071±0.066 mmHg.

CLINICAL RELEVANCE/APPLICATION

Noninvasive measurement of LV peak filling pressure differences derived from 4D flow MRI may prove its use in diastolic function evaluation.

SSCA08-6   Short Fixed Inversion Time Magnetic Resonance Late Gadolinium Enhancement In Infarct Patients With Concomitant Non-ischemic Fibrosis

Participants
Malgorzata Polacin, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

Short LGE, a 3D single breath-hold inversion recovery late gadolinium enhancement sequence with fixed, short inversion time (TI =110 ms at 1.5 Tesla) has a different image impression with dark scar, light grey blood pool and very bright remote myocardium. After better contrast between ischemic scars and blood pool has been proven in short LGE and infarct patients might have concomitant non-ischemic LGE, this study examined the visibility of non-ischemic fibrosis in infarct patients in short LGE compared to clinically used LGE sequence (standard LGE).*Methods and Materials Short LGE and standard LGE (same spatial resolution 1.2 x 1.2 mm², slice-thickness 8 mm; field of view 350 x 350 mm², 3D, single breath-hold) were acquired in 37 infarcts patients (17 female, mean age 59 ±8 years) with concomitant non-ischemic fibrosis (21 patients with septal fibrosis, 10 with epicardial fibrosis, 6 with fibrosis at the basal RV junction) at 1.5 T. For short LGE inversion time (TI) was fixed at 110 ms, standard LGE was acquired with adjusted TI. Three independent readers evaluated 629 segments (17-segment model) in short LGE and standard LGE in a blinded manner, using a 5-point Likert scale for evaluation of image quality (1= excellent, 5= non-diagnostic) and fibrosis visibility.

Standard LGE was considered reference standard.*Results Non-ischemic fibrosis was present in 117 segments (18,6%). All segments with fibrosis in standard LGE were detected in short LGE by all readers. Image quality was equal in short LGE compared to standard LGE (2 vs. 1.9, p=0.78) and visibility of fibrosis was not inferior (1.7 vs. 1.5, p=0.4) in short LGE. Agreement between the readers was good (ICC=0.899 and ICC=0.843).*Conclusions Short LGE was not inferior to standard LGE in detecting non-ischemic fibrosis in infarct patients. Short LGE does not require myocardial nulling and displays ischemic and non-ischemic fibrosis with equal visibility.*Clinical Relevance/Application Same fibrosis visibility in short LGE, a fast, 3D, one breath-hold sequence with fixed inversion time (no myocardial nulling required)

RESULTS

Non-ischemic fibrosis was present in 117 segments (18,6%). All segments with fibrosis in standard LGE were detected in short LGE by all readers. Image quality was equal in short LGE compared to standard LGE (2 vs. 1.9, p=0.78) and visibility of fibrosis was not inferior (1.7 vs. 1.5, p=0.4) in short LGE. Agreement between the readers was good (ICC=0.899 and ICC=0.843).

CLINICAL RELEVANCE/APPLICATION

Same fibrosis visibility in short LGE, a fast, 3D, one breath-hold sequence with fixed inversion time (no myocardial nulling required)

Participants

Krishna Juluru, MD, New York, New York (*Moderator*) Nothing to Disclose

Sub-Events

SSIN07   Keynote Speaker

Participants

Luciano M. Prevedello, MD, MPH, Columbus, Ohio (*Presenter*) Nothing to Disclose

SSIN07-2   Deep Reinforcement Learning-based Image Classification Achieves Perfect Testing Set Accuracy For MRI Brain Tumors With A Training Set Of Only 30 Images

Participants

Joseph Stember, MD, PhD, New York, New York (*Presenter*) Founder, Authera, LLC;Patent holder, Authera, LLC

PURPOSE

Image classification may be the fundamental task in imaging artificial intelligence. We have recently shown that reinforcement learning can achieve high accuracy for lesion localization and segmentation even with minuscule training sets. Here, we introduce reinforcement learning for image classification. In particular, we apply the approach to normal vs. tumor-containing 2D MRI brain images.*Methods and Materials We applied multi-step image classification to allow for combined Deep Q learning and TD(0) Q learning. We trained on a set of 30 images (15 normal and 15 tumor-containing). We tested on a separate set of 30 images (15 normal and 15 tumor-containing). For comparison, we also trained and tested a supervised deep learning classification network on the same set of training and testing images.*Results Whereas the supervised approach quickly overfit the training data and as expected performed poorly on the testing set (57% accuracy, just over random guessing), the reinforcement learning approach achieved an accuracy of 100%.*Conclusions We have shown a proof-of-principle application of rein- forcement learning to classification of brain tumors. We achieved perfect testing set accuracy with a training set of merely 30 images.*Clinical Relevance/Application Up until now, radiology AI has required hundreds to thousands of training images to achieve accurate classification. We have shown that our novel approach reaches very high accuracy with only 30 training set images. This can allow automated classification for rare diseases, for which only a handful of cases (and images) exist.

RESULTS

Whereas the supervised approach quickly overfit the training data and as expected performed poorly on the testing set (57% accuracy, just over random guessing), the reinforcement learning approach achieved an accuracy of 100%.

CLINICAL RELEVANCE/APPLICATION

Up until now, radiology AI has required hundreds to thousands of training images to achieve accurate classification. We have shown that our novel approach reaches very high accuracy with only 30 training set images. This can allow automated classification for rare diseases, for which only a handful of cases (and images) exist.

SSIN07-5   Clinical Decision Support AI System For Live Differential-diagnostic Guidance

Participants

Ewoud Pons, MD, Rotterdam, Netherlands (*Presenter*) Researcher, Reed Elsevier;

PURPOSE

Live AI systems can aid the radiologist at the time of reporting without leaving the reporting workflow. We developed such live system that automatically retrieves the most relevant differential-diagnostic guidance from STATdx® when reporting the finding section. The system can retrieve 126 relevant topics corresponding to chest X-ray radiographic findings.*Methods and Materials 126 selected chest STATdx® topics were annotated in 600 randomly selected chest X-ray reports from MIMIC CXR 2.0 by a board-certified radiologist and two radiology residents in training. This gold standard corpus was only used for tuning and validation of 16 different unsupervised AI and NLP methods, such as transformer-sentence and Radlex concept embeddings. All methods were combined in an optimised ensemble system. During each phase of development at least 20% of gold standard reports was withheld to prevent overfitting of the system. Area under the precision-recall curve (AUPCR) was calculated for system performance on the gold as well as inter-annotated agreement (IAA) on 100 reports. For additional evaluation the final system was applied to 100 never seen reports, scoring all retrieved topics for factual correctness and clinical relevance of the diagnostic guidance on a scale of 1-to-5*Results IAA for 100 reports of the gold standard was 0.752 AUPCR, which corresponds to "substantial agreement" in kappa. The optimised ensemble system performed 0.773 AUPCR. The system scored 4.26/5 for correctness and 3.25/5 for clinical relevance of retrieved topics.*Conclusions Performance of the system matched expert agreement and provided both correct and largely relevant topics, confirming feasibility of live diagnostic guidance by AI on for chest X-ray. Because the ensemble consists of unsupervised methods, generalisation to other specialty areas is realistic.*Clinical Relevance/Application Compared to existing systems the amount of identified observations is increased to 126 compared to 14 for CheXpert. This granularity of findings proved to be clinically important. Providing content in context improves utilisation of important information sources with the potential to

reduce uncertainty in diagnostic reporting, improve the quality of care and provide a powerful experience for radiology education. Such systems transform the process of seeking diagnostic guidance from a passive search outside the reporting workflow to an interactive user experience. Contextual retrieval of relevant guidelines and publications is faster and richer than traditional key word search. Future work should be directed at integrating more patient context from the EHR as well as epidemiological knowledge to enrich diagnostic recommendations by AI systems.

RESULTS

IAA for 100 reports of the gold standard was 0.752 AUPCR, which corresponds to "substantial agreement" in kappa. The optimised ensemble system performed 0.773 AUPCR. The system scored 4.26/5 for correctness and 3.25/5 for clinical relevance of retrieved topics.

CLINICAL RELEVANCE/APPLICATION

Compared to existing systems the amount of identified observations is increased to 126 compared to 14 for CheXpert. This granularity of findings proved to be clinically important. Providing content in context improves utilisation of important information sources with the potential to reduce uncertainty in diagnostic reporting, improve the quality of care and provide a powerful experience for radiology education. Such systems transform the process of seeking diagnostic guidance from a passive search outside the reporting workflow to an interactive user experience. Contextual retrieval of relevant guidelines and publications is faster and richer than traditional key word search. Future work should be directed at integrating more patient context from the EHR as well as epidemiological knowledge to enrich diagnostic recommendations by AI systems.

SSIN07-6   Deep Anatomical Federated Network (DAFNE) For Self-improving Segmentation Of Mr Images.

Participants
Francesco Santini, PhD, Basel, Switzerland (*Presenter*) Research Consultant, F. Hoffmann-La Roche Ltd

PURPOSE

To implement a new software tool for medical image segmentation based on deep neural networks trained through incremental and federated learning. Thanks to these concepts, the software performance continuously improves and adapts to different users' requirements without transfer of medical data.*Methods and Materials The software consists of a (free and open source) stand-alone program and a central server. In our software, each client performs an automatic segmentation of their dataset, which can be checked and refined in the user interface. The client then locally updates the models through a stochastic gradient descent algorithm based on the refinement and finally the server aggregates the clients' updates to build an improved model. The software is easily extensible by implementing an intuitive Python API to add new deep learning models. We provided pretrained models for the segmentation of the muscles of the leg and thigh, a task that is inherently complex because of their deformable anatomy and pathological involvement. We opened the usage to external users in March 2021 for free usage without restriction to a particular workflow. We collected performance metrics from the clients at every usage (Dice scores), and we performed local validation of the updated models against datasets with similar and different contrasts as the pretraining data.*Results After 62 incremental/federated learning epochs, the visual performance on our validation sets improved noticeably on T2-weighted images with minimal change in the proton-density datasets (original training contrast). The clients reported consistently high Dice scores (> 0.85) except for few outliers that reduced in number as the epochs progressed. An overall model improvement at each iteration can be observed.*Conclusions We demonstrated a free and open-source approach to medical image segmentation that is respectful of patient privacy (as no data are transferred) and is capable of continuous improvement and adaptation to the needs of the users by learning to recognize different contrasts and different pathologies.*Clinical Relevance/Application Segmentation of anatomical features is a necessary task to extract quantitative biomarkers. The presented method enables fast and reliable self-improving adaptive segmentation.

RESULTS

After 62 incremental/federated learning epochs, the visual performance on our validation sets improved noticeably on T2-weighted images with minimal change in the proton-density datasets (original training contrast). The clients reported consistently high Dice scores (> 0.85) except for few outliers that reduced in number as the epochs progressed. An overall model improvement at each iteration can be observed.

CLINICAL RELEVANCE/APPLICATION

Segmentation of anatomical features is a necessary task to extract quantitative biomarkers. The presented method enables fast and reliable self-improving adaptive segmentation.

Abstract Archives of the RSNA, 2021

SSPH13

Physics (Photon-Counting-Detector CT II)

Participants
Shuai Leng, PHD, Rochester, Minnesota (*Moderator*) License agreement, Siemens AG
Mats Danielsson, PhD, Stockholm, Sweden (*Moderator*) Consultant, General Electric Company

Sub-Events

SSPH13-1   Dose-Efficient Assessment Of Trabecular Microstructure Using Whole-Body Photon-Counting CT

Participants
Stefan Sawall, PhD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the potential of ultra-high resolution (UHR) photon-counting computed tomography (PCCT) for the assessment of trabecular microstructure in comparison to conventional, energy-integrating CT (EICT) and high-resolution peripheral quantitative CT (HR-pQCT).*Methods and Materials The pixels of clinical PC detectors are much smaller compared to conventional EICT detectors. Often, the resulting ultra-high resolution is not required and reconstructions are performed to the resolution of today's EICTs. From e.g. [Invest. Radiol. 55(2):111-119, 2020] it is known that acquisitions using smaller pixels can reduce noise compared to acquisitions with larger pixels. We herein investigate if this effect can be used to reduce the administered dose in examinations aimed at quantifying trabecular microstructure. Five human vertebral bodies were scanned in an abdomen phantom (QRM, Germany) using an experimental dual-source CT (Siemens Healthineers, Germany) housing an EI detector (0.60 mm pixel size at iso) and a PC detector (0.25 mm pixel size). A tube voltage of 120 kV was used. Tube current for EICT was 355 mAs (23.8 mGy CTDI32cm). Dose-matched UHR-PCCT (UHRdm, 23.8 mGy) and noise-matched acquisitions (UHRnm, 10.5 mGy) were performed and reconstructed to a voxel size of 0.156 mm using a sharp kernel. Trabecular separation (Tb.Sp) and bone mineral density (BMD) were quantified and compared to HR-pQCT (Xtreme CT, SCANCO Medical, Switzerland, 5.5 mGy CTDI10cm).*Results Noise in EICT was 113 HU on average. UHRdm acquisitions (same dose as EICT) showed a noise level of 71 HU while UHRnm (45% dose of EICT) showed the same noise level as EICT at the same spatial resolution. For BMD/(mg/cm³), the overall Mean±StdDev for EI, UHRdm and UHRnm were 171.27±28.94, 173.55±27.90 and 172.88±27.99, while for Tb.Sp/mm they were 1.250±0.245, 1.648±0.481 and 1.463±0.325. Tb.Sp and BMD did not show any significant differences between the investigated protocols. Tb.Sp showed a high agreement with XtremeCT.*Conclusions UHR-PC detectors allow for an accurate characterization of trabecular microstructure even when acquired at 55% less dose compared to a clinical EICT reference.*Clinical Relevance/Application PCCT allows for the assessment of trabecular microstructure at reduced dose.

RESULTS

Noise in EICT was 113 HU on average. UHRdm acquisitions (same dose as EICT) showed a noise level of 71 HU while UHRnm (45% dose of EICT) showed the same noise level as EICT at the same spatial resolution. For BMD/(mg/cm³), the overall Mean±StdDev for EI, UHRdm and UHRnm were 171.27±28.94, 173.55±27.90 and 172.88±27.99, while for Tb.Sp/mm they were 1.250±0.245, 1.648±0.481 and 1.463±0.325. Tb.Sp and BMD did not show any significant differences between the investigated protocols. Tb.Sp showed a high agreement with XtremeCT.

CLINICAL RELEVANCE/APPLICATION

PCCT allows for the assessment of trabecular microstructure at reduced dose.

SSPH13-2   First Results From A Prototype Full-size Photon Counting CT System: Counting And Spectral Imaging Performance At Clinical Dose Levels

Participants
Xiaohui Zhan, Vernon Hills, Illinois (*Presenter*) Employee, Canon Medical Systems Corporation

PURPOSE

In recent years, the semiconductor-based photon counting detectors have gained increasing interest in clinical CT applications. With the thresholding detection and energy selecting capability, the PCD measurements have the potential to provide better contrast and noise performance compared to the scintillator-based EID systems, and enable material decomposition for spectral imaging. In this work, we introduce our first prototype CdZnTe-based full size photon counting CT system, and present its initial performance on both counting and spectral imaging tasks at clinical dose levels.*Methods and Materials This system is designed based on a Canon Aqilion ONE ViSION™ (Fig. 1). The smallest detector pixel size is 342um, and each micro-pixel can output up to 6 energy bins of measurements. The readout can be configured into various macro-pixel schemes to reconstruct images at different spatial resolutions. The 3x3 macro-pixel mode generates a similar detection pitch as the typical EID system, and the resulted normal resolution images were evaluated here. Three 16cm phantoms were scanned with 120kVp, 50/100mA, 1s rotation. The counting images were generated based on events with photon energy >20keV, and the spectral images were generated using multiple energy bin counts (Fig. 2).*Results At both dose levels, the counting images demonstrate excellent HU accuracy and uniformity (Fig. 3), and are free of artifacts. The spectral images, presented as in basis material images and monoenergetic images (Fig. 4 - 6), demonstrate similar image quality and accurate material quantification capability (Tab. 1 - 3). The studies of larger phantoms with higher dose are underway, and results will be reported in the final submission.*Conclusions We have designed and built a prototype

full-size photon counting CT system, and acquired its first rotational counting and spectral images with various phantoms. The images evaluated so far prove its capability to scan at clinical dose levels and generate almost artifact free images with excellent quantitative accuracy.*Clinical Relevance/Application The initial performance of our first prototype PCCT system on both counting and spectral imaging tasks demonstrates its potential to reach diagnostic level image quality at clinical dose levels.

RESULTS

At both dose levels, the counting images demonstrate excellent HU accuracy and uniformity (Fig. 3), and are free of artifacts. The spectral images, presented as in basis material images and monoenergetic images (Fig. 4 - 6), demonstrate similar image quality and accurate material quantification capability (Tab. 1 - 3). The studies of larger phantoms with higher dose are underway, and results will be reported in the final submission.

CLINICAL RELEVANCE/APPLICATION

The initial performance of our first prototype PCCT system on both counting and spectral imaging tasks demonstrates its potential to reach diagnostic level image quality at clinical dose levels.

SSPH13-3   Optimal Virtual Monoenergetic Energy Level (keV) For Photon-counting-detector (PCD) CT Angiography

Participants
Chelsea Dunning, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To determine the optimal energy level (keV) for virtual monoenergetic images (VMI) in CT angiography (CTA) using photon-counting detector (PCD) CT.*Methods and Materials Under IRB approval, ten patients (abdominal, n=4; lower extremity, n=3; head & neck, n=3) referred for clinical CTA were scanned on an investigational whole-body PCD-CT (SOMATOM Count Plus, Siemens, Forchheim, Germany) at 120 or 140kV with CTDIvol matched to the clinical scan. All images were reconstructed using iterative reconstruction, a vascular kernel (Bv48), and 2mm slice thickness. Axial VMIs and coronal maximum intensity projections were created for 40-65keV in 5keV increments, with 65keV VMI serving as a surrogate for 120kV single energy CT. Contrast-to-noise ratio (CNR) was measured in the aorta, femoral, or carotid arteries over ten slices in each VMI series using soft tissue as the background. Two radiologists blindly ranked the six VMI series (1=best, 6=worst), focusing on overall image quality and visualization of small vessels and pathology. The mean rank and standard deviation for each energy level were calculated. Readers were asked to identify any VMI series that distinguished itself from others in terms of vessel/pathology visualization and artifacts.*Results Mean iodine CNR was highest in 40keV VMIs for all evaluated arteries, with an average CNR increase of 17% to 55% at 40keV compared to at 65keV. Across readers, the 50keV VMI series had the highest combined rank (2.3±1.1). Reader 1 ranked 40keV best (1.9±1.4), and Reader 2 ranked 50keV best (1.8±0.7). Among different body parts, the 45keV VMI was ranked the highest for head & neck (1.8±0.7) and lower extremity (2.3±1.4) PCD-CTA. Meanwhile, 50keV VMI was ranked highest for abdominal (2.4±1.4) PCD-CTA. The 40keV VMI received the highest score from the readers for iodine visualization in vessels, and the 65keV VMI for reduced metal and calcium-blooming artifacts.*Conclusions VMI at 40keV is best for visualizing specific contrast-enhanced arterial vasculature using PCD-CTA, in the absence of metal and calcium artifacts. Overall, the 45keV VMI is optimal for small body parts (e.g. head & neck and lower extremity) while 50keV is best for large body parts (e.g. abdomen).*Clinical Relevance/Application VMI series generated from PCD-CTA at lower energy levels (40-50keV) enables better visualization of small vessels. This can be used to reduce radiation or iodine-contrast dose.

RESULTS

Mean iodine CNR was highest in 40keV VMIs for all evaluated arteries, with an average CNR increase of 17% to 55% at 40keV compared to at 65keV. Across readers, the 50keV VMI series had the highest combined rank (2.3±1.1). Reader 1 ranked 40keV best (1.9±1.4), and Reader 2 ranked 50keV best (1.8±0.7). Among different body parts, the 45keV VMI was ranked the highest for head & neck (1.8±0.7) and lower extremity (2.3±1.4) PCD-CTA. Meanwhile, 50keV VMI was ranked highest for abdominal (2.4±1.4) PCD-CTA. The 40keV VMI received the highest score from the readers for iodine visualization in vessels, and the 65keV VMI for reduced metal and calcium-blooming artifacts.

CLINICAL RELEVANCE/APPLICATION

VMI series generated from PCD-CTA at lower energy levels (40-50keV) enables better visualization of small vessels. This can be used to reduce radiation or iodine-contrast dose.

SSPH13-5   Development And Application Of A Virtual Imaging Trial Platform To Evaluate And Optimize State-of-the-art Photon-counting CT

Participants
Ehsan Abadi, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate a virtual imaging trial platform that models the physics and geometry of a new investigational PCCT system to enable its evaluation and optimization across various diagnostic tasks.*Methods and Materials We extended a previously validated CT simulation platform (DukeSim) to model the scanner-specific geometry and physics of a new full field of view investigational dual-source PCCT system (NAEOTOM Alpha, Siemens Healthineers) equipped with CdTe photon-counting detectors (QuantaMax) with 290 μm pixel size (151x176μm at iso center) and 60 mm beam collimation. The platform was provisioned to simulate projections of computational phantoms using a ray-tracing module for primary signal and a Monte Carlo module for dose and scatter signal. A separate Monte Carlo-based detector response model accounted for the signal, noise, and crosstalk processes (K escape, K reabsorption, charge sharing, and electronic noise). Postprocessing was applied for water calibration and beam hardening correction. The developed simulation platform was validated by virtually reproducing images of ACR and multi-energy Gammex phantoms acquired using the investigational PCCT system at multiple dose levels. The real and simulated data were compared in terms of signal (HU), noise (magnitude, NPS), and resolution (MTF). To demonstrate clinical potential, anthropomorphic phantoms (XCAT phantom) were further virtually imaged with the scanner and with the models of two energy-integrating CT systems (Flash and Force). The resulting images were compared in terms of spatial resolution and HU accuracy.*Results The simulations closely reproduced the signal, noise, and resolution of the actual images with errors <5%. Compared to energy integrating CT, the new system demonstrated improved spatial resolution in terms of f50 from 0.33 1/mm up to 1.39 1/mm. The developed platform generated realistic images of computational phantoms across various image acquisition settings (e.g., spectra, detector energy threshold, reconstruction setting) and improved image contrast by 10 HU in the liver parenchyma for 20 keV

detector threshold, compared with Flash and FORCE scanners.*Conclusions A CT simulator can effectively represent the scanner-specific image quality attributes of a modeled investigational PCCT scanner. This tool enables systematic evaluation and optimization of the emerging technology for targeted quantitative performance in the clinic.*Clinical Relevance/Application Photon-counting CT is an emerging CT technology with great potential for improved quality, the effective use of which requires clinical evaluation and optimization. In the context of limited clinical availability, virtual imaging trials uniquely enable such evaluations.

RESULTS

The simulations closely reproduced the signal, noise, and resolution of the actual images with errors <5%. Compared to energy integrating CT, the new system demonstrated improved spatial resolution in terms of f50 from 0.33 1/mm up to 1.39 1/mm. The developed platform generated realistic images of computational phantoms across various image acquisition settings (e.g., spectra, detector energy threshold, reconstruction setting) and improved image contrast by 10 HU in the liver parenchyma for 20 keV detector threshold, compared with Flash and FORCE scanners.

CLINICAL RELEVANCE/APPLICATION

Photon-counting CT is an emerging CT technology with great potential for improved quality, the effective use of which requires clinical evaluation and optimization. In the context of limited clinical availability, virtual imaging trials uniquely enable such evaluations.

SSPH13-6   Whole-body Dual-source Photon-counting Detector (PCD) CT: Technical Assessment And Initial Experience

Participants
Shuai Leng, PHD, Rochester, Minnesota (*Presenter*) License agreement, Siemens AG

PURPOSE

The purpose of this study was to evaluate the performance of a new whole-body, dual-source PCD-CT system using phantoms and first patient scans.*Methods and Materials A 25 μm wire and 25 μm foil were scanned to measure modulation transfer function (MTF) and section sensitivity profile (SSP), respectively, using standard (144 x 0.4 mm) and high resolution (HR, 120 x 0.2 mm) modes of the investigational PCD-CT system (NAEOTOM Alpha, Siemens Healthineers). Images were reconstructed using sharp kernels and minimum possible slice thicknesses (standard: Hr76, 0.4 mm; HR: Hr84, 0.2 mm). The uniformity module of the ACR CT accreditation phantom was scanned using the HR mode and images reconstructed with and without iterative reconstruction (IR) to assess noise power spectra (NPS). A multi-energy (ME) CT phantom containing iodine (2, 5, 10, and 15mg/cc) was scanned using the standard mode (120 kV, CTDIvol 36 mGy) to evaluate material decomposition. A head phantom was scanned using the HR protocol (120 kV, CTDIvol 37 mGy, Hr84 kernel, 0.2 mm slice thickness) to demonstrate high resolution imaging. Under IRB, 18 patients referred for clinical CT exams were scanned on the PCD-CT system (non-contrast breast (2), coronary CTA (4), low-dose whole body (1), head/neck CTA (2), low-dose chest (7), abdominal CTA (1), and runoff CTA (1). Scan and reconstruction parameters were tailored to clinical indication.*Results MTF measurements showed a cut-off spatial frequency of 32 cm-1 (29 cm-1 at 10% MTF) for HR mode (Hr84 kernel) and 24 cm-1 (21 cm-1 at 10% MTF) for standard mode (Hr76 kernel). SSP measurements showed a full-width-half-maximum value of 0.34 mm (0.2 mm slice thickness, HR mode) and 0.63 mm (0.4 mm slice thickness, standard mode). NPS showed lower noise from IR without a shift in the peak frequency compared to conventional filtered back projection. MECT phantom results showed accurate iodine quantification (0.26 mg/cc root-mean-squared-error). Head phantom HR images showed delineation of bony anatomy. Patient images demonstrated a range of benefits, particularly increased spatial resolution for visualization of small structures and pathology, increased iodine contrast, and the availability of spectral data for all exams, including the 66 ms temporal resolution cardiac scans.*Conclusions The new PCD-CT system demonstrated improved spatial resolution compared to state-of-the-art conventional CT and accurate iodine quantification. First patient scans demonstrated improved image quality and capabilities.*Clinical Relevance/Application Comprehensive assessment of a new CT system and first patient scans show similar or improved performance relative to current scanners, providing evidence for its readiness for clinical adoption.

RESULTS

MTF measurements showed a cut-off spatial frequency of 32 cm-1 (29 cm-1 at 10% MTF) for HR mode (Hr84 kernel) and 24 cm-1 (21 cm-1 at 10% MTF) for standard mode (Hr76 kernel). SSP measurements showed a full-width-half-maximum value of 0.34 mm (0.2 mm slice thickness, HR mode) and 0.63 mm (0.4 mm slice thickness, standard mode). NPS showed lower noise from IR without a shift in the peak frequency compared to conventional filtered back projection. MECT phantom results showed accurate iodine quantification (0.26 mg/cc root-mean-squared-error). Head phantom HR images showed delineation of bony anatomy. Patient images demonstrated a range of benefits, particularly increased spatial resolution for visualization of small structures and pathology, increased iodine contrast, and the availability of spectral data for all exams, including the 66 ms temporal resolution cardiac scans.

CLINICAL RELEVANCE/APPLICATION

Comprehensive assessment of a new CT system and first patient scans show similar or improved performance relative to current scanners, providing evidence for its readiness for clinical adoption.

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Participants

Fiona Gilbert, MD, Cambridge, United Kingdom (*Moderator*) Research Grant, Hologic, IncResearch Grant, General Electric Company Research Consultant, Alphabet IncResearch Consultant, Kheiron Medical Technologies LtdResearch support, Bayer AGResearch collaboration, Volpara Health Technologies Limited

Sub-Events

SSBR10-1   Reducing False-positive Recalls By Adding Temporal Changes Information To An AI System For Breast Cancer Detection

Participants
Pierre Fillard, PhD, Paris, France (*Presenter*) Employee, Therapixel SA;Stockholder, Therapixel SA

PURPOSE

In breast cancer detection, change in findings throughout time is one of the major biomarkers for the presence of malignancy. In this study we evaluate the addition of temporal context information to an artificial intelligence (AI) system (called temporal AI) with the purpose of improving its specificity.*Methods and Materials A dataset of 2D mammograms was retrospectively collected from 5,848 patients from one radiology site in the United States and acquired between 2006 and 2019. Among them only examinations with at least one prior available within 18 months were kept. Cancer-positive examinations were confirmed by biopsy/surgery within 6 months after the acquisition, while negative screens were confirmed by a negative follow-up. A further selection was done in order to keep only cases deemed normal or benign (BIRADS 1 or 2) by the reader who had initially read the mammogram but who's prior was deemed suspicious (BIRADS 0), while both examinations were considered suspicious by an AI system. Final selection included 536 positive and 322 negative cases. We designed a new temporal AI able to output a level of suspicion from a pair of mammograms and its prior. Predictions of this new AI were compared with those of the reference AI (i.e., the commercially available version of the system). Comparison was carried out in terms of sensitivity at 100% Positive Predictive Value (PPV) and area under the precision-recall curve (AUCPRC).*Results Sensitivity at 100% PPV was 12.5% (95% CI: 8.3% to 17.6%) for the reference AI and 22.7% (95% CI: 19.2% to 27%) for the temporal AI, giving a sensitivity gain of 10.2% (95% CI: 4.4% to 15%). The AUCPRC shows an improvement from 79.7% (95% CI: 76.5% to 82.7%) for the reference AI to 84.2% (95% CI: 81.8% to 86.7%) for the temporal AI.These results indicate that the temporal AI can separate complex benign cases from cancer-positive ones hardly distinguishable from those when assessed without the prior, but clearly distinguishable when comparison with the prior can be done.*Conclusions The introduction of temporal change into an AI system was shown to improve specificity. We showed that temporal AI can detect about 20% of cancer-positive cases without producing any false positive, which is twice as much as a standard AI. This result, if confirmed by larger studies, could represent an important step towards the integration of AI as standalone systems into breast cancer screening programs. For instance, it could be used to detect high-risk patients before they leave the facility for an immediate diagnosis, or to prioritize patient recall for screening in backlogs that extended due to Covid19.*Clinical Relevance/Application AI can be integrated into screening practice to support or improve cancer detection without increasing false positive recalls.

RESULTS

Sensitivity at 100% PPV was 12.5% (95% CI: 8.3% to 17.6%) for the reference AI and 22.7% (95% CI: 19.2% to 27%) for the temporal AI, giving a sensitivity gain of 10.2% (95% CI: 4.4% to 15%). The AUCPRC shows an improvement from 79.7% (95% CI: 76.5% to 82.7%) for the reference AI to 84.2% (95% CI: 81.8% to 86.7%) for the temporal AI.These results indicate that the temporal AI can separate complex benign cases from cancer-positive ones hardly distinguishable from those when assessed without the prior, but clearly distinguishable when comparison with the prior can be done.

CLINICAL RELEVANCE/APPLICATION

AI can be integrated into screening practice to support or improve cancer detection without increasing false positive recalls.

SSBR10-2   The Potential Of Ai To Reduce Interval Cancer In A Middle Income Country Breast Cancer Screening Program

Participants
Erkin Aribal, Istanbul, Turkey (*Presenter*) Research Consultant, ScreenPoint Medical BV

PURPOSE

To evaluate the performance of an artificial intelligence (AI) system in detecting interval cancers among women with negative screening exams attending a national screening program of a middle income country.*Methods and Materials This retrospective study was performed with a data cohort between 2016-2019 derived from women between 40-69 who attended the national breast cancer screening program. During this period, the recall rate was on average 5.3%. The negative screening exams of 406 women who developed interval cancers before the next screening round were collected, and 446 women with normal follow-up. The pathological outcome and time-to-diagnosis were retrieved. All mammograms were processed by an AI cancer detection system (Transpara v 1.6, ScreenPoint Medical), assigning a score between 1-10 to the exam, representing an increasing likelihood of malignancy. The performance of the AI system for detection of interval cancers on negative screening exams was estimated in

terms of the area under the receiver operating characteristic curve (AUC), and sensitivity at 90% and 95.0% specificity, with 95% confidence intervals cancers.*Results More than half of all interval cancers (53%) were flagged by the highest AI score 10. The AUC of AI to detect signs of IC on negative screening exams was 0.80 (95% CI = 0.77-0.83). The sensitivity was 53.7% and 38.5% at specificity of 90% and 95.0%, respectively. The highest performance of AI was found for cases that were diagnosed within 6 months after screening (AUC: 0.85 (95% CI = 0.78-0.92), compared to cases diagnosed within 24 months after screening (AUC: 0.74 (95% CI = 0.67-0.81).*Conclusions AI has the potential to reduce rate of interval cancers, in case AI is applied as a second or third independent reader within a national breast cancer screening program.*Clinical Relevance/Application Middle income countries have limited human and financial resources for a screening program where AI have a potential to reduce the interval cancers and can be added as a second reader.

RESULTS

More than half of all interval cancers (53%) were flagged by the highest AI score 10. The AUC of AI to detect signs of IC on negative screening exams was 0.80 (95% CI = 0.77-0.83). The sensitivity was 53.7% and 38.5% at specificity of 90% and 95.0%, respectively. The highest performance of AI was found for cases that were diagnosed within 6 months after screening (AUC: 0.85 (95% CI = 0.78-0.92), compared to cases diagnosed within 24 months after screening (AUC: 0.74 (95% CI = 0.67-0.81).

CLINICAL RELEVANCE/APPLICATION

Middle income countries have limited human and financial resources for a screening program where AI have a potential to reduce the interval cancers and can be added as a second reader.

SSBR10-3   A Deep Learning Algorithm For Reducing False Positives In Screening Mammography

Participants
Stefano Pedemonte, PhD, Santa Clara, California (*Presenter*) Researcher, whiterabbit.ai

PURPOSE

Mammography screening improves outcomes for breast cancer by enabling early detection and treatment. While many countries have developed breast cancer screening systems, these systems have important limitations. High rates of false positives result in unnecessary procedures, patient anxiety and added costs. In this work, we evaluate a breast cancer rule-out system that reduces false positives by identifying non-suspicious cases.*Methods and Materials We trained a machine learning model to rule-out cancer and operate at high sensitivity, using 123,270 full-field digital mammograms (6,172 cancers) acquired in the US and the UK. The model is composed of 22 deep neural networks combined to achieve high performance in a meta-learning architecture. The operating point was chosen at 99% sensitivity on a cross-validation set to minimize false negatives. This algorithm was evaluated in a retrospective clinical study based on 11,594 held out screening exams (102 cancers) acquired at a major academic hospital in the US using two scanner models: Hologic Selenia Dimensions (SD: 7,586 exams, 88 cancers) and Hologic Selenia (HS: 4,008 exams, 14 cancers).*Results The rule-out device performance was found to depend on the number of cancer examples used in training for each scanner model (4,874 cancer cases in the training set were acquired on HS and 1,298 on SD). Overall sensitivity was 100% [95% confidence interval: 96.5%, 100%], in particular 100% [76.8%, 100%] for HS and 100% [95.5%, 100%] for SD. Recalls for diagnostic exams were reduced by 44.5% [40.4%, 48.8%] for HS and by 23.2% [20.0%, 25.9%] for SD. The number of benign needle biopsies was reduced by 9.5% [2.4%, 21.5%] for HS and by 6.8% [3.4%, 12.3%] for SD. The potential number of screening exams requiring radiologist's interpretation was reduced by 54.0% [52.4%, 55.5%] for HS and by 34.6% [33.7%, 35.8%] for SD.*Conclusions Devices that identify non suspicious mammograms can provide an important aid to radiologists and directly benefit patients and healthcare systems overall by reducing false positives, unnecessary procedures, and costs. Quality assurance mechanisms and improved training methods to guarantee uniformity of performance and studies based on large data sets will be critical to enable safe operation of these devices.*Clinical Relevance/Application Some studies report that more than half of women screened in the US are subjected to false positives and more than 20% to unnecessary procedures over their lifetime. Rule-out devices can change this.

RESULTS

The rule-out device performance was found to depend on the number of cancer examples used in training for each scanner model (4,874 cancer cases in the training set were acquired on HS and 1,298 on SD). Overall sensitivity was 100% [95% confidence interval: 96.5%, 100%], in particular 100% [76.8%, 100%] for HS and 100% [95.5%, 100%] for SD. Recalls for diagnostic exams were reduced by 44.5% [40.4%, 48.8%] for HS and by 23.2% [20.0%, 25.9%] for SD. The number of benign needle biopsies was reduced by 9.5% [2.4%, 21.5%] for HS and by 6.8% [3.4%, 12.3%] for SD. The potential number of screening exams requiring radiologist's interpretation was reduced by 54.0% [52.4%, 55.5%] for HS and by 34.6% [33.7%, 35.8%] for SD.

CLINICAL RELEVANCE/APPLICATION

Some studies report that more than half of women screened in the US are subjected to false positives and more than 20% to unnecessary procedures over their lifetime. Rule-out devices can change this.

SSBR10-4   A Benchmarking Study To Evaluate The Performance Of Two Artificial Intelligence Algorithms For Interval Cancer Detection In A UK Breast Screening Setting

Participants
Sarah Hickman, MBBS, Cambridge, United Kingdom (*Presenter*) Research collaboration, VaraResearch collaboration, ScreenPoint Medical BVResearch collaboration, Lunit IncResearch collaboration, Kheiron Medical Technologies LtdResearch collaboration, Alphabet IncResearch collaboration, Volpara Health Technologies Limi

PURPOSE

To investigate artificial intelligence (AI) algorithms for interval cancer (IC) detection in a UK breast screening programme (BSP).*Methods and Materials Two commercial AI algorithms were evaluated using retrospectively collected data from four mammographic system vendors from 2011-2020 in a single UK National Health Service (NHS) breast screening center. The study sample was screening mammograms of consecutive ICs from women with confirmed histological diagnosis together with age and year matched confirmed normal controls. Both AI algorithms were evaluated using their continuous score outputs, with a higher score indicating greater suspicion of cancer with performance investigated at two prespecified thresholds of specificity; one at 96%, based on NHSBSP data, and a lower threshold of 90% appropriate for subsequent consensus reading. A prespecified threshold of sensitivity was set to 30% - the estimated percentage of ICs detectable on the prior screening mammogram.*Results 2,077 four-view digital screening mammogram cases, including 528 (25.42%) interval cancers, were analyzed. For both algorithms the median score assigned to IC cases was higher than the median for normal cases (p < 0.01). At 96% specificity, sensitivities of

23.49% and 23.86% were achieved by AI-1 and AI-2, respectively with sensitivities of 37.50% and 35.80% at 90% specificity. At the 30% sensitivity threshold, the specificity was 93.87% and 92.45% respectively. The area under the receiver operating characteristic curve (AUC) of AI-1 and AI-2 was 0.72 and 0.71 respectively (p = 0.44), using both AI tools together resulted in an AUC of 0.74.*Conclusions By setting the threshold of the algorithm we were able to simulate performance within a UK screen reading workflow. Single reading with an AI algorithm to triage cases to the second reader at a 10% threshold, could improve IC detection. Use of ICs allows for separate testing to determine if significant improvements can be made at an acceptable specificity and should be included in benchmarking. As this study was limited to one screening center further testing is required.*Clinical Relevance/Application Testing artificial intelligence (AI) with datasets of interval cancers and normals using screening programme thresholds can give an indication of performance in an adaptive screen reading.

RESULTS

2,077 four-view digital screening mammogram cases, including 528 (25.42%) interval cancers, were analyzed. For both algorithms the median score assigned to IC cases was higher than the median for normal cases (p < 0.01). At 96% specificity, sensitivities of 23.49% and 23.86% were achieved by AI-1 and AI-2, respectively with sensitivities of 37.50% and 35.80% at 90% specificity. At the 30% sensitivity threshold, the specificity was 93.87% and 92.45% respectively. The area under the receiver operating characteristic curve (AUC) of AI-1 and AI-2 was 0.72 and 0.71 respectively (p = 0.44), using both AI tools together resulted in an AUC of 0.74.

CLINICAL RELEVANCE/APPLICATION

Testing artificial intelligence (AI) with datasets of interval cancers and normals using screening programme thresholds can give an indication of performance in an adaptive screen reading.

SSBR10-5 Deep Learning Predicts Interval And Screen-detected Cancer From Negative Screening Mammograms: A Case-case-control Study In 6369 Women

Participants
Lambert Leong, MS, Honolulu, Hawaii (*Presenter*) Nothing to Disclose

PURPOSE

The ability of deep learning models to classify women as at risk for either screen-detected by mammography or interval cancer (not detected on mammography) has not been comprehensively studied in the literature. Our goal was to examine the ability of deep learning models to estimate the risk of interval and screening detected breast cancers with and without clinical risk factors.*Methods and Materials This case-case-control study was performed on 25096 prospectively collected negative digital screening mammograms, ascertained from 2006 to 2014, a median of 2.8 years prior to any cancer. A total 1609 women had screen-detected breast cancer, 351 interval invasive breast cancer and 4409 were cancer free. A deep learning model was trained and validated on the negative mammograms prior to cancer to classify women into either as not having developed cancer or developed screening-detected or interval invasive cancer. Model effectiveness was evaluated as a matched concordance statistic (c-statistic) in a held-out (29.2%, 1669 out of 5708 women) test set of the mammograms. Deep learning models were bench marked against models using clinical risk factors including breast density. All models were adjusted for clinical risk factors including age (continuous), BMI (continuous, inverse BMI), first degree family history of breast cancer, history of biopsy, and race.*Results The c-statistics for comparing screen-detected cancers versus matched controls waw 0.66 (95% CI: 0.63, 0.69) with odds ratios (OR) 1.25 (1.17, 1.33) for the deep learning model, 0.62 (0.59, 0.65) for the clinical risk factors with BIRADS density model, and 0.66 (0.63, 0.69) for the combined deep learning and clinical risk factors model. For comparing interval cancers versus controls, the c-statistics were 0.64 (0.58, 0.71) with ORs 1.26 (1.10, 1.45) for the deep learning model, 0.71 (0.65, 0.77) for the risk factors with BIRADS density model, and 0.72 (0.66, 0.78) for the combined deep learning and clinical risk factors model.*Conclusions The deep learning model underperformed for interval cancer risk when compared to clinical risk factors including BIRADS density but outperformed in determining screen-detected cancer risk.*Clinical Relevance/Application Deep learning demonstrated the ability to predict three clinically relevant outcomes (no cancer, screening-detected cancer risk, and interval cancer risk) from negative mammograms and clinical risk factors.

RESULTS

The c-statistics for comparing screen-detected cancers versus matched controls waw 0.66 (95% CI: 0.63, 0.69) with odds ratios (OR) 1.25 (1.17, 1.33) for the deep learning model, 0.62 (0.59, 0.65) for the clinical risk factors with BIRADS density model, and 0.66 (0.63, 0.69) for the combined deep learning and clinical risk factors model. For comparing interval cancers versus controls, the c-statistics were 0.64 (0.58, 0.71) with ORs 1.26 (1.10, 1.45) for the deep learning model, 0.71 (0.65, 0.77) for the risk factors with BIRADS density model, and 0.72 (0.66, 0.78) for the combined deep learning and clinical risk factors model.

CLINICAL RELEVANCE/APPLICATION

Deep learning demonstrated the ability to predict three clinically relevant outcomes (no cancer, screening-detected cancer risk, and interval cancer risk) from negative mammograms and clinical risk factors.

SSBR10-6 I Spy With My AI: The Importance Of Thorough Retrospective Performance Evaluation Prior To AI Implementation.

Participants
Gerald Lip, MBBCh, Aberdeen, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Mammography hardware vendors provide significant software updates and/or changes to mammography machines every 3-5 years. These updates go largely unnoticed by human readers. This retrospective study hypothesizes that such updates can have a significant impact on the performance of an artificial intelligence (AI) tool. AI performance can be corrected if local validation is performed prior to implementation.*Methods and Materials We describe the evaluation of an AI tool over a 4-year period of consecutively acquired national screening mammograms. Images were acquired from two static unit machines and two mobile unit machines from a single breast screening centre. The centre is accredited as part of a national screening programme. Clinical outcomes and machine information were blinded until after the AI was run.*Results A high AUC (95.8) indicates strong AI performance. A rise in recall rate was observed after a specific point in time (an "event") for each machine (See figure: Aug 2016 for machine D; Jan 2019 for A and B; April 2019 for C). This event corresponds with additional DICOM tags being observed suggesting that software updates were added to these machines at these times. The dataset was split into two: one dataset before the event [no. of cases: all | positive = 9670 | 113]; a second dataset after the event [all | positive = 6339 | 99]. Use of

an updated threshold post-event allows for an acceptable recall rate (~10%) to be recovered. Note that the AI is being evaluated standalone and that recall rate would drop further when used in a double reading workflow.*Conclusions The existing literature on AI performance uses standard test metrics and human comparisons. We flag the importance of considering the impact that updates to mammography machines can have on AI performance. Local validation prior to implementation demonstrated that an updated threshold, optimized after a suspected software update event, would be more clinically appropriate for live use. Once live, in order to detect any changes as soon as possible, AI implementation must be followed by robust quality assurance, feedback and fallback processes.*Clinical Relevance/Application Large scale temporal review demonstrated that it is important to conduct a review of performance of AI over time, especially if hardware/ software updates are known to have or may have taken place.

RESULTS

A high AUC (95.8) indicates strong AI performance. A rise in recall rate was observed after a specific point in time (an "event") for each machine (See figure: Aug 2016 for machine D; Jan 2019 for A and B; April 2019 for C). This event corresponds with additional DICOM tags being observed suggesting that software updates were added to these machines at these times. The dataset was split into two: one dataset before the event [no. of cases: all | positive = 9670 | 113]; a second dataset after the event [all | positive = 6339 | 99]. Use of an updated threshold post-event allows for an acceptable recall rate (~10%) to be recovered. Note that the AI is being evaluated standalone and that recall rate would drop further when used in a double reading workflow.

CLINICAL RELEVANCE/APPLICATION

Large scale temporal review demonstrated that it is important to conduct a review of performance of AI over time, especially if hardware/ software updates are known to have or may have taken place.

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Abstract Archives of the RSNA, 2021

SSBR09

Science Session with Keynote: Breast Imaging (Artificial Intelligence and Radiomics in MRI/Artificial Intelligence in Digital Breast Tomosynthesis)

Participants

Katja Pinker-Domenig, MD, New York, New York (*Moderator*) Speakers bureaus:European Society of Breast Imaging (active)Siemens Healthineers (ended)IDKD 2019 (ended)Olea Medical (ended) Consulting, AdvisoryConsultantGenentech, Inc.05/19-presentConsultantMerantix Healthcare05/20- presentConsultantAURA Health

Sub-Events

SSBR09   Keynote Speaker

Participants

Emily F. Conant, MD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Hologic, Inc;Advisory Panel, Hologic, Inc;Research Grant, OM1, Inc;Research Grant, iCad, Inc;Advisory Panel, iCad, Inc;Speaker, Medscape, LLC

SSBR09-1   BI-RADS Reading Of Non-mass Lesions On DCE-MRI And Differential Diagnosis Performed By Radiomics And Deep Learning

Participants

Yang Zhang, New Brunswick, New Jersey (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the morphological distribution and internal enhancement pattern of benign and malignant lesions demonstrating non-mass enhancement on DCE-MRI, and to investigate the diagnostic performance of radiomics and deep learning using ResNet50.*Methods and Materials 150 patients with 104 malignant and 46 benign NME were analyzed. Three radiologists performed reading for morphological distribution and internal enhancement using the 5th BI-RADS lexicon. For each case, the 3D tumor mask was generated using Fuzzy-C-Means segmentation. Three DCE parametric maps related to wash-in, maximum, and wash-out were generated, and PyRadiomics was applied to extract features. The radiomics model was built using 5 machine learning algorithms. ResNet50 was implemented using three parametric maps as input. Approximately 70% of earlier cases were used for training, and 30% later cases held-out for testing.*Results The diagnostic BI-RADS in the original MRI report showed that 104/104 malignant and 36/46 benign lesions had BI-RADS score of 4A-5. For category reading, the kappa coefficient was 0.83 for morphological distribution (excellent), and 0.52 for internal enhancement (moderate). Segmental and Regional distribution were the most prominent for the malignant group, and focal distribution for the benign group. Eight radiomics features were selected by SVM. Among the 5 machine learning algorithms, SVM yielded the highest accuracy of 80.4% in training, 77.5% in testing datasets. ResNet50 had a better diagnostic performance, 91.5% in training, and 83.3% in testing datasets.*Conclusions BI-RADS scores and descriptors showed a substantial overlap; computer-aided methods with sophisticated machine learning and deep learning algorithms can be further developed to help solving the difficult problem in the diagnosis of NME on MRI.*Clinical Relevance/Application Deep learning using ResNet50 algorithm yielded a high diagnostic accuracy around 90%, which could provide a feasible tool for the difficult diagnosis of NME on MRI.

RESULTS

The diagnostic BI-RADS in the original MRI report showed that 104/104 malignant and 36/46 benign lesions had BI-RADS score of 4A-5. For category reading, the kappa coefficient was 0.83 for morphological distribution (excellent), and 0.52 for internal enhancement (moderate). Segmental and Regional distribution were the most prominent for the malignant group, and focal distribution for the benign group. Eight radiomics features were selected by SVM. Among the 5 machine learning algorithms, SVM yielded the highest accuracy of 80.4% in training, 77.5% in testing datasets. ResNet50 had a better diagnostic performance, 91.5% in training, and 83.3% in testing datasets.

CLINICAL RELEVANCE/APPLICATION

Deep learning using ResNet50 algorithm yielded a high diagnostic accuracy around 90%, which could provide a feasible tool for the difficult diagnosis of NME on MRI.

SSBR09-2   Application Of Two Deep Learning Networks For Diagnosis Of Breast Cancer On MRI: Automatic Detection Using Mask R-CNN Followed By Classification Using ResNet50

Participants

Yang Zhang, New Brunswick, New Jersey (*Presenter*) Nothing to Disclose

PURPOSE

We have previously developed a fully-automatic breast cancer detection method on MRI using Mask Regional-Convolutional Neural Network (R-CNN). We have also developed a deep learning model using ResNet50 to estimate the malignancy probability. In this study, these two deep learning networks were combined to test its diagnostic validity in clinical practice.*Methods and Materials The developed detection/classification network was tested in two datasets, performed on a 3T system. The first one had 176 cases, 103 cancer and 73 benign. The second one had 84 cases, 53 cancers and 31 benign. All slices were evaluated by a pre-

trained Mask R-CNN framework using ResNet101 as the backbone. The pre-contrast image, and the subtraction images of both breasts were used as inputs, so the symmetry could be utilized as reference. The detected suspicious area was further characterized by ResNet50. Three DCE parametric maps (F2-F1, F3-F1, F6-F3) were used as inputs. The evaluation was done using slice-based analysis, and then the obtained results from all slices of a lesion were combined to give a lesion-based diagnosis.*Results In the first dataset, 101 of 103 cancers were detected by Mask R-CNN as suspicious, and 99 of 101 were correctly classified by ResNet50 as cancer. 48 of 73 benign lesions, and 130 normal areas, were identified by Mask R-CNN as suspicious. Following classification by ResNet50, only 32 of these 178 remained as suspicious of malignancy. The overall sensitivity is 99/103=96%, with 32/153=21% false positive rates. The second dataset had more non-mass enhancing large lesions, and the performance was worse. 49 of 53 cancers were detected by Mask R-CNN as suspicious, and 43 were classified as cancer. The sensitivity is 43/53=81%. 6 of 31 benign lesions and 22 normal tissue areas were considered as suspicious of malignancy, with false positive rate of 28/84=33%.*Conclusions The previously developed Mask R-CNN detection model followed by ResNet50 classification model was directly applied to two new datasets, and achieved a high sensitivity. The false positive diagnosis, especially from the normal parenchymal enhancements, can be further eliminated by other algorithms.*Clinical Relevance/Application AI-based diagnostic tool has gradually become mature for clinical use. A combined Mask R-CNN and ResNet50 algorithm has the potential to provide a fully-automatic system for diagnosis of breast cancer on MRI.

RESULTS

In the first dataset, 101 of 103 cancers were detected by Mask R-CNN as suspicious, and 99 of 101 were correctly classified by ResNet50 as cancer. 48 of 73 benign lesions, and 130 normal areas, were identified by Mask R-CNN as suspicious. Following classification by ResNet50, only 32 of these 178 remained as suspicious of malignancy. The overall sensitivity is 99/103=96%, with 32/153=21% false positive rates. The second dataset had more non-mass enhancing large lesions, and the performance was worse. 49 of 53 cancers were detected by Mask R-CNN as suspicious, and 43 were classified as cancer. The sensitivity is 43/53=81%. 6 of 31 benign lesions and 22 normal tissue areas were considered as suspicious of malignancy, with false positive rate of 28/84=33%.

CLINICAL RELEVANCE/APPLICATION

AI-based diagnostic tool has gradually become mature for clinical use. A combined Mask R-CNN and ResNet50 algorithm has the potential to provide a fully-automatic system for diagnosis of breast cancer on MRI.

SSBR09-3   An AI System For Lesion Detection Using Multi-institutional Digital Breast Tomosynthesis Data

Participants
Julia Goldberg, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To train an AI lesion detection system jointly on internal and external DBT datasets and evaluate its performance in the SPIE-AAPM-NCI DAIR Digital Breast Tomosynthesis Lesion Detection (DBTex) Challenge.*Methods and Materials We collected a dataset of 100,420 internal DBT exams (N=85,896 patients [pts], 397 malignant, 726 benign) along with pixel-level lesion annotations of biopsied lesions. We also utilized 229,282 internal digital mammograms (N=141,397 pts, 849 malignant, 3,058 benign) and 700 DBT exams from the DBTex challenge (N=693 pts, 39 malignant, 62 benign) in training our models. All DBT exams were acquired with the Hologic Selenia Dimensions. We trained our deep convolutional neural networks to detect biopsy-proven lesions in DBT exams and evaluated them using 180 DBT exams (N=175 pts) from the test dataset of the DBTex challenge. Model performance of predicting bounding-boxes for lesions was assessed using Free-Response Operating Characteristic (FROC) curve analysis. Our final model is an ensemble of EfficientDet models trained on all available data and then fine-tuned on the exams from the DBTex challenge.*Results The mean age was 59.5, range 21.3 - 99.5. Internal DBT dataset density was 9.0% fatty, 40.4% scattered fibroglandular, 45.0% heterogeneously dense, and 5.4% extremely dense. Our model can output the slice where the lesion is most clearly visible.Our model ranked first in the DBTex Challenge by achieving the highest scores on the test set. Our model had a sensitivity of 91.2% at a threshold that leads to 2 false positive (FP) bounding box predictions per view on average, meaning that the model can detect 91.2% of all masses and architectural distortions at this threshold. This sensitivity was 49.2 percentage points higher than the baseline provided by the challenge organizers. In addition, among the subset of images with biopsy-confirmed lesions, the mean sensitivity at 4 different thresholds which lead to 1, 2, 3, and 4 FP predictions per view was 91.2%. This was the main evaluation metric of the competition in which our model outperformed all other participants.*Conclusions Our model trained on multi-institutional datasets produced the most accurate bounding-box lesion predictions in the DBTex Challenge.*Clinical Relevance/Application Aside from the most accurate lesion prediction, our model outputs the slice where the lesion is most clearly visible, potentially improving AI decision support and synthesizing AI-processed 2D images to maximize lesion conspicuity.

RESULTS

The mean age was 59.5, range 21.3 - 99.5. Internal DBT dataset density was 9.0% fatty, 40.4% scattered fibroglandular, 45.0% heterogeneously dense, and 5.4% extremely dense. Our model can output the slice where the lesion is most clearly visible.Our model ranked first in the DBTex Challenge by achieving the highest scores on the test set. Our model had a sensitivity of 91.2% at a threshold that leads to 2 false positive (FP) bounding box predictions per view on average, meaning that the model can detect 91.2% of all masses and architectural distortions at this threshold. This sensitivity was 49.2 percentage points higher than the baseline provided by the challenge organizers. In addition, among the subset of images with biopsy-confirmed lesions, the mean sensitivity at 4 different thresholds which lead to 1, 2, 3, and 4 FP predictions per view was 91.2%. This was the main evaluation metric of the competition in which our model outperformed all other participants.

CLINICAL RELEVANCE/APPLICATION

Aside from the most accurate lesion prediction, our model outputs the slice where the lesion is most clearly visible, potentially improving AI decision support and synthesizing AI-processed 2D images to maximize lesion conspicuity.

SSBR09-4   Triaging Women From MRI To Mammography To Adapt Screening To Changes In Breast Density Using Artificial Intelligence

Participants
Bas van der Velden, PhD, Utrecht, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Magnetic resonance imaging (MRI) is effective to screen women with extremely dense breasts, but it is more resource intensive than mammography. Breast density decreases with age, but density on MRI is not identical to mammographic density, raising the question when to return women to conventional mammography screening in future MRI-only screening setting. This study assesses

the feasibility of artificial intelligence (AI) to triage women from MRI-screening back to mammographic screening when appropriate.*Methods and Materials Women with extremely dense breasts in the multi-institutional DENSE trial received mammography and MRI in biennial screening rounds. We trained a regression convolutional neural network (CNN) to predict the mammographic density percentage (VolparaDensity version 1.5) from MRI only.We used data from the first two screening rounds to train the CNN. Input were precontrast 3D T1-weighted MRI, output was mammographic density percentage. Data were split in train (60%), validation (20%), and hold-out test (20%) set on participant level.Correlation between AI-predicted mammographic density based on MRI and actual mammographic density was assessed using Spearman's ?.Triaging from MRI to mammographic screening was assessed in the hold-out test set of the second screening round. Triaging was defined 'correct' when VolparaDensity and AI agreed on a density <15.5% for both breasts. We registered how often the AI correctly triaged these women at 95% specificity.*Results 4300 MRIs from 2867 women were included. Median mammographic density (interquartile range) was 19% (17%-22%) in the first round and 18% (15%-21%) in the second round. In the hold-out test set (N=860), correlation between AI-predicted mammographic density and VolparaDensity was ?=0.76 (P<0.001). In the hold-out test set of the second round (N=380), mammographic density of both breasts decreased to <15.5% in 69/380 (18%) women. The AI correctly identified this decrease in 40/69 (58%) women.*Conclusions AI shows potential to correctly triage more than half the number of women with decreased breast density from MRI-only screening back to mammographic screening at high specificity.*Clinical Relevance/Application AI-based triaging of women with extremely dense breasts from MRI-only screening back to mammography screening is feasible, enabling radiologists to reduce workload and re-allocate resources.

RESULTS

4300 MRIs from 2867 women were included. Median mammographic density (interquartile range) was 19% (17%-22%) in the first round and 18% (15%-21%) in the second round. In the hold-out test set (N=860), correlation between AI-predicted mammographic density and VolparaDensity was ?=0.76 (P<0.001). In the hold-out test set of the second round (N=380), mammographic density of both breasts decreased to <15.5% in 69/380 (18%) women. The AI correctly identified this decrease in 40/69 (58%) women.

CLINICAL RELEVANCE/APPLICATION

AI-based triaging of women with extremely dense breasts from MRI-only screening back to mammography screening is feasible, enabling radiologists to reduce workload and re-allocate resources.

SSBR09-5   AI-Triaging Of Breast MRI For Radiological Review In The Screening Of Women With Extremely Dense Breasts

Participants
Kenneth G. Gilhuijs, PhD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Supplemental screening with MRI in women with extremely dense breasts proved to be beneficial. As expected, most screening MRIs showed normal anatomical and physiological variation that does not require expert radiologist's review. We pursued automated triaging to dismiss examinations without lesions for radiological review, while still identifying all examinations with malignant disease.*Methods and Materials In this re-analysis of data from the DENSE trial (a randomized controlled trial into the additional value of MRI screening in women aged 50-75 years with extremely dense breasts and negative mammography, ClinicalTrials.gov NCT01315015), we included 4581/4783 (96%) dynamic contrast-enhanced T1-weighted breast MRI examinations from the first screening round, and 2901/3436 (84%) from the second round. Examinations were excluded if data were not available in full for artificial intelligence (AI) analysis. A convolutional neural network was trained using the examinations from the first round to distinguish between breasts with lesions (i.e., BI-RADS 2-5), and normal breasts without lesions (i.e., BI-RADS 1). Eight-fold internal-external validation and receiver-operating characteristic (ROC) analysis were applied. At 100% sensitivity, we established the fraction of examinations (bilateral) that could be dismissed from radiological review. The examinations from the second screening round were subsequently used to validate the AI.*Results The area under the ROC curve (AUC) in the first screening round was 0.81. Of the 785 examinations with lesions, 755 (96.2%; 95%CI 94.6%-97.4%) were considered non-normal (i.e., containing lesions, 77 of which were malignant), and would triage to radiological review. Conversely, 728 of 3796 examinations (19.2%; 95%CI 17.9%-20.5%) without lesions could be dismissed. All 77 examinations with cancer were detected. In the second screening round, the AUC was 0.79. All 20 examinations with cancer were detected. Of the 303 examinations with lesions, 278 (91.8%; 95%CI 88.1%-94.6%) were considered non-normal and would triage to radiological review. Conversely, 550 of 2598 examinations (21.2%; 95%CI 17.9%-20.5%) without lesions could be dismissed.*Conclusions AI-triaging of screening breast MRI in women with dense breasts shows potential to dismiss approximately 20% of normal examinations from radiological review without dismissing malignant disease.*Clinical Relevance/Application AI-triaging of screening breast MRI in women with dense breasts may reduce the workload of radiologists by automatically dismissing examinations that show normal anatomical and physiological variation, thus optimizing the use of resources.

RESULTS

The area under the ROC curve (AUC) in the first screening round was 0.81. Of the 785 examinations with lesions, 755 (96.2%; 95%CI 94.6%-97.4%) were considered non-normal (i.e., containing lesions, 77 of which were malignant), and would triage to radiological review. Conversely, 728 of 3796 examinations (19.2%; 95%CI 17.9%-20.5%) without lesions could be dismissed. All 77 examinations with cancer were detected. In the second screening round, the AUC was 0.79. All 20 examinations with cancer were detected. Of the 303 examinations with lesions, 278 (91.8%; 95%CI 88.1%-94.6%) were considered non-normal and would triage to radiological review. Conversely, 550 of 2598 examinations (21.2%; 95%CI 17.9%-20.5%) without lesions could be dismissed.

CLINICAL RELEVANCE/APPLICATION

AI-triaging of screening breast MRI in women with dense breasts may reduce the workload of radiologists by automatically dismissing examinations that show normal anatomical and physiological variation, thus optimizing the use of resources.

SSBR09-7   Artificial Intelligence For Digital Breast Tomosynthesis To Detect Breast Cancer: Validation Across Different Patient Populations And Mammography Vendors

Participants
Ki Hwan Kim, MD,PhD, Seoul, Korea, Republic Of (*Presenter*) Employee, Lunit Inc

PURPOSE

Use of artificial intelligence (AI) for mammography improves radiologists' performance in breast cancer detection, but most existing algorithms are based on conventional 2D digital mammography. This study aimed to develop an AI algorithm for the detection of

breast cancer on digital breast tomosynthesis (DBT) and to investigate the performance of the algorithm among women of different ethnicities and with different mammography vendors.*Methods and Materials An AI algorithm based on a deep convolutional neural network was trained and validated to detect breast cancer using 13435 DBT examinations performed on mammography machines from two different vendors (Hologic and GE) and collected from South Korea and the United States. The examinations included 3606 cancer cases confirmed by biopsy, 6863 benign cases confirmed by biopsy or at least two-year follow-up imaging, and 2966 normal cases. In addition, the developed AI algorithm was further validated with an independent external dataset that was not used for training, consisting of 700 DBT cases (39 cancers, 241 benign, and 420 normal) from the United States. The diagnostic performance of the AI algorithm was evaluated using receiver operating characteristic (ROC) curve analyses.*Results The AI algorithm demonstrated an area under the ROC curve (AUC) of 0.943 with sensitivity and specificity of 84.5% and 91.6%, respectively. In the South Korean dataset, the AUC was 0.935, sensitivity was 82.8%, and specificity was 93.2%. In the United States dataset, the AUC was 0.944, sensitivity was 84.8%, and specificity was 91.2%. In the Hologic dataset, the AUC was 0.943, sensitivity was 83.3%, and specificity was 91.8%. In the GE dataset, the AUC was 0.944, sensitivity was 87.1%, and specificity was 91.0%. The performance metrics of the AI algorithm on the external validation dataset were similar to those of the internal validation dataset (AUC of 0.940, sensitivity of 82.6%, and specificity of 92.0%).*Conclusions The AI algorithm developed with large-scale DBT data demonstrated high diagnostic performance in breast cancer detection with comparable performance across datasets from South Korea and the United States and across different mammography vendors.*Clinical Relevance/Application An AI algorithm using a large dataset of DBT may improve breast cancer detection and has the potential to show consistent performance across different patient populations and mammography vendors.

RESULTS

The AI algorithm demonstrated an area under the ROC curve (AUC) of 0.943 with sensitivity and specificity of 84.5% and 91.6%, respectively. In the South Korean dataset, the AUC was 0.935, sensitivity was 82.8%, and specificity was 93.2%. In the United States dataset, the AUC was 0.944, sensitivity was 84.8%, and specificity was 91.2%. In the Hologic dataset, the AUC was 0.943, sensitivity was 83.3%, and specificity was 91.8%. In the GE dataset, the AUC was 0.944, sensitivity was 87.1%, and specificity was 91.0%. The performance metrics of the AI algorithm on the external validation dataset were similar to those of the internal validation dataset (AUC of 0.940, sensitivity of 82.6%, and specificity of 92.0%).

CLINICAL RELEVANCE/APPLICATION

An AI algorithm using a large dataset of DBT may improve breast cancer detection and has the potential to show consistent performance across different patient populations and mammography vendors.

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Participants
Benjamin Fritz, MD, Zurich, Switzerland (*Moderator*) Nothing to Disclose
Mark Cresswell, MBBCh, Vancouver, British Columbia (*Moderator*) Consultant, Koninklijke Philips NV

Sub-Events

SSMK04-1   In-vivo Assessment Of Trapezio-metacarpal Joint Kinematics Using 4-D CT.

Participants
Nico Buls, DSc, PhD, Jette, Belgium (*Presenter*) Nothing to Disclose

PURPOSE

Advances in CT scanning procedures that combine temporal information and high-resolution volumetric data can be useful in the evaluation of diseases such as osteoarthritis (OA). The purpose of this study is to establish a quantitative analysis of the trapezio-metacarpal joint (TMCJ) kinematics using 4D-CT.*Methods and Materials Following approval from the ethical committee board of our institution, 4D-CT cine images (256-slice Revolution CT, GE Healthcare) were acquired on 5 healthy asymptomatic adults while they performed a cyclic movement of thumb opposition-reposition. Two scans were taken for each subject, one with free motion, and one with hindered motion induced by an elastic band between the thumb and the fifth phalanx to simulate disturbed motion. Image processing of the resulting images was done using custom code written in Python and based on the insight segmentation and registration toolkit (ITK). Image sequences were registered to calculate the transformations that describe the absolute and relative motion of the trapezium (Tz) and metacarpal (MC) bone in a local coordinate system (LCS) defined by anatomic landmarks. Optimization of the registration was performed for different similarity metrics (mean squares, normalized correlation, mutual information) and masks (fixed mask with dilation sizes ranging 1 to 5 voxels) by calculating Dice scores. Travelled distance of bone landmarks, range of motion (ROM) along the axes and areas of the motion coordinates projected on the LCS planes were computed to analyze the joint kinematics. Difference in kinematics between free motion and hindered motion was evaluated by paired t-tests.*Results Normalized correlation metric and a 5-voxel dilation mask yielded the best registration results (average dice score 0.917 and 0.972 for MC and Tz respectively) Movement disturbances and longer trajectories were visually noticed on the 2D and 3D kinematics for the cases hindered by the elastic band. Significantly higher values for travelled distance (p=0.027), volar ROM (p=0.002) and projected areas (p=0.002) were found on the hindered motion, revealing differences between the motion trajectories.*Conclusions Our study showed the feasibility of acquiring, processing and registering the images of 4D-CT on the TMCJ. The kinematic parameters and the motion visualization allowed observing differences between hindered and non-hindered thumb opposition-reposition.*Clinical Relevance/Application Quantitative imaging modalities are becoming increasingly useful in the understanding and evaluation of MSK conditions with dynamic CT being a promising tool. Such quantitative assessment could increase the clinical value of radiologic examinations as it adds a functional dimension to morphological data.

RESULTS

Normalized correlation metric and a 5-voxel dilation mask yielded the best registration results (average dice score 0.917 and 0.972 for MC and Tz respectively) Movement disturbances and longer trajectories were visually noticed on the 2D and 3D kinematics for the cases hindered by the elastic band. Significantly higher values for travelled distance (p=0.027), volar ROM (p=0.002) and projected areas (p=0.002) were found on the hindered motion, revealing differences between the motion trajectories.

CLINICAL RELEVANCE/APPLICATION

Quantitative imaging modalities are becoming increasingly useful in the understanding and evaluation of MSK conditions with dynamic CT being a promising tool. Such quantitative assessment could increase the clinical value of radiologic examinations as it adds a functional dimension to morphological data.

SSMK04-2   Comparison Of 3-dimensional Magnetic Resonance Imaging And Computed Tomography For Evaluation Of Glenoid Deformity In Shoulder Arthritis

Participants
Mohammad Samim, MD, MRCS, Eastchester, New York (*Presenter*) Nothing to Disclose

PURPOSE

3-dimentional (3-D) computed tomography (CT) is the imaging modality of choice for preoperative assessment of glenoid morphology in primary shoulder osteoarthritis. However, it is limited in its ability to evaluate the rotator cuff (RC) and also exposes patients to radiation. The aim of this study was to compare 3-D magnetic resonance imaging (MRI) and 3-D CT with respect to assessment of glenoid wear and RC integrity in osteoarthritic shoulders.*Methods and Materials CT and MRI were performed on the same day on 31 patients with osteoarthritic shoulders scheduled for shoulder arthroplasty and 3-D CT and 3-D MRI reconstructions were generated as per study protocol. Two reviewers independently performed glenoid morphometric measurements (inclination and version), and evaluated other parameters including glenoid erosion patterns, RC tear, integrity and RC muscle fatty infiltration grade. Mean differences between the two imaging modalities were calculated. Interobserver agreement was calculated using kappa coefficient (k).*Results 29 patients met the inclusion criteria. There were 5 A1, 7 A2, 8 B2 and 9 B3 glenoid morphology. The combined mean absolute difference in glenoid version between 3-D CT and 3-D MRI was 2.7°± 1.6° (range 0.15 to 7.85, P- value =

0.7). The combined mean absolute difference in glenoid inclination between 3-D CT and 3-D MR was 6.8° ± 4.1° (range 0.8° to 15.75°, P-value = 0.17). No significant inter-reader variation in glenoid version and inclination measurements on 3-D CT and 3-D MRI was found (P >0.05). The inter-reader reliability for both CT and MRI was strong and almost perfect for the Walch grading of glenoid bone loss (k= 1 k= 0.86, respectively). The accuracy of CT, compared to MRI, in determining any RC tear was excellent for full thickness tears (100%). Agreement between CT and MRI on Goutallier grading of fatty infiltration of the RC muscle was substantial for supraspinatus (k=0.65), moderate for infraspinatus (k=0.5) and fair for subscapularis (k=0.38).*Conclusions 3-D MR is comparable to 3-D CT and can be used as alternative for preoperative assessment of glenoid wear in arthritic shoulders. CT is comparable to MRI for detection of full thickness tears, but MRI provides more detailed evaluation of RC integrity.*Clinical Relevance/Application 3-D MRI can be used in lieu of 3-D CT for the assessment of glenoid bone loss in preoperative planning of shoulder arthroplasty ???????and has the advantage of better assessing the soft tissue pathologies, including rotator cuff tears and muscle atrophy.

RESULTS

29 patients met the inclusion criteria. There were 5 A1, 7 A2, 8 B2 and 9 B3 glenoid morphology. The combined mean absolute difference in glenoid version between 3-D CT and 3-D MRI was 2.7°± 1.6° (range 0.15 to 7.85, P- value = 0.7). The combined mean absolute difference in glenoid inclination between 3-D CT and 3-D MR was 6.8° ± 4.1° (range 0.8° to 15.75°, P-value = 0.17). No significant inter-reader variation in glenoid version and inclination measurements on 3-D CT and 3-D MRI was found (P >0.05). The inter-reader reliability for both CT and MRI was strong and almost perfect for the Walch grading of glenoid bone loss (k= 1 k= 0.86, respectively). The accuracy of CT, compared to MRI, in determining any RC tear was excellent for full thickness tears (100%). Agreement between CT and MRI on Goutallier grading of fatty infiltration of the RC muscle was substantial for supraspinatus (k=0.65), moderate for infraspinatus (k=0.5) and fair for subscapularis (k=0.38).

CLINICAL RELEVANCE/APPLICATION

3-D MRI can be used in lieu of 3-D CT for the assessment of glenoid bone loss in preoperative planning of shoulder arthroplasty ???????and has the advantage of better assessing the soft tissue pathologies, including rotator cuff tears and muscle atrophy.

SSMK04-3   High-resolution Photon-counting Detector (PCD) CT Of Small Joints

Participants
Kishore Rajendran, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To demonstrate improved spatial resolution of wrist and ankle CT exams using high-resolution (HR), photon-counting detector (PCD) CT.*Methods and Materials Patients who underwent clinically-indicated wrist or ankle exams were scanned on conventional energy-integrating detector (EID) CT with a comb filter at 120 kV and using the non-comb-based HR mode of an investigational whole-body PCD-CT (SOMATOM Count Plus, Siemens Healthineers) at 120 kV. EID-CT images were reconstructed using routine clinical protocol (Ur70 or Ur73 kernel, iterative reconstruction [IR] strength 2, minimum slice thickness, 0.4 or 0.6 mm), and PCD-CT images were reconstructed using HR kernel (Br84), IR strength 3, 0.4 mm slice thickness. Two musculoskeletal (MSK) radiologists blindly evaluated randomized and paired EID-CT and PCD-CT images, comparing visualization of predetermined critical joint structures using a 5-pt Likert scale; images were randomly labeled as candidate and reference, with readers assigning scores to the candidate images in comparison to the reference (1-worse visualization, poor diagnostic confidence, 2-worse visualization, no change in diagnostic confidence, 3-comparable image quality and confidence, 4-improved image quality, no change in confidence, 5 - improved confidence and visualization). A post-hoc assignment of reader scores was performed so they reflected PCD-CT visualization relative to EID-CT. Wilcoxon rank sum test was used to evaluate the relative image quality of PCT-CT compared to EID-CT using the quality comparison scores for visualization.*Results 12 patients underwent wrist CT (EID-CT mean CTDIvol = 19 mGy; PCD-CT mean CTDIvol = 9.6 mGy), and 7 patients underwent ankle CT (EID-CT mean CTDIvol = 18 mGy; PCT-CT CTDIvol = 13.8 mGy). MSK radiologists graded PCD-CT images as significantly better than EID-CT for critical structure visualization and diagnostic confidence (p < 0.001) with a median score of 4 for both ankles and wrists. Intraarticular gas, subchondral fracture, trabecular architecture, cystic changes in scaphoid, and metatarsal pseudoarthrosis were better delineated on PCD-CT.*Conclusions Despite a 24-50% dose reduction, PCD-CT in UHR mode demonstrated significantly better visualization of critical structures of the wrists and ankles compared to conventional EID-CT.*Clinical Relevance/Application Using PCD-CT with dose-efficient UHR, patient radiation dose can be reduced by up to 50% while simultaneously improving the image quality and diagnostic confidence for imaging of small joints.

RESULTS

12 patients underwent wrist CT (EID-CT mean CTDIvol = 19 mGy; PCD-CT mean CTDIvol = 9.6 mGy), and 7 patients underwent ankle CT (EID-CT mean CTDIvol = 18 mGy; PCT-CT CTDIvol = 13.8 mGy). MSK radiologists graded PCD-CT images as significantly better than EID-CT for critical structure visualization and diagnostic confidence (p < 0.001) with a median score of 4 for both ankles and wrists. Intraarticular gas, subchondral fracture, trabecular architecture, cystic changes in scaphoid, and metatarsal pseudoarthrosis were better delineated on PCD-CT.

CLINICAL RELEVANCE/APPLICATION

Using PCD-CT with dose-efficient UHR, patient radiation dose can be reduced by up to 50% while simultaneously improving the image quality and diagnostic confidence for imaging of small joints.

SSMK04-4   Significant Variability Exists In Preoperative Planning Software Measures Of Glenoid Morphology For Shoulder Arthroplasty

Participants
Nicholas Laucis, MD, Westland, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

Total shoulder arthroplasty (TSA) and reverse total shoulder arthroplasty (RTSA) are mainstays of definitive management of both degenerative and acute shoulder conditions. Glenoid component malpositioning in TSA and in RTSA have been shown to adversely affect both clinical and radiographic outcomes. Preoperative planning 3D imaging has become increasingly relied upon to improve component positioning in shoulder arthroplasty with multiple vendors offering shoulder arthroplasty planning software. We assessed the reliability of four shoulder arthroplasty 3D preoperative planning programs with comparison to manual measurements conducted by two fellowship-trained musculoskeletal radiologists.*Methods and Materials 76 CT scans of patients undergoing shoulder arthroplasty were separately analyzed for glenoid version and inclination by four software systems (VIP, Blueprint, TrueSight,

ExactechGPS). Inter-rater reliability (IRR) was assessed via intra-class correlation coefficient (ICC). For those shoulders with glenohumeral arthritis (58 of 76), ICC was also calculated when sub-grouping by modified Walch classification. Lin's concordance correlation coefficient (CCC) was calculated for each system with the radiologists' measurements.*Results IRR for the radiologists' measurements of glenoid version were excellent, 0.987 (95% CI: 0.966-0.995) and 0.937 (95% CI: 0.843-0.975). IRR for the radiologists' measurements of glenoid inclination were also excellent, 0.950 (95% CI: 0.840-0.982) and 0.966 (95% CI: 0.915-0.987). Measurements of glenoid version and inclination differed between at least two programs by 5º-10º in 75% and 92% of glenoids respectively, and by >10º in 18% and 45% respectively. ICC was excellent for version but only good for inclination. ICC was highest among Walch A glenoids for both version (near excellent) and inclination (good), and lowest among Walch D for version (near poor) and Walch B for inclination (moderate). For version, VIP had the highest concordance with radiologists' measurements; Blueprint had the lowest. For inclination, Blueprint had the highest concordance while ExactechGPS had the lowest.*Conclusions Significant variability in CT-based measures of glenoid version and inclination between four frequently utilized shoulder arthroplasty templating software worsens with glenoid deformity. Software concordance with radiologists' measurement is variable.*Clinical Relevance/Application Glenoid deformity had a strong influence on both version and inclination measurement reliability of the four software packages investigated. Further research is needed to understand how this variability should be accounted for during shoulder arthroplasty preoperative planning.

RESULTS

IRR for the radiologists' measurements of glenoid version were excellent, 0.987 (95% CI: 0.966-0.995) and 0.937 (95% CI: 0.843-0.975). IRR for the radiologists' measurements of glenoid inclination were also excellent, 0.950 (95% CI: 0.840-0.982) and 0.966 (95% CI: 0.915-0.987). Measurements of glenoid version and inclination differed between at least two programs by 5º-10º in 75% and 92% of glenoids respectively, and by >10º in 18% and 45% respectively. ICC was excellent for version but only good for inclination. ICC was highest among Walch A glenoids for both version (near excellent) and inclination (good), and lowest among Walch D for version (near poor) and Walch B for inclination (moderate). For version, VIP had the highest concordance with radiologists' measurements; Blueprint had the lowest. For inclination, Blueprint had the highest concordance while ExactechGPS had the lowest.

CLINICAL RELEVANCE/APPLICATION

Glenoid deformity had a strong influence on both version and inclination measurement reliability of the four software packages investigated. Further research is needed to understand how this variability should be accounted for during shoulder arthroplasty preoperative planning.

SSMK04-5   Physeal Stress Injuries Vs.Salter-harris Fractures:The Role Of The Perichondrium

Participants
Simukayi Mutasa, MD, Newport Beach, California (*Presenter*) Nothing to Disclose

PURPOSE

Differentiating physeal stress injuries (PSI) with Salter-Harris fractures (SHF) can sometimes be difficult. We propose that the perichondrium is an under-utilized differentiating marker and aim to determine whether or not it violated in SHFs versus PSIs.*Methods and Materials A retrospective study of MRI scans in patients with SHFs and PSIs was performed. 54 MRI scans were obtained in patients diagnosed with PSI (Top 3: 18 shoulders, 8 ankles, 8 elbows) and 35 in patients diagnosed with SHF (11 Knee, 10 Ankle, 3 wrist/elbow). 27 studies were excluded. After training on 20 examinations with a pediatric MSK specialist radiologist, the remaining cases were evaluated for discontinuity of the perichondrium by a PGY-VI Musculoskeletal radiology fellow (SM). Technical exclusion criteria included missing proton density, DESS, and/or T2 FSE sequences, or excessive motion artifact. Non-technical exclusion criteria involved no evidence of initial injury on subsequent second review by a pediatric MSK attending, imaging after physeal closure, and an imaging time period greater than 6 weeks after the inciting injury. Fisher exact test was used to calculate correlations between age, sex, and fracture class.*Results 0 of 35 remaining PSIs had evidence of perichondrial injury on imaging. 22 of 27 (82%) remaining SHFs had perichondrial breaks (Fisher's test p-value 0.00001). Of the SHFs age, sex, and Salter-Harris class were not significant predictors of the development of a perichondrial break (p = 0.16 In this study, the presence of perichondrium disruption is specific for the presence of a Salter-Harris fracture mechanism if a patient with an open physis at the joint of interest is imaged within 6 weeks. Conversely, an intact perichondrium on imaging does not preclude a Salter-Harris fracture mechanism. , 1.0, and 0.14 respectively).*Conclusions •Perichondrial disruption = specific for Salter-Harris fracture •Intact perichondrium does not preclude fracture. •Violation of the perichondrium may be used as a diagnostic criterion for differentiating Salter-Harris fractures from physeal stress injuries.*Clinical Relevance/Application Violation of the perichondrium may be used as a diagnostic criterion for differentiating Salter-Harris fractures from physeal stress injuries.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Violation of the perichondrium may be used as a diagnostic criterion for differentiating Salter-Harris fractures from physeal stress injuries.

SSMK04-6   Articular Drop-down Lesions: Imaging Findings, And Ominous And Non-ominous Mimics

Participants
Alessandra Sax, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Proximal humeral lesions are common, with benign subchondral and subentheseal processes predominating. However, occasionally lesions in this location are malignant, presenting a management challenge. We hypothesize that benign "articular drop-down" (ADD) lesions mimicking malignancy may represent imbibition of joint fluid into the humerus, with adjacent reactive change. Here, we delineated the imaging findings of such lesions and correlated them with pathology in order to provide guidance for this commonly encountered diagnostic dilemma.*Methods and Materials We retrospectively mined our PACS database for shoulder MRIs referred by the orthopedic oncology service for second-opinion interpretation of proximal humeral lesions. Images were reviewed by at least

two fellowship-trained musculoskeletal radiologists. Imaging features were documented (location, size, signal characteristics). We conducted a chart review for patient demographics and pathology results.*Results 20 MRI exams were reviewed in which ADD was offered as a leading diagnosis (average age 51; 9 female, 11 male). 80% of lesions were subarticular. 100% of the subarticular lesions were T2-hyperintense, T1-hypointense, with 80% showing adjacent curving fat (curved fat sign). 85% of the subarticular lesions were associated with arthritis or trauma. 16% of the subarticular lesions received direct MR arthrograms, with intra-osseous contrast extravasation from the joint into the lesion. 35% of patients received intravenous contrast, with varying degrees of enhancement. 35% of patients underwent needle biopsy. 25% of patients had a total shoulder replacement (for osteoarthritis). 86% of biopsy/resection specimens demonstrated trabeculated bone with reactive changes. None of the lesions in the subarticular location were malignant after biopsy/resection. 75% of non-subarticular lesions had completely non-aggressive imaging features and no biopsy was performed. One had imaging features of an aggressive chondroid lesion, and was subsequently a biopsy-proven chondrosarcoma that was resected.*Conclusions ADD lesions are common. We hypothesize this represents imbibition of synovial joint fluid into the proximal humerus, with reactive changes sometimes mimicking malignancy. We found that typical imaging features of these benign lesions include subarticular location with communication to the joint, T2-signal hyperintensity with varying degrees of enhancement, and the 'curved fat sign'. Our study provides clarification for the differential diagnosis and management of such lesions.*Clinical Relevance/Application By delineating the imaging findings of ADD lesions in the proximal humerus, we provide clarification to a commonly encountered diagnostic dilemma.

RESULTS

20 MRI exams were reviewed in which ADD was offered as a leading diagnosis (average age 51; 9 female, 11 male). 80% of lesions were subarticular. 100% of the subarticular lesions were T2-hyperintense, T1-hypointense, with 80% showing adjacent curving fat (curved fat sign). 85% of the subarticular lesions were associated with arthritis or trauma. 16% of the subarticular lesions received direct MR arthrograms, with intra-osseous contrast extravasation from the joint into the lesion. 35% of patients received intravenous contrast, with varying degrees of enhancement. 35% of patients underwent needle biopsy. 25% of patients had a total shoulder replacement (for osteoarthritis). 86% of biopsy/resection specimens demonstrated trabeculated bone with reactive changes. None of the lesions in the subarticular location were malignant after biopsy/resection. 75% of non-subarticular lesions had completely non-aggressive imaging features and no biopsy was performed. One had imaging features of an aggressive chondroid lesion, and was subsequently a biopsy-proven chondrosarcoma that was resected.

CLINICAL RELEVANCE/APPLICATION

By delineating the imaging findings of ADD lesions in the proximal humerus, we provide clarification to a commonly encountered diagnostic dilemma.

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Sub-Events

SPR-GU-1 **Using AI To Improve Image Processing Workflows For Clinical Practice Integration - Establishment Of An Automated CT Renal Donor Evaluation Protocol**

Participants
Timothy L. Kline, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

The goal of this study was to implement and evaluate an efficient method to facilitate the development of an automated workflow for renal donor evaluation from contrast-enhanced CT images.*Methods and Materials A total of 374 historical contrast-enhanced CT images and corresponding segmentation masks were curated. This data was used to train a deep learning convolutional neural network architecture to automatically segment the kidneys and relevant vasculature structures. The data was split into training (80%), validation (10%), and a hold-out test set (10%). Model architectures including 2D, 2D slab (multi-slice), multi-orientation (i.e. axial, coronal, sagittal), and 3D models were tested. Visual (i.e. qualitative), and quantitative assessment was performed to optimize and finalize the model. After model development of the automated tool, a validation study was performed to assess workflow improvement and Radiologist qualitative assessments comparing the previous manual workflow with the automated workflow.*Results Excellent visual renderings were generated by the final model. The max, median, mean, and min Dice similarity were 0.95, 0.92, 0.91, and 0.63, respectively. The case with the lowest Dice had an error in the manual segmentation (only the enhanced cortex region was segmented, and thus was properly segmented by the automated approach). The next lowest Dice was 0.85. In the validation study, all cases evaluated were accepted as properly segmenting the kidneys and all relevant vascular structures. In the limited roll-out phase, the automated workflow significantly reduced the overall workflow process - original 11.8±2.0 min, AI 1.1±1.0 min. The two radiologist readers that were surveyed to perform a visual inspection of both segmentations did not report a significant difference between the original and AI-corrected workflows.*Conclusions The automated workflow reduced image analysis processing time from 10-20 min, to 1-2 min per case. Radiologist review did not show any significant differences between renderings and the workflow process was significantly favored for the automated approach.*Clinical Relevance/Application This study completed the full scope of an automated workflow - from data curation, model prototyping, and ultimately a clinical simulation. With ~1000 donor evaluations forecasted for the coming year at our institution alone; a time-savings of 250 technologist/Radiologist labor hours could come from this one analytic. Based on this success, this study will form the foundation for future studies evaluating the integration of automated workflows into the clinical practice.

RESULTS

Excellent visual renderings were generated by the final model. The max, median, mean, and min Dice similarity were 0.95, 0.92, 0.91, and 0.63, respectively. The case with the lowest Dice had an error in the manual segmentation (only the enhanced cortex region was segmented, and thus was properly segmented by the automated approach). The next lowest Dice was 0.85. In the validation study, all cases evaluated were accepted as properly segmenting the kidneys and all relevant vascular structures. In the limited roll-out phase, the automated workflow significantly reduced the overall workflow process - original 11.8±2.0 min, AI 1.1±1.0 min. The two radiologist readers that were surveyed to perform a visual inspection of both segmentations did not report a significant difference between the original and AI-corrected workflows.

CLINICAL RELEVANCE/APPLICATION

This study completed the full scope of an automated workflow - from data curation, model prototyping, and ultimately a clinical simulation. With ~1000 donor evaluations forecasted for the coming year at our institution alone; a time-savings of 250 technologist/Radiologist labor hours could come from this one analytic. Based on this success, this study will form the foundation for future studies evaluating the integration of automated workflows into the clinical practice.

SPR-GU-10 **Combination Of Quantitative Parameters And Vesical Imaging- Report And Data System In Predicting Muscle Invasion Of Bladder Cancer**

Participants
Hongyu Yin, Tai Zhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the applicantion value of quantitative MRI parameters combined with Vesical Imaging-Reporting and Data System (VI-RADS) in predicting muscle-invasive bladder cancer(MIBC).*Methods and Materials Seventy-four patients with pathologically proven bladder cancer in our hospital between May 2015 and May 2021(57 cases with non-muscle-invasive bladder cancer(NMIBC) and 17 cases with MIBC) were retrospectively analyzed. All patients who underwent multiparametric magnetic resonance imaging(mp-MRI)before transurethral resection of bladder tumor(TURBT) or radical cystectomy. According to the VI-RADS criteria,two radiologists,with 2 and 15 years of clinic experience,scored all mp-MRI examinations. The quantitative parameters of mp-MRI, including the tumor contact length(TCL) , maximum tumor diameter(Dmax) and TCL/Dmax were measured and calculated independently. Interobserver agreement was assessed by the weighted-kappa coefficient, intraclass correlation coefficient(ICC)and Bland Altman analysis. LASSO regression was used to select the quantitative parameters that were significant for distinguishing MIBC.Logistics regression analysis was used to determine the ability of VI-RADS,quantitative parameters,and VI-RADS combined

with quantitative parameter to predict MIBC.The receiver operating characteristic(ROC) analysis was applied to evaluate the diagnostic performance.*Results Interobserver agreement was strong for VI-RADS scores (K=0.780), and almost perfect in the measurement of quantitative parameters (ICC:0.806-0.960). LASSO regression was used to extract VI-RADS and TCL/Dmax that were most significant for predicting MIBC.ROC analysis showed that VI-RADS score 4 was found to be the best cut-off level in predicting MIBC (AUC=0.890 and 0.904),with the sensitivity of 64.71% and 76.47%, the specificity of 98.15% and 96.30%, respectively. TCL/Dmax=1.027 was found to be the best cut-off level,with the AUC of 0.835,the sensitivity of 94.12%,the specificity of 71.93%.The AUC of VI-RADS combined with TCL/Dmax was 0.979, with the sensitivity of 100.00% and the specificity of 92.98%,which was higher than that of VI-RADS or TCL/Dmax alone. The difference was statistically significant(P<0.05).For the patients with VI-RADS 3, when TCL/Dmax is applied in addition to VI-RADS, the accuracy increases from 80.0% to 92.0%.*Conclusions VI-RADS has good diagnostic performance and interobserver agreement, and the combination of quantitative parameters and VI-RADS performed decently in distinguishing MIBC.*Clinical Relevance/Application VI-RADS can be encouraged to be used in daily practice, and the combined use of VI-RADS with TCL/Dmax may be a better method for detecting MIBC, especially for patient with VI-RADS 3.

RESULTS

Interobserver agreement was strong for VI-RADS scores (K=0.780), and almost perfect in the measurement of quantitative parameters (ICC:0.806-0.960). LASSO regression was used to extract VI-RADS and TCL/Dmax that were most significant for predicting MIBC.ROC analysis showed that VI-RADS score 4 was found to be the best cut-off level in predicting MIBC (AUC=0.890 and 0.904),with the sensitivity of 64.71% and 76.47%, the specificity of 98.15% and 96.30%, respectively. TCL/Dmax=1.027 was found to be the best cut-off level,with the AUC of 0.835,the sensitivity of 94.12%,the specificity of 71.93%.The AUC of VI-RADS combined with TCL/Dmax was 0.979, with the sensitivity of 100.00% and the specificity of 92.98%,which was higher than that of VI-RADS or TCL/Dmax alone. The difference was statistically significant(P<0.05).For the patients with VI-RADS 3, when TCL/Dmax is applied in addition to VI-RADS, the accuracy increases from 80.0% to 92.0%.

CLINICAL RELEVANCE/APPLICATION

VI-RADS can be encouraged to be used in daily practice, and the combined use of VI-RADS with TCL/Dmax may be a better method for detecting MIBC, especially for patient with VI-RADS 3.

SPR-GU-11 Multi-center Evaluation Of The Multi-parametric MRI Clear Cell Renal Cell Carcinoma Likelihood Score (CCLS) For Assessment Of Clinical T1a (<4cm) Solid Renal Masses

Participants
Nicola Schieda, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

Small renal masses (SRMs, <4 cm) are common and represent a diverse group of benign and malignant tumors. Clear cell renal cell carcinoma (ccRCC) represents the most common and aggressive subtype. A ccRCC Likelihood Score (ccLS) system to diagnose ccRCC on multi-parametric magnetic resonance imaging (mpMRI) has been proposed but lacks external validation. We evaluated the diagnostic performance and inter-observer agreement of the ccLS system to diagnose ccRCC in solid SRMs at 5 academic medical centers.*Methods and Materials This IRB-approved, retrospective, multi-center, cross-sectional study included 241 patients with 250 consecutive solid (=25% volume enhances) SRMs examined with mpMRI at 5 academic medical centers. All masses were histologically confirmed by nephrectomy (N=177) or 18-gauge needle biopsy (N=73). Masses with macroscopic fat were excluded. After a 1.5-hour training session, two radiologists at each center, blinded to histologic diagnosis, independently applied the ccLS system to 50 masses. Diagnostic performance was calculated for diagnosis of ccRCC using random effects logistic regression modeling, and distribution of ccRCC by ccLS was tabulated. Inter-observer agreement for ccLS was evaluated with Fleiss Kappa.*Results Mean size was 25±8 mm (range 10-39 mm). ccRCC was found in 48% (119/250) and other histologies in 52% (131/250). Sensitivity, specificity and positive predictive value for diagnosis of ccRCC (95% confidence interval [CI]) when ccLS=4 were: 75% (68%, 81%), 78% (72%, 84%), and 76% (69%, 81%), respectively. Negative predictive value of ccLS=2 was 88% (81%, 93%). The proportion of ccRCC in each of the five ccLS scores (95% CI) were 6% (2%, 13%), 38% (18%, 62%), 32% (24%, 40%), 71% (72%, 79%), and 81% (73%, 88%). Average inter-observer agreement for ccLS scoring across sites was moderate (Kappa=0.58 [0.42, 0.75]).*Conclusions The clear cell likelihood scoring (ccLS) system applied to mpMRI has moderate inter-observer agreement, differentiates ccRCC from other solid renal masses with moderate sensitivity and specificity, and has a good negative predictive value for ccRCC.*Clinical Relevance/Application This study establishes the reproducibility of the ccLS system, which provides a framework for a standardized approach to the characterization of small renal masses with multiparametric magnetic resonance imaging.

RESULTS

Mean size was 25±8 mm (range 10-39 mm). ccRCC was found in 48% (119/250) and other histologies in 52% (131/250). Sensitivity, specificity and positive predictive value for diagnosis of ccRCC (95% confidence interval [CI]) when ccLS=4 were: 75% (68%, 81%), 78% (72%, 84%), and 76% (69%, 81%), respectively. Negative predictive value of ccLS=2 was 88% (81%, 93%). The proportion of ccRCC in each of the five ccLS scores (95% CI) were 6% (2%, 13%), 38% (18%, 62%), 32% (24%, 40%), 71% (72%, 79%), and 81% (73%, 88%). Average inter-observer agreement for ccLS scoring across sites was moderate (Kappa=0.58 [0.42, 0.75]).

CLINICAL RELEVANCE/APPLICATION

This study establishes the reproducibility of the ccLS system, which provides a framework for a standardized approach to the characterization of small renal masses with multiparametric magnetic resonance imaging.

SPR-GU-14 Application Value Of Individualized Tube Voltage Selection In Renal Computed Tomography Angiography Imaging Based On Body Mass Index With Low Iodine Intake

Participants
Junjun Li, Xi'an, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the application value of individualized kVp selection in Renal CTA based on body mass index (BMI) in reducing radiation dose and contrast medium (CM) dose.*Methods and Materials Totally 100 patients (BMI=30kg/m2) who underwent renal CTA were divided into individualized kVp group (group A, n=50) and conventional 100kVp group (group B, n=50), both with automatic tube current modulation (ATCM). Group A used a personalized protocol: 70kVp, ATCM for noise index (NI) setting of 18 ASIR-V at 80%

strength, and CM dose rate of 17mgI/kg/s for 10s for BMI<25kg/m2 patients; 80kVp, ATCM for NI of 17 ASIR-V at 70% strength, and CM dose rate of 19mgI/kg/s for 10s for 25kg/m2=BMI=30kg/m2 patients. Group B used the standard protocol: 100kVp, 50ml of 350 mgI/ml CM at the flow rate of 4.5 ml/s. The CT values and SD values of the right renal artery and left renal artery were measured to calculate the signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR). The image quality was subjectively scored by two experienced radiologists blindly using a five-point criterion. The CM dose and effective radiation dose in both groups were calculated and compared. Image quality between the two groups was also compared.*Results There was no significant difference in patient characteristics between the two groups (P>0.05). Compared to group B, group A significantly reduced effective radiation dose (in mSv) by 28.4% (2.07±0.92 vs. 2.89±0.62), CM dose by 27.2% (12.75g±2.19gI vs. 17.5gI), and injection rate (in ml/s) by 22.7% (3.48±0.64 vs. 4.5) (all P<0.001). The two groups had similar SD values in erector spinae (P>0.05). Group A had significantly higher CT values, SNR and CNR values of the renal arteries than group B (all P<0.001). The two radiologists had excellent agreement (Kappa value >0.8, P<0.05) in the subjective scores and there was no statistically significant difference in the subjective scores of renal CTA images between the two groups (4.57±0.42 vs. 4.41±0.49) (P>0.05).*Conclusions BMI-based individualized kVp selection protocol in renal CTA imaging significantly reduces radiation dose and total iodine intake while maintaining diagnostic image quality.*Clinical Relevance/Application BMI-based individualized kVp selection protocol in renal CTA imaging significantly reduces radiation dose and total iodine intake while maintaining diagnostic image quality and reduce the risk of contrast-induced nephropathy

RESULTS

There was no significant difference in patient characteristics between the two groups (P>0.05). Compared to group B, group A significantly reduced effective radiation dose (in mSv) by 28.4% (2.07±0.92 vs. 2.89±0.62), CM dose by 27.2% (12.75g±2.19gI vs. 17.5gI), and injection rate (in ml/s) by 22.7% (3.48±0.64 vs. 4.5) (all P<0.001). The two groups had similar SD values in erector spinae (P>0.05). Group A had significantly higher CT values, SNR and CNR values of the renal arteries than group B (all P<0.001). The two radiologists had excellent agreement (Kappa value >0.8, P<0.05) in the subjective scores and there was no statistically significant difference in the subjective scores of renal CTA images between the two groups (4.57±0.42 vs. 4.41±0.49) (P>0.05).

CLINICAL RELEVANCE/APPLICATION

BMI-based individualized kVp selection protocol in renal CTA imaging significantly reduces radiation dose and total iodine intake while maintaining diagnostic image quality and reduce the risk of contrast-induced nephropathy

SPR-GU-16 Primary Renal Sarcomas - Imaging Features And Discrimination From Non-sarcoma Renal Tumors

Participants
Johannes Uhlig, Goettingen, Germany (*Presenter*) Speaker, Bayer AG

PURPOSE

Primary renal sarcomas are rare renal malignancies carrying a dismal prognosis. This study assessed imaging features of primary renal sarcomas to discriminate this rare malignancy from more common non-sarcoma renal tumors.*Methods and Materials Adult patients diagnosed with primary renal sarcomas from 1995-2018 on cross-sectional imaging studies were included from 11 European centers. The non-sarcoma renal tumor cohort was randomly selected from one center and sized 4:1 compared to renal sarcomas. For both renal sarcomas and non-sarcoma renal tumors, CT and MRI studies were assessed using 21 predefined imaging features. For discrimination of renal sarcomas vs. non-sarcoma renal tumors, a random forest algorithm was trained based on demographics and imaging features. Diagnostic performance was evaluated using a 10-fold cross-validation approach.*Results n=34 renal sarcomas were included and compared to n=136 non-sarcoma renal tumors. Renal sarcomas manifested in younger patients (median 55 vs. 67 years, p<0.01) and were more complex (high RENAL score complexity 79.4% vs. 25.7%, p<0.01). Renal sarcomas were larger (median diameter 108 vs. 43mm, p<0.01) with irregular shape and ill-defined margins, and more frequently demonstrated invasion of the renal vein or inferior vena cava, tumor necrosis, direct invasion of adjacent organs, and contact to renal artery or vein, compared to non-sarcoma renal tumors (p<0.05, each). The random forest algorithm yielded a median area-under-the ROC curve AUC=93.8% to predict renal sarcoma histology, with sensitivity=90.4%, specificity=76.5%, and positive predictive value=93.9%.*Conclusions Renal sarcomas are rare tumors manifesting as large masses in young patients. A random forest algorithm using demographics and standardized imaging features shows excellent diagnostic accuracy for discrimination of renal sarcomas from non-sarcoma renal tumors and might aid in clinical decision making.*Clinical Relevance/Application Primary renal sarcomas present with specific imaging features, which can be used to discriminate them from non-sarcoma renal tumors. Given the dismal prognosis of renal sarcomas, a timely and accurate diagnosis could optimize treatment.

RESULTS

n=34 renal sarcomas were included and compared to n=136 non-sarcoma renal tumors. Renal sarcomas manifested in younger patients (median 55 vs. 67 years, p<0.01) and were more complex (high RENAL score complexity 79.4% vs. 25.7%, p<0.01). Renal sarcomas were larger (median diameter 108 vs. 43mm, p<0.01) with irregular shape and ill-defined margins, and more frequently demonstrated invasion of the renal vein or inferior vena cava, tumor necrosis, direct invasion of adjacent organs, and contact to renal artery or vein, compared to non-sarcoma renal tumors (p<0.05, each). The random forest algorithm yielded a median area-under-the ROC curve AUC=93.8% to predict renal sarcoma histology, with sensitivity=90.4%, specificity=76.5%, and positive predictive value=93.9%.

CLINICAL RELEVANCE/APPLICATION

Primary renal sarcomas present with specific imaging features, which can be used to discriminate them from non-sarcoma renal tumors. Given the dismal prognosis of renal sarcomas, a timely and accurate diagnosis could optimize treatment.

SPR-GU-17 Proportion Of Prostate Cancers Diagnosed By Systematic Template Biopsy After Negative Multiparametric MRI And Predictive Clinical Factors Which May Influence Detection

Participants
Mohammad Haroon, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

Biopsy deferral in men with a negative multiparametric MRI (mpMRI) is gaining popularity in clinical practice; however, prostate cancer (PCa) may be diagnosed at subsequent template biopsy in this population. This study evaluated the proportion of men with PCa diagnosis at template biopsy following a negative mpMRI.*Methods and Materials This IRB-approved, retrospective, single center, cross-sectional study identified 201 consecutive men with negative mpMRI (PI-RADS score 1 or 2) performed before TRUS-guided systematic template biopsy. Clinical indication for mpMRI was active surveillance (AS; 52.7% [106/201] or pre-biopsy for

elevated PSA/abnormal DRE (biopsy naïve 15.9% [32/201] and previous negative template biopsy 31.3% [63/201]). Proportion of men with clinically significant (CS) PCa (ISUP grade group =2) diagnosed at subsequent template biopsy were recorded. PSA and PSA density (PSAD) were compared between groups to derive clinically predictive factors of PCa.*Results Overall, 16.4% (33/201) men had CS-PCa diagnosed at template biopsy; 22.6% (24/106) in the AS group and 9.5% (9/95) in the pre-biopsy group (p=0.009). In the AS group, both PSA (p=0.96) and PSAD (p=0.92) did not differ between men with or without CS-PCa diagnosed at subsequent template biopsy. In the pre-biopsy group, PSA (p<0.01) and PSAD (p<0.01) were higher in men with eventual CS-PCa diagnosed at template biopsy, but otherwise did not differ in men with or without a preceding negative template biopsy (p=0.62). Area under the ROC curve for diagnosis of CS-PCa in the pre-biopsy group using PSA and PSAD were: 0.60 (95% CI 0.39,0.82) and 0.72 (0.53,0.92). The optimal cutpoint for PSAD derived by the method of Youden was =0.21 with sensitivity and specificity of 67% and 71% respectively. Using a published cutpoint of =0.15 yielded sensitivity and specificity of 78% and 45% respectively.*Conclusions Clinically significant prostate cancer detection rates in men with negative mpMRI differs by clinical indication and in our study was approximately 25% in men undergoing active surveillance and 10% in men with pre-biopsy MRI. PSAD was not useful to predict eventual CS-PCa diagnosis in the AS group but was useful in the pre-biopsy group, with an optimal cutpoint of 0.21 yielding moderate accuracy for diagnosis of CS-PCa at subsequent template biopsy.*Clinical Relevance/Application Biopsy deferral after negative mpMRI should be considered separately for men referred for pre-biopsy evaluation versus active surveillance. PSAD may be a useful clinical metric to determine which men with negative pre-biopsy MRI should undergo template biopsy.

RESULTS

Overall, 16.4% (33/201) men had CS-PCa diagnosed at template biopsy; 22.6% (24/106) in the AS group and 9.5% (9/95) in the pre-biopsy group (p=0.009). In the AS group, both PSA (p=0.96) and PSAD (p=0.92) did not differ between men with or without CS-PCa diagnosed at subsequent template biopsy. In the pre-biopsy group, PSA (p<0.01) and PSAD (p<0.01) were higher in men with eventual CS-PCa diagnosed at template biopsy, but otherwise did not differ in men with or without a preceding negative template biopsy (p=0.62). Area under the ROC curve for diagnosis of CS-PCa in the pre-biopsy group using PSA and PSAD were: 0.60 (95% CI 0.39,0.82) and 0.72 (0.53,0.92). The optimal cutpoint for PSAD derived by the method of Youden was =0.21 with sensitivity and specificity of 67% and 71% respectively. Using a published cutpoint of =0.15 yielded sensitivity and specificity of 78% and 45% respectively.

CLINICAL RELEVANCE/APPLICATION

Biopsy deferral after negative mpMRI should be considered separately for men referred for pre-biopsy evaluation versus active surveillance. PSAD may be a useful clinical metric to determine which men with negative pre-biopsy MRI should undergo template biopsy.

SPR-GU-18 Computer-aided Diagnosis Of Prostate Cancer: External Validation Study Of Deep Learning Using Convolutional Neural Networks

Participants
Sung Bin Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The accurate detection of prostate cancer is an interesting but still challenging task. Multiparametric MRI is the essential method for diagnosing prostate cancer. Over the past two decades, computer-aided diagnosis (CAD) has been a rapidly growing and active area of research. The purpose of this study is to evaluate the performance of a CAD algorithm for identifying prostate cancer in multiparametric MRI.*Methods and Materials The prototype CAD algorithm using convolutional neural network has been developed with 1,500 cases data set for training and test with 5-fold cross validation method (4 training and 1 validation sequentially). This CAD algorithm performed auto segmentation of prostate gland and detection of prostate cancer. Then it merged to show result visualization as probability map for prostate cancer. The diagnostic performance of CAD algorithm for identifying prostate cancer from MRI was performed. 352 external validated multiparametric MRIs (T2-weighted, diffusion-weighted and apparent diffusion coefficient images, b value of 0, and 1000 s/mm2) at two institutions were enrolled for this study. All data were acquired on 3T MRI scanners with pelvic phased-array coils. Using pathologic diagnosis after radical prostatectomy whole mount specimen as gold standard or ground truth, the diagnostic performance of CAD algorithm using convolutional neural network for prostate cancer was evaluated. The prostate gland was arbitrary divided into three levels such as apex, mid gland and base. Each level was also divided into 4 areas (two peripheral zones and two transitional zones). In total, 4,224 areas in 352 patients were compared with pathology in a point-by-point manner.*Results The diagnostic performance of all prostate gland was a sensitivity of 71.1%, specificity of 82.1%, positive predictive value of 73.1%, negative predictive value of 80.6%, and accuracy of 77.7%. *Conclusions CAD algorithm in multiparametric prostate MRI using convolutional neural network can have compatible diagnostic performance for prostate cancer. Comprehensive further studies for different experienced radiologists to evaluate the performance with/without CAD algorithm are needed.*Clinical Relevance/Application In view of its compatible performance, we believe CAD algorithm in multiparametric MRI using convolutional neural network can be used as a useful supplementary tool in patients with suspicious of prostate cancer.

RESULTS

The diagnostic performance of all prostate gland was a sensitivity of 71.1%, specificity of 82.1%, positive predictive value of 73.1%, negative predictive value of 80.6%, and accuracy of 77.7%.

CLINICAL RELEVANCE/APPLICATION

In view of its compatible performance, we believe CAD algorithm in multiparametric MRI using convolutional neural network can be used as a useful supplementary tool in patients with suspicious of prostate cancer.

SPR-GU-19 Bladder Pressure Estimation Using Subharmonic Signal Scattered By Ultrasound Contrast Agents

Participants
Kourosh Kalayeh, PhD, Ann Arbor, Michigan (*Presenter*) Equipment Support, GE Healthcare

PURPOSE

Cystometrograms (CMG) evaluate the functionality of the bladder. The CMG catheter is inserted into the bladder through the urethra and fills the bladder with saline while recording its pressure. The presence of the catheter partially or completely occludes the urethra resulting in an increase in flow resistance and falsely elevated bladder pressures. This highlights the need for catheter-free bladder pressure measurements, specifically during voiding. The purpose of this study is, therefore, to use pressure sensitive

subharmonic signal scattered by ultrasound contrast agents (UCAs) to estimate benchtop bladder phantom (BBP) pressures-a method known as subharmonic aided pressure estimation (SHAPE).*Methods and Materials A bladder phantom is designed and built, capable of simulating clinically relevant bladder pressure tracings of variable compliance and non-voiding contractions. Definity® (Lantheus Medical Imaging, Billerica, MA, USA) commercial UCA is diluted in 0.9 % normal saline at an optimized concentration of 0.06 % v/v and infused using CMG equipment (30 ml/min). Simultaneously, UCA scattered subharmonic signal is acquired with a GE Logiq E10 ultrasound scanner equipped with SHAPE mode using a C2-9 probe. The ultrasound transmit output is set at a calibrated mechanical index (MI) for maximum ambient pressure sensitivity. The UCA concentration had been optimized to compensate for bubble destruction due the infusion system. All experiments are done in a water tank at room temperature. A TPX sheet (2 mm thickness) is used as an acoustic window as it has an acoustic impedance close to water and minimal attenuation.*Results The subharmonic signal shows an inverse relationship with BBP pressure, as the pressure increases the subharmonic signal amplitude decreases. The change in subharmonic signal varies linearly with BBP pressure with correlation factor of -0.057 dB/cmH2O (n=30, R2=0.73, RMSE=1.017 dB).*Conclusions A strong correlation is found to exist between UCA scattered subharmonic signal and BBP pressure. These findings provide the support to evaluate this method in vivo and take the next step towards developing a catheter-free voiding bladder pressure measurement using SHAPE.*Clinical Relevance/Application This work aims at developing a methodology for catheter-free voiding bladder pressure measurement. By doing so, bladder voiding pressure can be estimated more accurately under more natural conditions which in turn results in better assessment of bladder functionality.

RESULTS

The subharmonic signal shows an inverse relationship with BBP pressure, as the pressure increases the subharmonic signal amplitude decreases. The change in subharmonic signal varies linearly with BBP pressure with correlation factor of -0.057 dB/cmH2O (n=30, R2=0.73, RMSE=1.017 dB).

CLINICAL RELEVANCE/APPLICATION

This work aims at developing a methodology for catheter-free voiding bladder pressure measurement. By doing so, bladder voiding pressure can be estimated more accurately under more natural conditions which in turn results in better assessment of bladder functionality.

SPR-GU-2   Defining Diagnostic Criteria For Ductal Adenocarcinoma Of Prostate On Multi-parametric Magnetic Resonance Imaging

Participants
Weranja Ranasinghe, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To develop mpMRI criteria to define DACs and assess its diagnostic performance.*Methods and Materials Men with histologically proven DAC who had mpMRIs before radical prostatectomy (RP) were retrospectively identified from 2011-18. mpMRI diagnostic criteria were defined and used to compare men with =1cm in the peripheral zone DAC with the International Society of Urological Pathology (ISUP) grade group (GG) 4-5 PAC on biopsy, who underwent RP during the same time period and were matched 1:1 on tumor size on MRI and tumor location. Four radiologists, blinded to the diagnoses, separately scored the mpMRIs in consensus. STARD criteria were used to report diagnostic performance. Chi-Squared, T-tests, Mann-Whitney-U tests, Cohen's Kappa, and sensitivity analyses were performed.*Results Fifty-nine men with DAC (median age 63 (IQR 56,67) and 59 matched men with PAC (median age 64 (IQR 59,69) were compared to determine the presence of predefined mpMRI criteria: 1) intermediate T2 signal, 2) well-defined margin 3) lobulations and 4) hypointense rim.On the consensus read, =3 mpMRI features were detected in a higher proportion of DACs compared with PACs (76% vs. 12%, p<.001).If =3 features were present, then the features demonstrated 76% sensitivity, 88% specificity, 87% positive predictive value (PPV), and 79% negative predictive value (NPV) in diagnosing PCa with a DAC component and 100% sensitivity, 88% specificity, 65% PPV and 100% NPV in pure DAC.All DACs had restricted diffusion and contrast enhancement (p=1) but no differences in absolute or relative T2 signal intensity (p=.09) or ADC values compared with PACs (p=.73).*Conclusions DAC can be differentiated from PAC using =3 characteristic features with restricted diffusion and contrast enhancement on prostatic mpMRI.*Clinical Relevance/Application Ductal prostate adenocarcinoma (DAC) is an aggressive histologic variant of prostate cancer (PCa). However, DACs are often underappreciated on clinical exam, not detected on prostate biopsy, and currently cannot be characterized on multiparametric (MP) MRI. Based on our results, ductal prostate cancers can be characterized on MRI by the presence of =3 features (intermediate T2 signal, well-defined margin, lobulations, and intermittent, hypointense peripheral rim) with restricted diffusion and contrast enhancement.

RESULTS

Fifty-nine men with DAC (median age 63 (IQR 56,67) and 59 matched men with PAC (median age 64 (IQR 59,69) were compared to determine the presence of predefined mpMRI criteria: 1) intermediate T2 signal, 2) well-defined margin 3) lobulations and 4) hypointense rim.On the consensus read, =3 mpMRI features were detected in a higher proportion of DACs compared with PACs (76% vs. 12%, p<.001).If =3 features were present, then the features demonstrated 76% sensitivity, 88% specificity, 87% positive predictive value (PPV), and 79% negative predictive value (NPV) in diagnosing PCa with a DAC component and 100% sensitivity, 88% specificity, 65% PPV and 100% NPV in pure DAC.All DACs had restricted diffusion and contrast enhancement (p=1) but no differences in absolute or relative T2 signal intensity (p=.09) or ADC values compared with PACs (p=.73).

CLINICAL RELEVANCE/APPLICATION

Ductal prostate adenocarcinoma (DAC) is an aggressive histologic variant of prostate cancer (PCa). However, DACs are often underappreciated on clinical exam, not detected on prostate biopsy, and currently cannot be characterized on multiparametric (MP) MRI. Based on our results, ductal prostate cancers can be characterized on MRI by the presence of =3 features (intermediate T2 signal, well-defined margin, lobulations, and intermittent, hypointense peripheral rim) with restricted diffusion and contrast enhancement.

SPR-GU-20   Teaching A Machine To Find Adrenal Glands: Novel Machine Learning Model For Adrenal Gland Segmentation And Mass Classification On CT

Participants
Cory Robinson Weiss, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To develop a fully-automated machine learning model that can reliably segment and classify normal adrenal glands and adrenal masses on abdominal CT.*Methods and Materials The cohort consisted of 265 contrast-enhanced CT exams containing 421 normal

adrenal glands and 109 adrenal masses (63 left and 46 right). Of the 109 adrenal masses, 67 (61%) measured 1-2 cm, 32 (29%) measured 2-4 cm, and 10 (9%) measured >4 cm. There were 127 males and 138 females with mean age 60 years (range 21-93 years). All exams were reviewed by one of five radiologists and adrenal glands were classified as normal or containing a mass. Adrenal glands were manually outlined utilizing commercially available software (Visage Imaging, Berlin, Germany) to create labeled segmentations serving as the "ground truth." Ten randomly selected exams were reviewed by all 5 radiologists to determine interobserver variability. The cohort was divided into an initial training set of 214 exams with the subsequent validation and testing sets of 26 and 25 exams respectively. A two-stage machine-learning based pipeline was developed and validated. The first stage performed segmentation of the adrenal glands in the full portal venous phase contrast enhanced abdominal CT series using an ensemble of 3D UNet convolutional neural networks (CNN). In the second stage, volumetric regions of interest around each of the two adrenal glands were extracted and classified by an ensemble of 3D DenseNet CNNs as adrenal masses or normal glands. Primary outcome was the classification of adrenal masses based on radiologists' annotations. Segmentation and classification performance was evaluated by the Dice similarity coefficient which compares the degree of overlap between the radiologist's ground truth manual segmentation and model predicted segmentation.*Results In 45 of 49 (92%) of adrenal glands in the test set, the model was able to accurately outline the adrenal glands and correctly classify the adrenal as normal or containing a mass. Median radiologist inter-observer Dice scores were .884 and .890 for normal and adrenal masses respectively. Median model Dice scores on the same dataset were .806 and .845, showing close to expert segmentation performance.*Conclusions A novel machine learning-based model successfully (92%) segmented adrenal glands and classified them as normal or containing a mass on abdominal CT with performance comparable to radiologists.*Clinical Relevance/Application A machine learning tool can help identify adrenal masses which are present in 5-7% of the adult population. This can facilitate radiologist exam interpretation and potentially decrease interobserver variability.

RESULTS

In 45 of 49 (92%) of adrenal glands in the test set, the model was able to accurately outline the adrenal glands and correctly classify the adrenal as normal or containing a mass. Median radiologist inter-observer Dice scores were .884 and .890 for normal and adrenal masses respectively. Median model Dice scores on the same dataset were .806 and .845, showing close to expert segmentation performance.

CLINICAL RELEVANCE/APPLICATION

A machine learning tool can help identify adrenal masses which are present in 5-7% of the adult population. This can facilitate radiologist exam interpretation and potentially decrease interobserver variability.

SPR-GU-3   Clinical Utility Of Renal Ultrasound In COVID-19 Patients With Acute Kidney Injury - Worth The Risk? An Evaluation Of 108 Consecutive Inpatients

Participants
Hanisha Patel, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the clinical utility of renal ultrasound (US) in hospitalized COVID-19 patients with acute kidney injury and absence of other clinical symptoms of urinary obstruction.*Methods and Materials Keyword search of the electronic imaging database was performed for all adult patients with renal US between 12/1/2020 - 2/28/2021. Inclusion criteria included inpatient status, active COVID-19 infection at the time of imaging, acute kidney injury (=50% creatinine increase from baseline (if available), GFR decrease by =25%, and/or urine output below 0.5 mL/kg/hr for > 6 hours), and absence of other genitourinary symptoms (hematuria, flank pain, etc) that may prompt renal imaging. Patient demographics, medical history, clinical course, and renal US findings were recorded.*Results Keyword search resulted in a total of 661 patients, with the final cohort consisting of 108 consecutive inpatients (64M, 44F, mean age 68.1 ± 15.1 years) with 117 renal US meeting inclusion criteria. Renal US were performed on day 1 to day 38 (median 4 days, mean 7.5 ± 7.3 days) of hospitalization. Average serum creatinine at imaging was 2.90 ± 1.95 mg/dL, with baseline of 1.56 ± 1.08 mg/dL. Findings included echogenic parenchyma in 35.9% (42/117) of studies, renal atrophy in 6% (7/117), and renal stones in 4.3% (5/117). Hydronephrosis was seen in 5.1% (6/117), chronic in 3 cases, resolved in 2 cases with no intervention, and improved with Foley catheter flushing in one case. No patients required emergent stent placement. One renal biopsy was performed for nephrotic range proteinuria, with pathology of focal segmental glomerulosclerosis. There were no significant differences in demographics, medical history, or renal US findings in deceased patients (44/108, 40.7%) vs. patients that were discharged from the hospital (64/108, 59.3%). Deceased patients were significantly more likely to be in the ICU (p=<.001), intubated (p=<.007), and require dialysis (p=<.001). Mean serum creatinine at the time of renal US was higher for decreased patients compared to patients discharged from the hospital, though it was not significant (3.18 mg/dL vs. 2.67 mg/dL, p=.137).*Conclusions No emergent urological intervention was required in this cohort of inpatients hospitalized with active COVID-19 infection, AKI, and no other genitourinary signs or symptoms undergoing renal US. Given the low yield/clinical utility of renal US in this patient population, it should be reconsidered unless other genitourinary symptoms exist.*Clinical Relevance/Application Routine renal US in COVID-19 patients with AKI (but no other genitourinary signs or symptoms) should be reconsidered, as it may risk additional staff exposure (US technologists) to COVID-19 while adding little to no clinical utility.

RESULTS

Keyword search resulted in a total of 661 patients, with the final cohort consisting of 108 consecutive inpatients (64M, 44F, mean age 68.1 ± 15.1 years) with 117 renal US meeting inclusion criteria. Renal US were performed on day 1 to day 38 (median 4 days, mean 7.5 ± 7.3 days) of hospitalization. Average serum creatinine at imaging was 2.90 ± 1.95 mg/dL, with baseline of 1.56 ± 1.08 mg/dL. Findings included echogenic parenchyma in 35.9% (42/117) of studies, renal atrophy in 6% (7/117), and renal stones in 4.3% (5/117). Hydronephrosis was seen in 5.1% (6/117), chronic in 3 cases, resolved in 2 cases with no intervention, and improved with Foley catheter flushing in one case. No patients required emergent stent placement. One renal biopsy was performed for nephrotic range proteinuria, with pathology of focal segmental glomerulosclerosis. There were no significant differences in demographics, medical history, or renal US findings in deceased patients (44/108, 40.7%) vs. patients that were discharged from the hospital (64/108, 59.3%). Deceased patients were significantly more likely to be in the ICU (p=<.001), intubated (p=<.007), and require dialysis (p=<.001). Mean serum creatinine at the time of renal US was higher for decreased patients compared to patients discharged from the hospital, though it was not significant (3.18 mg/dL vs. 2.67 mg/dL, p=.137).

CLINICAL RELEVANCE/APPLICATION

Routine renal US in COVID-19 patients with AKI (but no other genitourinary signs or symptoms) should be reconsidered, as it may risk additional staff exposure (US technologists) to COVID-19 while adding little to no clinical utility.

SPR-GU-5   Assessment Of Elastographic Q-analysis Score Combined With PI-RADS Based On TRUS/MP-MRI

Fusion-guided Biopsy In Differentiating Benign And Malignant Prostate

Participants
Hongtian Tian, Shenzhen, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate Elastographic Q-Analysis Score(EQS) combined with PI-RADS based on rectal ultrasound (TRUS)/multiparametric MRI fusion biopsy in differentiating benign and malignant prostate lesions.*Methods and Materials A total of 296 patients with 318 prostate lesions who underwent TRUS/MP-MRI fusion biopsy between October 2017 and October 2019 at our hospital were retrospectively analyzed. The performance of the EQS was evaluated on the sites of the suspicious areas of MP-MRI.The cut-off value of EQS was obtained according to ROC curve, which was used to upgrade and downgrade the PI-RADS scores. The diagnostic efficacy of new PI-RADS was calculated based on pathological results and chi-square test.*Results In total, 318 MP-MRI suspicious prostate lesions, 94 lesions were confirmed as prostate cancer, and the rest were benign prostate lesions. The diagnostic coincidence rate of PIRADS was increased from 0.667 to 0.874 by using elastic ultrasound, among which the diagnostic rate of prostate cancer was increased from 0.557 to 0.806, and the diagnostic rate of non-prostate cancer was increased from 0.775 to 0.967.*Conclusions The TRUS/MP-MRI fusion-based combination of the EQS and the PI-RADS could improve the efficiency of differentiating malignant and benign prostate lesions.*Clinical Relevance/Application The combination of the PI-RADS and the EQS with TRUS/MP-MRI fusion can not only improve the accuracy of PCa diagnosis and the detection rate of clinically significant cancer but also reduce unnecessary biopsy procedures and prevent overdiagnosis.

RESULTS

In total, 318 MP-MRI suspicious prostate lesions, 94 lesions were confirmed as prostate cancer, and the rest were benign prostate lesions. The diagnostic coincidence rate of PIRADS was increased from 0.667 to 0.874 by using elastic ultrasound, among which the diagnostic rate of prostate cancer was increased from 0.557 to 0.806, and the diagnostic rate of non-prostate cancer was increased from 0.775 to 0.967.

CLINICAL RELEVANCE/APPLICATION

The combination of the PI-RADS and the EQS with TRUS/MP-MRI fusion can not only improve the accuracy of PCa diagnosis and the detection rate of clinically significant cancer but also reduce unnecessary biopsy procedures and prevent overdiagnosis.

SPR-GU-6   Diagnostic Performance Of Prostate 3t-multiparametric Magnetic Resonance Imaging In Different Race: Based On Pi-radsv2.1 And Using Whole-mount Histopathology Reference

Participants
Qi Miao, MD, Shenyang, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the relative performance of 3T-multiparametric Magnetic Resonance Imaging (3T-mpMRI) for the detection of clinically significant prostate cancer (csPCa) foci in African-, Asian- and European- American men with whole-mount histopathology (WMHP) reference.*Methods and Materials This IRB approved, HIPAA compliant observational study cohort comprised 556 patients, who underwent 3T-mpMRI prior to prostatectomy from July 2010 to December 2020. Patients were categorized into 3 different subcohorts stratified by race (African-, Asian- and European-American). The sub-analysis was performed using a propensity score caliper matching algorithm to match Asian to White and African to White in a 1:2 ratio using the variables age and PSA. The prostate cancer detection rate (CDR) and positive predicted value (PPV) of PCa, csPCa were compared in groups using Chi-square test or Fisher's Exact test.*Results Of the 556 men, 41 (7%), 40 (7%) and 475 (86%) were African-, Asian- and European- origin men, respectively. In unmatched analysis, the CDR csPCa of African, Asian and European subgroups were 66%, 73% and 71% (p=0.767). In matched analysis, CDRcsPCa of African, and European- origin subcohorts were 66% and 77%, (p=0.162) and CDRcsPCa of Asian and European subcohorts was 73% and 64%, (p=0.280). In matched analysis, PPVscsPCa of African and European-origin were 67% and 87% (p=0.324). The PPVscsPCa of Asian and European-origin subgroup were 79% and 71% (p=0.325).*Conclusions 3T mpMRI has good performance for the detection of csPCa among African, Asian and European-origin subgroups, but the CDR csPCa and PPV csPCa of African origin subcohort were lower than the Asian and European subcohorts.*Clinical Relevance/Application For African origin men the performance of 3TmpMRI for clinically suspected csPCa, may require additional modifications to improve performance.

RESULTS

Of the 556 men, 41 (7%), 40 (7%) and 475 (86%) were African-, Asian- and European- origin men, respectively. In unmatched analysis, the CDR csPCa of African, Asian and European subgroups were 66%, 73% and 71% (p=0.767). In matched analysis, CDRcsPCa of African, and European- origin subcohorts were 66% and 77%, (p=0.162) and CDRcsPCa of Asian and European subcohorts was 73% and 64%, (p=0.280). In matched analysis, PPVscsPCa of African and European-origin were 67% and 87% (p=0.324). The PPVscsPCa of Asian and European-origin subgroup were 79% and 71% (p=0.325).

CLINICAL RELEVANCE/APPLICATION

For African origin men the performance of 3TmpMRI for clinically suspected csPCa, may require additional modifications to improve performance.

SPR-GU-8   Augmenting AI With Automated Segmentation Of Report Findings Applied To Prostate Cancer Detection In Biparametric MRI

Participants
Joeran Bosma, BSC, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

To improve risk stratification of clinically significant prostate cancer (csPCa) with a 3D deep learning detection model, by augmenting the largest prostate MRI dataset reported in literature to date.*Methods and Materials This retrospective study included 6,866 prostate bpMRI studies (axial T2-weighted, high b-value (= 1400) and apparent diffusion coefficient scans) from 5,646 consecutive patients, with elevated PSA or clinical suspicion of PCa, between 2014-2020 for training. All studies were evaluated by experienced radiologists during clinical routine. The findings in 2,659 studies were manually segmented.We propose a hybrid framework to augment our detection model with more training data. After training with expert csPCa segmentations, we

generate automatic cancer segmentations by masking our model predictions with the number of csPCa lesions automatically extracted from radiology reports. An augmented detection model is then trained jointly on manual and automatically generated csPCa segmentations.Models trained on expert or augmented cancer segmentations are evaluated on 296 visits of 296 consecutive men with elevated PSA or clinical suspicion of prostate cancer from an independent, external, centre. Ground truth is provided by MR-guided and TRUS-guided biopsies, and radical prostatectomy when available. Studies are considered positive if they have at least one Gleason grade group = 2 lesion (csPCa).We trained our models on expert and augmented segmentations with 5-fold cross-validation and 5 restarts. Diagnostic performance was evaluated using the Area under the Receiver Operating Characteristic curve (AUROC). We performed a permutation test to obtain the statistical significance level.*Results Augmenting the training set with automatic csPCa segmentations guided by report findings, significantly improves the case-level risk stratification of csPCa. For the external test set, the AUROC increased from 85.7±2.5% to 89.0±1.2% (P < 0.0001).On the external test set, experienced radiologists had a sensitivity of 91.4±2.7% at 78.3±2.4% specificity. At the same sensitivity, adding automatic segmentations improved the model's specificity from 46.8±12.8% to 62.0±7.1% (P < 0.0001).*Conclusions Augmenting training with automatic report driven segmentations of prostate cancer in bpMRI significantly improved the risk-stratification of the deep learning prostate cancer detection model.*Clinical Relevance/Application Risk stratification for clinically significant prostate cancer using prostate MRI is instrumental to reduce over-treatment. Deep learning can assist, but requires expensive expert segmentations.

RESULTS

Augmenting the training set with automatic csPCa segmentations guided by report findings, significantly improves the case-level risk stratification of csPCa. For the external test set, the AUROC increased from 85.7±2.5% to 89.0±1.2% (P < 0.0001).On the external test set, experienced radiologists had a sensitivity of 91.4±2.7% at 78.3±2.4% specificity. At the same sensitivity, adding automatic segmentations improved the model's specificity from 46.8±12.8% to 62.0±7.1% (P < 0.0001).

CLINICAL RELEVANCE/APPLICATION

Risk stratification for clinically significant prostate cancer using prostate MRI is instrumental to reduce over-treatment. Deep learning can assist, but requires expensive expert segmentations.

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Sub-Events

SPR-NMMI-12   **Evaluation Of Baseline Tumor Burden As Response Predictor For Lymphoma Patients Undergoing CAR T-Cell Therapy**

Participants
Michael Winkelmann, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Chimeric antigen receptor (CAR) T-cell therapy with patient-derived T cells against tumor cells are approved for relapsed or refractory (r/r) diffuse large B-cell lymphoma (DLBCL). In some of the clinical trials for FDA approval, extensive tumor burden was associated with poor survival. We re-assessed the impact of tumor burden before transfusion on response at 3 months, progression-free (PFS) and overall survival (OS).*Methods and Materials Consecutive r/r DLBCL patients with CT imaging at baseline (BL) and CT or PET/CT at 3 months (follow-up; FU) after CAR T-cell transfusion were selected. For all patients, up to 6 target lesions were 3D-segmented using MintLesion at both time points. The sum of target lesion volume (STLV) was used to represent tumor burden (TB). Moreover, SUVmax and Deauville score were calculated for patients with FU PET/CT imaging. The prognostic value of BL-TB was evaluated for complete metabolic response (CMR)/ Deauville Score in FU PET/CT and for stratification of PFS and OS.*Results 28 patients were included (median age: 64 years, 57% male) with median baseline STLV of 88.3 ml and mean baseline STLV of 189 ml. Both median and mean STLV at baseline did not significantly stratify PFS (Figure 1A+B) or OS (Figure 1C+D). For 23 patients with FU PET/CT imaging, PET parameters were analyzed with a median SUVmax of 4.3. 14 patients showed CMR (Deauville score 1-3) and 9 patients had no CMR (Deauville score 4+5). There was no significant difference in distribution of BL-TB and Deauville score at FU (Figure 2). BL-TB showed no significant correlation with FU-TB (Figure 3A; r=0.21, p=0.29) or FU-SUVmax (Figure 3B; r=-0.08, p=0.73).*Conclusions In this post-marketing study, tumor burden at baseline had only limited prognostic value regarding response at 3 months, PFS or OS. Our data indicate that clinical patient selection for CAR T cell treatment should therefore not exclude patients solely based on extensive tumor burden. Future studies should explore the prognostic value of other baseline imaging markers.*Clinical Relevance/Application CAR T-cell therapy has emerged as a new effective antigen-driven cell-based immunotherapy to treat patients with DLBCL. Identifying prognostic parameters at baseline is crucial for patient selection.

RESULTS

28 patients were included (median age: 64 years, 57% male) with median baseline STLV of 88.3 ml and mean baseline STLV of 189 ml. Both median and mean STLV at baseline did not significantly stratify PFS (Figure 1A+B) or OS (Figure 1C+D). For 23 patients with FU PET/CT imaging, PET parameters were analyzed with a median SUVmax of 4.3. 14 patients showed CMR (Deauville score 1-3) and 9 patients had no CMR (Deauville score 4+5). There was no significant difference in distribution of BL-TB and Deauville score at FU (Figure 2). BL-TB showed no significant correlation with FU-TB (Figure 3A; r=0.21, p=0.29) or FU-SUVmax (Figure 3B; r=-0.08, p=0.73).

CLINICAL RELEVANCE/APPLICATION

CAR T-cell therapy has emerged as a new effective antigen-driven cell-based immunotherapy to treat patients with DLBCL. Identifying prognostic parameters at baseline is crucial for patient selection.

SPR-NMMI-13   **Ga-68 FAPI Imaging Versus FDG-PET Imaging In Hepatocellular Carcinoma**

Participants
Vineel Inampudi I, MD, Vijayawada, India (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to assess the diagnostic accuracy of FDG PET-CT assessment of Hepatocellular Carcinoma and the benefit of using Ga-68 Fibroblast Activation Protein Inhibitor (FAPI) instead of FDG in the PET assessment of the same.*Methods and Materials This study is a prospective study that has been carried out at our institution on 850 patients between January 2015 to January 2021 who were diagnosed to have HCCs on PET-CT assessment with confirmation on either biopsy or AFP assessment. The SUVmax of these tumors using both FDG and Ga-68 FAPI were studied and compared.*Results 850 patients, had both FDG and Ga-68 FAPI assessment 1 day apart. 581 patients had lesions where the largest dimension was more than 5 cm while 269 patients had a largest lesion dimension of less than 5 cm. 443 patients had background cirrhosis and 407 patients did not have chronic liver disease. Out of the total 850 patients who underwent FDG PET-CT, 781 lesions were FDG avid and 69 lesions did not show FDG uptake while all 850 patients who underwent Ga-68 FAPI imaging showed lesion avidity. The mean SUVmax of HCCs among the 850 patients who underwent both imaging modalities 1 day apart was 4.39 + 2.1 for FDG and 12.29 + 6.86 for Ga-68 FAPI with a p value < 0.05 (significant). The sensitivity of FDG in detection of HCC was 92% and that of Ga-68 FAPI was 100%.*Conclusions Ga-68 FAPI PET assessment for Hepatocellular carcinomas is a useful imaging tool in terms of definitive assessment of malignancy and scores higher than FDG-PET in accuracy for diagnosing HCC and can possibly replace FDG in the future.*Clinical Relevance/Application Hepatocellular carcinoma is one of the most common malignancies in our country and is encountered across various age groups. Apart from a few clinical parameters, imaging forms a major part of the assessment of these malignancies which present as hepatic masses and the core question to be answered in every case is whether the mass is benign or malignant and if malignant, then

whether it is hepatocellular carcinoma or another malignancy such as Cholangiocarcinoma. The use of multiple imaging characteristics on contrast enhanced CT scans has formed the basis of diagnosis however PET-CT assessment with FDG has been less accurate owing to the variable uptake by HCCs.

RESULTS

850 patients, had both FDG and Ga-68 FAPI assessment 1 day apart. 581 patients had lesions where the largest dimension was more than 5 cm while 269 patients had a largest lesion dimension of less than 5 cm. 443 patients had background cirrhosis and 407 patients did not have chronic liver disease. Out of the total 850 patients who underwent FDG PET-CT, 781 lesions were FDG avid and 69 lesions did not show FDG uptake while all 850 patients who underwent Ga-68 FAPI imaging showed lesion avidity. The mean SUVmax of HCCs among the 850 patients who underwent both imaging modalities 1 day apart was 4.39 + 2.1 for FDG and 12.29 + 6.86 for Ga-68 FAPI with a p value < 0.05 (significant). The sensitivity of FDG in detection of HCC was 92% and that of Ga-68 FAPI was 100%.

CLINICAL RELEVANCE/APPLICATION

Hepatocellular carcinoma is one of the most common malignancies in our country and is encountered across various age groups. Apart from a few clinical parameters, imaging forms a major part of the assessment of these malignancies which present as hepatic masses and the core question to be answered in every case is whether the mass is benign or malignant and if malignant, then whether it is hepatocellular carcinoma or another malignancy such as Cholangiocarcinoma. The use of multiple imaging characteristics on contrast enhanced CT scans has formed the basis of diagnosis however PET-CT assessment with FDG has been less accurate owing to the variable uptake by HCCs.

SPR-NMMI-14   A Novel Approach To Targeting Bacterial Infection - D-[11C]methionine PET/MRI In Humans

Participants
Ilona Polvoy, MD, San Fransisco, California (*Presenter*) Nothing to Disclose

PURPOSE

This ongoing trial investigates the biodistribution, dosimetry and diagnostic performance of D-[11C]methionine ([11C]D-Met), a novel bacteria-specific PET radiotracer. Current clinical imaging of infection is not specific, unable to distinguish infection from mimics such as tumors or inflammation. [11C]D-Met, based on a 'mirror-image' amino acid, is rapidly incorporated into peptidoglycan, part of the bacterial cell wall. We recently developed a reliable radiosynthesis that was successfully tested in animal infection models. Now, we report human dosimetry as well as initial results in patients with suspected prosthetic joint infection (PJI).*Methods and Materials 370-740 MBq [11C]D-Met was synthesized by automated in-loop radiosynthesis followed by injection of asingle bolus into 6 HVs (3 males, 3 female) and 3 patients with suspected PJI. HVs underwent 6 whole-body PET/MRI scans for purposes of dosimetry. Time-activity curves were used to calculate residence time for each source organ. Absorbed doses to each organ and body effective dose were calculated using OLINDA/EXM 1.1 with ICRP60 tissue weighting factors. Patients with suspected PJI received dynamic PET for 30 minutes targeted at the site of infection followed by a whole body PET/MRI.*Results Effective dose was estimated at 0.0040 mSv/MBq with highest activity in the urinary and hepatobiliary systems. [11C]D-Met showed clearance from both hepatobiliary (slow) and urinary (rapid) pathways. Early background uptake was observed in the liver, pancreas and kidneys with minimal background uptake in other organs. Importantly, minimal uptake was observed in the GI tract or lungs, despite potential concerns regarding the uptake within the human microbiomes. Additionally, minimal background uptake was observed in the spine, CNS or musculoskeletal system. In 2/3 patients with suspected PJI, [11C]D-Met showed increased focal uptake in the area of interest in both early focused scans and delayed whole-body scans.*Conclusions [11C]D-Met was well tolerated by both HVs and infected patients. No adverse effects were reported. Furthermore, the agent showed increased focal uptake in an area of suspected chronic infection, making this a promising agent for infection imaging.*Clinical Relevance/Application [11C]D-Met PET/MR imaging is a novel imaging technique with modest radiation dose, minimal background, and no observed adverse effects. Targeted imaging of bacteria could have an important impact on the diagnosis and management of infections.

RESULTS

Effective dose was estimated at 0.0040 mSv/MBq with highest activity in the urinary and hepatobiliary systems. [11C]D-Met showed clearance from both hepatobiliary (slow) and urinary (rapid) pathways. Early background uptake was observed in the liver, pancreas and kidneys with minimal background uptake in other organs. Importantly, minimal uptake was observed in the GI tract or lungs, despite potential concerns regarding the uptake within the human microbiomes. Additionally, minimal background uptake was observed in the spine, CNS or musculoskeletal system. In 2/3 patients with suspected PJI, [11C]D-Met showed increased focal uptake in the area of interest in both early focused scans and delayed whole-body scans.

CLINICAL RELEVANCE/APPLICATION

[11C]D-Met PET/MR imaging is a novel imaging technique with modest radiation dose, minimal background, and no observed adverse effects. Targeted imaging of bacteria could have an important impact on the diagnosis and management of infections.

SPR-NMMI-17   Intravesicular Radionuclide Therapy Against Superficial Bladder Cancer

Participants
Akiva Mintz, MD, PhD, New York, New York (*Presenter*) Consultant, Regeneron Pharmaceuticals, Inc

PURPOSE

Our long-term goal is to develop an effective minimally invasive therapy that can reach below the urothelium of the bladder to attack tumor cells. External beam radiation of the bladder is used for advancing or refractory disease, but the risk of injury to the bladder and adjacent organs make this option suboptimal. Therefore, goal is to locally administer [90Y]Biotin-Avidin to deliver short range (3-7mm) radiation that penetrates the bladder urothelium and reaches throughout the bladder wall (3-5mm) which cannot be accomplished by other locoregional bladder therapies. [90Y]Biotin-Avidin presents an optimal vehicle due to its easy radiolabeling using DOTA-Biotin precursor and its highly negative charge that is pulled toward the positively charged urothelial and cancer cell membranes.*Methods and Materials For biodistribution, rats were injected intravesicularly with [68Ga]Biotin-Avidin for a 4 hour period, after which the bladder was washed 3 times with saline. During and after the scan, rats were imaged with microPET to visualize the systemic biodistribution, followed by post necropsy organ counting to confirm PET findings. For therapy, mice were implanted orthotopically with luciferase-expressing MB49 mouse bladder cancer cells. At 3 days post implantation, when tumor cells were confirmed below the urothelial surface, we infused mice intravesicularly for 2 hours with 250µCi of [90Y]Biotin-Avidin and subsequently washed with saline. Mice were imaged at days 10 after tumor implantation to quantitate biologic activity of [90Y]Biotin-Avidin.*Results Biodistribution of [68Ga]Biotin-Avidin did not demonstrate any significant systemic distribution outside

the bladder (all organs reading at or near baseline defined <0.1% ID/g) and the bladder measuring 0.15% ID/g. For the therapeutic experiments in our orthotopoic model of invasive bladder cancer, we did not observe any toxicity from intravesicular [90Y]Biotin-Avidin treatment. Bioluminescent imaging demonstrated significantly decreased tumor burden in [90Y]Biotin-Avidin treated mice (n=8) compared to control injected mice.*Conclusions Our results demonstrate potential safety and efficacy of intravesicular radionuclide therapy with [90Y]Biotin-Avidin against bladder cancer.*Clinical Relevance/Application Superficial transitional bladder carcinoma is responsible for 16,000 deaths per year. 70 percent of patients present with superficial non-muscle invasive disease, 50% of whom progress to devastating total cystectomy or to incurable metastatic disease. Given its reach below the urothelial surface, intravesicular radionuclide therapy against bladder cancer has the potential to eradicate early invasive disease in conjunction with standard-of-care local therapy.

RESULTS

Biodistribution of [68Ga]Biotin-Avidin did not demonstrate any significant systemic distribution outside the bladder (all organs reading at or near baseline defined <0.1% ID/g) and the bladder measuring 0.15% ID/g. For the therapeutic experiments in our orthotopoic model of invasive bladder cancer, we did not observe any toxicity from intravesicular [90Y]Biotin-Avidin treatment. Bioluminescent imaging demonstrated significantly decreased tumor burden in [90Y]Biotin-Avidin treated mice (n=8) compared to control injected mice.

CLINICAL RELEVANCE/APPLICATION

Superficial transitional bladder carcinoma is responsible for 16,000 deaths per year. 70 percent of patients present with superficial non-muscle invasive disease, 50% of whom progress to devastating total cystectomy or to incurable metastatic disease. Given its reach below the urothelial surface, intravesicular radionuclide therapy against bladder cancer has the potential to eradicate early invasive disease in conjunction with standard-of-care local therapy.

SPR-NMMI-5 18F-Florbetaben PET/CT Clinical Interpretation: Visual Assessment And Semiquantitative Analysis

Participants
David Petrover, MD, New Hyde Park, New York (*Presenter*) Nothing to Disclose

PURPOSE

Amyloid PET plays a vital role in in vivo detection of ß-Amyloid (Aß) accumulation in Alzheimer's disease. Increasingly, neuroradiologic trainees and infrequent readers are relying on semiquantitative analyses to support clinical diagnostic efforts. However, there is limited data assessing correspondence between visual assessment and semiquantitative analysis in the evaluation of cortical amyloid burden.*Methods and Materials We conducted a retrospective review of [18F]-florbetaben PET/CT studies acquired at our institution from June 2016-May 2018 (N=167). Visual interpretation to determine Aß+ status was conducted by two independent readers blinded to each other's interpretation. After reads were completed, scans were post-processed utilizing MIMneuro software, which generated regional-based semiquantitative Z-scores indicating cortical amyloid burden following industry standards including using the whole cerebellum as the reference region.*Results 167 [18F]-florbetaben PET/CTs were obtained (83 F, 84 M; mean age 76.1 ± 6.8 y). 92/167 (reader 1) and 101/167 scans (reader 2) scans were considered positive for amyloid deposition (agreement = 92.2%, ?=0.84). An additional 9 scans were identified as possible amyloid-positive based solely on semiquantitative analyses. The largest semiquantitative differences were identified in the left frontal lobe (Z = 7.74 in Aß+ versus 0.50 in Aß- subjects). All unilateral regions showed large statistically significant differences in Aß burden (P=2.08E-28 in all cases). Semiquantitative scores were highly sensitive to Aß+ status and highly accurate in their ability to identify amyloid-positive patients, defined as positive scan by both readers (AUC = 0.90 [0.79-1.00]). Spread analyses suggested that amyloid deposition was most severe in left posterior cingulate gyrus, where amyloid-positive individuals were most likely to cross standard cutoffs. The largest differences between negative and positive individuals were in left frontal lobe, and analyses using region-specific cutoffs indicated that presence of amyloid in the temporal and anterior cingulate cortex, while exhibiting relatively low Z-scores, were the more common.*Conclusions Visual assessment and semiquantitative analysis provide highly congruent results, thereby enhancing reader confidence and improving scan interpretation. This is particularly relevant given recent advances in development of amyloid-targeting disease modifying therapeutics, allowing for accurate patient selection for clinical trials and assessment of target engagement and treatment efficacy.*Clinical Relevance/Application Qualitative assessment of amyloid PET scans may be facilitated by relying on results from semiquantitative analysis.

RESULTS

167 [18F]-florbetaben PET/CTs were obtained (83 F, 84 M; mean age 76.1 ± 6.8 y). 92/167 (reader 1) and 101/167 scans (reader 2) scans were considered positive for amyloid deposition (agreement = 92.2%, ?=0.84). An additional 9 scans were identified as possible amyloid-positive based solely on semiquantitative analyses. The largest semiquantitative differences were identified in the left frontal lobe (Z = 7.74 in Aß+ versus 0.50 in Aß- subjects). All unilateral regions showed large statistically significant differences in Aß burden (P=2.08E-28 in all cases). Semiquantitative scores were highly sensitive to Aß+ status and highly accurate in their ability to identify amyloid-positive patients, defined as positive scan by both readers (AUC = 0.90 [0.79-1.00]). Spread analyses suggested that amyloid deposition was most severe in left posterior cingulate gyrus, where amyloid-positive individuals were most likely to cross standard cutoffs. The largest differences between negative and positive individuals were in left frontal lobe, and analyses using region-specific cutoffs indicated that presence of amyloid in the temporal and anterior cingulate cortex, while exhibiting relatively low Z-scores, were the more common.

CLINICAL RELEVANCE/APPLICATION

Qualitative assessment of amyloid PET scans may be facilitated by relying on results from semiquantitative analysis.

SPR-NMMI-6 "Theranostics" - Molecular Imaging and Radionuclide Therapy for Metastatic Colorectal Cancer Targeting CSCP1

Participants
Tahleesa Cuda, Brisbane, Australia (*Presenter*) Nothing to Disclose

PURPOSE

The five-year survival for patients with metastatic colorectal cancer (CRC) is less than 12%. Theranostics is a novel imaging and therapy modality consisting of molecular imaging and radionuclide therapy. Molecular imaging and radionuclide therapy use radionuclides conjugated to antigen-specific ligands to specifically image and treat metastatic cancers.10D7 is a monoclonal antibody which targets CDCP1, a transmembrane glycoprotein overexpressed on a range of malignancies including CRC. This study sought to assess whether CDCP1 is a suitable molecular imaging and radionuclide therapy target for CRC in a range of preclinical

models.*Methods and Materials We assessed the avidity during positron emission tomography (PET) imaging of Zirconium-89 (89Zr)-10D7 in detecting CRC in a range of mouse models.In a therapeutic phase, tumour response of mice bearing CRC treated with the radioligand Lutetium-177 (177Lu)-10D7 was assessed.*Results During PET imaging, 89Zr-10D7 demonstrated significantly higher avidity than control radioligands demonstrating high specificity for CRC. 177Lu-10D7 was significantly more effective than conventional chemotherapy at reducing CRC tumour growth. 177Lu-10D7 also improved the efficacy of conventional chemotherapy.*Conclusions Molecular imaging targeting CDCP1 has high specificity for CRC in preclinical models. Radionuclide therapy targeting CDCP1 may have a role as a standalone therapy agent or synchronous agent for use with existing therapies to achieve a synergistic effect. Theranostics targeting CDCP1 may offer a new therapy for patients with metastatic CRC. Further progression towards humanisation and clinical trial should be sought.

RESULTS

During PET imaging, 89Zr-10D7 demonstrated significantly higher avidity than control radioligands demonstrating high specificity for CRC. 177Lu-10D7 was significantly more effective than conventional chemotherapy at reducing CRC tumour growth. 177Lu-10D7 also improved the efficacy of conventional chemotherapy.

SPR-NMMI-7 Clinical Activity Of Yttrium-90-labeled Ibritumomab Tiuxetan For Treatment Of Relapsed Or Refractory B Cell Non-Hodgkin Lymphoma

Participants
Kaoru Maruyama, Osaka, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the efficacy of yttrium-90-labeled ibritumomab tiuxetan radioimmunotherapy (90Y-IT) in patients with relapsed or refractory non-Hodgkin lymphoma (NHL).*Methods and Materials This is a retrospective study of 68 NHL patients received 90Y-IT between October 2012 and December 2017. Patient characteristics included a mean age of 68 years (range, 45 to 87 years old); 50% men; 60% stage III/IV; 90% three or more prior therapies before baseline. NHL included 47 Follicular lymphoma (FL), 15 Mucosa associated lymphoid tissue lymphoma (MALT), and 6 Mantle cell lymphoma (MCL). Response was evaluated at 3 months after 90Y-IT using 18F-fluorodeoxyglucose positron emission tomography/computed tomography, etc. By using Kaplan-Meier method overall survival (OS), progression-free survival (PFS), and duration of response in responders (complete response, CR; partial response, PR) were analyzed (Table 1).*Results An overall response rate (ORR) of 87% (a 63% CR and a 24% PR rate) was observed (Table 2). Age had no impact on response (less than 60 years vs. more than 60 years, Fisher's exact test p=ns). The duration of follow-up between 90Y-IT and the latest clinical record ranged from 0.9 to 101 months. Kaplan-Meier estimated OS and PFS rate in all patients was 88% and 53% at 50 months after 90Y-IT, respectively. Among histological subgroups, OS rate in MCL was 50% at 11 months. In the MCL group, the rapid progression in the non-responders lowered the median OS. All responses were durable, lasting from 4 to 96 months. At 5 years after 90Y-IT, eight patients remained in CR.*Conclusions Radioimmunotherapy with 90Y-labeled ibritumomab tiuxetan is a very active agent in treatment of relapsed or refractory B-cell NHL, especially FL and MALT. The observation suggested that patients with MCL may require more aggressive management.*Clinical Relevance/Application 90Y-labeled ibritumomab tiuxetan is an effective treatment option for patients with B cell NHL who had failed prior chemotherapy, including patients of aged over 60 years old.

RESULTS

An overall response rate (ORR) of 87% (a 63% CR and a 24% PR rate) was observed (Table 2). Age had no impact on response (less than 60 years vs. more than 60 years, Fisher's exact test p=ns). The duration of follow-up between 90Y-IT and the latest clinical record ranged from 0.9 to 101 months. Kaplan-Meier estimated OS and PFS rate in all patients was 88% and 53% at 50 months after 90Y-IT, respectively. Among histological subgroups, OS rate in MCL was 50% at 11 months. In the MCL group, the rapid progression in the non-responders lowered the median OS. All responses were durable, lasting from 4 to 96 months. At 5 years after 90Y-IT, eight patients remained in CR.

CLINICAL RELEVANCE/APPLICATION

90Y-labeled ibritumomab tiuxetan is an effective treatment option for patients with B cell NHL who had failed prior chemotherapy, including patients of aged over 60 years old.

Abstract Archives of the RSNA, 2021

Science Session with Keynote: Breast Imaging (Breast Density and Risk)

Participants

Wendy B. Demartini, MD, Stanford, California (*Moderator*) Advisory Board, Kheiron Medical Technologies Ltd
Maxine S. Jochelson, MD, New York, New York (*Moderator*) Speaker, General Electric Company

Sub-Events

SSBR05   Keynote Speaker

Participants
Jennifer A. Harvey, MD, Rochester, New York (*Presenter*) Stockholder, Volpara Health Technologies LimitedBesins/BHR Pharmaceuticals.

SSBR05-5   Impact On Risk Categorization With Inclusion Of Mammographic Density In The Tyrer-cuzick Model

Participants
Stamatia Destounis, MD, Rochester, New York (*Presenter*) Medical Advisory Committee, Hologic, Inc;Medical Advisory Board, iCAD, Inc

PURPOSE

To understand the impact of mammographic density (MD) measures on clinically actionable breast cancer risk estimates reported by the Tyrer-Cuzick (TC) model, and differential impacts on subgroups of our population.*Methods and Materials We identified 59,257 women who underwent full-risk assessment using TC version 7 (TCv7) at the time of screening at a specialized breast imaging clinic, between 7 July 2019 and 31 January 2020. Using thresholds of low (<15%), intermediate (15-20%) and high (=20%) lifetime risk, we determined which women would have experienced a change in clinical management following the addition of volumetric breast density (VBD) or BI-RADS to TC version 8 (TCv8). To determine whether MD is differentially affecting specific subsets of women, analysis was conducted in R using the epitools package.*Results Overall, we found that compared to the 8.3% of women classified as high-risk using the TC (v7) model with no density input, there were significantly higher proportions of high-risk women when using TCv8 with VBD (11.4%; p<0.001) versus lower proportion using BI-RADS (6.9%; p<0.001). When considering a change in risk category in either direction by including density, women under age 55 had an odds ratio (OR) of 2.8 when using VBD and 3.5 using BIRADS (p < 0.001). Premenopausal women had an OR of 2.6 when using VBD and 2.9 using BIRADS (p < 0.001). Of 896 (1.5%) women who became low risk by adding density using the VBD, there were 144 (16%) with a family history of a first degree relative with breast cancer under the age 45. Of women at low or intermediate risk using TCv8, 36% had dense breasts.*Conclusions Younger, pre-menopausal women are more affected by the addition of MD to the TC risk model. A substantial number of women who fall into low or intermediate risk categories have dense breasts (36%) and may still benefit from supplemental imaging. Many women with a family history whose lifetime risk fall below 20% when using breast density will meet criteria for genetic testing.*Clinical Relevance/Application Clinics wanting to establish high-risk screening programs should understand that different MD measures incorporated into risk models can differentially impact patient management.

RESULTS

Overall, we found that compared to the 8.3% of women classified as high-risk using the TC (v7) model with no density input, there were significantly higher proportions of high-risk women when using TCv8 with VBD (11.4%; p<0.001) versus lower proportion using BI-RADS (6.9%; p<0.001). When considering a change in risk category in either direction by including density, women under age 55 had an odds ratio (OR) of 2.8 when using VBD and 3.5 using BIRADS (p < 0.001). Premenopausal women had an OR of 2.6 when using VBD and 2.9 using BIRADS (p < 0.001). Of 896 (1.5%) women who became low risk by adding density using the VBD, there were 144 (16%) with a family history of a first degree relative with breast cancer under the age 45. Of women at low or intermediate risk using TCv8, 36% had dense breasts.

CLINICAL RELEVANCE/APPLICATION

Clinics wanting to establish high-risk screening programs should understand that different MD measures incorporated into risk models can differentially impact patient management.

SSBR05-6   Denser Or Just Thinner? Mammographic Breast Density Characterization Around The World

Participants
Ioannis Sechopoulos, PhD, Nijmegen, Netherlands (*Presenter*) Research Grant, Siemens AG;Speakers Bureau, Siemens AG;Research Grant, Canon Medical Systems Corporation;Scientific Advisory Board, Fischer Medical;Research Grant, Sectra AB;Research Grant, ScreenPoint Medical BV;Research Grant, Volpara Health Technologies Limited

PURPOSE

To determine if the distributions of volumetric breast density (VBD) across screening populations around the world are consistent when compared at equal compressed breast thicknesses.*Methods and Materials Six digital mammography screening datasets from different countries were collected. Each dataset consisted of the VBD estimates (Volpara Health Ltd.), compressed breast thickness, view (cranio-caudal (CC) or medio-lateral oblique (MLO)), side, and an anonymized exam ID. In total, data from 780,648

screened women =50 years old (USA: 189,859; Netherlands: 32,757; Norway: 547,614; Brazil: 6,402; Malaysia: 2,121; Greece: 1,895) were included. The distribution of VBD within each of 10 different compressed breast thickness bins (15-25 mm, 26-35 mm, etc.) was analyzed separately per view, to estimate the 5th, 10th, 25th, 50th, 75th, 90th and 95th percentile density for each thickness bin and their corresponding 95% CI. Differences between the mean VBD across datasets and the corresponding VBD for the same percentiles in each dataset were compared.*Results The difference in the VBDs for the same percentile density and breast thickness across the screening programs had a range of CC: -4.4% - +5.0% and MLO: -5.8% - +6.3% from the worldwide means. The majority (516/686=75%) of these differences were statistically significant. For example, for a 56-65 mm thick CC-view breast, the 5th, 50th, and 95th percentile VBDs across the six datasets ranges are 2.4% - 3.3%, 4.2% - 6.5%, and 10.7% - 16.6%, respectively (5/6, 3/6, and 4/6 statistically different from the mean VBDs of 2.8%, 5.3%, and 13.4%).*Conclusions Descriptive statistics on breast characteristics are required in some settings, such as for dosimetry or estimation of cancer development risk, but international variations in the prevalence of dense breasts suggests that a single model may not be broadly representative. However, this quantitative analysis of data from six countries demonstrates that breasts of comparable thickness actually have similar VBD distributions across populations, with the differences being statistically, but probably not clinically, significant. This suggests that, in the absence of patient-specific VBD estimates, a single population-based model of VBD as a function of breast thickness may be appropriate for worldwide use for many applications.*Clinical Relevance/Application If the breast thickness is also considered, the same criteria for categorizing breast density based on VBD can be used worldwide, for applications such as radiation dose estimates or risk modeling.

RESULTS

The difference in the VBDs for the same percentile density and breast thickness across the screening programs had a range of CC: -4.4% - +5.0% and MLO: -5.8% - +6.3% from the worldwide means. The majority (516/686=75%) of these differences were statistically significant. For example, for a 56-65 mm thick CC-view breast, the 5th, 50th, and 95th percentile VBDs across the six datasets ranges are 2.4% - 3.3%, 4.2% - 6.5%, and 10.7% - 16.6%, respectively (5/6, 3/6, and 4/6 statistically different from the mean VBDs of 2.8%, 5.3%, and 13.4%).

CLINICAL RELEVANCE/APPLICATION

If the breast thickness is also considered, the same criteria for categorizing breast density based on VBD can be used worldwide, for applications such as radiation dose estimates or risk modeling.

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Participants
Scott Simpson, DO, Philadelphia, Pennsylvania (*Moderator*) Nothing to Disclose
Seth J. Kligerman, MD, La Jolla, California (*Moderator*) Speakers Bureau, Boehringer Ingelheim GmbH;Author, RELX;Consultant, Riverain Technologies, LLC;Consultant, Bayer AG

Sub-Events

SSCH01-1   The Role Of Chest CT In Phenotyping High Risk COVID-19 Patients

Participants
Fatemeh Darvizeh, MD, Milan, Italy (*Presenter*) Nothing to Disclose

PURPOSE

The aim of the present study was to investigate the role of chest CT in risk stratification of COVID-19 patients, measuring quantitative biomarkers of cardiovascular risk (calcium score), fragility (sarcopenia) and dysmetabolism (fatty liver, osteoporosis).*Methods and Materials This study is a retrospective multicenter observational study. 1845 consecutive COVID-19 patients from 15 hospitals in Northen Italy underwent chest CT within 72 hours from hospital admission were enrolled. All clinical data including demographics, comorbidities, and lab tests were collected from electronic medical records as well as oxygen therapy, access to ICU and in-hospital death. All chest CT were analyzed in a single core-lab and the following parameters were extracted: well-aereted lung volume, percentage of pneumonia involvement, coronary artery calcium (CAC) scoring, paraverterbral muscle density (D12) as marker of sarcopenia, bone density (D12) as marker of osteoporosis and liver density as marker of liver steatosis. Uni/multivariate analyses were performed using Logistic regression models.*Results The final cohort consisted of 1669 patients (1104 men) with median age of 67 years old. The mortality rate was found higher in men (28%) compared to women (19%, p <0.001).COVID-19 was found more lethal in elderly (75.39±10.21 vs. 56.42±14.76 y.o p <0.001) with higher CAC score (547.96±1067.14 vs. 243.01±813.03, p <0.001), higher degree of sarcopenia (32.43±19.56 vs. 43.83±12.64 HU, p <0.001), liver steatosis (41.77±16.49 vs. 50.85±12.78 HU, p <0.001) and lower bone density (111.54±45.26 vs. 164.30±51.05 HU, p <0.001). All these CT parameters were predictors of unfavorable outcome at univariate analysis. At multivariate analysis, sarcopenia was a CT predictor of death (p=0.005) independent from gender (p=0.017 for men and p=0.02 for women), together with fatty liver in men (p=0.004). Sarcopenia was associated to severe pneumonia (>50% of lung involvement) at multivariable model (p=0.002), together with older age, male sex, higher BMI, lower SatO2, higher LDH and CRP.*Conclusions Sarcopenia and fatty liver at chest CT are associated to pneumonia severity and outcome in COVID-19.*Clinical Relevance/Application In COVID-19 patients, Chest CT provides information about patient's fragility and metabolic alterations affecting disease severity and outcome.

RESULTS

The final cohort consisted of 1669 patients (1104 men) with median age of 67 years old. The mortality rate was found higher in men (28%) compared to women (19%, p <0.001).COVID-19 was found more lethal in elderly (75.39±10.21 vs. 56.42±14.76 y.o p <0.001) with higher CAC score (547.96±1067.14 vs. 243.01±813.03, p <0.001), higher degree of sarcopenia (32.43±19.56 vs. 43.83±12.64 HU, p <0.001), liver steatosis (41.77±16.49 vs. 50.85±12.78 HU, p <0.001) and lower bone density (111.54±45.26 vs. 164.30±51.05 HU, p <0.001). All these CT parameters were predictors of unfavorable outcome at univariate analysis. At multivariate analysis, sarcopenia was a CT predictor of death (p=0.005) independent from gender (p=0.017 for men and p=0.02 for women), together with fatty liver in men (p=0.004). Sarcopenia was associated to severe pneumonia (>50% of lung involvement) at multivariable model (p=0.002), together with older age, male sex, higher BMI, lower SatO2, higher LDH and CRP.

CLINICAL RELEVANCE/APPLICATION

In COVID-19 patients, Chest CT provides information about patient's fragility and metabolic alterations affecting disease severity and outcome.

SSCH01-2   Quantitative Chest CT Combined With Plasma Cytokines Predicts Outcomes In COVID-19 Patients

Participants
Emma Klein, MS, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To assess the power of 1) chest CT qualitative score, 2) chest CT quantitative measurements, 3) soluble cytokines in plasma independently and 4) in combination for predicting death during hospitalization and maximum severity degree in COVID-19 patients.*Methods and Materials 152 COVID-19 patients admitted to a single institution, with plasma cytokine assessment and a chest CT within 5 days from admission were included. Demographics, clinical, and laboratory variables, including plasma cytokines (IL-6, IL-8, and TNF-a) were collected. A CT qualitative score based on the extent of lung involvement (score 0-20), was obtained by two independent radiologists; and a CT quantitative analysis was performed using a segmentation software supervised by one reader, to calculate total lung volume (ml), aerated lung volume (ml), ground-glass opacities (GGO) volume (ml), consolidation volume (ml), and GGO to aerated lung ratio. We used spearman correlations, fisher exact test and cox proportional hazard models to test the relationships between variables and endpoints. Next, we used elastic net regression strategy to evaluate predictive power of five scenarios: 1) Cytokines, 2) CT qualitative, 3) CT quantitative, 4) Combined cytokines + CT and, 5) A feature

optimized model, to predict hospital death and maximum severity degree (WHO score). We validated the performance of our models using a combination of training/testing splits and cross-fold validation followed by ROC analysis. Finally, we built a nomogram for risk of death during hospitalization using the variables from our optimized model.*Results The mortality rate was 17.1% (n=26). The maximum severity degree achieved was mild (n= 78, 51.3%) or severe (n=74, 47.3%). Prediction power was fair to good, with AUCs for hospital death and maximum severity degree, as follows: 1) Cytokine model 0.70 (CI: 65-75%) and 0.70 (CI: 66-75%); 2) CT qualitative model 0.60 (CI: 57-62%) and 0.74 (CI: 70-78%); 3) CT quantitative model 0.66 (CI: 60-70%) and 0.81 (CI: 77-86%), 4) combined model 0.75 (CI: 69-80%) and 0.84 (CI: 80-88%); and 5) optimized model 0.78 (CI: 72-84%) and 0.82 (CI: 76-86%). Clinical variables such as O2 and demographics were not predictive and filtered during coefficient selection except for age.*Conclusions Chest-CT assessment in combination with plasma cytokines may represent a useful non-invasive tool to predict death and maximum severity degree in COVID-19 patients.*Clinical Relevance/Application Chest-CT assessment in combination with plasma cytokines may be helpful in triaging COVID-19 patients and managing future outbreaks.

RESULTS

The mortality rate was 17.1% (n=26). The maximum severity degree achieved was mild (n= 78, 51.3%) or severe (n=74, 47.3%). Prediction power was fair to good, with AUCs for hospital death and maximum severity degree, as follows: 1) Cytokine model 0.70 (CI: 65-75%) and 0.70 (CI: 66-75%); 2) CT qualitative model 0.60 (CI: 57-62%) and 0.74 (CI: 70-78%); 3) CT quantitative model 0.66 (CI: 60-70%) and 0.81 (CI: 77-86%), 4) combined model 0.75 (CI: 69-80%) and 0.84 (CI: 80-88%); and 5) optimized model 0.78 (CI: 72-84%) and 0.82 (CI: 76-86%). Clinical variables such as O2 and demographics were not predictive and filtered during coefficient selection except for age.

CLINICAL RELEVANCE/APPLICATION

Chest-CT assessment in combination with plasma cytokines may be helpful in triaging COVID-19 patients and managing future outbreaks.

SSCH01-3   Chest-CT Derived Pulmonary Hypertension At The Admission Predicts Overall Survival In COVID-19 Patients: Insight From 1461 Consecutive Patients In Italy

Participants
Anna Palmisano, MD, Milan, Italy (*Presenter*) Nothing to Disclose

PURPOSE

In non-COVID-19 setting, enlarged main pulmonary artery diameter (MPAD) resulted associated to pulmonary hypertension and mortality. Aim was to investigate and validate the association between MPAD enlargement and overall survival in COVID-19 patients.*Methods and Materials This is a cohort study on 1469 consecutive COVID-19 patients submitted to chest-CT within 72 hours from admission in seven tertiary level hospitals in Northern Italy, between March 1st to April 20th, 2020. Derivation cohort (n=761) included patients from the first three participating hospitals, validation cohort (n=633) included patients from the remaining hospitals. CT images were centrally analyzed in a core-lab blinded to clinical data. Prognostic value of MPAD on overall survival was evaluated at adjusted and multivariable Cox's regression analysis and final multivariable model tested on a validation cohort.*Results In the derivation cohort, the median age was 69 [IQR, 58-77] years and 537 (70.6%) were male. In the validation cohort, the median age was 69 [IQR, 59-77] years with 421 (66.5%) males. Enlarged MPAD (=31mm) was a predictor of mortality at adjusted (hazard ratio, HR [95% CI]: 1.741 [1.253-2.418], P<0.001) and multivariable regression analysis (HR [95% CI]: 1.592 [1.154-2.196], P=0.005), together with male gender, old age, high creatinine, low well-aerated lung volume and high pneumonia extension (c-index [95% CI]=0.826 [0.796-0.851]). Model discrimination was confirmed on the validation cohort (c-index [95% CI]=0.789 [0.758-0.823]), also using CT measurement from a second reader (c-index [95% CI]=0.790 [0.753;0.825]).*Conclusions Enlarged MPAD (=31 mm) at admitting chest-CT is independent predictor of mortality in COVID-19.*Clinical Relevance/Application Enlargement of main pulmonary artery diameter at chest-CT performed within 72 hours from the admission was associated to a higher rate of in-hospital mortality in COVID-19 patients.

RESULTS

In the derivation cohort, the median age was 69 [IQR, 58-77] years and 537 (70.6%) were male. In the validation cohort, the median age was 69 [IQR, 59-77] years with 421 (66.5%) males. Enlarged MPAD (=31mm) was a predictor of mortality at adjusted (hazard ratio, HR [95% CI]: 1.741 [1.253-2.418], P<0.001) and multivariable regression analysis (HR [95% CI]: 1.592 [1.154-2.196], P=0.005), together with male gender, old age, high creatinine, low well-aerated lung volume and high pneumonia extension (c-index [95% CI]=0.826 [0.796-0.851]). Model discrimination was confirmed on the validation cohort (c-index [95% CI]=0.789 [0.758-0.823]), also using CT measurement from a second reader (c-index [95% CI]=0.790 [0.753;0.825]).

CLINICAL RELEVANCE/APPLICATION

Enlargement of main pulmonary artery diameter at chest-CT performed within 72 hours from the admission was associated to a higher rate of in-hospital mortality in COVID-19 patients.

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Abstract Archives of the RSNA, 2021

Science Session with Keynote: Nuclear Medicine/Molecular Imaging (Advances in Molecular Oncologic Imaging)

Participants

Gary Ulaner, MD,PhD, Irvine, California (*Moderator*) Speaker, Siemens AG;Speaker,Lantheus Holdings;Research support, General Electric Company;Research support, F. Hoffmann-La Roche Ltd;Research support, Lantheus Holdings;Research support, Novartis AG
Andrei Iagaru, MD, Stanford, California (*Moderator*) Research Grant, General Electric Company;Research Grant, Lantheus Holdings;Research Grant, Novartis AG

Sub-Events

SSNMMI01   Keynote Speaker

Participants
Gary Ulaner, MD,PhD, Irvine, California (*Presenter*) Speaker, Siemens AG;Speaker,Lantheus Holdings;Research support, General Electric Company;Research support, F. Hoffmann-La Roche Ltd;Research support, Lantheus Holdings;Research support, Novartis AG

SSNMMI01-2   18F-Fluoroestradiol PET/CT Imaging Of Invasive Lobular Carcinoma

Participants
Matthew Covington, MD, Salt Lake City, Utah (*Presenter*) Consultant, inviCRO, LLC

PURPOSE

Invasive lobular carcinoma (ILC), the second-most common breast cancer subtype, is often difficult to detect on physical examination and standard imaging to include mammography, ultrasound, CT, and FDG-PET/CT. Given that ILC has high rates of estrogen receptor (ER) positivity (around 95% of ILC's are ER positive), imaging of ERs using 18F-Fluoroestradiol-PET/CT (FES-PET/CT) may advance ILC detection. The primary purpose of this study is to establish the positive detection rate of histologically proven ILC on FES-PET/CT. A higher proportion of tumors are expected to have positive uptake by FES-PET/CT compared to FDG-PET/CT.*Methods and Materials This study has IND and IRB approval. 24 patients with biopsy proven ILC from any body site will be recruited and enrolled. FES-PET/CT will be performed with a 6 mCi dose and 60 minute uptake time. An optional FDG-PET/CT scan is also offered if not already performed within 4 weeks of enrollment. Positive uptake at site of biopsy proven ILC will be documented on FES-PET/CT and, if available, FDG-PET/CT, as defined by focal uptake above background and, for FES, SUVmax >1.5.*Results 9 female patients, average age of 61.7 years (range 41 to 82 years) with 14 sites of biopsy proven ILC (13 breast, 1 axilla) have been enrolled over 4 months of accrual. All patients have ILC diagnosed on biopsy within 12 weeks of imaging. Of the 14 sites of biopsy proven ILC, 12 of 13 are ER+ and one is triple negative. All 14 demonstrated positive uptake on FES-PET/CT (average SUVmax of 4.7 (range 1.5 to 12.7)). FDG-PET/CT was performed on 6 patients with 10 lesions. On FDG-PET/CT, 9 of 10 lesions (90%) demonstrated positive uptake.*Conclusions Preliminary analysis shows positive FES-PET/CT at all sites of ILC. One case of ER+ ILC showed abnormal uptake on FES-PET/CT that was not evident on FDG-PET/CT. One case of triple negative ILC on biopsy did show abnormal FES uptake, suggesting possible tumoral heterogeneity with some ER+ disease.*Clinical Relevance/Application This is the first prospective study to evaluate the performance of FES-PET/CT in a dedicated population of histologically proven ILC cases. The study results may be of particular importance to ILC patients for whom conventional imaging is frequently inaccurate.

RESULTS

9 female patients, average age of 61.7 years (range 41 to 82 years) with 14 sites of biopsy proven ILC (13 breast, 1 axilla) have been enrolled over 4 months of accrual. All patients have ILC diagnosed on biopsy within 12 weeks of imaging. Of the 14 sites of biopsy proven ILC, 12 of 13 are ER+ and one is triple negative. All 14 demonstrated positive uptake on FES-PET/CT (average SUVmax of 4.7 (range 1.5 to 12.7)). FDG-PET/CT was performed on 6 patients with 10 lesions. On FDG-PET/CT, 9 of 10 lesions (90%) demonstrated positive uptake.

CLINICAL RELEVANCE/APPLICATION

This is the first prospective study to evaluate the performance of FES-PET/CT in a dedicated population of histologically proven ILC cases. The study results may be of particular importance to ILC patients for whom conventional imaging is frequently inaccurate.

SSNMMI01-3   Simultaneous 18F-FDG PET/MRI Radiomics And Machine Learning Analysis For The Prediction Of Axillary Lymph Node Status In Breast Cancer

Participants
Valeria Romeo, Naples, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To investigate whether radiomics and machine learning (ML) applied to simultaneous 18F-FDG PET/MRI allow prediction of the axillary lymph node (LN) status in breast cancer (BC) patients through the assessment of intratumor heterogeneity.*Methods and Materials In this IRB-approved prospective, single institution study, 74 patients with 82 histologically proven BC lesions and axillary LN (negative LN=31, positive LN=51) were included and underwent simultaneous breast 18F-FDG PET/MRI. Images were analyzed to extract quantitative parameters from dynamic contrast-enhanced (DCE) (tumor Mean Transit Time, Volume Distribution, Plasma

Flow), diffusion-weighted imaging (DWI) (tumor ADCmean and contralateral breast parenchyma), and PET (tumor SUVmax, mean and minimum, SUVmean of ipsi- and contralateral breast parenchyma) images. Whole-lesion manual segmentation was then performed on DCE, T2-w, DWI and PET images to extract handcrafted first-, second- and higher-order radiomics features. Different ML models were developed using a fine gaussian support vector machine (SVM) classifier with a 5-fold cross validation and different combinations of quantitative parameters and radiomics features to obtain the highest accuracy for prediction of axillary LN status, in terms of absence/presence of LN metastasis.*Results Eight radiomics models were developed. Among these, the model employing radiomics features extracted from DCE, ADC and PET images obtained the highest accuracy (AUROC 0.784, 95% CI 0.697 - 0.871) for prediction of LN status, with sensitivity, specificity, PPV and NPV of 75.5%, 66.8%, 68.8%, and 73.9%, respectively.*Conclusions A ML-based radiomics model using handcrafted 18F-FDG PET/MRI radiomics features extracted from BC allows prediction of axillary LN status through the assessment of intratumor heterogeneity.*Clinical Relevance/Application Radiomics and ML applied to 18F-FDG PET/MRI show promise for a non-invasive assessment of nodal status and treatment planning of breast cancer patients.

RESULTS

Eight radiomics models were developed. Among these, the model employing radiomics features extracted from DCE, ADC and PET images obtained the highest accuracy (AUROC 0.784, 95% CI 0.697 - 0.871) for prediction of LN status, with sensitivity, specificity, PPV and NPV of 75.5%, 66.8%, 68.8%, and 73.9%, respectively.

CLINICAL RELEVANCE/APPLICATION

Radiomics and ML applied to 18F-FDG PET/MRI show promise for a non-invasive assessment of nodal status and treatment planning of breast cancer patients.

SSNMMI01-4 Comparison Of Nodal Staging Between CT, MRI And 18F-FDG PET/MRI In Patients With Newly Diagnosed Breast Cancer

Participants
Janna Morawitz, MD, Dusseldorf, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To compare CT, MRI and 18F-fluorodeoxyglucose positron emission tomography (18F-FDG PET/MRI) for nodal status, regarding quantity and location of metastatic locoregional lymph nodes in patients with newly diagnosed breast cancer.*Methods and Materials 182 patients (mean age 52.7 ± 11.9 years) were included in this prospective double-center study. Patients underwent dedicated contrast enhanced chest/abdomen/pelvis computed tomography (CT) and whole-body (18F-FDG PET/) magnet resonance imaging (MRI). Thoracal datasets were evaluated separately regarding quantity, lymph node station (axillary level I-III, supraclavicular, internal mammary chain) and lesion character (benign vs. malign). Histopathology served as reference standard for patient-based analysis. Patient-based and lesion-based analyses were compared by a Mc Nemar test. Sensitivity, specificity, positive and negative predictive value as well as accuracy were assessed for all three imaging modalities.*Results On a patient-based analysis, PET/MRI correctly detected significantly more nodal positive patients than MRI (p<0.0001) and CT (p<0.0001). No statistically signifigant difference was seen between CT and MRI. PET/MRI detected 193 lesions in 75 patients (41.2 %), while MRI detected 123 lesions in 56 patients (30.8 %) and CT detected 104 lesions in 50 patients (27.5 %), respectively. Differences were statistically significant on a lesion-based analysis (PET/MRI vs. MRI, p<0.0001; PET/MRI vs. CT, p<0.0001; MRI vs. CT, p=0.015). Subgroup analysis for different lymph node stations showed that PET/MRI detected significantly more lymph node metastases than MRI and CT in each location (axillary level I-III, supraclavicular, mammary internal chain). MRI was superior to CT only in axillary level I (p=0.0291).*Conclusions 18F-FDG PET/MRI outperforms CT or MRI in detecting nodal involvement on a patient-based and on a lesion-based analysis. Furthermore PET/MRI was superior to CT or MRI in detecting lymph node metastases in all lymph node stations. Of all tested imaging modalities, PET/MRI showed the highest sensitivity, whereas CT showed the lowest sensitivity, but was most specific.*Clinical Relevance/Application PET/MRI localizes lymph node metastases with a higher detection rate and accuracy than MRI and CT and it can reliably be used for nodal staging in primary breast cancer patients.

RESULTS

On a patient-based analysis, PET/MRI correctly detected significantly more nodal positive patients than MRI (p<0.0001) and CT (p<0.0001). No statistically signifigant difference was seen between CT and MRI. PET/MRI detected 193 lesions in 75 patients (41.2 %), while MRI detected 123 lesions in 56 patients (30.8 %) and CT detected 104 lesions in 50 patients (27.5 %), respectively. Differences were statistically significant on a lesion-based analysis (PET/MRI vs. MRI, p<0.0001; PET/MRI vs. CT, p<0.0001; MRI vs. CT, p=0.015). Subgroup analysis for different lymph node stations showed that PET/MRI detected significantly more lymph node metastases than MRI and CT in each location (axillary level I-III, supraclavicular, mammary internal chain). MRI was superior to CT only in axillary level I (p=0.0291).

CLINICAL RELEVANCE/APPLICATION

PET/MRI localizes lymph node metastases with a higher detection rate and accuracy than MRI and CT and it can reliably be used for nodal staging in primary breast cancer patients.

SSNMMI01-5 A Pilot Study Of 68Ga-PSMA11 And68Ga-RM2 PET/MRI For Evaluation Of Prostate Cancer Response To High Intensity Focused Ultrasound (HIFU) Therapy

Participants
Heying Duan, MD, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

Prostate specific membrane antigen (PSMA) and gastrin-releasing peptide receptors (GRPR) are both overexpressed in prostate cancer (PC). The degree of their expression at various stages of PC is not yet well understood. In this study, we evaluated a novel approach combining both 68Ga-RM2 and 68Ga-PSMA11 PET/MRI within each PC patient before and after treatment with high intensity focused ultrasound (HIFU) to assess accuracy of localization and response to treatment.*Methods and Materials Nine men, aged 63.7±8.8 years, with newly diagnosed PC were prospectively enrolled. Pre HIFU, patients underwent prostate biopsy, prostate multiparametric MRI (mpMRI), 68Ga-PSMA11 and 68Ga-RM2 PET/MRI. Response to HIFU treatment was assessed with 68Ga-PSMA11 and 68Ga-RM2 PET/MRI. For localization, the prostate was contoured and divided into 12 segments (apex lateral, apex medial, base lateral, base medial, mid lateral, mid medial, left and right, respectively) using PET/MRI data. Maximum standardized uptake values (SUVmax) of PC lesions, and background in each segment were collected.*Results Pre HIFU biopsy revealed 16 lesions of which 12 were clinically significant with a Gleason score (GS) =7 and *mpMRI showed 10 lesions with 9 being

=PIRADS 4. 68Ga-PSMA11 and 68Ga-RM2 PET/MRI demonstrated 20 and 19 positive lesions, respectively, with 17 congruent in 9 patients and 6 incongruent lesions in 4 patients. HIFU treated 21 zones whereas 20 were identified with both radiotracers and one was negative in 68Ga-RM2, but positive in 68Ga-PSMA11. In this patient, pre HIFU biopsy showed GS 4+3 and mpMRI PIRADS 4. For treatment evaluation, 68Ga-PSMA11 and 68Ga-RM2 PET/MRI were performed 8.59±4.23 and 9.21±2.45 months, respectively, after HIFU. In all patients, PET/MRI was negative for the respective treated area. Pre-treatment PSA prostate specific antigen (PSA) and PSA density were 9.04±3.59 ng/mL and 0.21±0.09 ng/ml2, respectively, and decreased significantly after HIFU to 3.93±2.62 ng/mL (P=0.00) and 0.10±0.07 ng/ml2 (P=0.02), respectively. Concordantly, pre-treatment SUVmax decreased significantly for both tracers (68Ga-PSMA11: 13.80±10.72 vs 3.45±3.58 [P=0.03] and 68Ga-RM2 12.09±9.95 vs 3.70±4.10 [P=0.02] before and after HIFU respectively).*Conclusions Our results show that 68Ga-PSMA11 and 68Ga-RM2 PET/MRI identified the dominant lesion for HIFU in 100% and 88.9%, respectively. Both radiotracers accurately verified response to treatment in all patients. The 6 incongruent lesions suggest different expression patterns of PSMA and GRPR in PC. Larger studies are needed to shed light on that.*Clinical Relevance/Application 68Ga-PSMA11 and 68Ga-RM2 PET/MRI are useful in identifying the dominant lesion for HIFU and treatment verification.

RESULTS

Pre HIFU biopsy revealed 16 lesions of which 12 were clinically significant with a Gleason score (GS) =7 and mpMRI showed 10 lesions with 9 being =PIRADS 4. 68Ga-PSMA11 and 68Ga-RM2 PET/MRI demonstrated 20 and 19 positive lesions, respectively, with 17 congruent in 9 patients and 6 incongruent lesions in 4 patients. HIFU treated 21 zones whereas 20 were identified with both radiotracers and one was negative in 68Ga-RM2, but positive in 68Ga-PSMA11. In this patient, pre HIFU biopsy showed GS 4+3 and mpMRI PIRADS 4. For treatment evaluation, 68Ga-PSMA11 and 68Ga-RM2 PET/MRI were performed 8.59±4.23 and 9.21±2.45 months, respectively, after HIFU. In all patients, PET/MRI was negative for the respective treated area. Pre-treatment PSA prostate specific antigen (PSA) and PSA density were 9.04±3.59 ng/mL and 0.21±0.09 ng/ml2, respectively, and decreased significantly after HIFU to 3.93±2.62 ng/mL (P=0.00) and 0.10±0.07 ng/ml2 (P=0.02), respectively. Concordantly, pre-treatment SUVmax decreased significantly for both tracers (68Ga-PSMA11: 13.80±10.72 vs 3.45±3.58 [P=0.03] and 68Ga-RM2 12.09±9.95 vs 3.70±4.10 [P=0.02] before and after HIFU respectively).

CLINICAL RELEVANCE/APPLICATION

68Ga-PSMA11 and 68Ga-RM2 PET/MRI are useful in identifying the dominant lesion for HIFU and treatment verification.

SSNMMI01-6 PSMA Expression In Hepatocellular Carcinoma (HCC): Immunohistochemistry And Imaging With 68Ga-PSMA PET Using Cyclotron-produced 68Ga

Participants
Garima Suman, MD,MBBS, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To determine the protein expression and localization of PSMA in surgically resected HCC and to prospectively evaluate 68Ga-PSMA PET imaging using cyclotron-produced 68Ga in patients with HCC.*Methods and Materials In phase I, PSMA immunohistochemistry on tissue microarrays of surgically resected HCCs (n=148) was scored for PSMA expression (0 = none, 0.5 = < 5%, 1 = 5-30%, 2=31-60%, 3=61-100%) and findings were correlated to histopathology and clinical variables using multivariate logistic regression. Overall survival following surgical resection for HCC was estimated using Kaplan-Meier analysis stratified by HCC PSMA expression. In phase II, 68Ga-PSMA PET/CT (n=15) or PET/MRI (n=5) was performed in 20 patients (23 lesions) with treatment-naïve HCC after written informed consent. PSMA uptake in lesions was graded qualitatively in reference to liver and spleen, and semi-quantitatively including tumor-to-liver background ratio (TBR). Cross-sectional imaging features were compared between lesions with high vs. low PSMA uptake.*Results PSMA was expressed in 91% of HCCs (n=134) and predominantly localized to the neovasculature. 75% (n=113) of HCCs showed PSMA expression greater than 30% and 40% (n=58) of HCCs showed PSMA expression greater than 60%. Higher HCC tumor grade was associated with positive PSMA expression (p=0.012). No association between positive HCC PSMA expression and tumor size (p=0.14), fibrosis (p=0.35), cirrhosis (p=0.74), HBV (p=0.31) or HCV (p=0.15). There was a trend toward improved survival among HCCs without PSMA expression compared to those with PSMA expression (median OS: 4.2 v. 1.9 years post-surgery; p=0.273). Image quality was excellent in all PET studies. On qualitative evaluation, 61% (n=14) lesions had high PSMA uptake (higher than liver or spleen). Patients with high PSMA uptake had SUVmax [median (range)] 10.6 (4.9-26.5), SUVmean 5 (2.6-12.7), and TBR 2 (1.1-8.0). Two patients had PSMA-avid portal vein tumor thrombus and one patient had PSMA-avid metastatic gastrohepatic lymph node. Lesions with high PSMA uptake had higher relative frequency of background cirrhosis (p=0.02) (14/14; 100%) vs. lesions with low PSMA uptake (6/9; 67%) but other imaging features including size were not different.*Conclusions PSMA is expressed on the neovasculature of a high proportion of HCCs. Its ex vivo expression translates to tumor avidity on 68Ga-PSMA PET imaging, which suggests that PSMA has the potential to be an imaging biomarker in patients with HCC.*Clinical Relevance/Application The high avidity of HCC lesions on PSMA PET opens the prospect for investigation of PSMA-targeted radionuclide therapy as a novel therapeutic option in patients with progressive/advanced PSMA-avid HCC after failure of other systemic options.

RESULTS

PSMA was expressed in 91% of HCCs (n=134) and predominantly localized to the neovasculature. 75% (n=113) of HCCs showed PSMA expression greater than 30% and 40% (n=58) of HCCs showed PSMA expression greater than 60%. Higher HCC tumor grade was associated with positive PSMA expression (p=0.012). No association between positive HCC PSMA expression and tumor size (p=0.14), fibrosis (p=0.35), cirrhosis (p=0.74), HBV (p=0.31) or HCV (p=0.15). There was a trend toward improved survival among HCCs without PSMA expression compared to those with PSMA expression (median OS: 4.2 v. 1.9 years post-surgery; p=0.273). Image quality was excellent in all PET studies. On qualitative evaluation, 61% (n=14) lesions had high PSMA uptake (higher than liver or spleen). Patients with high PSMA uptake had SUVmax [median (range)] 10.6 (4.9-26.5), SUVmean 5 (2.6-12.7), and TBR 2 (1.1-8.0). Two patients had PSMA-avid portal vein tumor thrombus and one patient had PSMA-avid metastatic gastrohepatic lymph node. Lesions with high PSMA uptake had higher relative frequency of background cirrhosis (p=0.02) (14/14; 100%) vs. lesions with low PSMA uptake (6/9; 67%) but other imaging features including size were not different.

CLINICAL RELEVANCE/APPLICATION

The high avidity of HCC lesions on PSMA PET opens the prospect for investigation of PSMA-targeted radionuclide therapy as a novel therapeutic option in patients with progressive/advanced PSMA-avid HCC after failure of other systemic options.

Abstract Archives of the RSNA, 2021

Participants
Marc Kachelriess, PhD, Heidelberg, Germany (*Moderator*) Nothing to Disclose
Hao Gong, PhD, Rochester,, Minnesota (*Moderator*) Nothing to Disclose

Sub-Events

SSPH05-1   Single Image Local Variance Estimator: Deep Learning Framework For CT Noise Quantification

Participants
Nathan Huber, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Noise quantification is fundamental to CT image quality assessment and protocol optimization; however, methods to measure noise level in patient exams are limited. This study demonstrates Single Image Local Variance EstimatoR (SILVER), a widely accessible deep learning-based framework for estimating CT noise level directly based on patient images.*Methods and Materials SILVER was implemented using a convolutional neural network (CNN) trained with anthropomorphic phantom data. A torso phantom was scanned with 100 repetitions using a sequential whole-body-low-dose (WBLD) protocol (120 kV, 70 mAs, CTDIvol = 4.71 mGy) and reconstructed using FBP with a medium sharp kernel (Br64). Linear noise scaling data augmentation was used to improve generalizability to different noise levels. The noise map was calculated as the pixel-wise standard deviation of repeated scans. Phantom data was split into patches for training; training input was a single CT image and the training label was the corresponding noise map based on 100 repeated scans. A modified U-Net architecture was trained with mean-squared-error loss. Following training, SILVER was tested on two independently acquired phantoms (pelvis and head) and compared to noise maps calculated from 100 repeated scans. Additionally, SILVER was tested on ten patient WBLD-CT exams and accuracy assessed at uniform regions of interest (ROI).*Results When tested on two independent phantoms, the SILVER noise map closely matched the target noise map calculated based on repeated scans (RMSE: 6.7 HU). Within ten patient exams, SILVER noise map accuracy was verified with respect to noise measurements at several uniform ROI, including: aorta (95% agreement), brain (94% agreement), liver (93% agreement), and airways (91% agreement).*Conclusions The SILVER framework enabled accurate pixel-wise noise level estimate directly based on patient images. This method is widely accessible since it operates in the image domain and requires only phantom data for training.*Clinical Relevance/Application Patient CT noise estimate is beneficial for image quality assessment, protocol optimization, and adaptive image processing. The SILVER framework is easy to implement and can accurately estimate noise map based on patient CT images.

RESULTS

When tested on two independent phantoms, the SILVER noise map closely matched the target noise map calculated based on repeated scans (RMSE: 6.7 HU). Within ten patient exams, SILVER noise map accuracy was verified with respect to noise measurements at several uniform ROI, including: aorta (95% agreement), brain (94% agreement), liver (93% agreement), and airways (91% agreement).

CLINICAL RELEVANCE/APPLICATION

Patient CT noise estimate is beneficial for image quality assessment, protocol optimization, and adaptive image processing. The SILVER framework is easy to implement and can accurately estimate noise map based on patient CT images.

SSPH05-2   Validation Of Deep Transfer Learning On CT Scans For Informing Steroid Treatment Of 864 COVID-19 Patients

Participants
Jordan Fuhrman, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

The primary treatment for severe COVID-19 patients is corticosteroid administration. The authors previously developed a deep learning system to evaluate COVID-19 patient CT scans to predict if a patient would require steroids during their course of treatment. The previous study had a limited dataset of 41 patients; thus, the purpose of this study was to validate the deep learning system on a substantially larger patient cohort of 916 patients.*Methods and Materials In this retrospective study, a cascaded deep transfer learning approach was used to extract features from a VGG-19 convolutional neural network architecture pre-trained for emphysema detection on CT scans. The feature space dimension was reduced using principal component analysis and a support vector machine was trained for steroid treatment-related predictions. The initial study utilized 41 scans while the new independent cohort consisted of 864 scans. The new data were divided into subsets based on image acquisition parameters including scanner manufacturer (GE, Siemens, Philips, United, FMI) to determine its effect on performance. Classification performance of the full dataset and each subset was characterized through the area under the ROC curve (AUC) with statistical comparison.*Results Classifier performance (AUC) for the task of predicting use of steroids demonstrated a statistically significant reduction from 0.85 +/- 0.10 to 0.68 +/- 0.04 (p=0.02), but both were found statistically significantly different from AUC=0.5 (p=0.002, p=0.0001). Initial performance varied based on scanner manufacturer ranging from AUC of 0.52 to 0.64.*Conclusions While the performance was reduced on the expanded dataset, this may be attributed to limited training data and increased variety

of scanner manufacturers. Classification performances showed statistically significant performance, indicating strong potential for quantitative CT in informing steroid treatments with performance varying across scanner manufacturers.*Clinical Relevance/Application Clinical decisions for management and treatment of severe COVID-19 patients via steroid administrations can be supported by deep learning on a large, diverse dataset.

RESULTS

Classifier performance (AUC) for the task of predicting use of steroids demonstrated a statistically significant reduction from 0.85 +/- 0.10 to 0.68 +/- 0.04 (p=0.02), but both were found statistically significantly different from AUC=0.5 (p=0.002, p=0.0001). Initial performance varied based on scanner manufacturer ranging from AUC of 0.52 to 0.64.

CLINICAL RELEVANCE/APPLICATION

Clinical decisions for management and treatment of severe COVID-19 patients via steroid administrations can be supported by deep learning on a large, diverse dataset.

SSPH05-3   A Deep Learning Approach For The Estimation Of Partially Exposed Organs In CT

Participants
John E. Damilakis, PHD, Iraklion, Greece (*Presenter*) Nothing to Disclose

PURPOSE

Patient-specific Monte Carlo (MC) organ dose estimation using patient's CT images is limited to the scanning length and does not allow dose estimation for partially exposed organs or organs located outside the imaged region. The aim of this study was to train and evaluate a deep learning model for the prediction of liver dose in adult thorax CT examinations.*Methods and Materials The acquisition parameters and demographic data were recorded for a series of 200 patients of various sizes referred for thorax CT. All examinations were performed with a GE Revolution 64 scanner (GE Healthcare, Chicago, IL). Tube current modulation profile data were extracted from the DICOM header of each reconstructed CT image sequence. ?he water-equivalent diameter (WED) body size metric was calculated for each patient. Whole-body phantoms were developed using the extended Cardiac-Torso (XCAT) anatomical phantom framework to resemble the patients as much as possible. To obtain the 'ground truth' liver doses, thorax MC simulations were performed on each phantom with an equipment-specific and patient-specific MC code (ImpactMC, CT Imaging GmbH, Erlangen, Germany) using scan patient data for each exam. An Artificial Neural Network (ANN) was optimized and trained to predict liver doses. Thirty chest-abdomen CT exams were used for validation.*Results The root mean-squared error (RMSE) was 1.98 and 1.35 for the training and test set. The kV, tube load, scanning length, liver volume and WED were the most important features. A very good agreement was observed between liver doses estimated by the ANN algorithm and the MC simulation performed on the chest-abdomen CT exams used for validation (maximum difference in liver doses less than 10%).*Conclusions The current study demonstrated the feasibility of predicting liver dose using an ANN model. The method can be further expanded to include other partially exposed organs or organs outside the CT image volume. Further work is required to assess the robustness of the AI algorithm for larger patient sets.This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No755523.*Clinical Relevance/Application Machine learning can be used for accurate CT organ dose estimates outside the scan volume. A dose calculation algorithm with both high accuracy and high efficiency is much desired in today's medical imaging clinic.

RESULTS

The root mean-squared error (RMSE) was 1.98 and 1.35 for the training and test set. The kV, tube load, scanning length, liver volume and WED were the most important features. A very good agreement was observed between liver doses estimated by the ANN algorithm and the MC simulation performed on the chest-abdomen CT exams used for validation (maximum difference in liver doses less than 10%).

CLINICAL RELEVANCE/APPLICATION

Machine learning can be used for accurate CT organ dose estimates outside the scan volume. A dose calculation algorithm with both high accuracy and high efficiency is much desired in today's medical imaging clinic.

SSPH05-4   Deep Learning-based Coronary Artery Motion Estimation And Compensation For Iterative Cardiac CT Reconstructions

Participants
Joscha Maier, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Cardiac motion may lead to reconstruction artifacts that degrade the diagnostic quality of cardiac CT and impair the assessment of coronary arteries. Therefore, we recently proposed the so-called deep partial-angle based motion compensation (Deep PAMoCo) that uses a neural network to estimate and compensate for coronary artery motion. While first results were restricted to analytic reconstructions, we here combine the Deep PAMoCo with an iterative reconstruction to further improve image quality.*Methods and Materials The Deep PAMoCo algorithm is based on the concept of partial-angle reconstructions (PARs). It divides the 180° scan range into several consecutive angular segments and reconstructs them separately. Due to the small angular coverage, these PARs have a high temporal resolution and represent a certain subphase of the cardiac cycle with virtually no motion artifacts. By applying a motion vector field (MVF), the PARs can be deformed to represent the same motion state. The sum of the deformed PARs yields the final motion-compensated reconstruction. In this process, the Deep PAMoCo uses a neural network that is trained to predict the MVF based on the set of input PARs and that applies this MVF internally. Here, the network was trained on 100,000 simulated datasets containing different coronary artery shapes and motion patterns. Finally, it was tested on 25 clinical cases that were reconstructed using an iterative algorithm (SAFIRE, Siemens Healthineers). Results were compared against a conventional MoCo approach and an analytic reconstruction.*Results For all 25 test cases, the Deep PAMoCo was able to remove motion artifacts regardless of the contrast, the radius and the motion amplitude of the coronary artery. Here, the Deep PAMoCo clearly outperformed the conventional approach in terms of image quality and processing time. Compared to an analytic reconstruction, the combination of the Deep PAMoCo with the iterative approach could reduce noise by 35 % on average, which corresponds to a potential dose reduction of 57 %.*Conclusions Combining the Deep PAMoCo with an iterative reconstruction provides an efficient approach to reduce motion artifacts in cardiac CT while enabling low dose protocols.*Clinical Relevance/Application Combining the Deep PAMoCo with an iterative reconstruction provides an efficient approach to reduce motion artifacts in cardiac CT while enabling low dose protocols.

RESULTS

For all 25 test cases, the Deep PAMoCo was able to remove motion artifacts regardless of the contrast, the radius and the motion amplitude of the coronary artery. Here, the Deep PAMoCo clearly outperformed the conventional approach in terms of image quality and processing time. Compared to an analytic reconstruction, the combination of the Deep PAMoCo with the iterative approach could reduce noise by 35 % on average, which corresponds to a potential dose reduction of 57 %.

CLINICAL RELEVANCE/APPLICATION

Combining the Deep PAMoCo with an iterative reconstruction provides an efficient approach to reduce motion artifacts in cardiac CT while enabling low dose protocols.

SSPH05-5   Generalizability Of Deep Convolutional-Neural-Network-Based Metal-Artifact-Reduction In CT-Guided Interventional Oncology Procedures

Participants
Liqiang Ren, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To assess the generalizability of deep convolutional neural networks (CNN) trained to reduce metal artifacts introduced by metallic probes in CT-guided interventional percutaneous kidney cryoablation procedures.*Methods and Materials Image and projection data were exported from the planning scan of ten CT-guided kidney cryoablation cases (Siemens SOMATOM Edge). CNN training images were created from these data by artificially inserting a cryoablation probe (Boston Scientific IceForce) in both projection space (images with artifacts, inputs) and image space (artifacts-free images, targets) at matching locations. The process was repeated at multiple positions/orientations for each case. Images were reconstructed using manufacturer-provided reconstruction software and clinical reconstruction parameters. With these data, two CNN models were trained to identify and remove the probe-induced artifacts from the input images. One model was trained on input data containing a single probe; whereas the second model was trained on data containing up to 4 probes intersecting a single plane. The two models were subsequently applied to previously unseen patient images from treatment monitoring scans during kidney cryoablations. Generalizability of the two models was tested on CT images with different slice thickness, reconstruction field-of-view (rFOV), reconstruction kernel, or number of intersecting probes. The optimal model was further tested on CT images for which the model was not trained, containing differences including metallic probe type, procedure location, or CT scanner model. Each variation was tested on 3 independent cases.*Results The single-probe model effectively reduced metal artifacts in patient images matching the training data parameters. Its performance slightly degraded with different rFOVs and was ineffective for different slice thickness, reconstruction kernel, or number of probes. The multi-probe model was effective for soft-tissue ablation procedures regardless of the number or type of probes and was generalizable to CT images from different CT scanner models. Its performance, however, degraded when applied to images from ablation procedures performed in different anatomical regions such as the chest or the spine.*Conclusions The multi-probe model outperformed the single-probe model by incorporating training data containing multiple intersecting probes and was generalizable to soft-tissue ablation procedures regardless of the number/type of probes, or CT scanner models.*Clinical Relevance/Application Generalizability of metal artifact reduction algorithms applied to CT-guided procedures is clinically important, as it is common to have different number and type of probes within the same CT image.

RESULTS

The single-probe model effectively reduced metal artifacts in patient images matching the training data parameters. Its performance slightly degraded with different rFOVs and was ineffective for different slice thickness, reconstruction kernel, or number of probes. The multi-probe model was effective for soft-tissue ablation procedures regardless of the number or type of probes and was generalizable to CT images from different CT scanner models. Its performance, however, degraded when applied to images from ablation procedures performed in different anatomical regions such as the chest or the spine.

CLINICAL RELEVANCE/APPLICATION

Generalizability of metal artifact reduction algorithms applied to CT-guided procedures is clinically important, as it is common to have different number and type of probes within the same CT image.

SSPH05-6   Scalable And Generalizable Small ROI Imaging Using Backprojection And Deep Learning

Participants
Chengzhu Zhang, BS, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

To reduce radiation dose as well as scatter in cone beam CT imaging, the scanning field of view (FOV) is often reduced. However, this reduction of FOV inevitably leads to the notoriously difficult interior tomography problem. In this work, a new method was developed to enable scalable and generalizable small ROI imaging with high quantitative accuracy.*Methods and Materials The method consists of two steps: the acquired fully truncated projection data was weighted to account for data redundancy and then backprojected to form an initial image. This initial image turns out to be the blurred version of the true image with a specific 1/r blurring kernel. In the second step, a deep learning method was developed to reconstruct the true image. To train the deblurring model, 5,409 clinical MDCT images from head, chest and abdomen were curated. To test the performance of the new reconstruction method, 1,067 simulated clinical cases and 376 experimental clinical cases were used. The objective image quality assessment metric SSIM was used to evaluate the image quality. To test the generalizability of the developed method, additional experimental data were acquired using head phantom data acquired from our benchtop cone beam CT system.*Results 1) The method reconstructed artifact-free 5 cm FOV ROIs regardless of their locations. The reconstructed ROIs maintained all detailed structures with almost identical visualization as non-truncated FBP at the same ROI location. 2) The statistical SSIM of the trained model was reported as 0.985±0.018 evaluated on all simulated test data and 0.940 ± 0.025 evaluated on all experimental data test data. 3) The method was shown to be generalizable to phantom data acquired from the benchtop system.*Conclusions A scalable and generalizable small ROI image reconstruction method was developed to enable small ROI imaging with 5 cm diameter at arbitrary location.*Clinical Relevance/Application A low dose, low scatter artifact imaging method was developed for use in image-guided interventions and image-guided therapy with x-ray beams being collimated to illuminate a small ROI.

RESULTS

1) The method reconstructed artifact-free 5 cm FOV ROIs regardless of their locations. The reconstructed ROIs maintained all detailed structures with almost identical visualization as non-truncated FBP at the same ROI location. 2) The statistical SSIM of the

trained model was reported as 0.985±0.018 evaluated on all simulated test data and 0.940 ± 0.025 evaluated on all experimental data test data. 3) The method was shown to be generalizable to phantom data acquired from the benchtop system.

CLINICAL RELEVANCE/APPLICATION

A low dose, low scatter artifact imaging method was developed for use in image-guided interventions and image-guided therapy with x-ray beams being collimated to illuminate a small ROI.

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Participants
Sean Woolen, MD, San Francisco, California (*Moderator*) Research Grant, Siemens AG;Investigator, SIemens AG
Stella Kang, MD,MSc, New York, New York (*Moderator*) Royalties, Wolters Kluwer nv

Sub-Events

SSNPM03-4 Magnetic Resonance Spectroscopy For The Differentiation Of Recurrent Glioma From Radiation Necrosis: A Cost Effectiveness Analysis

Participants
Huijun Liao, BS, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

In the US, Magnetic Resonance Spectroscopy (MRS) has been difficult to reimbursed due to the 1994 national noncoverage determination by the Center for Medicare & Medicaid Services. However, the NCD was removed in 2020 leaving the coverage decisions to the state and local level. To support the need for MRS reimbursement, evidence of its cost-effectiveness is needed. The goal of this study was to determine the cost-effectiveness of MRS in its most widely used clinical application, the differentiation of recurrent glioma and radiation necrosis, utilizing a decision-analytic model.*Methods and Materials Model A decision-analytic model was based on the scenario provided by the BCBS TEC Assessment Report that compared the effectiveness of when MRS is performed and not performed for recurrent and necrosis differentiation. Analysis was performed over 5yr, 10yr and lifetime horizons. Input data were derived from systematic literature searches, meta-analyses, and medical fee book. Sensitivity Analysis: A probabilistic sensitivity analysis was performed on all study variables over a plausible range of values to recalculate model results in order to account for variability in factors such as test cost and local expertise and a Monte-Carlo simulation was used to create 1000 samples. All analysis and Monte Carlo simulations were performed by using a custom script using Microsoft® Excel.*Results In the deterministic model, the results showed that it cost less and had higher quality of life years (QALYs) over 5yr, 10yr and lifetime horizons respectively when a MRS exam was performed with incremental cost-effectiveness ratio (ICER) of -$98,978,-$50,666 and -$41,349 per QALY gained. All three ICER scatter plots of probabilistic sensitivity analysis for MRS versus no MRS performed (Fig. 1) had their summary points in Quadrant-D where MRS performed was more effective (incremental QALYs: 0.13,0.19,0.22) and less expensive (incremental Cost: -$12,678, -$10,233, -$8121). At a Willingness-to-Pay (WTP) threshold of $0 per QALY, MRS performed was already superior to no MRS performed in 73%, 62% and 62% of simulations for 5yr, 10yr and lifetime horizon respectively as shown in Fig 2. MRS performed was dominated in even 97%, 97% and 96% of simulations at WTP threshold of $50,000 (US-standard).*Conclusions Our results suggested that performing MRS was more effective and less costly compared with not performing MRS for recurrent glioma and necrosis differentiation. MRS should be considered reimbursable by policy makers in U.S.*Clinical Relevance/Application Our cost-effectiveness analysis showed that performing MRS was more cost-effective than not performing MRS for recurrent glioma and necrosis differentiation. MRS should be considered reimbursable by policy makers in U.S.

RESULTS

In the deterministic model, the results showed that it cost less and had higher quality of life years (QALYs) over 5yr, 10yr and lifetime horizons respectively when a MRS exam was performed with incremental cost-effectiveness ratio (ICER) of -$98,978,-$50,666 and -$41,349 per QALY gained. All three ICER scatter plots of probabilistic sensitivity analysis for MRS versus no MRS performed (Fig. 1) had their summary points in Quadrant-D where MRS performed was more effective (incremental QALYs: 0.13,0.19,0.22) and less expensive (incremental Cost: -$12,678, -$10,233, -$8121). At a Willingness-to-Pay (WTP) threshold of $0 per QALY, MRS performed was already superior to no MRS performed in 73%, 62% and 62% of simulations for 5yr, 10yr and lifetime horizon respectively as shown in Fig 2. MRS performed was dominated in even 97%, 97% and 96% of simulations at WTP threshold of $50,000 (US-standard).

CLINICAL RELEVANCE/APPLICATION

Our cost-effectiveness analysis showed that performing MRS was more cost-effective than not performing MRS for recurrent glioma and necrosis differentiation. MRS should be considered reimbursable by policy makers in U.S.

SSNPM03-6 Mismatch Between Supply Of Radiologists And Need For Imaging Services By US Geographic Region And State, From 2012-2018

Participants
Aditya Khurana, BS, Scottsdale, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

Evaluate associated changes in the supply of radiologists and the need for imaging services in the aging United States population, by region and state.*Methods and Materials Supply of radiologists was estimated by the number of radiologists providing care to Medicare beneficiaries, by state and region, extracted from the CMS POSPUF (Physician and Other Supplier Public Use File) Database of Medicare Part B claims submitted. Demand for imaging services was estimated by the number of Medicare beneficiaries by state, obtained from the Kaiser Family Foundation. Overall, regional and state level rates of growth from 2012 to 2018 were

tabulated. The difference between the rate of growth of Medicare beneficiaries and the rate of growth of diagnostic radiologists was calculated for each region and state.*Results In 2012, 29,079 radiologists submitted claims to Medicare Part B, which increased to 30,354 in 2018 (+4.4%). Growth of radiologists was largest in the South (9,660, 10,290, 6.5%), followed by West (6,000, 6,340, 5.7%), Northeast (6,739, 6,910, 2.5%), and Midwest (6,680, 6,814, 2.0%). Growth of radiologists by state ranged from -19.6% (133, 107) in Maine to 21.5% (634, 770) in Minnesota.In 2012, there were 36,498,774 Medicare beneficiaries, which increased to 38,388,936 in 2018 (7.4%). Growth of Medicare beneficiaries was largest in the West (6,600,369, 7,642,302, 15.8%), followed by Northeast (6,858,841, 7,092,518, 3.4%), South (14,440,393, 14,895,104, 3.2%), and Midwest (8,599,171, 8,759,012, 1.9%). Growth of Medicare beneficiaries by state ranged from -10.8% (704,622, 628,709) in Alabama to 14.8% (125,943, 144,690) in Hawaii.Growth in beneficiaries outpaced growth in radiologists, with the mismatch in beneficiaries to radiologists being -3.0% overall, and by region -10.1% West, -0.9% Northeast, +0.1% Midwest, and 3.4% South. By state, the mismatch ranged from -26.7% in Hawaii to +28.5% in Minnesota.*Conclusions The overall growth in the Medicare population from 2012 to 2018 outpaced growth in the supply of radiologists. The mismatch of supply and demand for imaging services among the states differed by more than 50%. In some regions and states, such as the West, the growth of diagnostic radiologists may not be keeping up with the demand for imaging services. At the same time, the South and some states demonstrate the opposite trend in the supply demand mismatch, which could trend toward and overabundance of radiologists and potential limitations in radiologists' job prospects.*Clinical Relevance/Application Geographic variations in the mismatch of demand for imaging services and the supply of radiologists may result in widening variations in the availability of imaging services for Medicare patients and radiologists' job prospects.

RESULTS

In 2012, 29,079 radiologists submitted claims to Medicare Part B, which increased to 30,354 in 2018 (+4.4%). Growth of radiologists was largest in the South (9,660, 10,290, 6.5%), followed by West (6,000, 6,340, 5.7%), Northeast (6,739, 6,910, 2.5%), and Midwest (6,680, 6,814, 2.0%). Growth of radiologists by state ranged from -19.6% (133, 107) in Maine to 21.5% (634, 770) in Minnesota.In 2012, there were 36,498,774 Medicare beneficiaries, which increased to 38,388,936 in 2018 (7.4%). Growth of Medicare beneficiaries was largest in the West (6,600,369, 7,642,302, 15.8%), followed by Northeast (6,858,841, 7,092,518, 3.4%), South (14,440,393, 14,895,104, 3.2%), and Midwest (8,599,171, 8,759,012, 1.9%). Growth of Medicare beneficiaries by state ranged from -10.8% (704,622, 628,709) in Alabama to 14.8% (125,943, 144,690) in Hawaii.Growth in beneficiaries outpaced growth in radiologists, with the mismatch in beneficiaries to radiologists being -3.0% overall, and by region -10.1% West, -0.9% Northeast, +0.1% Midwest, and 3.4% South. By state, the mismatch ranged from -26.7% in Hawaii to +28.5% in Minnesota.

CLINICAL RELEVANCE/APPLICATION

Geographic variations in the mismatch of demand for imaging services and the supply of radiologists may result in widening variations in the availability of imaging services for Medicare patients and radiologists' job prospects.

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Sub-Events

SPR-IN-1   **Accurate Weakly-supervised Volumetric Universal Lesion Segmentation Using Large-scale Clinical RECIST Diameter Annotations And Regional Level Set Loss**

Participants
Youbao Tang, PhD, Bethesda, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Volumetric universal lesion segmentation (VULS) via computed tomography (CT) scans may be a clinically desirable means to precisely assess disease progression and therapy response. Radiologists usually do not perform volumetric lesion segmentation due to time constraints, even though it proves helpful. To reduce this manual burden, we design an Attention-enhanced High-Resolution Network (AHRNet) for accurate volumetric universal lesion segmentation using large-scale clinical RECIST (Response Evaluation Criteria in Solid Tumors) diameter annotations as weak supervisory signals and regional level set loss for optimizing the lesion boundary delineation.*Methods and Materials AHRNet provides advanced high-resolution deep image features by involving a decoder, dual-attention and scale attention mechanisms, which are crucial to performing accurate lesion segmentation. RLS can optimize the model reliably and effectively in a weakly-supervised fashion, forcing segmentation close to the lesion boundary. To make learning the model feasible, a pseudo mask is generated by fitting an ellipse from long- and short- axis diameters of each RECIST annotation. AHRNet was trained on the large-scale NIH DeepLesion dataset consisting of 32,735 lesions labeled with RECIST diameters from 10,594 studies of 4,459 patients. 1,000/200 lesions were randomly selected from 500/140 patients and manually annotated their 2D/3D masks as the validation/test set. The remaining patients' images served as the training set. A hold-out set containing 500 lesions with 3D masks from 160 patients was collected from another hospital for external real-life evaluation.*Results On the DeepLesion test dataset, AHRNet remarkably improved the VULS performance by increasing the 3D Dice score from 0.764±0.11 (the best previous result) to 0.866±0.068, demonstrating that AHRNet works significantly more accurately. Furthermore, AHRNet achieved a 3D Dice score of 0.858±0.045 on the external hold-out test set, indicating that AHRNet performs VULS stably and robustly.*Conclusions We proposed a powerful network and a novel loss for accurate volumetric universal lesion segmentation by reliably weakly-supervised learning from a large quantity of clinical RECIST diameter annotations. It brings in more robust and accurate volumetric lesion segmentation measurements for a variety of lesion classes covering all body sections.*Clinical Relevance/Application The proposed method is potentially of high importance for automated and large-scale tumor 3D volume measurement/management in the domain of precision quantitative radiology and oncology imaging. As such, it can help clinicians to achieve accurate tumor response measurements on CT in a large clinical scale.

RESULTS

On the DeepLesion test dataset, AHRNet remarkably improved the VULS performance by increasing the 3D Dice score from 0.764±0.11 (the best previous result) to 0.866±0.068, demonstrating that AHRNet works significantly more accurately. Furthermore, AHRNet achieved a 3D Dice score of 0.858±0.045 on the external hold-out test set, indicating that AHRNet performs VULS stably and robustly.

CLINICAL RELEVANCE/APPLICATION

The proposed method is potentially of high importance for automated and large-scale tumor 3D volume measurement/management in the domain of precision quantitative radiology and oncology imaging. As such, it can help clinicians to achieve accurate tumor response measurements on CT in a large clinical scale.

SPR-IN-10   **Explainable AI In Radiology: Side-by-side Comparison Of Two Contemporary Techniques**

Participants
Eduardo Farina, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

To compare whether Grad-CAM or SHAP gives better post-hoc explanations to the results produced by deep learning models in three different radiological scenarios.*Methods and Materials Three deep learning models (using the VGG16 architecture) were trained for three different tasks: detect brain hemorrhage, detect gadolinium in brain MRI, and differentiate an abdominal CT scan in portal phase from non-contrast. We then randomly selected 20 test images from each task and extracted their Grad-CAM (Gradient-weighted Class Activation Mapping) for the last layer and trained a SHAP (SHapley Additive exPlanations) Deep Explainer using 32 training images to get the SHAP values for the same selected images for which we have extracted Grad-CAM. Later, five radiologists (each with at least 4 years of experience) judged whether SHAP or Grad-CAM have produced more suitable explanations for the results produced by each model, or if both had given similarly good or bad explanations. For hypothesis testing, we used Wilcoxon Rank Test to compare whether SHAP or Grad-CAM have outperformed each other in each task and in the overall answers.*Results Our results showed that for each of the three different tasks, and for all the models together, SHAP gave a better explanation (visualization) of where the model is looking at for the prediction than Grad-CAM (for Hemorrhage Head-CT, Gadolinium Head MRI, Abdominal CT Portal phase, and combined answers' p-values were: 0.03, < 0.001, 0.01 and < 0.001, respectively).*Conclusions The explanations provided by using SHAP Deep Explainer outperformed Grad-CAM for model post-hoc explanation, showing that they might be more useful than Grad-CAM in different classification tasks.*Clinical Relevance/Application

The resistance to adopting AI in radiology due to the opaque nature of deep learning models can be alleviated by using post-hoc explanations of the models' predictions.

RESULTS

Our results showed that for each of the three different tasks, and for all the models together, SHAP gave a better explanation (visualization) of where the model is looking at for the prediction than Grad-CAM (for Hemorrhage Head-CT, Gadolinium Head MRI, Abdominal CT Portal phase, and combined answers' p-values were: 0.03, < 0.001, 0.01 and < 0.001, respectively).

CLINICAL RELEVANCE/APPLICATION

The resistance to adopting AI in radiology due to the opaque nature of deep learning models can be alleviated by using post-hoc explanations of the models' predictions.

SPR-IN-12 Deep Learning For Detecting Pulmonary Tuberculosis Via Chest Radiography: An International Study Across 10 Countries

Participants
Sahar Kazemzadeh, Mountain View, California (*Presenter*) Employee, Alphabet Inc;Stockholder, Alphabet Inc

PURPOSE

Tuberculosis (TB) is a top-10 cause of death worldwide. Though the WHO recommends chest radiographs (CXR) for TB screening, lack of access to expertise in CXR interpretation limits its use in many regions. To help with this problem, we developed a deep learning system (DLS) to detect active TB, evaluated it with retrospective data from multiple countries and settings, and compared its performance to radiologists from both endemic (India) and non-endemic (US) practice settings.*Methods and Materials We trained a DLS using over 100,000 de-identified CXR from 9 countries spanning Africa, Asia, and Europe. To improve generalization, we incorporated large-scale CXR pretraining, attention pooling, and semi-supervised learning via "noisy student". The DLS was evaluated on a combined test set of 1,262 images (1 per patient) from China, India, US, and Zambia, with TB confirmation via microbiology or molecular testing. Given WHO targets of 90% sensitivity and 70% specificity, the DLS's operating point was prespecified to favor sensitivity over specificity.*Results The DLS's receiver operating characteristic (ROC) curve was above all 9 India-based radiologists, with an area under the curve (AUC) of 0.90 (95%CI 0.87-0.92). At the prespecified operating point, the DLS's sensitivity (88%) was higher than the India-based radiologists (median sensitivity: 74%, range 69-87%, p<0.001 for superiority), and the DLS's specificity (79%) was non-inferior to these radiologists (median specificity: 86%, range 78-88%, p=0.004). Similar trends were observed within HIV positive and sputum smear positive sub-groups within these datasets. We additionally found that 5 US-based radiologists were more sensitive but less specific than the India-based radiologists. The DLS was similarly non-inferior to this second cohort of radiologists. Depending on the setting, use of the DLS as a prioritization tool could reduce the cost per positive TB case detected by 40-80% compared to the use of molecular testing alone.*Conclusions We developed a DLS to detect active pulmonary TB on CXR, that generalized to patient populations from 4 regions of the world, and merits prospective evaluation to assist cost-effective screening efforts in settings with scarce access to radiologists.*Clinical Relevance/Application Our AI detects pulmonary tuberculosis on chest x-rays with performance comparable to radiologists, and could be a cost-effective way to select patients for confirmatory workup and treatment.

RESULTS

The DLS's receiver operating characteristic (ROC) curve was above all 9 India-based radiologists, with an area under the curve (AUC) of 0.90 (95%CI 0.87-0.92). At the prespecified operating point, the DLS's sensitivity (88%) was higher than the India-based radiologists (median sensitivity: 74%, range 69-87%, p<0.001 for superiority), and the DLS's specificity (79%) was non-inferior to these radiologists (median specificity: 86%, range 78-88%, p=0.004). Similar trends were observed within HIV positive and sputum smear positive sub-groups within these datasets. We additionally found that 5 US-based radiologists were more sensitive but less specific than the India-based radiologists. The DLS was similarly non-inferior to this second cohort of radiologists. Depending on the setting, use of the DLS as a prioritization tool could reduce the cost per positive TB case detected by 40-80% compared to the use of molecular testing alone.

CLINICAL RELEVANCE/APPLICATION

Our AI detects pulmonary tuberculosis on chest x-rays with performance comparable to radiologists, and could be a cost-effective way to select patients for confirmatory workup and treatment.

SPR-IN-13 Commercial Artificial Intelligence Solutions For Radiology: A Market Update

Participants
Kicky van Leeuwen, MSc, Nijmegen, Netherlands (*Presenter*) Technical Expert, Scarlet NB

PURPOSE

Provide an overview of the current market of regulatory-cleared artificial intelligence (AI) software for radiology.*Methods and Materials An overview of CE marked AI products for clinical radiology is maintained online (https://www.AIforRadiology.com). Vendors were asked to verify and complete the product information. This overview allows for analysis of market trends. Characteristics of the market were based on the state of the database on the 1st of May 2021.*Results In May 2021 there were 161 CE marked AI products on the market, an increase of 36% compared with one year prior. The growth from 2019 to 2020 was 69% (from 70 to 118 products). The number of vendors offering AI products only grew with 13% from 61 in 2020 to 69 in 2021. The average number of products per company therefore increased from 1.9 to 2.3. The time from company founding to the first product on the market is on average 4 years and 1 month. Most prevalent are tools for neuro and chest imaging. With respect to modality, CT and MR covered 62% of all products. Half of the CE marked AI products (51%) have also been cleared by the FDA. To our knowledge, only four products were CE marked under the new Medical Device Regulations. Subscription or licensing are the most popular pricing models. The majority of products are offered with both the option of local and cloud-based installation.*Conclusions The growth of AI products new to the market is slowing down. This effect is even stronger for vendors. Existing vendors have been expanding their portfolios.*Clinical Relevance/Application The market of AI products for radiology is growing. Our research provides a transparent overview of the available products and their evidence.

RESULTS

In May 2021 there were 161 CE marked AI products on the market, an increase of 36% compared with one year prior. The growth from 2019 to 2020 was 69% (from 70 to 118 products). The number of vendors offering AI products only grew with 13% from 61 in

2020 to 69 in 2021. The average number of products per company therefore increased from 1.9 to 2.3. The time from company founding to the first product on the market is on average 4 years and 1 month. Most prevalent are tools for neuro and chest imaging. With respect to modality, CT and MR covered 62% of all products. Half of the CE marked AI products (51%) have also been cleared by the FDA. To our knowledge, only four products were CE marked under the new Medical Device Regulations. Subscription or licensing are the most popular pricing models. The majority of products are offered with both the option of local and cloud-based installation.

CLINICAL RELEVANCE/APPLICATION

The market of AI products for radiology is growing. Our research provides a transparent overview of the available products and their evidence.

SPR-IN-14 Leveraging Large-scale Weakly Labeled Data For Semi-supervised Mammogram Mass Detection

Participants
Yuxing Tang, Bethesda, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To develop a novel self-training-based semi-supervised learning framework for robust mass detection in mammograms, by leveraging the probabilistic image-level labels generated from the diagnostic report by a BERT-based natural language processing (NLP) model on a large-scale dataset.*Methods and Materials We collected a large-scale mammography dataset containing 134,520 images with diagnostic reports from 30,495 patients, among which 2,634 images have pixel-level mass masks labeled by radiologists. To fully leverage the diagnosis reports, we adopt a BERT-based NLP model to generate the probability of mass presence for the corresponding image, which is subsequently assigned as the image-level probabilistic label. We propose a novel semi-supervised learning framework to leverage a small number of fully labeled and large-scale weakly labeled images (with diagnostic reports) for mass detection. Starting with a fully supervised model trained on the data with pixel-level masks, the proposed framework iteratively refines the model itself using the entire weakly labeled data in a self-training fashion. A novel consistency-based sample selection strategy is proposed to identify those most informative samples for each iteration, based on the current model output and the soft labels of the weakly labeled data. A soft cross-entropy loss and a soft focal loss are also designed to serve as the image-level and pixel-level classification loss respectively.*Results A hold-out testing set of 689 mammography studies (2,756 images) manually labeled by radiologists was used to evaluate the performance of the proposed mass detection framework. Using all the fully and weakly labeled images, the sensitivities at 0.1, 0.2, 0.5, 1, and 2 false positive per image (FPPI) are 0.726, 0.778, 0.820, 0.850, and 0.962, respectively. Training using 25% (or 50%) of the fully labeled images together with the weakly labeled data, our semi-supervised model achieves performance on par ($p>0.05$) with training using 50% (or 100%) of the fully labeled images.*Conclusions The proposed semi-supervised learning model can effectively take advantage of soft labels generated by the NLP and pixel-level prediction, which models them as a means of uncertainties for weak data. It has a high sensitivity for mass detection. The performance of our self-training method can be persistently increased with more weakly labeled data available. It also demonstrates better mass detection accuracy than the supervised baseline and other comparing methods.*Clinical Relevance/Application The proposed framework enables large-scale self-training from weakly labeled data, which can reduce the effort of manual annotations from medical experts. It is unique and universally practical in medical image analysis.

RESULTS

A hold-out testing set of 689 mammography studies (2,756 images) manually labeled by radiologists was used to evaluate the performance of the proposed mass detection framework. Using all the fully and weakly labeled images, the sensitivities at 0.1, 0.2, 0.5, 1, and 2 false positive per image (FPPI) are 0.726, 0.778, 0.820, 0.850, and 0.962, respectively. Training using 25% (or 50%) of the fully labeled images together with the weakly labeled data, our semi-supervised model achieves performance on par ($p>0.05$) with training using 50% (or 100%) of the fully labeled images.

CLINICAL RELEVANCE/APPLICATION

The proposed framework enables large-scale self-training from weakly labeled data, which can reduce the effort of manual annotations from medical experts. It is unique and universally practical in medical image analysis.

SPR-IN-16 Prediction Of Radiography Study Volume And Turnaround Times

Participants
Akhil Dhamija, Lebanon, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Traditionally, radiologist schedules are constructed so that a predetermined, fixed number of radiologists cover a service. This process is inefficient as it does not account for variation in the daily study volume or the potential radiologist capacity. The purpose of this study was to determine if a machine learning (ML) algorithm could be used to predict study turnaround times (TAT = final report completion time - end exam time) based on the scheduled compliment of radiologists.*Methods and Materials A retrospective study was performed at a large academic children's hospital with a large pediatric radiology fellowship program. Data from all radiographs performed between 2017-2019 was extracted from multiple radiology information systems. Radiologist scores were calculated based on their mean and median TAT, shift type (day/night), and predicted volume per shift. Pearson correlation coefficients were determined between the predictor variables and the mean and median TAT. A ML pipeline with recursive feature selection using random forests and hyper parameter tuning using grid search for random forest and neural network models was used to find the best performing model on a test data spanning 3 months with training data from previous 33 months.*Results 397,806 radiographs were included in the data analysis. The mean TAT was weakly correlated ($R2 = \sim0.4$) with several variables. There was a noticeable increase in the rolling 7-day mean TAT from June to September each year thought to be due to the on-boarding of new fellows (Figure 1). Each day's mean TAT was weakly correlated with the same day's mean TAT from the prior week ($R2 = 0.43$). The modeling pipeline's prediction for daily study volume was strongly correlated with the actual study volume ($R2 = \sim 0.9$). However, there was little correlation between the predicted mean and median TAT and the actual values ($R2 = <0.32$) (Table 1). *Conclusions Optimizing radiologist scheduling using machine learning techniques is not feasible in its current iteration. Currently, we can only predict the study volume with a high-level of certainty.*Clinical Relevance/Application Prediction forecasts for shift turnaround times require further development and variable identification. Study volume can be predicted with a high level of accuracy.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Prediction forecasts for shift turnaround times require further development and variable identification. Study volume can be predicted with a high level of accuracy.

SPR-IN-2   Synthesis Of Discriminative Imaging Features Using Generative Adversarial Networks

Participants
Kyle Hasenstab, PhD, La Jolla, California (*Presenter*) Nothing to Disclose

PURPOSE

Convolutional neural networks (CNN) have been proposed to assist in radiological diagnosis, but current methods of providing CNN transparency are limited. We sought to assess the feasibility of a novel strategy using a generative adversarial network (GAN) to improve CNN explainability, through synthesis of images representative of CNN features.*Methods and Materials We previously developed two CNNs: one for regression of N-terminal pro-hormone brain natriuretic peptide (NT-proBNP) from chest radiographs, and a second for classification of intravenous contrast uptake adequacy on hepatobiliary phase MRI. With IRB approval and waiver of informed consent, we obtained 21,374 x-ray images and 826 hepatobiliary phase MRI volumes for algorithm development. Images were propagated through each CNN and features from the final fully-connected layer were extracted. Linear dimension reduction techniques were applied to reduce to a subset of principal features. A novel feature interpretation GAN (FIGAN) was then trained to synthesize images based on these principal features and structural segmentations. FIGAN-synthesized images were then reviewed by radiologists to determine the interpretations of these principal features for each CNN. FIGAN was also compared to conventional approaches for CNN explainability, including gradient-weighted class activation maps (Grad-CAMs) and saliency maps (SMs).*Results FIGAN-synthesized x-ray images showed that inference of NT-proBNP relied on size of the cardiomediastinal silhouette, body habitus, and perihilar pulmonary vasculature. FIGAN-synthesized MRI images showed that inference of hepatobiliary phase adequacy relied on differential enhancement of liver parenchyma and veins, textural nodularity, and hepatic venous opacification. Grad-CAM and SM results showed nonspecific and inconsistent CNN attention across the source images.*Conclusions FIGAN is effective and reliable for synthesizing visual representations of imaging features utilized by regression and classification CNNs to improve CNN explainability and is particularly beneficial for delineating both the location and visual characteristics of imaging features used by CNNs.*Clinical Relevance/Application The proposed algorithm can be used to visualize discriminative regional and diffuse imaging features used by CNNs and may help improve transparency of CNNs for medical imaging.

RESULTS

FIGAN-synthesized x-ray images showed that inference of NT-proBNP relied on size of the cardiomediastinal silhouette, body habitus, and perihilar pulmonary vasculature. FIGAN-synthesized MRI images showed that inference of hepatobiliary phase adequacy relied on differential enhancement of liver parenchyma and veins, textural nodularity, and hepatic venous opacification. Grad-CAM and SM results showed nonspecific and inconsistent CNN attention across the source images.

CLINICAL RELEVANCE/APPLICATION

The proposed algorithm can be used to visualize discriminative regional and diffuse imaging features used by CNNs and may help improve transparency of CNNs for medical imaging.

SPR-IN-4   Inpainting Of Anatomical Side (L/R) Mark For Enhancing Deep Learning Classifier In Chest Radiographs Of Multi-Center Trials

Participants
Ki Duk Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To propose an L/R mark inpainting with deep learning to enhance a classifier between normal and abnormal, which could be used to overcome different protocols between centers of placing anatomical side markers in multicenter.*Methods and Materials 2,000 normal and 2,000 abnormal chest radiographs from two centers (A, B) were evenly enrolled. 200 randomly sampled radiographs from public National Institutes of Health (NIH) dataset were also used as an external validation. The anatomical side markers on chest radiographs from center-A can indicate normal or abnormal labels, while other centers do not have such bias. To evaluate the influence of the markers, inpainting these markers were performed for all centers with EfficientDet to first detect region of interest (ROI) of markers and InpaintingGAN to inpaint only the ROI by replacing it with relevant information. A ResNet50 based classifier were developed using center-A data with original and inpainted datasets. The center-A dataset was divided into training, tuning, and validation sets as 6:2:2. External validations on the center-B and the NIH datasets were performed with two models. The area under the curve (AUC), accuracy, sensitivity, and specificity were evaluated and compared. In addition, attention map which shows highlighted region for classification was also compared.*Results In center-B, AUC, accuracy, sensitivity, and specificity were 0.672, 0.501, 0.002, and 1.000, respectively for the original model and 0.738, 0.659, 0.744, and 0.573, respectively for the marker inpainted model. In NIH dataset, those were 0.618, 0.45, 0.216, and 0.924, respectively for the original model and 0.737, 0.685, 0.739, and 0.576, respectively for the marker inpainted model. Pairwise comparisons of receiver operating characteristics (ROC) curves showed difference between original model and marker inpainted model (P < 0.0001, P = 0.049 for center-B, NIH dataset, respectively). In addition, attention map shows highlighted region on L/R marker in the original model while anatomical regions in the marker inpainted model, which was confirmed by an thoracic expert radiologist with more than 20 years' experience.*Conclusions The L/R marker inpainted model significantly enhanced the classification performance of external datasets, which could be useful to develop a more robust and accurate deep learning classifier especially with dataset from multicenter.*Clinical Relevance/Application Our model is expected to improve the robustness and performance of computer aided detection with dataset from multicenter by inpainting anatomical side markers.

RESULTS

In center-B, AUC, accuracy, sensitivity, and specificity were 0.672, 0.501, 0.002, and 1.000, respectively for the original model and 0.738, 0.659, 0.744, and 0.573, respectively for the marker inpainted model. In NIH dataset, those were 0.618, 0.45, 0.216, and 0.924, respectively for the original model and 0.737, 0.685, 0.739, and 0.576, respectively for the marker inpainted model. Pairwise

comparisons of receiver operating characteristics (ROC) curves showed difference between original model and marker inpainted model (P < 0.0001, P = 0.049 for center-B, NIH dataset, respectively). In addition, attention map shows highlighted region on L/R marker in the original model while anatomical regions in the marker inpainted model, which was confirmed by an thoracic expert radiologist with more than 20 years' experience.

CLINICAL RELEVANCE/APPLICATION

Our model is expected to improve the robustness and performance of computer aided detection with dataset from multicenter by inpainting anatomical side markers.

SPR-IN-5 Classification Of Focal Liver Lesions In CT Images Using Uncertainty-aware Ensemble Of Radiomics And Deep Learning Classifiers

Participants
Hansang Lee, Daejeon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To improve the classification efficiency of focal liver lesions (FLLs) in CT images, we propose an uncertainty-weighted ensemble method for integrating radiomics and deep learning classifiers using the uncertainty estimated from two classifiers.*Methods and Materials A dataset of 502 portal phase CT scans of 1,290 FLLs with 676 cysts, 130 hemangiomas, and 484 metastases, was used. First, we train a random forest (RF) on 67-dimensional radiomic texture and shape features and an AlexNet CNN on the training images. From two trained classifiers, we evaluate the aleatoric uncertainty through the test-time augmentation (TTA) method. In TTA, the affine-based augmentation is applied to each test data, and the uncertainty is computed by the entropy of the label distribution obtained from the classified labels of the augmented test data. In the integration of two classifiers, we propose an uncertainty-weighted ensemble to integrate the two classifiers while also maintaining the advantage of each classifier. In the uncertainty-weighted ensemble, the label distributions of two classifiers weighted by the inversed uncertainty are linearly combined to obtain the ensemble distribution. The uncertainty-weighted ensemble allows the classifier to significantly reflect the decision of one classifier with high certainty in its decision.*Results In experiments, we compared the results of the proposed method with those of a single RF, a single AlexNet, and a linear combination ensemble of two classifiers. The two single classifiers of RF and AlexNet achieved an accuracy of 82.7% and 78.8%, respectively, and both classifiers have a higher probability of misclassification in higher uncertainty cases. The linear combination ensemble of the two classifiers achieved an accuracy of 81.8%, showing lower performance than a single RF. The proposed method showed improved results than single classifiers and a linear combination ensemble through the uncertainty weighted ensemble. As a result, the proposed method achieved an accuracy of 85.0%, showing improvements of 2.3%p, 6.2%p, and 3.2%p compared to the single RF, single AlexNet, and the linear combination ensemble, respectively.*Conclusions The proposed uncertainty-weighted ensemble weighs each classifier's uncertainty in combining the two classifiers so that the classifier which is more certain in its own decision is further reflected. (This work was supported by the NRF grant funded by the MSIT No. 2020R1A2C1102140)*Clinical Relevance/Application Our method can be applied not only to tumor analysis problems in which radiomic feature learning is important but also to the overall tasks of integrating two learners with different characteristics.

RESULTS

In experiments, we compared the results of the proposed method with those of a single RF, a single AlexNet, and a linear combination ensemble of two classifiers. The two single classifiers of RF and AlexNet achieved an accuracy of 82.7% and 78.8%, respectively, and both classifiers have a higher probability of misclassification in higher uncertainty cases. The linear combination ensemble of the two classifiers achieved an accuracy of 81.8%, showing lower performance than a single RF. The proposed method showed improved results than single classifiers and a linear combination ensemble through the uncertainty weighted ensemble. As a result, the proposed method achieved an accuracy of 85.0%, showing improvements of 2.3%p, 6.2%p, and 3.2%p compared to the single RF, single AlexNet, and the linear combination ensemble, respectively.

CLINICAL RELEVANCE/APPLICATION

Our method can be applied not only to tumor analysis problems in which radiomic feature learning is important but also to the overall tasks of integrating two learners with different characteristics.

SPR-IN-6 A Prospective Controlled Study Of Distension Protocols In Bladder Mp-MRI

Participants
Juan Hu, Kunming, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the imaging quality of bladder mpMRI with different bladder distension protocols and explore the optimal patient preparation protocol for VI-RADS application.*Methods and Materials Patients who applied for pelvic mpMRI examination in our hospital from July 2020 to April 2021 were prospectively included with the approval of the hospital ethics committee, and were randomly divided into three groups after signing informed consent: Group 1 (urine holding alone: urine abstinence after urination 1~2 hours before scan), Group 2 (water drinking alone: drinking 500-1000 ml of water within 0.5~1 hour before scan), Group 3 (urine holding and water drinking: urination 1~2 hours before the examination + drinking 500~1000ml water before the scan). The pelvic mpMRI was performed on a 3.0T MR scanner, and the sequences included high-resolution T2WI (axial/coronal/sagittal), DWI/ADC (b-value=0/1000/1400 s/mm2), and DCE. A reviewer who was unaware of the preparation protocol performed separate quality scores for T2WI, DWI/ADC, and DCE(arterial phase) of bladder wall; motion artifacts affecting the bladder wall were evaluated; initial and final sequence bladder volumes (Vpre, Vpost) were measured using 3D Slicer, and volume changes(Vpost-pre) were calculated. Patients filled out the scale to collect height, weight, urination time, and water drink time, etc. Vpre, Vpost, and Vpost-pre in each group, the image quality and motion artifacts of each sequence in each group were compared by SPSS 21.0 software. Differences were considered statistically significant at P < 0.05.*Results The differences of Vpre, Vpost, and Vpost-pre were statistically significant(P=0.001, 0.000, 0.000) in group 1 (31 cases, 55.9±14.4 years), group 2 (31 cases, 56.2±12.9 years) and group 3 (30 cases,60.0±13.6 years). T2WI, DWI/ADC, DCE quality scores showed: Group 3 > Group 2 > Group 1, and the differences were statistically significant (F=9.989,9.844,13.068; P=0.000,0.000,0.000), while the differences in motion artifact scores between groups were not statistically significant (F=1.861; P=0.161).*Conclusions The combination of the urine holding and water drinking protocol has advantages over urine holding or water drinking alone protocol in bladder distension and image quality.*Clinical Relevance/Application The combination of the urine holding and water drinking protocol is recommended as the optimal bladder distension protocol for VI-RADS scoring of bladder mpMRI.

RESULTS

The differences of Vpre, Vpost, and Vpost-pre were statistically significant(P=0.001, 0.000, 0.000) in group 1 (31 cases, 55.9±14.4 years), group 2 (31 cases, 56.2±12.9 years) and group 3 (30 cases,60.0±13.6 years). T2WI, DWI/ADC, DCE quality scores showed: Group 3 > Group 2 > Group 1, and the differences were statistically significant (F=9.989,9.844,13.068; P=0.000,0.000,0.000), while the differences in motion artifact scores between groups were not statistically significant (F=1.861; P=0.161).

CLINICAL RELEVANCE/APPLICATION

The combination of the urine holding and water drinking protocol is recommended as the optimal bladder distension protocol for VI-RADS scoring of bladder mpMRI.

SPR-IN-8   FedNorm: Federated Learning With Modality-based Normalization

Participants
Shadi Albarqouni, PhD, Munchen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Organ segmentation is an important task in medical image analysis, which can be performed by deep learning models to assist physicians with their diagnoses. However, labeling medical datasets for organ segmentation is expensive and requires expert knowledge. As a consequence, many hospitals cannot provide the required amount of data to train a deep learning model on their own. Typically, one would collect data from multiple hospitals and train a model in a centralized manner, but this is often not possible due to privacy regulations, especially in the medical sector. Therefore, it would be helpful to train a shared, decentralized model, where training data from different modalities and multiple hospitals contributes to the training process.*Methods and Materials In this work, we focus on multi-modal liver segmentation with CT and MRI data using federated learning. We present a novel federated learning algorithm, FedNorm, which uses a normalization technique based on the modalities of the data. Additionally, FedNorm learns a global model which can compute the liver segmentation mask for CT and MRI input scans. We compare FedNorm to other state-of-the-art federated learning algorithms, namely; FedAvg, FedAvgM, FedVC, FedBN, and SiloBN, in multiple settings, where different numbers of clients and modalities participate during training. Therefore, we validate our method on five publicly available datasets: LiTS17 (w/o 3D-IRCADb, 111 patients), 3D-IRCADb (20 patients), Multi-Atlas (30 patients), SLIVER07 (20 patients), CHAOS19 (20 CT and 100 MR scans). Furthermore, we evaluate the generalization performance of the shared global model on unseen multi-modal data.*Results We show that FedNorm outperforms other federated learning approaches on unseen data by a large margin. In one of our MRI generalization tests, FedNorm shows 8x higher global Dice score over SiloBN (0.076 to 0.752), which is the best performing algorithm among the others. In the per-patient evaluation, 9x higher Dice score over SiloBN (0.066 to 0.718) is achieved.*Conclusions Due to the great generalization performance of our trained global model, there is no need to train a separate model at each hospital. It is sufficient if only a few hospitals with different modalities contribute to the training process. Further, our method allows users to feed the model with either a CT or MR image and always get a liver segmentation.*Clinical Relevance/Application In general, FedNorm allows training accurate liver segmentation models, which can be used in a variety of applications. Examples of such applications would be the detection of liver cancer, which is preceded by liver enlargement as a physical sign, or the task of liver age prediction.

RESULTS

We show that FedNorm outperforms other federated learning approaches on unseen data by a large margin. In one of our MRI generalization tests, FedNorm shows 8x higher global Dice score over SiloBN (0.076 to 0.752), which is the best performing algorithm among the others. In the per-patient evaluation, 9x higher Dice score over SiloBN (0.066 to 0.718) is achieved.

CLINICAL RELEVANCE/APPLICATION

In general, FedNorm allows training accurate liver segmentation models, which can be used in a variety of applications. Examples of such applications would be the detection of liver cancer, which is preceded by liver enlargement as a physical sign, or the task of liver age prediction.

SPR-IN-9   Feddis: Disentangled Federated Learning For Unsupervised Brain Pathology Segmentation

Participants
Shadi Albarqouni, PhD, Munchen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Collecting and labeling medical data is cumbersome and costly. Data is often scattered across multiple institutions, and privacy regulations make it difficult to access. In addition, medical images must be reviewed by specially trained physicians, which is time-consuming and expensive. The goal of this work is to collaboratively train an ML model to segment anomalies in brain MR scans without sharing local data and without requiring labeled images. Still, in such a distributed setup, data heterogeneity between institutes/datasets poses a major challenge.*Methods and Materials To mitigate this problem, we propose a novel federated method called Federated Disentanglement (FedDis), to disentangle the parameter space in shape and appearance and learn only a global shape model. Our method is based on the premise that the underlying anatomical structure in MR scans of the brain is similar across different institutions and scanners, and sharing shape information would be beneficial in detecting abnormalities.*Results In this work, we use healthy brain scans from 623 subjects from multiple institutions with real-world data (OASIS, ADNI) in a federated manner. We validated our method FedDis on real pathological databases with 109 subjects: two publicly available MS lesions (MSLUB, MSISBI) and an in-house database with MS and glioblastoma (MSI and GBI). Our method reached an average dice score of 0.38, outperforming the state-of-the-art (sota) Auto Encoder by 42% and the sota federated method by 11%.*Conclusions We have shown superior performance of our FedDis on a couple of publicly available databases of MR Braim pathologies; Multiple Sclerosis, and Glioblastoma. The code idea of our method of disentangling the parameter space in shape and appearance and learn only a global shape model has been shown its effectiveness.*Clinical Relevance/Application This work shows a scalable and efficient solution to brain anomaly detection that can be used to improve the radiological workflow efficiency by guiding clinicians to abnormalities that might otherwise go undetected.

RESULTS

In this work, we use healthy brain scans from 623 subjects from multiple institutions with real-world data (OASIS, ADNI) in a federated manner. We validated our method FedDis on real pathological databases with 109 subjects: two publicly available MS lesions (MSLUB, MSISBI) and an in-house database with MS and glioblastoma (MSI and GBI). Our method reached an average dice score of 0.38, outperforming the state-of-the-art (sota) Auto Encoder by 42% and the sota federated method by 11%.

CLINICAL RELEVANCE/APPLICATION

This work shows a scalable and efficient solution to brain anomaly detection that can be used to improve the radiological workflow efficiency by guiding clinicians to abnormalities that might otherwise go undetected.

Abstract Archives of the RSNA, 2021

Sub-Events

SPR-RO-1   **Imaging And Treatment Of Primary And Metastatic Tumors Via Abscopal Immunotherapy Involving Reductions In Circulating Tumor Cells (CTCs), CTC Clusters, And Their Extravasation Using Targeted Antigen-capturing Nanoparticles Containing Ezrin Inhibitor And Ouabain Directed By Radiation.**

Participants
Satoshi G. Harada, MD, Shiwa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

In vivo imaging and treatment of primary and metastasized tumors using microcapsules releasing antigen-capturing nanoparticles (AC-NPs) containing Ezrin inhibitor (NSC 668394) and Ouabain in two radiation sessions with programmed death-ligand 1 (PD-L1) blockade.*Methods and Materials For session 1, nanocapsules (NCs) generated by modifying iopamiron and 400 µg of anti-PD-L1 antibody (Ab) were mixed with 1.0 mL of 4% alginate, 3% hyaluronate, and 1 µg/mL of P-selectin solution and sprayed into 0.5 mmol/L of $FeCl_2$ supplemented with 1 µg/mL of anti-a4ß1 Ab. NCs were injected intravenously into BALB/c mice with primary K7M2 tumors in the left hind leg and lung metastases. After 9 h, primary tumors were exposed to 10 or 20 Gy of 60Co ?-rays. For session 2, 400 nM of Ouabain and 30 µM of NSC 668394 were encapsulated in poly(lactic-co-glycolic) acid (PLGA) AC-NPs via nanoprecipitation. The particles were mixed with the alginate-hyaluronate cocktail and sprayed into 0.5 mmol/L of $FeCl_2$ supplemented with 1 µg/mL of anti-P-selectin Ab. NCs (1×10^{10}) were injected intravenously. After 9 h, the tumors were irradiated, as in session 1.*Results In session 1, anti-a4ß1 NCs accumulating around primary and metastatic tumors were detected on computed tomography. NCs released P-selectin and anti-PD-L1 Ab on irradiation. In session 2, NCs accumulated around primary tumors via a P-selectin antigen (Ag)-Ab reaction and released PLGA AC-NPs containing Ouabain and NSC 668394. PLGA AC-NPs captured and transported tumor-derived protein Ag released by the second radiation dose to dendritic cells (DCs), which intensified DC-mediated cluster of differentiation (CD)8+ T-cell priming. The primed antitumor CD8+ T cells targeted primary and metastatic tumors, single circulating tumor cells (CTCs), and CTC clusters with PD-L1 blockade from session 1. Furthermore, Ouabain from PLGA AC-NPs dissociated CTC clusters. NSC 668394 then inhibited CTC extravasation and dissociated CTC clusters, reducing new metastasis seeding. These treatments conferred increased antitumor effects (enhancement factor 1.9) and reduced metastasis by 90.3%.*Conclusions Our NC improves tumor diagnosis and treatment.*Clinical Relevance/Application Targeted AC-NP-mediated immunotherapy with radiation-directed Ouabain and Ezrin inhibitor enhances the primary and metastatic antitumor effects of radiotherapy with PD-L1 blockade.

RESULTS

In session 1, anti-a4ß1 NCs accumulating around primary and metastatic tumors were detected on computed tomography. NCs released P-selectin and anti-PD-L1 Ab on irradiation. In session 2, NCs accumulated around primary tumors via a P-selectin antigen (Ag)-Ab reaction and released PLGA AC-NPs containing Ouabain and NSC 668394. PLGA AC-NPs captured and transported tumor-derived protein Ag released by the second radiation dose to dendritic cells (DCs), which intensified DC-mediated cluster of differentiation (CD)8+ T-cell priming. The primed antitumor CD8+ T cells targeted primary and metastatic tumors, single circulating tumor cells (CTCs), and CTC clusters with PD-L1 blockade from session 1. Furthermore, Ouabain from PLGA AC-NPs dissociated CTC clusters. NSC 668394 then inhibited CTC extravasation and dissociated CTC clusters, reducing new metastasis seeding. These treatments conferred increased antitumor effects (enhancement factor 1.9) and reduced metastasis by 90.3%.

CLINICAL RELEVANCE/APPLICATION

Targeted AC-NP-mediated immunotherapy with radiation-directed Ouabain and Ezrin inhibitor enhances the primary and metastatic antitumor effects of radiotherapy with PD-L1 blockade.

SPR-RO-2   **Comparison Of Longitudinal MRI Radiomic Texture Features Between Protons And Photon Radiation Therapy In Non-tumoral Regions Of Brain At The Same Dose Levels In Paediatric Patients With Brain Tumours - An Exploratory Study**

Participants
Priyanka Sakhavalkar, MSc, BDS, Nashik, India (*Presenter*) Nothing to Disclose

PURPOSE

To assess if there is any difference in T2 texture features between non-tumoral parts of brain in photon vs proton radiotherapy at the same dose levels.*Methods and Materials Longitudinal retrospective study was carried out in 51 paediatric patients diagnosed with primary brain tumours treated with photon (Ph;n=30) or proton (Pr;n=21) radiotherapy. T2 baseline and at each fixed time point from the date of surgery to two years following radiotherapy were selected for the textural analysis. Scans were bias corrected, registered with the CT dose maps and with baseline scan for each patient. Regions of interest (ROI) of fixed diameter were drawn in 11 predetermined non-tumoral regions of brain including in peri-tumoural region (PTV). ROIs were placed in homogenous white/grey matter. Radiation dose was calculated in each of these 11 ROIs and texture features were extracted using pyradiomics. Data were analysed using machine learning & statistical analysis and 16 primary texture features were compared between therapies across whole brain and in each ROI separately at the same dose levels (between 0-60 Gy)*Results 1.Whole brain: When all 11 ROIs were analysed together in 50 patients, mean of different longitudinal textural feature values showed

significant differences (p <0.005) between both therapies at each dose levels. Number of observations (N) were different at each dose group in each therapy due to difference in dose distribution. At dose group A(0-10.55Gy;N=Ph144,Pr 609)& C(20.56-30.55Gy;N=Ph172,Pr26) means of 15 longitudinal feature value showed significant difference; at B(10.56-20.55Gy;Ph58,Pr83) & E (40.56-50.55;GyN=Ph108,Pr42), significant difference was shown by mean of 1 feature , at dose D (30.56-40.55Gy;N=Ph196,Pr27) mean of 3 feature values showed difference and 11 features mean values showed significant difference at dose F(50.56-60.55Gy; N=Ph514,Pr128) 2.In each ROI: When similar ROI was selected and compared, significant difference (p<0.005) was seen in some mean values. Individual features showing significant difference vary as per dose group. Eg. Mean of total energy at dose E, at pons showed significant difference*Conclusions There is a significant difference in some primary textural feature values over non-tumoural brain parenchyma at the same dose levels between proton and photon therapy. Radiomic texture analysis is promising technique to understand these differences.*Clinical Relevance/Application This is a first radiomic study showing significant difference in some of the textural features between proton and photon therapy pointing to the possible difference in underlying biologic/structural brain changes after each therapy. This may imply different biologic effect of each therapy.

RESULTS

1.Whole brain: When all 11 ROIs were analysed together in 50 patients, mean of different longitudinal textural feature values showed significant differences (p <0.005) between both therapies at each dose levels. Number of observations (N) were different at each dose group in each therapy due to difference in dose distribution. At dose group A(0-10.55Gy;N=Ph144,Pr 609)& C(20.56-30.55Gy;N=Ph172,Pr26) means of 15 longitudinal feature value showed significant difference; at B(10.56-20.55Gy;Ph58,Pr83) & E (40.56-50.55;GyN=Ph108,Pr42), significant difference was shown by mean of 1 feature , at dose D (30.56-40.55Gy;N=Ph196,Pr27) mean of 3 feature values showed difference and 11 features mean values showed significant difference at dose F(50.56-60.55Gy; N=Ph514,Pr128) 2.In each ROI: When similar ROI was selected and compared, significant difference (p<0.005) was seen in some mean values. Individual features showing significant difference vary as per dose group. Eg. Mean of total energy at dose E, at pons showed significant difference

CLINICAL RELEVANCE/APPLICATION

This is a first radiomic study showing significant difference in some of the textural features between proton and photon therapy pointing to the possible difference in underlying biologic/structural brain changes after each therapy. This may imply different biologic effect of each therapy.

SPR-RO-3   Treatment Compliance To Linac-based Prostate SBRT Using Real-time Electromagnetic Tracking

Participants
RAFFAELLA LUCCHINI, MONZA, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To investigate treatment compliance and early gastrointestinal (GI) and genitourinary (GU) side effects in patients with organ confined prostate cancer following linac-based Stereotactic Body Radiation Therapy (SBRT) using an electromagnetic (EM) tracking device for real-time intra-fraction organ motion.*Methods and Materials Ten consecutive patients with prostate cancer (cT2-T3N0M0) were treated with dose escalated prostate SBRT in 4 or 5 fractions, in a single week, for a total dose of 38 Gy or 40 Gy, respectively. A volumetric modulated arc therapy (VMAT) was delivered on VersaHD linac with two 6FFF or 10FFF arcs optimized to have the 95% isodose covering at least 95% of the PTV (2 mm isotropic expansion of the CTV). The EM tracking device consisted in an integrated Foley catheter with a transmitter in a dedicated lumen, which was placed before the first treatment fraction and removed after the last one. After the daily CBCT, the system monitored the transmitter position, and the beam delivery was interrupted whenever the displacement exceeded 2 mm. Organ motion mitigation was obtained by a rectal micro-enema and a 100 cc bladder filling. Acute toxicity was evaluated with Common Terminology Criteria for Adverse Events version 5 (CTCAE_v5) scale at baseline and during treatment.*Results Median age was 74 years (range 63-82). Intermediate and high risk prostate cancer accounted for 70% and 30% respectively. Median International Prostate Symptom Score (IPSS) score at baseline was 8 (range 2-14). Median PTV volume was 81.2 cc (range 48.9-128.5). Average total treatment time lasted 9.3 minutes (range 6-14), 5.8 minutes (range 3-9) for setup and 3.5 minutes (range 2-5) for beam delivery. In 41% of the monitored fractions, a new CBCT was mandated. The prostate was found within 1 mm from its initial position in 78.7% of the beam-on time, between 1 and 2 mm in 19.1%, and exceeds 2 mm only in 2.2%. All patients completed the treatment in the expected time and their compliance to the procedure was excellent. No clinically significant acute Grade 2 or higher GI (rectal) and GU toxicity was observed. Only one patient experienced acute Grade 1 GI toxicity, while acute Grade 1 GU toxicity occurred in five (50%) patients.*Conclusions Linac-based SBRT by means of VMAT-FFF technique coupled with daily image guidance including real-time EM tracking allowed dose-escalated treatment with negligible early side effects.*Clinical Relevance/Application The procedure was implemented rapidly and resulted well tolerated and less invasive than the surgically implanted transmitter.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

The procedure was implemented rapidly and resulted well tolerated and less invasive than the surgically implanted transmitter.

SPR-RO-4   Combined Positron Emission Tomography-Computed Tomography And Magnetic Resonance Imaging For Response Evaluation In Patients With Squamous Cell Anal Carcinoma Treated With Curative-intent Chemoradiotherapy

Participants
Pratik Adusumilli, MBChB, Leeds, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

The aim was to assess effectiveness of Fluorine-18 Fluorodeoxyglucose (FDG) positron emission tomography-computed tomography

(PET-CT) and magnetic resonance imaging (MRI) for response assessment post curative-intent chemoradiotherapy (CRT) in anal squamous cell carcinoma (ASCC) and evaluate their efficacy for risk stratification.*Methods and Materials Consecutive patients with ASCC treated with curative-intent CRT at a large tertiary referral centre between January 2018 and April 2020 were retrospectively identified. Patient demographics, treatment and follow-up information including progression free survival (PFS) and overall survival (OS) outcomes were collated. Imaging was evaluated by 3 Radiologists using qualitative response assessment criteria with consensus agreement. Two-proportion z-test was used to assess differences in diagnostic performance metrics (sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy). Kaplan-Meier survival analysis (Mantel-Cox log-rank) was performed.*Results 75 patients with median follow-up of 17.8 months (range 5 - 32.6) were included. 52 (69.3%) female and 23 (30.7%) male, median age 62 years (range 35 - 85). 15/75 (20%) had persistent anorectal and/or nodal disease after CRT. 3 patients died, median time to death 6.2 months (range 5 - 18.3). MRI and PET-CT response assessment performance metrics were broadly similar. When considered in combination there were statistically significant improvements in performance (Accuracy 94.7%, PPV 78.9%, NPV 100%). Kaplan Meier analysis demonstrated significant differences in PFS between responders and non-responders at PET-CT (p=0.007), MRI (p=0.005) and consensus evaluation (p=0.000). Cox regression analysis of PFS demonstrated a lower hazard ratio (HR) and narrower 95% confidence intervals for consensus findings (HR=0.093, p=0.000).*Conclusions Combined PET-CT and MRI response assessment post CRT was a better predictor of subsequent outcome than either modality alone. This could have valuable clinical benefits by guiding personalized risk-adapted patient follow-up and warrants further evaluation in a prospective study.*Clinical Relevance/Application Combined imaging response assessment with PET-CT and MRI more effectively stratified patients and could have valuable clinical benefits by guiding personalized risk-adapted follow-up.

RESULTS

75 patients with median follow-up of 17.8 months (range 5 - 32.6) were included. 52 (69.3%) female and 23 (30.7%) male, median age 62 years (range 35 - 85). 15/75 (20%) had persistent anorectal and/or nodal disease after CRT. 3 patients died, median time to death 6.2 months (range 5 - 18.3). MRI and PET-CT response assessment performance metrics were broadly similar. When considered in combination there were statistically significant improvements in performance (Accuracy 94.7%, PPV 78.9%, NPV 100%). Kaplan Meier analysis demonstrated significant differences in PFS between responders and non-responders at PET-CT (p=0.007), MRI (p=0.005) and consensus evaluation (p=0.000). Cox regression analysis of PFS demonstrated a lower hazard ratio (HR) and narrower 95% confidence intervals for consensus findings (HR=0.093, p=0.000).

CLINICAL RELEVANCE/APPLICATION

Combined imaging response assessment with PET-CT and MRI more effectively stratified patients and could have valuable clinical benefits by guiding personalized risk-adapted follow-up.

SPR-RO-6   **Patterns Of Failure In Immunosuppressed Patients With Cutaneous Squamous Cell Carcinomas Of The Head And Neck Undergoing Adjuvant Radiotherapy**

Participants
Teresa Easwaran, MD,MS, Minneapolis, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Chronically immunosuppressed patients are at higher risk for both the development and recurrence of cutaneous malignancies, which are associated with a more aggressive disease phenotype. Prior retrospective studies have demonstrated that cutaneous squamous cell carcinomas of the head and neck (cSCC-HN) in immunosuppressed patients have a 3-4 fold greater risk of locoregional disease recurrence compared to immunocompetent patients. In this study, we retrospectively examined a cohort of immunosuppressed patients with cSCC-HN, assessing patterns of recurrence based on treatment modalities.*Methods and Materials We retrospectively reviewed patients with cSCC-HN who had undergone either bone marrow transplant (BMT) or solid organ transplant (SOT) at the University of Minnesota between 2011-2020. Variables including demographics, tumor grade and stage, type of immunosuppression, treatment techniques and site of first recurrence were recorded. Categorical variables were tested using Fisher's exact test, and continuous variables were tested via the Wilcoxon rank-sum test. All statistical analysis was conducted using JMP Pro 15.2.*Results We identified a total of 174 patients treated for cSCC-HN with history of BMT (n=25) and SOT (n=149) with a median follow-up of 53.9 months [Range: 1.4-118.8 months]. The majority (89%) of patients had well-differentiated or intermediate-grade tumors, and clinical T1 or T2 tumors (85%). Mohs micrographic surgery (MMS) was the most frequently utilized treatment modality (n=137), followed by WLE +/- elective neck dissection (n=20). A total of 13 patients received adjuvant radiotherapy. A total of 50 patients developed recurrent disease. Isolated local recurrence was the most common site of initial failure (54%), followed by regional (20%), distant (12%) and loco-regional failure (6%). The majority of local recurrences occurred with MMS as the definitive surgical modality (76%). Of the 13 patients who received adjuvant radiotherapy, 1 patient developed a nodal recurrence, and 1 developed distant disease. Zero patients who underwent adjuvant radiotherapy developed local recurrence.*Conclusions Immunosuppressed patients with cSCC-HN have significantly worse treatment outcomes compared to immunocompetent patients. Despite a preponderance of early stage and low or intermediate grade disease within our selected patients, we observed high rates of disease recurrence with local recurrence predominating as the most common site of failure. We observed no local recurrences in our population who underwent adjuvant radiotherapy.*Clinical Relevance/Application Higher risk patients, such as those chronically immunosuppressed, may benefit from more upfront, aggressive therapeutic strategies for cSCC-HN.

RESULTS

We identified a total of 174 patients treated for cSCC-HN with history of BMT (n=25) and SOT (n=149) with a median follow-up of 53.9 months [Range: 1.4-118.8 months]. The majority (89%) of patients had well-differentiated or intermediate-grade tumors, and clinical T1 or T2 tumors (85%). Mohs micrographic surgery (MMS) was the most frequently utilized treatment modality (n=137), followed by WLE +/- elective neck dissection (n=20). A total of 13 patients received adjuvant radiotherapy. A total of 50 patients developed recurrent disease. Isolated local recurrence was the most common site of initial failure (54%), followed by regional (20%), distant (12%) and loco-regional failure (6%). The majority of local recurrences occurred with MMS as the definitive surgical modality (76%). Of the 13 patients who received adjuvant radiotherapy, 1 patient developed a nodal recurrence, and 1 developed distant disease. Zero patients who underwent adjuvant radiotherapy developed local recurrence.

CLINICAL RELEVANCE/APPLICATION

Higher risk patients, such as those chronically immunosuppressed, may benefit from more upfront, aggressive therapeutic strategies for cSCC-HN.

Sub-Events

SPR-CA-1 **Motion Distortion In ECG-gated Photon-counting CT: Resolution Mode-dependency In A Coronary Tree Phantom**

Participants
Jayasai Rajagopal, BA, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the impact of differing pixel size on motion distortion in a photon-counting CT system*Methods and Materials An investigational single source photon-counting CT scanner (CounT, Siemens, Germany) with ECG gating was used to image a custom coronary tree phantom with models of healthy, stenotic, and stented arteries. A cardiac motion simulator (QRM, Germany) which mimics motion in the x, y, and z-planes was used. Images were acquired with matched parameters (140 kV, 120 mAs) at rest and at 60 beats per minute. Additionally, repeated high dose stationary images (140 kV, 330 mAs) were averaged to generate a motion-free, reduced noise reference standard. Scans were completed at both standard (0.5mm2) and high-resolution (0.25 mm2) pixel sizes. Reconstructions were performed using a manufacturer's standard adaptive filter to maximize the resolution of images. Motion acquisitions were reconstructed at four phases: 0%, 25%, 50%, 75%. Regions of interest were drawn around vessels and the vessels automatically segmented. Difference from the reference standard image was evaluated for vessel diameter and vessel circularity. Sorensen-Dice coefficient (DSC) between the reference standard and stationary or motion images were compared between the two resolutions.*Results PCCT exhibited motion artifacts similar to those in conventional CT including increased variability in diameter and circularity measurements compared to stationary images. High-resolution and standard resolution images showed similar rates of degradation from the reference standard. The stenotic vessel showed more variation than healthy or stented vessels in both standard and high-resolution settings. High-resolution motion images had an average DSC of 0.56 compared to 0.59 for standard resolution motion images.*Conclusions High-resolution images exhibited motion distortion similar to that in standard resolution images suggesting that changes in pixel size have limited impact on motion distortion.*Clinical Relevance/Application Photon-counting CT permits higher resolution than is currently available. However, that advantage does not seem to influence motion associated with the ECG-gated imaging of a coronary tree phantom.

RESULTS

PCCT exhibited motion artifacts similar to those in conventional CT including increased variability in diameter and circularity measurements compared to stationary images. High-resolution and standard resolution images showed similar rates of degradation from the reference standard. The stenotic vessel showed more variation than healthy or stented vessels in both standard and high-resolution settings. High-resolution motion images had an average DSC of 0.56 compared to 0.59 for standard resolution motion images.

CLINICAL RELEVANCE/APPLICATION

Photon-counting CT permits higher resolution than is currently available. However, that advantage does not seem to influence motion associated with the ECG-gated imaging of a coronary tree phantom.

SPR-CA-10 **Automated Coronary Calcium Scoring In Non-gated Chest CT With Multiple Protocols: Direct Comparison To ECG-gated CT**

Participants
Jiangtao Yu, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

Although several artificial intelligence (AI)-based methods have been developed for coronary calcium (CAC) quantification in non-gated chest CT, their performance directly compared to reference scores in electrography (ECG) gated CAC scans has not been investigated.*Methods and Materials From 1st August 2019 to 31st July 2020, 586 patients underwent non-gated chest CT and ECG-gated CAC scoring CT in the same session were included in this retrospective study. An AI-based software based on 3D U-Net deep learning model was used for automated CAC scoring in non-gated chest CT. Dedicated ECG-gated CAC scoring was severed as a reference, and Agatston score risk categories was defined as follows:0, 1-10, 11-100,101-400 and >400. The agreement and reliability between two methods and accuracy of automated method for risk categorization was determined. The analyses were performed for all non-gated scans, and scans at tube voltage of 100KVp and 120KVp separately.*Results Bland-Altman showed good agreement between automated method and the reference regardless CAC score in non-gated CT was slightly underestimated. The mean difference was -7.9, -1.7, -12.6 for all non-gated scans, non-gated scans at 100KVp and 120KVp respectively. The limits of agreement were narrower for automated software with respect to CAC scoring for all non-gated scans and scans at 100KVp. The reliability for AI-based software in relation to dedicate ECG-gated CAC scoring was excellent, the ICCs were 0.98(P<0.001) for all scans, and 0.98(P<0.001) for scans at 100KV and 0.97 (P<0.001) at 120KV, respectively. AI-based software showed a weighted ? values of 0.87(P<0.001), 0.84(P<0.001) and 0.89(P<0.001) and the accuracy of 83.8%,80.7% and 86.1% for all scans, scans at 100KVp and 120KVp, respectively. Particularly for diagnosis power of CAC of zero, 4 non-gated scans at 100KVp and 3 scans at 120KVp were misclassified into non-zero Agatston score group, the false positivity was 2.9% (4/137) and 1.6% (3/183) respectively. AI-based software missed CAC lesions in 17 non-gated scans at 100KVp and 18 scans at 120KVp, the false negativity

was 15.3% (17/111) and 11.6% (18/155).*Conclusions AI-based automated CAC scores in diverse non-gated chest CT was in good concordance with reference standard, and accurate for cardiovascular diseases risk categorizations. However, it should be continuously improved to deal with challenging non-gated scans.*Clinical Relevance/Application Since current evidence with respect to CAC score in cardiac risk prediction was mainly based on dedicated ECG-gated scans, this head-to-head comparison would facilitate the automated CAC scoring in daily routine chest CT examination, and patients would benefit from the evaluation without additional radiation exposure.

RESULTS

Bland-Altman showed good agreement between automated method and the reference regardless CAC score in non-gated CT was slightly underestimated. The mean difference was -7.9, -1.7, -12.6 for all non-gated scans, non-gated scans at 100KVp and 120KVp respectively. The limits of agreement were narrower for automated software with respect to CAC scoring for all non-gated scans and scans at 100KVp. The reliability for AI-based software in relation to dedicate ECG-gated CAC scoring was excellent, the ICCs were 0.98(P<0.001) for all scans, and 0.98(P<0.001) for scans at 100KV and 0.97 (P<0.001) at 120KV, respectively. AI-based software showed a weighted ? values of 0.87(P<0.001), 0.84(P<0.001) and 0.89(P<0.001) and the accuracy of 83.8%,80.7% and 86.1% for all scans, scans at 100KVp and 120KVp, respectively. Particularly for diagnosis power of CAC of zero, 4 non-gated scans at 100KVp and 3 scans at 120KVp were misclassified into non-zero Agatston score group, the false positivity was 2.9% (4/137) and 1.6% (3/183) respectively. AI-based software missed CAC lesions in 17 non-gated scans at 100KVp and 18 scans at 120KVp, the false negativity was 15.3% (17/111) and 11.6% (18/155).

CLINICAL RELEVANCE/APPLICATION

Since current evidence with respect to CAC score in cardiac risk prediction was mainly based on dedicated ECG-gated scans, this head-to-head comparison would facilitate the automated CAC scoring in daily routine chest CT examination, and patients would benefit from the evaluation without additional radiation exposure.

SPR-CA-11 Identify Ischemic, Infarcted, Hibernant, And Normal Myocardium By Stress And Rest T1 Mapping Without The Application Of Gadolinium Contrast Agents

Participants
Baiyan Zhuang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

In chronic coronary artery disease (CAD), accurate detection of ischemic and hibernant myocardium is important because targeted revascularization improves clinical outcomes. T1 mapping using cardiac magnetic resonance (CMR) is sensitive to the changes in myocardial water content, including myocardial blood volume [1]. The aim of this study was to evaluate the potential of T1 mapping at rest and during adenosine triphosphate stress for the detection of ischemic, hibernant and infarct myocardium in a swine model using pathology as gold reference.*Methods and Materials Twelve adult male Chinese miniature swine aged 6-12 months with the induction of chronic coronary artery stenosis were enrolled in this study. The CMR imaging was performed at four time points: baseline, 1 week-, 2 weeks- and 4 weeks- after surgery. Pre- and post-contrast T1 mapping at rest and during adenosine triphosphate stress, first-pass perfusion and stress perfusion as well as late gadolinium enhancement were performed at all imaging time points. Myocardial perfusion reserve index (MPRI), stress MBF (myocardial blood flow) and MPR (myocardial perfusion reserve) as the ratio of stress to rest MBF were calculated. The native T1, extracelluar volume (ECV) and their percentage were also calculated based on T1 mapping.*Results The rest native T1 value of infarct, hibernant, ischemia and normal myocardium were 1586.4±159.0ms, 1350.7±165.5ms, 1218.8±153.4ms, 1101.8±107.7ms, respectively. The rest ECV value of infarct, hibernant, ischemia and normal myocardium were 73.89±8.27, 40.25±7.77, 34.09±3.00, 24.48±2.71, respectively. MPRI was associated with the change of native T1 (stress native T1 minus rest native T1, ?native T1) (r=-0.45, p=0.005) and native T1 percentage (?native T1/ rest native T1) (r=-0.50, p=0.034). Besides, there were correlation observed between MPRI and the change of ECV (r=-0.41, p<0.001) and ECV percentage (r=-0.41, p=0.005). It was also observed that MPR was associated with rest and stress native T1 (p<0.001, r=-0.634, -0.766 respectively).*Conclusions In this study, we identified the native T1 and ECV values of four myocardium types in chronic ischemic cardiomyopathy. The rest/stress T1 mapping has the potential to detect ischemia and hibernation without the need for gadolinium contrast.*Clinical Relevance/Application CMR rest/ stress native T1 mapping is a novel diagnostic test that can evaluate ischemic myocardium in coronary artery disease (CAD) which can target revascularization. Native T1 mapping doesn't need contrast, thus, could be used in renal insufficiency patients and could avoid unnecessary ICA, anaphylaxis and contrast deposit.

RESULTS

The rest native T1 value of infarct, hibernant, ischemia and normal myocardium were 1586.4±159.0ms, 1350.7±165.5ms, 1218.8±153.4ms, 1101.8±107.7ms, respectively. The rest ECV value of infarct, hibernant, ischemia and normal myocardium were 73.89±8.27, 40.25±7.77, 34.09±3.00, 24.48±2.71, respectively. MPRI was associated with the change of native T1 (stress native T1 minus rest native T1, ?native T1) (r=-0.45, p=0.005) and native T1 percentage (?native T1/ rest native T1) (r=-0.50, p=0.034). Besides, there were correlation observed between MPRI and the change of ECV (r=-0.41, p<0.001) and ECV percentage (r=-0.41, p=0.005). It was also observed that MPR was associated with rest and stress native T1 (p<0.001, r=-0.634, -0.766 respectively).

CLINICAL RELEVANCE/APPLICATION

CMR rest/ stress native T1 mapping is a novel diagnostic test that can evaluate ischemic myocardium in coronary artery disease (CAD) which can target revascularization. Native T1 mapping doesn't need contrast, thus, could be used in renal insufficiency patients and could avoid unnecessary ICA, anaphylaxis and contrast deposit.

SPR-CA-12 Detection Of Potentially Salvageable Myocardium In Acute Myocardial Infarcts: Tissue Characteristics And Functional Improvement Of Gray Areas On Late-gadolinium-enhanced, Parametric Mapping, And Cine MR Imaging On Initial And Follow-up Scans

Participants
Jun Cheol Park, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

We hypothesized that less-damaged myocardial tissue included in the hyperenhanced areas of acute myocardial infarcts (AMI) on late-gadolinium-enhanced MR imaging (LGE) could be further differentiated with the degree of signal intensity on LGE and T1- and T2-parametric mapping. We sought to correlate the areas with gray or white signal intensity on LGE on initial MR imaging with global

and segmental systolic functional recovery on follow-up imaging.*Methods and Materials This retrospective study included 55 patients with AMI who had undergone initial and follow-up (mean follow-up duration, 8.0 ± 5.1 months) cardiac MR imaging. The areas of AMI were classified into two groups according to the severity of the signal intensities of myocardial infarcts on LGE as gray or white AMI by visual analysis. Patients were divided into two groups according to the amount of gray AMI (GAMI): group 1 with GAMI = 33% of total volume of AMI, group 2 with GAMI < 33% of total volume of AMI. Initial, follow-up, and changes in global and segmental left ventricular function were assessed by comparing LV function parameters on cine MR imaging.*Results There were 47 patients (85.5%) with mixed GAMI and WAMI, 6 patients (10.9%) with WAMI only, and 2 patients (3.6%) with GAMI only. GAMI and WAMI showed significant differences in signal intensity ratio compared with remote normal myocardium (2.07 vs. 3.88, p<0.001), T1 relaxation times (1102 ms vs. 1224 ms, p<0.001), T2 relaxation times (57 ms vs. 72 ms, p < 0.001), and extracellular volume fraction (35% vs. 55%, p = 0.002). The percentage of AMI over total myocardial volume (volume [%]) proportionately decreased on follow-up as compared with initial volume (%) by 63.5% and 28.9% in group 1 and group 2 (p < 0.001). Global LV ejection fraction significantly differed between two groups ([initial CMR: group 1, 62.2%; group 2, 50.2%; p < 0.001]. [follow-up CMR, group 1, 67.7%; group 2, 55.1%; p < 0.001). Systolic wall thickening in segments with = 50% depth of AMI was significantly differed between the segments with GAMI = 50% depth of thickness and those with GAMI < 50% depth of thickness on initial (43.2% vs. 23.8%, p < 0.001) and follow-up (74.3% vs. 39.9%, p = 0.006) CMR.*Conclusions GAMI beneficially contributes to LV function in AMI patients and can be considered as a potentially salvageable myocardium.*Clinical Relevance/Application AMI with lower signal intensity (SI) on LGE implicates better functional recovery than that with higher SI on LGE.

RESULTS

There were 47 patients (85.5%) with mixed GAMI and WAMI, 6 patients (10.9%) with WAMI only, and 2 patients (3.6%) with GAMI only. GAMI and WAMI showed significant differences in signal intensity ratio compared with remote normal myocardium (2.07 vs. 3.88, p<0.001), T1 relaxation times (1102 ms vs. 1224 ms, p<0.001), T2 relaxation times (57 ms vs. 72 ms, p < 0.001), and extracellular volume fraction (35% vs. 55%, p = 0.002). The percentage of AMI over total myocardial volume (volume [%]) proportionately decreased on follow-up as compared with initial volume (%) by 63.5% and 28.9% in group 1 and group 2 (p < 0.001). Global LV ejection fraction significantly differed between two groups ([initial CMR: group 1, 62.2%; group 2, 50.2%; p < 0.001]. [follow-up CMR, group 1, 67.7%; group 2, 55.1%; p < 0.001). Systolic wall thickening in segments with = 50% depth of AMI was significantly differed between the segments with GAMI = 50% depth of thickness and those with GAMI < 50% depth of thickness on initial (43.2% vs. 23.8%, p < 0.001) and follow-up (74.3% vs. 39.9%, p = 0.006) CMR.

CLINICAL RELEVANCE/APPLICATION

AMI with lower signal intensity (SI) on LGE implicates better functional recovery than that with higher SI on LGE.

SPR-CA-13 Diagnostic Accuracy Of Myocardial Enhancement Ratio To Aorta Assumed Static Computed Tomography Perfusion For Identification Of Myocardial Ischemia

Participants
Takanori Kouchi, Toon, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the feasibility of myocardial enhancement ratio to aorta (MER) using stress dynamic computed tomography perfusion (CTP) for the detection of myocardial ischemia assessed by single photon emission computed tomography (SPECT).*Methods and Materials Nineteen patients who underwent dynamic CTP and SPECT for suspicion of myocardial ischemia were retrospectively evaluated. One static CTP image was selected from dynamic CTP images at sub-optimal phase for detecting myocardial ischemia. MER was calculated on a segment-based analysis by dividing myocardial enhancement (HU) obtained the static CTP image by peak enhancement of the ascending aorta (HU) in the timing bolus scan. Additionally, myocardial CT attenuation (HU) and transmural perfusion ratio (TPR) were also calculated as another quantitative parameter for the static CTP imaging. The diagnostic performance of MER, TPR, and myocardial CT attenuation were analyzed for detecting myocardial ischemia assessed by SPECT, and compared by receiver operating characteristic (ROC) analysis among MER, TPR, and myocardial CT attenuation.*Results Fifty-two of 304 segments (17%) had myocardial ischemia. MER, TPR and myocardial CT attenuation in ischemic segments were significantly lower than that in normal segments (MER; 0.65 (0.51-0.79) vs. 0.99 (0.88-1.11), TPR; 0.88 (0.76-0.96) vs. 1.00 (0.96-1.04), myocardial CT attenuation; 111 (95-126) HU vs. 131 (117-145) HU, p <0.05 in each). The area under the ROC curve of MER was significantly higher than both TPR (0.86 vs. 0.77, p <0.05) and myocardial CT attenuation (0.86 vs. 0.73, p <0.05) for identifying myocardial ischemia assessed by SPECT. Sensitivity, specificity, and accuracy were 79%, 86% and 85% for MER (cut-off: 0.81), 67%, 85% and 82% for TPR (cut-off: 0.92), and 79%, 60% and 63% for myocardial CT attenuation (cut-off: 127), respectively.*Conclusions MER assumed static CTP may be feasible for detecting myocardial ischemia assessed by SPECT, and had significantly higher diagnostic performance than conventional quantitative parameter of TPR and myocardial CT attenuation.*Clinical Relevance/Application MER is a novel quantitative parameter for static myocardial CTP imaging with high diagnostic accuracy. MER has a potential to contribute to reducing radiation dose associated with myocardial CTP imaging by encouraging the use of static CTP imaging instead of dynamic CTP imaging.

RESULTS

Fifty-two of 304 segments (17%) had myocardial ischemia. MER, TPR and myocardial CT attenuation in ischemic segments were significantly lower than that in normal segments (MER; 0.65 (0.51-0.79) vs. 0.99 (0.88-1.11), TPR; 0.88 (0.76-0.96) vs. 1.00 (0.96-1.04), myocardial CT attenuation; 111 (95-126) HU vs. 131 (117-145) HU, p <0.05 in each). The area under the ROC curve of MER was significantly higher than both TPR (0.86 vs. 0.77, p <0.05) and myocardial CT attenuation (0.86 vs. 0.73, p <0.05) for identifying myocardial ischemia assessed by SPECT. Sensitivity, specificity, and accuracy were 79%, 86% and 85% for MER (cut-off: 0.81), 67%, 85% and 82% for TPR (cut-off: 0.92), and 79%, 60% and 63% for myocardial CT attenuation (cut-off: 127), respectively.

CLINICAL RELEVANCE/APPLICATION

MER is a novel quantitative parameter for static myocardial CTP imaging with high diagnostic accuracy. MER has a potential to contribute to reducing radiation dose associated with myocardial CTP imaging by encouraging the use of static CTP imaging instead of dynamic CTP imaging.

SPR-CA-14 Correlation Of Myocardial Strain And Late Gadolinium Enhancement By Cardiac Magnetic Resonance After ST-segment Elevation Myocardial Infarction: A Sub-analysis Of OCTAMI

Participants
Shiqin Yu, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the correlation of cardiac magnetic resonance (CMR) feature-tracking with conventional CMR parameters in patients with ST-segment elevation myocardial infarction (STEMI).*Methods and Materials This sub-analysis of OCTAMI registry included 129 patients who finished a CMR follow-up one month after STEMI. Cine images were applied to calculate both global and segmental left ventricular peak strain parameters. The patients were divided into two groups by left ventricular ejection fraction (LVEF) and compared with 42 healthy controls. Segmental late gadolinium enhancement (LGE) was graded according to LGE transmurality as follows (1) > 0 to = 25% (2) > 25 to = 50% (3) > 50 to = 75% and (4) > 75%. Left ventricle was divided into infarcted, adjacent and remote region to assess regional function.*Results Compared with controls, global radial (28.39±5.08% vs 38.54±9.27%, p<0.05), circumferential (-16.91±2.11% vs -20.77±2.78%, p<0.05) and longitudinal (-13.06±2.15 vs -15.52±2.69, p<0.05) strain were impaired in STEMI patients with normal LVEF (=55%). Strain parameters were strongly associated with LGE (radial: r=0.65; circumferential: r=0.69; longitudinal: r=0.61; all p<0.05). A significant and stepwise impairment of global strains was observed in groups divided by LGE tertiles. Furthermore, segmental strain was different in various degree of LGE extent especially for radial and circumferential strain. Strains of adjacent region were better than infarcted region in radial and circumferential directions and worse than remote region in all three directions.*Conclusions Both global and regional strain could stratify different extent of LGE. Although without LGE, adjacent region had impaired strains comparing with remote region.*Clinical Relevance/Application CMR feature-tracking could permit detecting decline in left ventricular function with preserved LVEF and discriminating different degrees of myocardial infarction assessed by LGE. And CMR feature-tracking is a potential supplement to LVEF and LGE for assessment in STEMI patients.

RESULTS

Compared with controls, global radial (28.39±5.08% vs 38.54±9.27%, p<0.05), circumferential (-16.91±2.11% vs -20.77±2.78%, p<0.05) and longitudinal (-13.06±2.15 vs -15.52±2.69, p<0.05) strain were impaired in STEMI patients with normal LVEF (=55%). Strain parameters were strongly associated with LGE (radial: r=0.65; circumferential: r=0.69; longitudinal: r=0.61; all p<0.05). A significant and stepwise impairment of global strains was observed in groups divided by LGE tertiles. Furthermore, segmental strain was different in various degree of LGE extent especially for radial and circumferential strain. Strains of adjacent region were better than infarcted region in radial and circumferential directions and worse than remote region in all three directions.

CLINICAL RELEVANCE/APPLICATION

CMR feature-tracking could permit detecting decline in left ventricular function with preserved LVEF and discriminating different degrees of myocardial infarction assessed by LGE. And CMR feature-tracking is a potential supplement to LVEF and LGE for assessment in STEMI patients.

SPR-CA-16 Fractal Analysis Of 4D CT Myocardial Perfusion Imaging To Differentiate Macro- And Microvascular Causes Of Chronic Ischemia: A Multicenter Validation Study

Participants
Florian Michallek, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Noninvasive differentiation of epicardial stenosis and microvascular causes of chronic myocardial ischemia is challenging. In this report, we validate previously established fractal analysis for the differentiation of macrovascular and microvascular chronic myocardial ischemia by quantifying chaos of perfusion patterns using the fractal dimension (FD).*Methods and Materials A total of 101 patients with suspected chronic myocardial ischemia and indication for invasive coronary angiography (ICA) underwent dual-source CT imaging workup including CT angiography, dynamic 4D perfusion CT (CTP) with i.v. adenosine stress testing and delayed enhancement (DE) imaging in a prospective multicenter study. ICA constituted the reference standard for differentiating macro- and microvascular ischemia. We defined macrovascular ischemia as visual =90% diameter stenosis on ICA, or =50% diameter stenosis and positive fractional flow reserve (FFR) (<0.8) alongside a perfusion defect in the downstream myocardium on CTP. Microvascular ischemia was defined as appreciable myocardial perfusion defect on CTP without criteria for macrovascular ischemia. Per-segment analysis was performed using the 17-segments model of the American Heart Association (AHA). Segments with signs of DE were excluded. Diagnostic accuracy of fractal analysis was evaluated by sensitivity, specificity and area under the receiver operating characteristic curve (AUC).*Results From a total of 1717 myocardial segments in 101 patients, 560 segments showed an appreciable perfusion defect on CTP with prevalences of n=185 for macrovascular and n=375 for microvascular ischemia. Fractal analysis identified perfusion patterns with a highly significant statistical difference (p<0.001): median FD was 4.26 (interquartile range [IQR]: 0.05) in macrovascular ischemia, and 4.36 (IQR: 0.05) in microvascular ischemia. The previously established FD threshold for differentiation of macro- from microvascular ischemia (FD<4.31) achieved a per-segment sensitivity of 0.93 (0.88-0.96) and specificity of 0.82 (0.78-0.86) with AUC of 0.90 (0.87-0.93) in diagnosing macro- over microvascular ischemia.*Conclusions In a prospective multicenter cohort with high prevalence of microvascular ischemia, fractal analysis of 4D CT perfusion accurately differentiated macro- and microvascular causes of myocardial ischemia.*Clinical Relevance/Application Fractal analysis of CTP might be used as a noninvasive gatekeeper test prior to invasive testing to pivot ICA indications.

RESULTS

From a total of 1717 myocardial segments in 101 patients, 560 segments showed an appreciable perfusion defect on CTP with prevalences of n=185 for macrovascular and n=375 for microvascular ischemia. Fractal analysis identified perfusion patterns with a highly significant statistical difference (p<0.001): median FD was 4.26 (interquartile range [IQR]: 0.05) in macrovascular ischemia, and 4.36 (IQR: 0.05) in microvascular ischemia. The previously established FD threshold for differentiation of macro- from microvascular ischemia (FD<4.31) achieved a per-segment sensitivity of 0.93 (0.88-0.96) and specificity of 0.82 (0.78-0.86) with AUC of 0.90 (0.87-0.93) in diagnosing macro- over microvascular ischemia.

CLINICAL RELEVANCE/APPLICATION

Fractal analysis of CTP might be used as a noninvasive gatekeeper test prior to invasive testing to pivot ICA indications.

SPR-CA-17 Cardiac Stress Perfusion For Assessment Of Cardiac Allograft Vasculopathy After Heart Transplantation

Participants
Yura Ahn, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To determine the role of stress myocardial CT perfusion (CTP) in identifying cardiac allograft vasculopathy (CAV)*Methods and Materials From December 2018 to April 2021, eighty heart transplant patients (59 male, age range of 18-76 years) underwent coronary angiography, intravascular ultrasound, and CTP. Two radiologists independently segmented the myocardium and measured the myocardial blood flow (MBF) in whole myocardium and in each 16 segments. Two cardiologists independently assessed and made consensus of the presence of CAV based on coronary angiography and intravascular ultrasound. The perfusion parameters was compared between patient with and without CAV. The receiver-operating characteristics analysis was performed to evaluate the diagnostic accuracy of CTP.*Results The CAV was diagnosed in 43 of 80 patients. Patients with CAV had significantly lower MBF than patient without CAV (MBF of whole myocardium, 146 ± 35 vs. 127 ± 30 mL/100mL/min, P=0.014; MBF of average of 16 myocardial segments, 141 ± 35 vs. 124 ± 32 mL/100mL/min, P=0.026). The area under the ROC curve for predicting CAV was 0.65.*Conclusions CTP revealed differences in MBF to CAV status in heart transplant patients, reflecting their histopathology.*Clinical Relevance/Application CTP is a noninvasive modality which could give the information predicting CAV, the major long-term complication in heart transplantation.

RESULTS

The CAV was diagnosed in 43 of 80 patients. Patients with CAV had significantly lower MBF than patient without CAV (MBF of whole myocardium, 146 ± 35 vs. 127 ± 30 mL/100mL/min, P=0.014; MBF of average of 16 myocardial segments, 141 ± 35 vs. 124 ± 32 mL/100mL/min, P=0.026). The area under the ROC curve for predicting CAV was 0.65.

CLINICAL RELEVANCE/APPLICATION

CTP is a noninvasive modality which could give the information predicting CAV, the major long-term complication in heart transplantation.

SPR-CA-19   Diagnostic Accuracy Of Subtraction Coronary CT Angiography In Patients With Severe Calcification Or Stents: Comparison Between Readers With Different Levels Of Experience

Participants
Fang Li, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Subtraction coronary CT angiography (CCTA) may reduce blooming and beam-hardening artefacts. This study aimed to assess its value in improving the diagnostic accuracy and confidence of readers with different levels of CCTA imaging interpretation experience.*Methods and Materials We prospectively enrolled patients with severe calcification or stents who underwent CCTA and invasive coronary angiography (ICA). Target segment images were independently evaluated by three groups of radiologists with different experience levels with CCTA using ICA as the standard reference. Diagnostic accuracy was measured by the area under the curve (AUC), using =50% stenosis as the cut-off value. Diagnostic confidence was computed for each radiologist and each reading group with different levels of experience.*Results In total, 146 target segments with severe calcification or stents from 51 patients were analysed. The mean specificity of conventional CCTA for each group ranged from 22.1%-41.4% on a per-segment basis and 2.9-9.8 on a per-patient basis, which significantly improved following the inclusion of subtraction CCTA (range, 81.9%-85.4%; 52.9%-74.3%; all p<0.001). Following calcification subtraction, the mean sensitivity significantly decreased for novice (p<0.001). Following the addition of subtraction CCTA , the mean AUCs of subtraction CCTA were significantly increased, values ranged from 0.53,0,54 and 0.61 to 0.70, 0.74 and 0.85 for novice, junior, and senior groups on a per-segment basis ; and ranged from 0.52,0,50 and 0.53 to 0.73, 0.77 and 0.71 on a per-patient basis (all p<0.001). For conventional CCTA, the mean diagnostic confidence was 2.5±1.0, 3.2±0.7, and 2.6±0.7 for the novice, junior and senior reading groups, respectively. Comparatively, each reading group showed significantly stronger diagnostic confidence with subtraction CCTA, with mean values of 3.4±0.8, 3.9±0.9, and 4.5±0.7 (all p<0.001).*Conclusions Subtraction CCTA could improve the diagnostic accuracy and diagnostic confidence of radiologists at all experience levels of coronary angiography interpretation. Senior readers performed better than novices in evaluating lumen stenosis on subtraction CCTA images.*Clinical Relevance/Application Subtraction CCTA could improve the diagnostic accuracy and diagnostic confidence of radiologists at all experience levels of coronary angiography interpretation.

RESULTS

In total, 146 target segments with severe calcification or stents from 51 patients were analysed. The mean specificity of conventional CCTA for each group ranged from 22.1%-41.4% on a per-segment basis and 2.9-9.8 on a per-patient basis, which significantly improved following the inclusion of subtraction CCTA (range, 81.9%-85.4%; 52.9%-74.3%; all p<0.001). Following calcification subtraction, the mean sensitivity significantly decreased for novice (p<0.001). Following the addition of subtraction CCTA , the mean AUCs of subtraction CCTA were significantly increased, values ranged from 0.53,0,54 and 0.61 to 0.70, 0.74 and 0.85 for novice, junior, and senior groups on a per-segment basis ; and ranged from 0.52,0,50 and 0.53 to 0.73, 0.77 and 0.71 on a per-patient basis (all p<0.001). For conventional CCTA, the mean diagnostic confidence was 2.5±1.0, 3.2±0.7, and 2.6±0.7 for the novice, junior and senior reading groups, respectively. Comparatively, each reading group showed significantly stronger diagnostic confidence with subtraction CCTA, with mean values of 3.4±0.8, 3.9±0.9, and 4.5±0.7 (all p<0.001).

CLINICAL RELEVANCE/APPLICATION

Subtraction CCTA could improve the diagnostic accuracy and diagnostic confidence of radiologists at all experience levels of coronary angiography interpretation.

SPR-CA-20   Performance Of Machine Learning-based Coronary Computed Tomography Angiography For Selecting The Revascularization Candidates

Participants
Zengfa Huang, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

The study investigated the performance of machine learning based coronary computed tomography angiography (ML-CCTA) for therapeutic decision compared with invasive coronary angiography (ICA) based on 2018 European Society of Cardiology/European Association for Cardio-Thoracic Surgery (ESC/EACTS) guidelines.*Methods and Materials The study population consisted of 322 consecutive stable CAD patients with an interval of less than 30 days between CCTA and ICA who were divided as a test set was included from July 2017 to July 2019 for the final analysis. The therapeutic strategy and the appropriate revascularization procedure were selected using ML-CCTA, CCTA and ICA independently.*Results When using ICA as a standard reference, the sensitivity, specificity, PPV (positive predictive value), NPV (negative predictive value) and accuracy of ML-CCTA for selecting revascularization candidates were 87.01%, 96.43%, 95.71%, 89.01% and 91.93%, respectively. The AUC (area under the curve)

was 0.92 (95% CI: 0.88-0.95). The diagnostic performance of ML-CCTA for selecting PCI (percutaneous coronary intervention) candidates were 79.41%, 97.24%, 88.52%, 94.64% and 93.48%, respectively. The AUC was 0.88 (95% CI: 0.84-0.92). The diagnostic performance of ML-CCTA for selecting CABG (coronary artery bypass graft) candidates were 84.88%, 97.46%, 92.41%, 94.65% and 94.10%, respectively. The AUC was 0.91 (95% CI: 0.88-0.94).*Conclusions ML-CCTA had the ability to distinguish between patients who need revascularization or not and to make the appropriate decision for patients with revascularization strategy selection compared with traditional ICA.*Clinical Relevance/Application ML-CCTA enables the decision making to be performed rapidly within a clinical workflow. ML-CCTA had the ability to distinguish between patients who need revascularization or not and to make the appropriate decision for patients with revascularization strategy selection compared with traditional ICA.

RESULTS

When using ICA as a standard reference, the sensitivity, specificity, PPV (positive predictive value), NPV (negative predictive value) and accuracy of ML-CCTA for selecting revascularization candidates were 87.01%, 96.43%, 95.71%, 89.01% and 91.93%, respectively. The AUC (area under the curve) was 0.92 (95% CI: 0.88-0.95). The diagnostic performance of ML-CCTA for selecting PCI (percutaneous coronary intervention) candidates were 79.41%, 97.24%, 88.52%, 94.64% and 93.48%, respectively. The AUC was 0.88 (95% CI: 0.84-0.92). The diagnostic performance of ML-CCTA for selecting CABG (coronary artery bypass graft) candidates were 84.88%, 97.46%, 92.41%, 94.65% and 94.10%, respectively. The AUC was 0.91 (95% CI: 0.88-0.94).

CLINICAL RELEVANCE/APPLICATION

ML-CCTA enables the decision making to be performed rapidly within a clinical workflow. ML-CCTA had the ability to distinguish between patients who need revascularization or not and to make the appropriate decision for patients with revascularization strategy selection compared with traditional ICA.

SPR-CA-22   Reference Values Of Myocardial Native T1 And Extracellular Volume Fraction In Healthy Subjects At 3-Tesla Cardiac Magnetic Resonance Imaging: Standardization With Phantom-based Correction

Participants
Young Joo Suh, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to provide reference values of myocardial native T1 and extracellular volume (ECV) fraction in healthy subjects and investigate the effect of the phantom-based correction method for standardization of myocardial T1 value.*Methods and Materials Seventy-one healthy asymptomatic adult (= 20 years) volunteers of 5 different age groups (34 men and 37 women, mean age 45.5 ± 15.5 years) were prospectively enrolled from three academic hospitals. Cardiac magnetic resonance imaging including Modified Look-Locker Inversion recovery T1 mapping sequence was performed using a 3-Tesla system with different type of scanner for each hospital. Native T1 and ECV fraction were measured at short-axis T1 map and analyzed for the mean values of the entire 16 segment. T1MES phantom was scanned and blood and myocardial T1 value of the each subject was corrected based on the site-specific equation derived from T1MES phantom. Mean native T1 and ECV fraction were compared between values before and after phantom-based correction using one-way analysis of variance, and variability in native T1 and ECV fraction among institutions were compared using a coefficient of variation (COV).*Results Mean native T1 value was significantly different between three institutions (1198.7 ± 32.1 ms for institution A, 1217.7 ± 39.9 ms for institution B, and 1232.7 ± 31.1 ms for institution C; P=0.002), but mean ECV was not significantly different between institutions (26.6-27.5%,P=0.355). After phantom-based correction, mean native T1 was 1289.7 ± 32.4 ms and ECV 25.0 ± 2.7% for all subjects. Corrected native T1 value was not significantly different between three institutions (1284.6 ± 31. 5 ms for institution A, 1296.5 ± 39.1 ms for institution B, and 1291.3 ± 29.3 ms for institution C; P=0.497), and ECV was also not significantly different between institutions (24.1-25.9%, P=0.078). After phantom-based correction, COV for native T1 value between three institutions was decreased from 3.0% to 2.5. Native T1 was longer in female compared to male up to the age of 40 years, after which there was no significant difference according to the sex.*Conclusions Standardized reference T1 values can be provided with phantom-based correction method in healthy subjects.*Clinical Relevance/Application Phantom-based correction method may allow standardization of myocardial T1 values, which can facilitate the application of T1 mapping in multi-institutional, large-scale clinical trials.

RESULTS

Mean native T1 value was significantly different between three institutions (1198.7 ± 32.1 ms for institution A, 1217.7 ± 39.9 ms for institution B, and 1232.7 ± 31.1 ms for institution C; P=0.002), but mean ECV was not significantly different between institutions (26.6-27.5%,P=0.355). After phantom-based correction, mean native T1 was 1289.7 ± 32.4 ms and ECV 25.0 ± 2.7% for all subjects. Corrected native T1 value was not significantly different between three institutions (1284.6 ± 31. 5 ms for institution A, 1296.5 ± 39.1 ms for institution B, and 1291.3 ± 29.3 ms for institution C; P=0.497), and ECV was also not significantly different between institutions (24.1-25.9%, P=0.078). After phantom-based correction, COV for native T1 value between three institutions was decreased from 3.0% to 2.5. Native T1 was longer in female compared to male up to the age of 40 years, after which there was no significant difference according to the sex.

CLINICAL RELEVANCE/APPLICATION

Phantom-based correction method may allow standardization of myocardial T1 values, which can facilitate the application of T1 mapping in multi-institutional, large-scale clinical trials.

SPR-CA-26   Correlation Between Non-contrast Chest CT Findings And Clinical Outcomes In Hospitalized Patients With COVID-19 Pneumonia With Positive PCR For SARS-Cov-2 During The First Wave

Participants
Jaime Verdugo, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

PURPOSE

As the global Covid-19 pandemic continues, current efforts have shifted to determine early prognostic factors that may tailor the therapeutic options and subsequent mortality risk. Recent studies have shown a close relationship between cardiovascular (CV) risks and infected patients' evolution. Imaging biomarkers such as coronary artery calcium (CAC) score have an established role in long-term CV event risk stratification but might also provide prognostic information. The purpose of this study is to evaluate the relation between non-contrast chest CT findings and clinical outcomes on a representative sample of inpatients with Covid-19 during the first wave of the pandemic.*Methods and Materials This IRB-approved clinical series included 326 cases with a mean age of 56.8 years +/-16.5, ranging from 17 to 93 years hospitalized between May 1 and June 31. CT images were retrospectively analyzed, and multiple CT variables registered, such as the RSNA-STR-ACR Consensus Statement pattern, presence of organizing

pattern (OP), presence of CAC, total volume and average density of the pulmonary opacities (PO), lung injury extent, and average density of the liver, among others. On those with measurable CAC, Agatston Score (AS) from non-ECG gated chest CT was calculated using semi-automated software (SyngoVia). After a stepwise selection with a probability threshold of 10%, multivariable logistic regression was modeled to evaluate these variables' relationship, using patient outcomes as a dependent variable.*Results Of the 326 cases, 103 had CAC, with a mean score of 486 UA (SD 965 range: 2 - 5648 UA). In multivariate regression, the findings related to a higher mortality odd were the absence of an OP, a high average density of PO, and CAC in the LM and the RCA (table). Mortality risk was directly associated with AS values; for every 100 AU increase, the risk of dying increased by 5% (p-value= 0.003). The discrimination capacity is 60%. Hepatic steatosis was related to a greater probability of climbing on the therapeutic scale (OR: 1.89 p: 0.043 95% CI: 1.02 - 3.52), but there was no relation with a greater probability of dying.*Conclusions COVID-19 patients with CAC had a higher risk of dying, and the risk increased as AS value climb. The absence of OP, the higher average density of PO, and the presence of CAC in the LM and the RCA were associated with higher mortality risk.*Clinical Relevance/Application Determine early prognostic factors and score to tailor the treatment of Covid-19 patients.

RESULTS

Of the 326 cases, 103 had CAC, with a mean score of 486 UA (SD 965 range: 2 - 5648 UA). In multivariate regression, the findings related to a higher mortality odd were the absence of an OP, a high average density of PO, and CAC in the LM and the RCA (table). Mortality risk was directly associated with AS values; for every 100 AU increase, the risk of dying increased by 5% (p-value= 0.003). The discrimination capacity is 60%. Hepatic steatosis was related to a greater probability of climbing on the therapeutic scale (OR: 1.89 p: 0.043 95% CI: 1.02 - 3.52), but there was no relation with a greater probability of dying.

CLINICAL RELEVANCE/APPLICATION

Determine early prognostic factors and score to tailor the treatment of Covid-19 patients.

SPR-CA-27 Prognostic Value Of Late Gadolinium Enhancement In Left Ventricular Noncompaction: A Multicenter Study

Participants
Wei Huang, MBBS,MBBS, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

Current diagnostic criteria of left ventricular noncompaction (LVNC) may have poor relationship with adverse prognosis, late gadolinium enhancement(LGE) was a predictor of major adverse cardiovascular events (MACE), but the risk stratification of LGE in patients with LVNC remains unclearly.*Methods and Materials We retrospectively analyzed the clinical and cardiovascular magnetic resonance (CMR) data for 75 patients from three institutes,and examined the correlation between LGE and MACE based on the extent, pattern (including a specific ring-like pattern) and locations of LGE in LVNC.*Results A total of 51 patients (68%) presented LGE. Patients with LGE had higher diastolic blood pressures (p=0.023), lower LVEF (p=0.005), greater LVEDV (p=0.001) and LVESV (p<0.001), larger left ventricular systolic mass (p=0.001) and diastolic mass (p=0.001), and tended to have a worse New York Heart Association (NYHA)class (p=0.01). At 4.3 years follow-up (interquartile range: 2.1 to 5.7 years), MACE occurred in 29 (38.7%). Adjusted hazard ratios for patients with an LGE extent of 0 to 7.5%, 7.5% to 15% and >15%, respectively, were 2.01 (95% confidence interval [CI]: 0.50 to 8.03), 7.42 (95% CI: 1.76 to 31.3) and 9.02 (95% CI: 2.11 to 38.52) for MACE. The presence of ring-like, multiple segments, free-wall and mid-wall LGE were associated with increased risk of MACE after adjustment.*Conclusions In LVNC, the risk of MACE was increased significantly when the LGE extent higher than 7.5%, and the presence of ring-like, multiple segments and free-wall LGE were associated with MACE. These results suggested the value of risk stratification of LGE in patients with LVNC.*Clinical Relevance/Application Our study provides useful models based on the extent, pattern and location of LGE for the prediction of MACE in LVNC.

RESULTS

A total of 51 patients (68%) presented LGE. Patients with LGE had higher diastolic blood pressures (p=0.023), lower LVEF (p=0.005), greater LVEDV (p=0.001) and LVESV (p<0.001), larger left ventricular systolic mass (p=0.001) and diastolic mass (p=0.001), and tended to have a worse New York Heart Association (NYHA)class (p=0.01). At 4.3 years follow-up (interquartile range: 2.1 to 5.7 years), MACE occurred in 29 (38.7%). Adjusted hazard ratios for patients with an LGE extent of 0 to 7.5%, 7.5% to 15% and >15%, respectively, were 2.01 (95% confidence interval [CI]: 0.50 to 8.03), 7.42 (95% CI: 1.76 to 31.3) and 9.02 (95% CI: 2.11 to 38.52) for MACE. The presence of ring-like, multiple segments, free-wall and mid-wall LGE were associated with increased risk of MACE after adjustment.

CLINICAL RELEVANCE/APPLICATION

Our study provides useful models based on the extent, pattern and location of LGE for the prediction of MACE in LVNC.

SPR-CA-28 Relationship Between Max LCBI (4) Of NIRS-IVUS And CT Value Of Coronary Plaque In Coronary Artery Stenosis Lesions.

Participants
Daisuke Kittaka, RT, Kanagawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

We report a comparison of the CT values of coronary artery stenosis measured using coronary CT images and maximum lipid-core burden index (max LCBI (4))of Near infrared spectroscopy intravascular ultrasound (NIRS-IVUS).*Methods and Materials 1. We retrospectively collected 50 cases of NIRS-IVUS performed by PCI within 3 months after performing coronary CT. 2. The CT value of the plaque at the stenosis lesion were measured from the coronary CT images. CT values <50 HU were classified as lipid plaques, 50 = CT = 120 were classified as fibrous plaques, and 120 <CT values were classified as calcified plaques. The relationship between plaque properties divided into 3 groups and maxLCBI (4) of NIRS-IVUS were evaluated. 3. The CT value of plaque measured using coronary CT images was compared with maxLCBI (4) of NIRS-IVUS.*Results 1. The CT values of plaques measured using coronary CT images were divided into 3 groups and compared with maxLCBI (4) of NIRS-IVUS. As a result, there was a significant difference between maxLCBI (4) of calcified plaque and fibrous plaque. There was also a significant difference in maxLCBI (4) between calcified plaque and lipid plaque. There was no significant difference in maxLCBI (4) between fibrous and lipid plaques. 2. The CT value of plaque measured using coronary CT images and maxLCBI (4) of NIRS-IVUS showed a correlation (r2 = 0.245, p = 0.0003). 3. When the cut-off value of maxLCBI (4) of NIRS-IVUS was set to 400, the CT value of plaque measured using coronary CT images was 97HU with a sensitivity of 84.2% and a specificity of 67.5%.*Conclusions The CT value of coronary artery stenosis measured using coronary CT images and maxLCBI (4) of NIRS-IVUS showed a correlation. Therefore, it was suggested that the coronary

artery event could be predicted by evaluating the CT value of the coronary artery stenosis.*Clinical Relevance/Application Coronary events can be predicted by evaluating the CT value of coronary artery stenosis measured using coronary CT images and maxLCBI (4) of NIRS-IVUS.

RESULTS

1. The CT values of plaques measured using coronary CT images were divided into 3 groups and compared with maxLCBI (4) of NIRS-IVUS. As a result, there was a significant difference between maxLCBI (4) of calcified plaque and fibrous plaque. There was also a significant difference in maxLCBI (4) between calcified plaque and lipid plaque. There was no significant difference in maxLCBI (4) between fibrous and lipid plaques. 2. The CT value of plaque measured using coronary CT images and maxLCBI (4) of NIRS-IVUS showed a correlation (r2 = 0.245, p = 0.0003). 3. When the cut-off value of maxLCBI (4) of NIRS-IVUS was set to 400, the CT value of plaque measured using coronary CT images was 97HU with a sensitivity of 84.2% and a specificity of 67.5%.

CLINICAL RELEVANCE/APPLICATION

Coronary events can be predicted by evaluating the CT value of coronary artery stenosis measured using coronary CT images and maxLCBI (4) of NIRS-IVUS.

SPR-CA-29   High-pitch CT Angiography For TAVR Planning On A Novel Photon Counting Dual-source Scanner - Image Quality And Radiation Dose

Participants
Katharina Rippel, Augsburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To compare image quality and radiation dose of a novel photon counting dual-source CT scanner with a second generation dual-source CT with energy integrating detector in patients who undergo ECG-gated CT angiography of the thoracoabdominal aorta prior to Transcatheter Aortic Valve Replacement (TAVR).*Methods and Materials Here, we present initial data from 10 consecutive patients who underwent an ECG-triggered unenhanced scan for valvular calcium quantification followed by a high-pitch, wide-range CTA on a novel photon counting dual-source scanner (NAEOTOM Alpha, Siemens Healthineers, Erlangen, Germany) (PCD-CT group). For comparison, 10 consecutive patients who underwent a similar scan and contrast protocol on a second generation dual-source CT scanner were retrospectively included and used as a control group. Basic demographic data were compared. Enhancement and image noise were measured as mean CT values in the ascending aorta and standard deviation within surrounding air, respectively.*Results There were no significant differences between both groups in sex ratio (3 male, 7 female in both groups), age (81.5 ± 6.8 vs. 80.4 ± 9.3 years) or BMI (72.5 ± 15.7 vs. 68.4 ± 7.5 kg/m²). Intraaortic enhancement was significantly higher in the PCD-CT group (497 ± 121 HU vs. 375 ± 89 HU, p = 0.029) and image noise slightly higher (10.2 ± 1.9 HU vs. 6.8 ± 1.5 HU, p < 0.05). DLP was significantly lower in the PCD-CT group (242 ± 109 HU vs. 505 ± 118 HU, p < 0.01).*Conclusions In comparison with second generation dual-source CT scanners, the novel photon counting dual-source CT scanner allows radiation dose reductions of at least 50% for TAVR planning CT's while maintaining optimal image quality.*Clinical Relevance/Application In comparison with second generation dual-source CT scanners, the novel photon counting dual-source CT scanner allows for radiation dose reductions of at least 50% in TAVR planning CTA scans while maintaining optimal image quality.

RESULTS

There were no significant differences between both groups in sex ratio (3 male, 7 female in both groups), age (81.5 ± 6.8 vs. 80.4 ± 9.3 years) or BMI (72.5 ± 15.7 vs. 68.4 ± 7.5 kg/m²). Intraaortic enhancement was significantly higher in the PCD-CT group (497 ± 121 HU vs. 375 ± 89 HU, p = 0.029) and image noise slightly higher (10.2 ± 1.9 HU vs. 6.8 ± 1.5 HU, p < 0.05). DLP was significantly lower in the PCD-CT group (242 ± 109 HU vs. 505 ± 118 HU, p < 0.01).

CLINICAL RELEVANCE/APPLICATION

In comparison with second generation dual-source CT scanners, the novel photon counting dual-source CT scanner allows for radiation dose reductions of at least 50% in TAVR planning CTA scans while maintaining optimal image quality.

SPR-CA-30   Head To Head Comparison Reproducibility And Inter-reader Agreement Of An AI Based Coronary Stenosis Algorithm Vs Level 3 Readers

Participants
Elina Khasanova, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate inter-reader (IRR) agreement and reproducibility in coronary stenosis assessment from coronary CT angiography (CCTA) between level 3 readers vs an AI-based algorithm (Heartflow, HF).*Methods and Materials 50 CCTAs were processed by the HF model by separate analysts. The same 50 CCTAs were interpreted by 3 certified Level 3 readers. Intra-reader reproducibility was generated for 15 of these 50 cases which were read by all readers 3 times, 1-2 weeks apart, and for the HF model processed by the same analysts 3 times. IRR agreement data was generated for all 50 cases which were read once by each reader independently. Percentage stenosis was collected per segment, per vessel and per patient. Stenosis severity was assessed according to the CAD-RADS™ classification and was additionally graded as mild (<39%), moderate (40-69%), and severe (>70%). Intrareader reproducibility, HF model reproducibility, IRR and HF model agreement were evaluated by Fleiss' kappa statistical method.*Results While inferior to the AI analysis, the readers exhibited good reproducibility and moderate agreement in per segment stenosis evaluation (K 0.66 and K 0.50) compared to excellent reproducibility and agreement of the HF model (K 0.81 and 0.85 respectively) in 15 cases.The analysis of total 50 cases demonstrated poor per segment (K 0.33) and moderate per vessel (K 0.48) IRR agreement compared to good and excellent HF model agreement (K 0.69 and 0.78). Moderate agreement for grading severe stenosis by using 3 stenosis buckets was observed among the readers (K 0.50) and HF model (K 0.56) whereas by using CAD-RADS™ grades the agreement was poor (K 0.33) for both. Good-to-moderate agreement in scoring moderate stenosis (40-69 %) in per segment, per vessel and per patient analysis by HF model (K 0.68; 0.68, 0.51) compared to poor IRR agreement (K 0.20; 0,28; 0.04) were shown. In grading 25-49% and 50-69% stenoses (CAD-RADS™ categories) the IRR agreement was poor in per segment, per vessel and per patient assessment (K 0.14 and 0.13; 0.30 and 0.16; 0.10 and 0.09) compared to good and moderate HF agreement (K 0.67 and 0.53; 0.68 and 0.55; 0.7 and 0.47).*Conclusions Our analysis of an AI based automated coronary stenosis assessment resulted in superior reproducibility and higher agreement than level 3 CCTA readers in this feasibility analysis.The use of reporting system with broader stenosis bucket improves inter-reader agreement. Further larger studies including evaluation of diagnostic accuracy compared to ICA are needed.*Clinical Relevance/Application The AI-based automated tool and with analyst input may improve readers agreement and reproducibility in reporting of moderate stenosis and non-obstructive disease

in a more targeted per-vessel and per segment manner.

RESULTS

While inferior to the AI analysis, the readers exhibited good reproducibility and moderate agreement in per segment stenosis evaluation (K 0.66 and K 0.50) compared to excellent reproducibility and agreement of the HF model (K 0.81 and 0.85 respectively) in 15 cases.The analysis of total 50 cases demonstrated poor per segment (K 0.33) and moderate per vessel (K 0.48) IRR agreement compared to good and excellent HF model agreement (K 0.69 and 0.78). Moderate agreement for grading severe stenosis by using 3 stenosis buckets was observed among the readers (K 0.50) and HF model (K 0.56) whereas by using CAD-RADS™ grades the agreement was poor (K 0.33) for both. Good-to-moderate agreement in scoring moderate stenosis (40-69 %) in per segment, per vessel and per patient analysis by HF model (K 0.68; 0.68, 0.51) compared to poor IRR agreement (K 0.20; 0,28; 0.04) were shown. In grading 25-49% and 50-69% stenoses (CAD-RADS™ categories) the IRR agreement was poor in per segment, per vessel and per patient assessment (K 0.14 and 0.13; 0.30 and 0.16; 0.10 and 0.09) compared to good and moderate HF agreement (K 0.67 and 0.53; 0.68 and 0.55; 0.7 and 0.47).

CLINICAL RELEVANCE/APPLICATION

The AI-based automated tool and with analyst input may improve readers agreement and reproducibility in reporting of moderate stenosis and non-obstructive disease in a more targeted per-vessel and per segment manner.

SPR-CA-4 MRI Derived Global Early Diastolic Longitudinal Strain Rate And Prognosis Of Patients With Heart Failure With Preserved Ejection Fraction (HFpEF)

Participants
Jian He, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To find the correlation of worse LV global early diastolic longitudinal strain rate (eGLSR) and outcomes (all-cause death or HF hospitalization) in patients with HFpEF.*Methods and Materials In this retrospective study, consecutive patients with HFpEF underwent cardiovascular magnetic resonance (CMR) imaging were enrolled from Jan 2010 to Mar 2013. Correlations between strain parameters derived from Feature Tracking and outcomes were analyzed using linear regression. Univariable and multivariable Cox proportional regression were performed to determine the prognostic relevance of myocardial strain for clinical outcomes.*Results A total of 186 HFpEF patients (mean age, 59 years, 41.4% women) were included. eGLSR was correlated with LV end-diastolic volume index (LVEDVi) (r = -0.39, P < .001), LV end-systolic volume index (LVESVi) (r = -.44, P < .001), heart rate (r = .35, P < .001), and LVEF (r = .30, P < .001). At a median follow-up of 9.2 years, 38.7% (72/186) patients experienced the primary composite outcome (all-cause death or HF hospitalization). Impaired eGLSR (< median, 0.57/s) was predictive of the composite outcome (adjusted hazard ratio, 2.61 , 95% confidence interval, 1.40-4.87; P = .002) after adjustment for clinical, laboratory, and imaging variables in multivariable Cox models.*Conclusions Left ventricular global early diastolic longitudinal strain rate is a simple and feasible marker and independently associated with the prognosis of heart failure with preserved ejection fraction patients. Further multi-center, larger sample prospective investigations are needed to verify the clinical value of myocardial strain in these patients.*Clinical Relevance/Application 1. Left ventricular early diastolic longitudinal strain rate (eGLSR) from feature tracking is increasingly becoming available in earlier subclinical LV diastolic dysfunction description of Heart Failure with preserved ejection fraction (HFpEF) patients.2. eGLSR may extend the application of feature-tracking and assist in clinical diagnosis and prognosis evaluation of HFpEF .

RESULTS

A total of 186 HFpEF patients (mean age, 59 years, 41.4% women) were included. eGLSR was correlated with LV end-diastolic volume index (LVEDVi) (r = -0.39, P < .001), LV end-systolic volume index (LVESVi) (r = -.44, P < .001), heart rate (r = .35, P < .001), and LVEF (r = .30, P < .001). At a median follow-up of 9.2 years, 38.7% (72/186) patients experienced the primary composite outcome (all-cause death or HF hospitalization). Impaired eGLSR (< median, 0.57/s) was predictive of the composite outcome (adjusted hazard ratio, 2.61 , 95% confidence interval, 1.40-4.87; P = .002) after adjustment for clinical, laboratory, and imaging variables in multivariable Cox models.

CLINICAL RELEVANCE/APPLICATION

1. Left ventricular early diastolic longitudinal strain rate (eGLSR) from feature tracking is increasingly becoming available in earlier subclinical LV diastolic dysfunction description of Heart Failure with preserved ejection fraction (HFpEF) patients.2. eGLSR may extend the application of feature-tracking and assist in clinical diagnosis and prognosis evaluation of HFpEF .

SPR-CA-5 Elevated Coronary Flow Vorticity Calculated Using A Mesh-free Simulation Is Related To Functionally Significant Coronary Stenosis

Participants
Nobuo Tomizawa, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the relationship between coronary flow vorticity calculated using a mesh-free simulation from coronary CT angiography data and the presence of functionally significant stenosis assessed by invasive fractional flow reserve (FFR).*Methods and Materials We retrospectively included 37 consecutive patients (50 vessels) who underwent coronary CT angiography and subsequent coronary angiography including FFR measurement between October 2018 and March 2020. Minimal lumen area (MLA), diameter stenosis (DS), and lesion length (LL) of coronary CT angiography were recorded. Coronary flow simulation was performed using the CT data by the moving particle semi-implicit method, which is a particle-based mesh-free method of computational fluid dynamics. The simulation was performed in a 4 cm length including the stenosis segment. Vorticity was calculated based on the velocity data. A lesion with invasive FFR =0.80 was determined as significant stenosis.*Results The mean invasive FFR was 0.83 ± 0.10 and 18 vessels (36%) had significant stenosis. Vorticity was significantly higher in lesions with significant stenosis than the remaining lesions (1847 ± 717 vs 788 ± 492, p <0.001). Small MLA (R2 = 0.14, p = 0.007) and severe DS (R2 = 0.20, p = 0.001) significantly related to low FFR. The relationship between LL and FFR was not significant (R2 = 0.002, p = 0.75). Vessels with high vorticity showed low FFR (R2 = 0.47, p <0.001). Multivariate logistic regression analysis showed that vorticity (p = 0.003) remained a significant factor to predict significant stenosis when MLA (p = 0.04), DS (p = 0.36), and LL (p = 0.96) was considered. The area under the curve of the receiver operating characteristic analysis increased significantly when vorticity was considered along with MLA, DS, and LL (0.94 vs 0.83, p = 0.02), while the accuracy increased from 80% to 90% with marginal significance (p = 0.06).*Conclusions High coronary flow vorticity is a significant factor to predict functionally significant stenosis other than morphological factors such as DS, MLA, and LL.*Clinical Relevance/Application Assessment of coronary flow vorticity would be

important to predict functionally significant coronary stenosis other than conventional factors such as lumen area, stenosis grade, and lesion length.

RESULTS

The mean invasive FFR was 0.83 ± 0.10 and 18 vessels (36%) had significant stenosis. Vorticity was significantly higher in lesions with significant stenosis than the remaining lesions (1847 ± 717 vs 788 ± 492, p <0.001). Small MLA (R^2 = 0.14, p = 0.007) and severe DS (R^2 = 0.20, p = 0.001) significantly related to low FFR. The relationship between LL and FFR was not significant (R^2 = 0.002, p = 0.75). Vessels with high vorticity showed low FFR (R^2 = 0.47, p <0.001). Multivariate logistic regression analysis showed that vorticity (p = 0.003) remained a significant factor to predict significant stenosis when MLA (p = 0.04), DS (p = 0.36), and LL (p = 0.96) was considered. The area under the curve of the receiver operating characteristic analysis increased significantly when vorticity was considered along with MLA, DS, and LL (0.94 vs 0.83, p = 0.02), while the accuracy increased from 80% to 90% with marginal significance (p = 0.06).

CLINICAL RELEVANCE/APPLICATION

Assessment of coronary flow vorticity would be important to predict functionally significant coronary stenosis other than conventional factors such as lumen area, stenosis grade, and lesion length.

SPR-CA-6   The Impact Of Deep Learning Reconstruction On Image Quality And Machine LearningBased Coronary CT AngiographyDerived Fractional Flow Reserve Values

Participants
Cheng Xu, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the impact of deep learning reconstruction (DLR) on image quality and machine learning-based coronary CT angiography-derived fractional flow reserve (CT-FFRML) values.*Methods and Materials 30 consecutive patients with known or suspected CAD who underwent coronary CTA on a 320-slice CT scanner and subsequent invasive coronary angiography were enrolled. DLR was compared with filtered back projection (FBP), statistical-based iterative reconstruction (SBIR), and model-based iterative reconstruction (MBIR). Subjective and objective images quality evaluation were performed. Correlation coefficients were calculated using the nonparametric Spearman's rank correlation coefficient. Invasive fractional flow reserve FFR and quantitative flow ratio (QFR) were used as the reference standard respectively. An FFR/QFR value of 0.8 or less was considered hemodynamically significant.*Results 169 lesions in 30 patients (23 men and 7 women; 63.0±8.6 years) were finally enrolled for analysis. The image quality of DLR was superior to that of FBP, SBIR and MBIR, with the lowest image noise of 14.4. There were no significant differences of the CT-FFRML values among these four approaches. Of the 169 lesions, 10 had invasive FFR results and 70 had QFR results. The overall diagnostic performances of MBIR and DLP were slight higher than FBP and SBIR. The sensitivity, specificity and diagnostic accuracy to identify hemodynamically significant stenosis were 88.89%, 81.25%, 87.14% for MBIR, and 90.74%, 75.00%, 87.14% for DLP, respectively.*Conclusions Our study showed that DLR algorithm improved image quality and slightly improved diagnostic performances of CT-FFRML value compared with FBP and AIDR.*Clinical Relevance/Application DLR algorithm improved image quality of coronary CTA and slightly improved diagnostic performances of CT-FFRML value.

RESULTS

169 lesions in 30 patients (23 men and 7 women; 63.0±8.6 years) were finally enrolled for analysis. The image quality of DLR was superior to that of FBP, SBIR and MBIR, with the lowest image noise of 14.4. There were no significant differences of the CT-FFRML values among these four approaches. Of the 169 lesions, 10 had invasive FFR results and 70 had QFR results. The overall diagnostic performances of MBIR and DLP were slight higher than FBP and SBIR. The sensitivity, specificity and diagnostic accuracy to identify hemodynamically significant stenosis were 88.89%, 81.25%, 87.14% for MBIR, and 90.74%, 75.00%, 87.14% for DLP, respectively.

CLINICAL RELEVANCE/APPLICATION

DLR algorithm improved image quality of coronary CTA and slightly improved diagnostic performances of CT-FFRML value.

SPR-CA-7   Myocardial T1, T2 Mapping And Late Gadolinium Enhancement Using Cardiac Magnetic Resonance Imaging In Chemotherapy Patients: A Single Center Retrospective Study

Participants
Jinhee Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to quantitatively assess cardiac magnetic resonance imaging (CMR) images using T1, T2 mapping, and late gadolinium enhancement (LGE) imaging in chemotherapy (CTx) patients.*Methods and Materials We retrospectively reviewed CMR images of patients who were diagnosed with cancer. Patients who underwent CMR (3T, Magnetom Trio Trim or Prisma fit, Siemens Hewalthineers) with T1 mapping (modified 5(3)3 MOLLI sequence), T2 mapping sequences (T2-prepared, single-shot TrueFISP sequence), and LGE imaging (phase-sensitive inversion recovery-prepared TrueFISP sequence) between January 2015 and January 2021 were included. CMR findings including ventricular functions, T1, T2 mapping, and ECV values, and the presence or patterns of LGE of the left ventricular myocardium were evaluated.*Results Of the 274 cancer patients, 79 patients with other cardiomyopathy and 31 patients with other scan protocols were excluded. A total of 164 patients were included. Of these, 75 (45.7%) patients underwent CTx, and 37 (49.3%) received anthracycline-based CTx. 43 (57.3%) patients had dilated cardiomyopathy (left ventricular ejection fraction <40%). The native T1, T2, and ECV values were higher in the CTx group than in the non-CTx group (1327.7ms, 51.4ms, 32.0% vs. 1284.9ms, 49.5ms, 29.9%, p<0.001, 0.003, 0.01, each other). In the CTx group, native T1, T2, and ECV values were higher in the anthracycline (AC) group than in the non-AC group (1333.2ms, 52.5ms, 32.9% vs. 1322.8ms, 50.4, 31.4% with insignificant p-value) LGE was positive in 48 (64%) patients in the CTx and 50 (56%) patients in the non-CTx groups. The most common pattern of LGE was linear LGE in the mid-ventricle and was noted in 27 (42.2%) patients.*Conclusions CMR is a useful diagnostic tool for the evaluation of chemotherapy-induced cardiotoxicity.*Clinical Relevance/Application As the number of cancer survivors is increasing because of the early diagnosis of cancer and advances in treatment, the importance of life expectancy is emerging. The adverse effects of anti-cancer drugs are important considerations. Cardiovascular disease is the second most critical factor related to the life expectancy of cancer patients after tumor recurrence. Chemotherapy-induced cardiotoxicity is a serious complication of cancer treatment that causes severe morbidity and mortality. Various anti-cancer drugs are known to induce cardiotoxicity. In particular, anthracycline agents are notorious for heart failure. CMR is useful for myocardial tissue characterization. However, the imaging findings for CTx-induced cardiomyopathy have not yet been fully determined.

RESULTS

Of the 274 cancer patients, 79 patients with other cardiomyopathy and 31 patients with other scan protocols were excluded. A total of 164 patients were included. Of these, 75 (45.7%) patients underwent CTx, and 37 (49.3%) received anthracycline-based CTx. 43 (57.3%) patients had dilated cardiomyopathy (left ventricular ejection fraction <40%). The native T1, T2, and ECV values were higher in the CTx group than in the non-CTx group (1327.7ms, 51.4ms, 32.0% vs. 1284.9ms, 49.5ms, 29.9%, p<0.001, 0.003, 0.01, each other). In the CTx group, native T1, T2, and ECV values were higher in the anthracycline (AC) group than in the non-AC group (1333.2ms, 52.5ms, 32.9% vs. 1322.8ms, 50.4, 31.4% with insignificant p-value) LGE was positive in 48 (64%) patients in the CTx and 50 (56%) patients in the non-CTx groups. The most common pattern of LGE was linear LGE in the mid-ventricle and was noted in 27 (42.2%) patients.

CLINICAL RELEVANCE/APPLICATION

As the number of cancer survivors is increasing because of the early diagnosis of cancer and advances in treatment, the importance of life expectancy is emerging. The adverse effects of anti-cancer drugs are important considerations. Cardiovascular disease is the second most critical factor related to the life expectancy of cancer patients after tumor recurrence. Chemotherapy-induced cardiotoxicity is a serious complication of cancer treatment that causes severe morbidity and mortality. Various anti-cancer drugs are known to induce cardiotoxicity. In particular, anthracycline agents are notorious for heart failure. CMR is useful for myocardial tissue characterization. However, the imaging findings for CTx-induced cardiomyopathy have not yet been fully determined.

SPR-CA-8   T1 Map-based Radiomics Score For Prediction Of Left Ventricular Reverse Remodeling In Non-ischemic Dilated Cardiomyopathy Patients

Participants
Suyon Chang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the usefulness of the radiomics score (rad-score) in predicting left ventricular reverse remodeling (LVRR) in patients with non-ischemic dilated cardiomyopathy (NIDCM).*Methods and Materials We reviewed 314 patients with NIDCM who underwent cardiac magnetic resonance imaging (CMR) with T1 mapping (training set, n=274; external validation set, n=40). Radiomics features were extracted from the native T1 map of CMR. Rad-score was generated by using the least absolute shrinkage and selection operator (LASSO) logistic regression model. A traditional clinico-radiologic model, radiomic model, and combined model were built using a logistic regression method to predict LVRR in one year. A bootstrap stepwise selection was applied to select predictors for multivariable model construction. The results were further validated in the external validation set. C-index and calibration statistics with bootstrap were used to assess the performance of the models.*Results Rad-score was positively associated with LVRR (odds ratio 111.6, 95% confidence interval [CI]: 1.1, 17391.3). In a combined model, late gadolinium enhancement extent, ventricular natriuretic peptide, rad-score, systolic blood pressure, smoking history, age, and diastolic blood pressure were included as significant predictors. Combined model resulted in better performance for the estimation of LVRR (C-index 0.758, 95% CI: 0.698, 0.818) than the traditional model (C-index 0.738, 95% CI: 0.677, 0.800). In the external validation set, combined model also showed improvement for the prediction of LVRR (C-index 0.765, 95% CI: 0.593, 0.936) compared to the traditional model (C-index 0.758, 95% CI: 0.587, 0.929).*Conclusions The rad-score demonstrated incremental value to the traditional clinico-radiologic model for the estimation of individual LVRR in patients with NIDCM.*Clinical Relevance/Application Combination of the rad-score to the traditional clinico-radiologic risk factors may serve as a complementary biomarker for risk stratification for patients with NIDCM.

RESULTS

Rad-score was positively associated with LVRR (odds ratio 111.6, 95% confidence interval [CI]: 1.1, 17391.3). In a combined model, late gadolinium enhancement extent, ventricular natriuretic peptide, rad-score, systolic blood pressure, smoking history, age, and diastolic blood pressure were included as significant predictors. Combined model resulted in better performance for the estimation of LVRR (C-index 0.758, 95% CI: 0.698, 0.818) than the traditional model (C-index 0.738, 95% CI: 0.677, 0.800). In the external validation set, combined model also showed improvement for the prediction of LVRR (C-index 0.765, 95% CI: 0.593, 0.936) compared to the traditional model (C-index 0.758, 95% CI: 0.587, 0.929).

CLINICAL RELEVANCE/APPLICATION

Combination of the rad-score to the traditional clinico-radiologic risk factors may serve as a complementary biomarker for risk stratification for patients with NIDCM.

SPR-CA-9   A Validation And Observer Performance Study Of A Deep Learning-based Software For Automatic Measurement Of Native T1 Value And Extracellular Volume Fraction In Cardiac Magnetic Resonance Imaging

Participants
Suyon Chang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To validate a deep learning-based software for automatic measurement of myocardial native T1 value and extracellular volume (ECV) fraction in T1 mapping cardiac magnetic resonance imaging.*Methods and Materials A deep learning-based software (based on Attention R2U-net) was used for automatic analysis of T1 map (segmentation of native T1 and post-T1 map, and measurement of native T1 value and ECV fraction). A data set for 95 patients (27 normal, 32 dilated cardiomyopathy, 36 left ventricular hypertrophy [12 hypertrophic cardiomyopathy, 12 Fabry disease, 12 amyloidosis]) was used to validate automatically calculated T1 value and ECV fraction. Ground truth was set by manual analysis in consensus of two expert readers. Additionally, four radiologist readers analyzed the same images and the results were compared. Dice similarity coefficient (DSC), Bland-Altman analysis, and intraclass correlation coefficient (ICC) were used to evaluate the performance of the software.*Results The software achieved fast segmentation (<5s/image) with high DSC (0.86 ± 0.05 on native T1 and 0.75 ± 0.17 on post-T1 map). Bland-Altman analysis showed good agreement between the automated method and ground truth (mean 9.8, 95% limit of agreement ± 32.4 for native T1; mean 0.9, 95% limit of agreement ± 4.8 for ECV). The ICC of native T1 and ECV by automatic method vs. ground truth (0.98 and 0.97, respectively) were comparable to those between ground truth vs. other radiologist readers (0.97-1 and 0.99-1, respectively).*Conclusions The deep learning-based software allows fast automatic analysis of T1 mapping images, which is comparable to the radiologist readers.*Clinical Relevance/Application Automatic measurement of T1 value and ECV fraction can be a beneficial assistance tool which mitigates the burden of manual analysis.

RESULTS

The software achieved fast segmentation (<5s/image) with high DSC (0.86 ± 0.05 on native T1 and 0.75 ± 0.17 on post-T1 map). Bland-Altman analysis showed good agreement between the automated method and ground truth (mean 9.8, 95% limit of agreement ± 32.4 for native T1; mean 0.9, 95% limit of agreement ± 4.8 for ECV). The ICC of native T1 and ECV by automatic method vs. ground truth (0.98 and 0.97, respectively) were comparable to those between ground truth vs. other radiologist readers (0.97-1 and 0.99-1, respectively).

CLINICAL RELEVANCE/APPLICATION

Automatic measurement of T1 value and ECV fraction can be a beneficial assistance tool which mitigates the burden of manual analysis.

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Sub-Events

PH05-A1   **A Comparative Study Of One-stop Head And Neck CTA+CTP And Conventional Head And Neck CTA+CTP**

Participants
Wei Jing, Shizuishan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the difference in image quality, radiation dose and contrast agent dosage between one-stop head and neck computed tomography angiography(CTA) and computed tomography perfusion(CTP)and conventional head and neck CTA+CTP.*Methods and Materials sixty patients with clinically suspected acute stroke were collected in our hospital from September to December 2020, and randomly divide them into groups A and B. The head and neck CTA+CTP scan was performed with GE Revolution CT. In group A, a one-stop head and neck CTA+CTP examination was performed. A small-dose test of about 15ml was performed first to determine the CTA time. During the head and neck CTP, the head and neck CTA was performed quickly, and then the CTP was quickly switched to continue scanning. In group B, conventional head and neck CTA+CTP scans were performed. CTP was performed first. After 5 minutes, CTA scans were performed. Analyze and compare the differences in blood vessel CT value, image noise (SD) and signal-to-noise ratio (SNR=CT vessel/SD muscle) at the level of the aortic arch, common carotid artery, internal carotid artery, and middle cerebral artery in groups A and B. The efective radiation dose (ED) of the two groups of patients and the amount of contrast agent in the two groups were recorded. Using SPSS 23.0 software, the two groups of patients were compared by independent sample t test.*Results There were no statistically significant differences in the CT values, SD and SNR of blood vessels at the levels of the remaining aortic arch, common carotid artery, internal carotid artery, and middle cerebral artery in groups A and B (P>0.05); the ED of A and B groups were 2.27±0.09mSv and 2.52±0.54mSv, which was statistically significant (P<0.05). Group A was 10% less than group B; the amount of contrast medium in the two groups A and B was 70.20±9.99ml and 126.33±13.36ml respectively, which was statistically different (P<0.05). Compared with group B, group A decreased by 45%;. The average inspection time of group A was (2.35±0.45) min, the average time of group B inspection was (8.51±0.73) min, and the inspection time was reduced by 78%.*Conclusions Compared with conventional head and neck CTA+CTP, the one-stop head and neck CTA+CTP guarantees the image quality, while reducing the radiation hazard of patients and the harm of contrast agent nephropathy, and greatly reducing the examination time.*Clinical Relevance/Application Compared with conventional head and neck CTA+CTP, the one-stop head and neck CTA+CTP while reducing the radiation hazard of patients and the hazard of contrast agent nephropathy, and greatly reducing the examination time, so as to buy valuable time for emergency stroke patients.

RESULTS

There were no statistically significant differences in the CT values, SD and SNR of blood vessels at the levels of the remaining aortic arch, common carotid artery, internal carotid artery, and middle cerebral artery in groups A and B (P>0.05); the ED of A and B groups were 2.27±0.09mSv and 2.52±0.54mSv, which was statistically significant (P<0.05). Group A was 10% less than group B; the amount of contrast medium in the two groups A and B was 70.20±9.99ml and 126.33±13.36ml respectively, which was statistically different (P<0.05). Compared with group B, group A decreased by 45%;. The average inspection time of group A was (2.35±0.45) min, the average time of group B inspection was (8.51±0.73) min, and the inspection time was reduced by 78%.

CLINICAL RELEVANCE/APPLICATION

Compared with conventional head and neck CTA+CTP, the one-stop head and neck CTA+CTP while reducing the radiation hazard of patients and the hazard of contrast agent nephropathy, and greatly reducing the examination time, so as to buy valuable time for emergency stroke patients.

PH05-A11   **Application Of Deep Learning Reconstruction In MR: Higher Resolution MR Imaging In Shorter Scan Time**

Participants
Mo Kadbi, PhD, Irvine, California (*Presenter*) Employee, Canon Medical Systems Corporation;

PURPOSE

One inherent challenge in MRI is finding the optimal balance of Signal-to-Noise Ratio (SNR), image resolution, and scan time. As spatial resolution increases, voxel size is reduced and in turn available signal per voxel is decreased, resulting in more noise in the MR image. To compensate for this signal loss, signal averaging or phase oversampling are often used to restore SNR, at the consequence of longer scan times. In this study, a Deep Learning Reconstruction (DLR) is used to remove the noise from the MR images and improve SNR. This additional SNR can then be exploited to increase resolution without the need for additional signal averaging, phase oversampling and increased scan time.*Methods and Materials Routine clinical images of ankle, wrist, and lumbar spine, hip, and shoulder were acquired on volunteers on 1.5T and 3T scanners. Two sets of protocols were acquired in each scan session. First, a routine clinical protocol with conventional reconstruction (CR) method using typical post processing filters and reconstruction was optimized to for what would be considered typical image quality. Second, a modified protocol to achieve higher spatial resolution in a shorter scan time using the DLR method. Most sequence parameters were kept identical between the CR and DLR protocols. Wherever the DLR scan had an abundant SNR, spatial resolution was increased, and the number of acquisitions

(NAQ) and/or signal oversampling were reduced in order to shorten the scan time. To evaluate the impact of the DLR on image quality, the SNR and contrast change were measured in bone and muscle in various anatomies.*Results Clinical images acquired in various anatomies using the routine protocol and the modified protocol revealed that the DLR based images achieve a similar or better image quality to the CR images. Higher spatial resolution was achieved with the DLR scan which resulted in sharper images. The higher resolution images were obtained while the SNR was improved and the scan time was reduced in all anatomies. The scan time reduction varied between 22-52% for different anatomies, which can be advantageous for the orthopedic imaging wherein patients, usually experiencing severe pain, could benefit from the shorter scan time.*Conclusions Deep Learning Reconstruction can help to increase SNR and spatial resolution in neuro and orthopedic MR imaging. In addition, shorter scan time can be achieved by reducing number of signal averaging and/or oversampling. Thus, higher resolution images with improved image quality can be acquired in shorter scan times.*Clinical Relevance/Application Higher resolution images with high image quality and SNR were acquired in shorter scan times using a Deep Learning Reconstruction method on various anatomical regions.

RESULTS

Clinical images acquired in various anatomies using the routine protocol and the modified protocol revealed that the DLR based images achieve a similar or better image quality to the CR images. Higher spatial resolution was achieved with the DLR scan which resulted in sharper images. The higher resolution images were obtained while the SNR was improved and the scan time was reduced in all anatomies. The scan time reduction varied between 22-52% for different anatomies, which can be advantageous for the orthopedic imaging wherein patients, usually experiencing severe pain, could benefit from the shorter scan time.

CLINICAL RELEVANCE/APPLICATION

Higher resolution images with high image quality and SNR were acquired in shorter scan times using a Deep Learning Reconstruction method on various anatomical regions.

PH05-A4   Tin Prefiltration In Extremity Cone-beam CT Imaging With A Twin Robotic X-ray System

Participants
Andreas Kunz, MD, Wuerzburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Spectral shaping is an established approach to achieve dose reduction in various CT applications, whereas in cone-beam CT, the benefits of tin prefiltration relative to already optimized spectra have not been thoroughly assessed thus far. To investigate the effect of tin filer application on radiation exposure and image quality of extremity cone-beam CT scans with a twin-robotic X-ray system.*Methods and Materials Elbow, wrist and ankle joints of two cadaveric specimens were examined in a laboratory setup using a high-resolution scan mode with various combinations of prefiltration (standard copper, experimental tin filter), tube voltage and current-time product. Volume CT dose indices were computed for a 16 cm polymethylmethacrylate phantom. Image quality of protocols was assessed subjectively by five radiologists and compared with Wilcoxon signed rank tests. Fleiss' kappa was calculated to measure interrater agreement. To provide an additional semiquantitative criterion for image quality, contrast-to-noise ratios (CNR) were computed in standardized regions of interest.*Results Radiation dose ranged from 17.4 mGy in the clinical standard protocol without tin filter to as low as 0.7 mGy with tin prefiltration. Image quality ratings and CNR for tin-filtered scans with 100 kV were lower than for 80 kV studies with copper filtration despite higher dose (11.2 and 5.6 vs. 4.5 mGy; p<0.001). Observer evaluation and CNR showed no difference between 100 kV scans with tin filtration and 60 kV copper-filtered scans with 75% dose reduction (subjective: p=0.101; CNR: p=0.706). Moderate to substantial interrater agreement was indicated by Fleiss' kappa of 0.597 (95% confidence interval 0.567-0.626; p<0.001).*Conclusions While considerable dose reduction could also be achieved with tin filter application, the twin-robotic X-ray system's potential for low-dose extremity joint imaging was maximized with a dedicated low-kilovolt scan protocol in patients without metal implants.*Clinical Relevance/Application In situations without extensive beam-hardening artifacts, lowering the tube voltage appears more promising than tin prefiltration for dose reduction in peripheral joint cone-beam CT imaging.

RESULTS

Radiation dose ranged from 17.4 mGy in the clinical standard protocol without tin filter to as low as 0.7 mGy with tin prefiltration. Image quality ratings and CNR for tin-filtered scans with 100 kV were lower than for 80 kV studies with copper filtration despite higher dose (11.2 and 5.6 vs. 4.5 mGy; p<0.001). Observer evaluation and CNR showed no difference between 100 kV scans with tin filtration and 60 kV copper-filtered scans with 75% dose reduction (subjective: p=0.101; CNR: p=0.706). Moderate to substantial interrater agreement was indicated by Fleiss' kappa of 0.597 (95% confidence interval 0.567-0.626; p<0.001).

CLINICAL RELEVANCE/APPLICATION

In situations without extensive beam-hardening artifacts, lowering the tube voltage appears more promising than tin prefiltration for dose reduction in peripheral joint cone-beam CT imaging.

PH05-A6   Technical Performance Of A Novel Dual-energy CT System With Deep Learning-based Dual Energy Reconstruction

Participants
Luuk J. Oostveen, DIPLPHYS, Nijmegen, Netherlands (*Presenter*) Research Grant, Canon Medical Systems Corporation

PURPOSE

To evaluate the technical performance of a novel dual-energy (DE) CT system and compare it to that of standard single-energy (SE) CT at the same dose level.*Methods and Materials DE and SE images of three different phantoms were acquired with a CT system with rapid tube voltage switching (80 / 135 kV) that uses deep learning to complete the sinogram data (Aquilion One Prism Edition, Canon Medical Systems Corporation, Otawara, Japan). The dose for the DE and SE acquisitions of each phantom were set to those selected by the automatic exposure control (AEC) set at the manufacturer-recommended settings for DE mode. For reference, the dose that the AEC would have selected in SE mode for each phantom was also recorded. Virtual monochromatic images (VMIs) from 40 keV to 130 keV in 10 keV steps as well as iodine maps were reconstructed from the DE data. SE images were acquired at 120 kV and reconstructed with a hybrid iterative algorithm (HIR; AIDR 3D standard, FC18). All reconstructions were at 0.5 mm slice thickness. Modulation transfer functions (MTFs) were determined using a 50 μm tungsten wire. Noise magnitude (SD), noise power spectrum (NPS), and homogeneity were calculated from a 320 mm water phantom. Iodine quantification accuracy and contrast-to-noise ratios (CNR) relative to water for 2, 5, 10, and 15 mg I/ml were determined using a multi-energy CT (MECT) phantom (Gammex 1472, Sun Nuclear, Melbourne, Australia). Low-contrast visibility was determined using the Catphan 500 phantom (The Phantom Laboratory, Salem, NY, USA) at 10 mm slice thickness.*Results The MTF of DE VMIs was

higher than that of SE images (20% MTF: 7.2 lp/cm at 40 keV, 8.1 lp/cm at =70 keV, 6.3 lp/cm for SE). SD was lowest at 70 keV VMI (12.0 HU) and lower than that of SE (18.3 HU). The average NPS frequency was 2.2 lp/cm for SE and varied between 2.3 and 4.2 lp/cm for VMIs. Iodine quantification inaccuracy was on average 0.5 mg I/ml with a maximum of 1 mg I/ml (at 5 mg I/ml). The highest CNR for all iodine concentrations was at 60 keV, 2.5 times higher than the CNR for SE. At 70 keV the number of visible low contrast objects was comparable to that in SE. CTDIvol for the DE acquisitions of the water, MECT, and Catphan phantoms were 12.6, 15.4, and 12.6 mGy, respectively. AEC-driven SE acquisitions would have resulted in CTDIvol of 5.0, 8.6, and 2.5 mGy, respectively.*Conclusions Deep learning-based DE CT can create sharper, lower noise VMIs with up to 2.5 times higher iodine CNR compared to SE at the same dose. At manufacturer-recommended settings, the dose used in DE is higher than that in SE.*Clinical Relevance/Application For applications in which visibility of iodine or iodine quantification is crucial, deep learning-based dual-energy might be a better option than single-energy acquisitions.

RESULTS

The MTF of DE VMIs was higher than that of SE images (20% MTF: 7.2 lp/cm at 40 keV, 8.1 lp/cm at =70 keV, 6.3 lp/cm for SE). SD was lowest at 70 keV VMI (12.0 HU) and lower than that of SE (18.3 HU). The average NPS frequency was 2.2 lp/cm for SE and varied between 2.3 and 4.2 lp/cm for VMIs. Iodine quantification inaccuracy was on average 0.5 mg I/ml with a maximum of 1 mg I/ml (at 5 mg I/ml). The highest CNR for all iodine concentrations was at 60 keV, 2.5 times higher than the CNR for SE. At 70 keV the number of visible low contrast objects was comparable to that in SE. CTDIvol for the DE acquisitions of the water, MECT, and Catphan phantoms were 12.6, 15.4, and 12.6 mGy, respectively. AEC-driven SE acquisitions would have resulted in CTDIvol of 5.0, 8.6, and 2.5 mGy, respectively.

CLINICAL RELEVANCE/APPLICATION

For applications in which visibility of iodine or iodine quantification is crucial, deep learning-based dual-energy might be a better option than single-energy acquisitions.

PH05-A8   Detection Of Juxta-vascular Pulmonary Nodules Based On Deep Learning Artificial Intelligence (DL-AI) System In Chest Low-dose CT(LDCT) Images

Participants
Fang Wang, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

Juxta-vascular pulmonary nodules (JVPN) have a high risk of being malignant yet are often challenging to be detected due to vascular interference. This study evaluated the performance of a DL-AI system in assisting the detection of JVPN in chest LDCT images.*Methods and Materials 104 participants who underwent chest LDCT screening (effective dose 1.5mSv for each participant) on a 256-slice wide-detector CT (Revolution, GE Healthcare) were enrolled. Two senior chest radiologists reviewed the LDCT images with the assistance of a DL-AI system (InferRead CT Lung Research). A total of 216 JVPNs (34 nodules were near pulmonary hilum, 56 nodules were central and 126 nodules were peripheral) were confirmed by two senior chief radiologists' consensus readings and were served as the reference standard. Two residents independently reviewed the CT images for the presence of pulmonary nodules, first without the DL-AI system, and then with the assistance of the DL-AI system and consensus readings were obtained and utilized for analysis. The sensitivity (true-positive rate) was calculated as the number of detected nodules divided by the total number of reference standard nodules. The false-positive rate was calculated as the number of false-positive nodules divided by the total number of participants.*Results The sensitivity for detecting JVPNs near the pulmonary hilum was remarkably increased from 58.8% without DL-AI to 94.1% with DL-AI. For central JVPNs, detection sensitivity was also improved with the assistance of the DL-AI system, from 64.3% to 94.6% with the DL-AI. The sensitivity of JVPNs in the peripheral lung was increased from 79.4% without DL-AI to 97.6% with DL-AI. False-positive rates were also greatly reduced with the assistance of the DL-AI system, from 4.8% to 1.0%, from 3.8% to 1.9% and from 2.9% to 1.0% for JVPNs near the pulmonary hilum area, central and peripheral, respectively.*Conclusions DL-AI improved diagnostic performance in the detection of all regions JVPNs on LDCT for junior residents, with the greatest help in the region that is the most difficult for residents.*Clinical Relevance/Application It is potentially feasible to detect more juxta-vascular pulmonary nodules with the assistance of DL-AI system for the early lung cancer detection.

RESULTS

The sensitivity for detecting JVPNs near the pulmonary hilum was remarkably increased from 58.8% without DL-AI to 94.1% with DL-AI. For central JVPNs, detection sensitivity was also improved with the assistance of the DL-AI system, from 64.3% to 94.6% with the DL-AI. The sensitivity of JVPNs in the peripheral lung was increased from 79.4% without DL-AI to 97.6% with DL-AI. False-positive rates were also greatly reduced with the assistance of the DL-AI system, from 4.8% to 1.0%, from 3.8% to 1.9% and from 2.9% to 1.0% for JVPNs near the pulmonary hilum area, central and peripheral, respectively.

CLINICAL RELEVANCE/APPLICATION

It is potentially feasible to detect more juxta-vascular pulmonary nodules with the assistance of DL-AI system for the early lung cancer detection.

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Sub-Events

IR02-A3   The Association Between Gut Hormones And Weight Changes After Bariatric Arterial Embolization During The Beat Obesity Trial

Participants

Muhammad Latif, MBBS, Dundalk, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Bariatric arterial embolization (BAE) is an endovascular procedure with promising results for the treatment of obesity. It induces ischemia in the gastric fundus, the main site of endogenous ghrelin, the only known orexigenic hormone. Preliminary results suggest that BAE-induced changes in gut hormones contribute to postprocedural weight loss by influencing satiety, hunger, and energy homeostasis. Our study objective was to evaluate the association between ghrelin, peptide YY 3-36 (PYY3-36), and glucagon-like peptide 1 (GLP-1) and weight changes post-BAE during the course of 1-year follow-up.*Methods and Materials Patients enrolled in the BEAT Obesity Trial were evaluated at 1- and 2-weeks and 3- , 6- , and 12-months post-embolization. Patients were instructed to fast after dinner before their appointments and were fed a mixed meal test. At each follow-up appointment, blood work was collected after 0, 15, 30, 60, 120, 180, and 240 minutes to measure ghrelin, PYY3-36, and GLP-1 levels. To facilitate longitudinal data analysis, data from a representative group of responders (defined as patients consistently in the top tertile of weight loss at each visit throughout the yearlong study) were compared with data from a representative group of non-responders (defined as patients who were consistently in the bottom tertile of weight loss at each visit).*Results There was a significant decrease in percent change ghrelin in non-responders, at 60- and 180-minute timepoint at the week-2 appointment (estimated difference between 60 vs. 0 minute: -29; 95% CI: -49, -9; p = 0.008) and estimated difference between 180 vs. 0 minutes: -30, 95%CI: -53, -7, p = 0.016). Responders showed statistically decreased serum ghrelin compared with non-responders at months 6 and 12, corresponding with greater weight loss in these patients over this time. PYY3-36 and GLP-1 levels showed no difference between the two groups. Area-under-the-curve (AUC) hormone analysis at each visit showed a significant difference in ghrelin between the two groups. No significant difference was found in AUC values for GLP-1 and PYY3-36.*Conclusions Responders to BAE who had consistent weight loss throughout follow-up showed decreased ghrelin levels compared with non-responders, supporting decreased ghrelin as a mechanism underlying BAE-induced weight loss, similar to vertical sleeve gastrectomy surgery. Similar PYY3-36 and GLP-1 levels between the groups, unlike traditional bariatric surgery, may be attributed to lack of direct effect of BAE on the distal small intestine.*Clinical Relevance/Application Bariatric embolization is feasible and appears to be well tolerated in severely obese patients.

RESULTS

There was a significant decrease in percent change ghrelin in non-responders, at 60- and 180-minute timepoint at the week-2 appointment (estimated difference between 60 vs. 0 minute: -29; 95% CI: -49, -9; p = 0.008) and estimated difference between 180 vs. 0 minutes: -30, 95%CI: -53, -7, p = 0.016). Responders showed statistically decreased serum ghrelin compared with non-responders at months 6 and 12, corresponding with greater weight loss in these patients over this time. PYY3-36 and GLP-1 levels showed no difference between the two groups. Area-under-the-curve (AUC) hormone analysis at each visit showed a significant difference in ghrelin between the two groups. No significant difference was found in AUC values for GLP-1 and PYY3-36.

CLINICAL RELEVANCE/APPLICATION

Bariatric embolization is feasible and appears to be well tolerated in severely obese patients.

IR02-A4   Causal Effect Of Transjugular Intrahepatic Portosystemic Shunt On Perioperative Clinical Outcomes In Patients Undergoing Orthotopic Liver Transplantation: 2002-2021 United Network For Organ Sharing Registry

Participants

John Moon, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

To estimate the causal effect of TIPS on key perioperative biomarkers and clinical outcomes including ascites, hepatic encephalopathy (HE), albumin, bilirubin, creatinine, International Normalized Ratio (INR), Child Pugh score (CPS), and Model for End-stage Liver Disease (MELD) score in HCC and non-HCC patients waiting for OLT.*Methods and Materials We applied an inverse probability of treatment weighted (IPTW) model to estimate the causal effect of TIPS on each of the above outcomes. Causal effects were estimated by applying weighted regression models, ordinary least squares regression for continuous outcomes, multinomial logistic regression for nominal outcomes, and ordered logistic regression for ordinal variables. Regression weights were estimated using the IPTW framework, or, a binomial logistic regression to estimate the probability of receiving TIPS given baseline confounders from the time of patient enrollment into UNOS.*Results Among non-HCC patients, TIPS was causally associated with a decrease in perioperative levels of albumin (95% CI: -0.179, -0.166; p<0.001), bilirubin (95% CI: -1.003, -0.789; p<0.001), creatinine (95% CI: -0.148, -0.129; p<0.001), INR (95% CI: -0.127, -0.105; p<0.001), and the MELD score (95% CI: -1.16079, -0.984; p<0.001). TIPS was also causally associated with an increase in proportional odds ratio (i.e. higher ratio meaning lower score) for CPS (95% CI: 1.133, 1.161; p<0.001), ascites (95% CI: 1.279, 1.314; p<0.001), and HE (95%CI: 1.305, 1.342;

p<0.001). Among HCC patients, TIPS was causally associated with a decrease in albumin (95% CI: -0.394, -0.322; p<0.001). However, TIPS was causally associated with an increase in bilirubin (95% CI: 0.789, 0.984; p<0.001), creatinine (95% CI: 0.070, 0.110; p<0.001), INR (95% CI: 0.070, 0.147; p<0.01), and the MELD score (95% CI: 2.493, 2.996; p<0.001). TIPS was also causally associated with an increased proportional odds ratio (i.e. higher ratio meaning lower score) for CPS (95% CI: 3.016, 3.625; p<0.001), ascites (95% CI: 2.268, 2.790; p<0.001), and HE (95% CI: 2.456, 3.035; p<0.001).*Conclusions Biomarkers associated 30-day mortality are favorably decreased in non-HCC but not in HCC patients. Clinical symptom severity and scoring are favorably decreased in both groups.*Clinical Relevance/Application In both HCC and non-HCC patients, TIPS decreases hepatic encephalopathy and ascites. Child-Pugh Score, as a surrogate to life expectancy and perioperative mortality, is also decreased in both HCC and non-HCC patients.

RESULTS

Among non-HCC patients, TIPS was causally associated with a decrease in perioperative levels of albumin (95% CI: -0.179, -0.166; p<0.001), bilirubin (95% CI: -1.003, -0.789; p<0.001), creatinine (95% CI: -0.148, -0.129; p<0.001), INR (95% CI: -0.127, -0.105; p<0.001), and the MELD score (95% CI: -1.16079, -0.984; p<0.001). TIPS was also causally associated with an increase in proportional odds ratio (i.e. higher ratio meaning lower score) for CPS (95% CI: 1.133, 1.161; p<0.001), ascites (95% CI: 1.279, 1.314; p<0.001), and HE (95%CI: 1.305, 1.342; p<0.001). Among HCC patients, TIPS was causally associated with a decrease in albumin (95% CI: -0.394, -0.322; p<0.001). However, TIPS was causally associated with an increase in bilirubin (95% CI: 0.789, 0.984; p<0.001), creatinine (95% CI: 0.070, 0.110; p<0.001), INR (95% CI: 0.070, 0.147; p<0.01), and the MELD score (95% CI: 2.493, 2.996; p<0.001). TIPS was also causally associated with an increased proportional odds ratio (i.e. higher ratio meaning lower score) for CPS (95% CI: 3.016, 3.625; p<0.001), ascites (95% CI: 2.268, 2.790; p<0.001), and HE (95% CI: 2.456, 3.035; p<0.001).

CLINICAL RELEVANCE/APPLICATION

In both HCC and non-HCC patients, TIPS decreases hepatic encephalopathy and ascites. Child-Pugh Score, as a surrogate to life expectancy and perioperative mortality, is also decreased in both HCC and non-HCC patients.

IR02-A6   Repetitive Transarterial Hepatic Chemoperfusion For The Treatment Of Advanced Hepatic Uveal Melanoma Metastases - Assessment Of Prognostic Determinants

Participants
Julia Isabelle Wimmer, MD, Essen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Evaluation of prognostic determinants in patients with advanced hepatic uveal melanoma metastases treated with repetitive whole liver transarterial hepatic chemoperfusion (THC) as palliative treatment.*Methods and Materials 105 patients (50,5% male; 92% bilobar disease) with a median age of 61.7 years (range 27-81) first treated between 2010-2017 were retrospectively assessed. A median of 5 (range: 1-10) THC sessions with melphalan (88%, median: 40mg) or fotemustin (12%, median: 180mg) were performed. The inflammatory marker SII (Systemic immune inflammation index) was calculated as follows: (platelets/nl × neutrophils/nl)/ (lymphocytes/nl). Kaplan-Meier analysis for median overall survival in months (OS; 95%CI), univariate (UVA) and multivariate (MVA) analyses (Hazard ratio; 95%CI) were performed.*Results Median OS after first THC was 8.2 (95%CI: 6.4-11.1) months. Regarding prognostic OS markers, UVA identified number of hepatic tumor lesions <10 (0.4; 0.2-0.6; p<.0001), long axis of largest hepatic lesion <median of 58.8mm (0.4; 0.3-0.6; p<.0001), SII <median of 975.2 (0.4; 0.3-0.7; p=.0001), normal bilirubin (0.3; 0.2-0.7; p=.003), normal AST values (0.3; 0.2-0.5; p<.0001), normal ALT values (0.4; 0.3-0.6; p<.0001), normal AP values (0.5; 0.3-0.8; p=.002), normal LDH values in comparison to intermediate (248-1000 U/l; 0.5; 0.3-0.9; p<.0001) and high (>1000 U/l; 0.1; 0.06-0.3; p<.0001) LDH values and normal whole protein (0.3; 0.2-0.6; p=.0001) as significant predictors for longer survival. MVA confirmed size of largest liver lesion <median (0.36; 0.18-0.7; p=.003), normal bilirubin (0.26; 0.1-0.69; p=.007) and normal whole protein (0.2; 0.09-0.5; p=.0005) as independent predictors for longer OS. Survival prediction could further be improved combining significant factors from MVA: Patients with size of largest lesion <median, normal bilirubin, and normal whole protein survived the longest with 12.5 months (95%CI: 10.2-15.8) compared to patients with only two (8.2; 3.5-18.9), one (5.2; 4.3-6.4) and none (1.1; 0.3-3.5) of the beneficial factors, p<.0001. The difference between each group was statistically significant in UVA.*Conclusions THC is an effective palliative treatment option for patients with advanced uveal melanoma liver metastases. In addition, the size of the largest liver lesion, bilirubin, and whole protein serve as relevant prognostic determinants of survival, aiding in identifying patients potentially profiting from therapy.*Clinical Relevance/Application Clinical decision-making regarding appropriate patient selection and treatment effectiveness may be improved with information on essential predictors for the overall survival of patients with uveal melanoma liver metastases undergoing THC.

RESULTS

Median OS after first THC was 8.2 (95%CI: 6.4-11.1) months. Regarding prognostic OS markers, UVA identified number of hepatic tumor lesions <10 (0.4; 0.2-0.6; p<.0001), long axis of largest hepatic lesion <median of 58.8mm (0.4; 0.3-0.6; p<.0001), SII <median of 975.2 (0.4; 0.3-0.7; p=.0001), normal bilirubin (0.3; 0.2-0.7; p=.003), normal AST values (0.3; 0.2-0.5; p<.0001), normal ALT values (0.4; 0.3-0.6; p<.0001), normal AP values (0.5; 0.3-0.8; p=.002), normal LDH values in comparison to intermediate (248-1000 U/l; 0.5; 0.3-0.9; p<.0001) and high (>1000 U/l; 0.1; 0.06-0.3; p<.0001) LDH values and normal whole protein (0.3; 0.2-0.6; p=.0001) as significant predictors for longer survival. MVA confirmed size of largest liver lesion <median (0.36; 0.18-0.7; p=.003), normal bilirubin (0.26; 0.1-0.69; p=.007) and normal whole protein (0.2; 0.09-0.5; p=.0005) as independent predictors for longer OS. Survival prediction could further be improved combining significant factors from MVA: Patients with size of largest lesion <median, normal bilirubin, and normal whole protein survived the longest with 12.5 months (95%CI: 10.2-15.8) compared to patients with only two (8.2; 3.5-18.9), one (5.2; 4.3-6.4) and none (1.1; 0.3-3.5) of the beneficial factors, p<.0001. The difference between each group was statistically significant in UVA.

CLINICAL RELEVANCE/APPLICATION

Clinical decision-making regarding appropriate patient selection and treatment effectiveness may be improved with information on essential predictors for the overall survival of patients with uveal melanoma liver metastases undergoing THC.

IR02-A7   An Overview Of Techniques To Improve Future Liver Remnant (FLR)

Awards
Identified for RadioGraphics

Participants

Pouya Entezari, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Insufficient future liver remnant (FLR) precludes many patients with hepatic malignancy from undergoing curative surgery.2. Different methods of FLR hypertrophy have been developed to convert patients with small FLR into surgical candidates. However, there is a lack of consensus regarding the method of choice. Knowledge of these techniques can help to choose the optimum method, based on individual characteristics, for the patients.

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Abstract Archives of the RSNA, 2021

Sub-Events

HN04-D1   Multi-parametric MR Imaging Of Head And Neck Cancer: Imaging Biomarker For Tumor Hypoxia And Heterogeneity

Participants
Yoshimi Anzai, MD,MPH, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

PURPOSE

Tumor hypoxia is one of the physiological factors for treatment resistance and likely contributes to poor overall survival among patients with head and neck cancer (HNC). Identifying hypoxic features of HNC may allow the personalizing treatment plan. A prospective cohort study was conducted used multiparametric MR (MPMR) imaging correlated with treatment response assessed by 3 months FDG-PET. The image analysis approach was developed to incorporate FDG-PET and quantitative MRI characteristics of tumor (ADC, oxygen-enhanced T1 and T2* maps, and Ktrans) to facilitate 3D visualization of multiparametric information.*Methods and Materials In this prospective pilot study, 13 patients with newly diagnosed HNC were recruited. All patients provided written consent. Subjects underwent MPMR imaging on a 3T MRI scanner with 20 channel head and neck coil. MRI protocol included air and oxygen-enhanced T1 and T2* mapping, DWI, and DCE MRI. R2* (1/T2*) and T1 of blood decreases with O2 saturation. It is expected that normoxic tumor regions show a reduction of R2* and T1, whereas hypoxic tumor regions show stable or increased R2* and T1. Primary tumors and metastatic lymph nodes were manually traced on T2w images. 1D and 2D histograms of all pixels from a primary tumor and lymph node metastases were generated for ADC, Ktrans, ADC, and R2* and R1 (1/T1). In addition, a multiparametric color map was developed as a proof of concept. *Results 8 subjects completed the 3 months post-treatment FDG-PET scan to assess treatment response. Tumor pixels for non-responders had a higher volume fraction of lower Ktrans, higher ADC, and lower R2* than those for responders. 3D composite color maps demonstrate areas of perfusion uncoupling, a feature of hypoxia, as well as intra-tumoral heterogeneity (figure 1).*Conclusions Oxygen-enhanced T1 and T2* mapping MRI may show a slight change in R2* and R1, where oxygen is delivered. MPMR imaging has the potential to reveal the spatial distribution of hypoxic regions within a tumor. MPMR imaging has the potential to serve as a non-invasive imaging of tumor hypoxia and predict treatment failure.*Clinical Relevance/Application A composite color map combining quantitative information from multiparametric imaging (oxygen-enhanced T1 and T2* mapping, DWI, DCE, and FDG-PET) has the potential to reveal the spatial distribution of the area of hypoxia within a tumor.

RESULTS

8 subjects completed the 3 months post-treatment FDG-PET scan to assess treatment response. Tumor pixels for non-responders had a higher volume fraction of lower Ktrans, higher ADC, and lower R2* than those for responders. 3D composite color maps demonstrate areas of perfusion uncoupling, a feature of hypoxia, as well as intra-tumoral heterogeneity (figure 1).

CLINICAL RELEVANCE/APPLICATION

A composite color map combining quantitative information from multiparametric imaging (oxygen-enhanced T1 and T2* mapping, DWI, DCE, and FDG-PET) has the potential to reveal the spatial distribution of the area of hypoxia within a tumor.

VA03-B

Vascular Imaging Tuesday Poster Discussions

Sub-Events

VA03-B1   **Dose Management Capabilities Of Digital Variance Angiography: 70 % Decrease Of DSA-related Radiation Exposure In Lower Limb X-ray Angiography**

Participants

Marcell Gyano, MD, Budakeszi, Hungary (*Presenter*) Employee, Kinepict Health Ltd;Researcher, Kinepict Health Ltd

PURPOSE

In previous clinical studies Digital Variance Angiography (DVA), a new image processing method provided higher contrast-to-noise ratio (CNR) and better image quality than Digital Subtraction Angiography (DSA). The aim of this study was to investigate, whether the previously observed quality reserve of DVA can be used to reduce radiation exposure in lower limb X-ray angiography.*Methods and Materials Our prospective study enrolled 30 peripheral artery disease patients (Fontaine IIb-IV, mean age 70 years, range 52-85 years; 10 females, mean age 73 years, range 55-85 years; and 20 males, mean age 69 years, range 52-85) undergoing diagnostic lower limb X-ray angiography between April and July 2019. In all enrolled patients, both normal (1.2 μGy/frame) and low-dose (0.36 μGy/frame) protocols were used for the acquisition of images in three anatomical regions. The CNR of DSA and retrospectively generated DVA images were calculated, and the quality was evaluated by seven specialists using a 5-grade Likert scale. For investigating non-inferiority, the difference of low-dose DVA and normal dose DSA scores (DVA30-DSA100) was analyzed by the one-sample Wilcoxon test.*Results DVA produced consistently higher (two to threefold) CNR than DSA. The highest ratios (3.0-3.1) were observed in the crural region. In the visual evaluation, DVA30 received significantly higher scores than DSA100 (difference 0.25±0.07, p=0.001). There was no significant difference in the femoral region (-0.08±0.06, p=0.435), but DSA100 received significantly higher score in the abdominal region (-0.26±0.12, p=0.036). However, after exclusion of patients with excessive intestinal gases (3/30, 10% of patients), the difference in the abdominal region decreased to (-0.10 ± 0.09, p=0.350) and was no longer significant.*Conclusions Our data show that, with some caveats, DVA allows a very substantial (70%) reduction of DSA-related radiation exposure in lower limb interventions, therefore this technology might increase the safety of these endovascular procedures.*Clinical Relevance/Application The previously observed quality reserve of Digital Variance Angiography allows for a substantial DSA-related radiation exposure reduction (up to 70%) in lower limb X-ray angiography without compromising the image quality.

RESULTS

DVA produced consistently higher (two to threefold) CNR than DSA. The highest ratios (3.0-3.1) were observed in the crural region. In the visual evaluation, DVA30 received significantly higher scores than DSA100 (difference 0.25±0.07, p=0.001). There was no significant difference in the femoral region (-0.08±0.06, p=0.435), but DSA100 received significantly higher score in the abdominal region (-0.26±0.12, p=0.036). However, after exclusion of patients with excessive intestinal gases (3/30, 10% of patients), the difference in the abdominal region decreased to (-0.10 ± 0.09, p=0.350) and was no longer significant.

CLINICAL RELEVANCE/APPLICATION

The previously observed quality reserve of Digital Variance Angiography allows for a substantial DSA-related radiation exposure reduction (up to 70%) in lower limb X-ray angiography without compromising the image quality.

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RI05-B

Reproductive Imaging Thursday Poster Discussions

Sub-Events

RI05-B1   **Imaging Overdiagnosis Of Acquired Uterine Arteriovenous Malformation**

Participants
Julia Saltalamacchia, MD, Portland, Oregon (*Presenter*) Nothing to Disclose

PURPOSE

The true incidence of uterine arteriovenous malformation (AVM) is unknown, but it has been increasingly reported in case series, usually without pathologic confirmation. Radiographic diagnosis of uterine AVM often discourages intervention such as dilation and curettage (D+C) due to concern for uncontrollable hemorrhage. As such, there have been increasing preemptive uterine artery embolizations (UAE). However, few examples in literature reliably distinguishes the presentation or imaging findings of a true uterine AVM from hypervascular retained products of conception (RPOC). This study aims to (1) assess the predictive value of an imaging diagnosis of AVM, and (2) evaluate the clinical course and outcomes of patients with imaging findings suspicious for uterine AVM at a single institution.*Methods and Materials This IRB-approved, retrospective study from 2000-2021, included all patients with imaging reports raising concerns for uterine AVM and excluded those with incomplete data or who were lost to follow up. Search terms included "uterine AVM," "uterine arteriovenous malformation," "uterus AND AVM," "uterus AND arteriovenous malformation". Initial presentation, b-HCG level, imaging reports, management, and pathology were collected and analyzed. Using the pathologic specimen as the standard when available, the positive predictive value of US was calculated.*Results A total of 22 patients were identified. All patients had transvaginal US, 10/22 (45%) had subsequent MRI, and 2/22 (9%) had subsequent CTA . Pathology specimen was available in 16/22 (73%) patients. The positive predictive value of US diagnosis of AVM was 6.3%. Subsequent MRI and CTA did not differ from initial US diagnosis. Most common final pathologic diagnosis was RPOC: 9/16 (56%). Others included normal endometrium, retained placenta accreta, and polyps. Of the 22 patients, 3/22 (14%) underwent hysterectomy, 6/22 (27%) UAE, 9/22 (40%) D&C, and 4/22 (18%) were managed conservatively. Only one out of six who underwent UAE had pathologically confirmed AVM; pathology from others included RPOC (3), normal endometrium (1), and placenta increta (1). Notably, of the patients with confirmed RPOC, (4/9) 45% had a negative b-HCG at presentation.*Conclusions US significantly overdiagnoses uterine AVM. MRI, CTA and b-HCG are unlikely to be helpful. The diagnosis of AVM may also result in unnecessary or over-treatment of these patients including UAE and hysterectomy.*Clinical Relevance/Application This study questions the true incidence of acquired AVM in existing literature. Knowing how significant the overdiagnosis is can encourage consideration of D+C or direct visualization and removal of tissue with hysteroscopy prior to pursuing more invasive treatment with UAE or hysterectomy.

RESULTS

A total of 22 patients were identified. All patients had transvaginal US, 10/22 (45%) had subsequent MRI, and 2/22 (9%) had subsequent CTA . Pathology specimen was available in 16/22 (73%) patients. The positive predictive value of US diagnosis of AVM was 6.3%. Subsequent MRI and CTA did not differ from initial US diagnosis. Most common final pathologic diagnosis was RPOC: 9/16 (56%). Others included normal endometrium, retained placenta accreta, and polyps. Of the 22 patients, 3/22 (14%) underwent hysterectomy, 6/22 (27%) UAE, 9/22 (40%) D&C, and 4/22 (18%) were managed conservatively. Only one out of six who underwent UAE had pathologically confirmed AVM; pathology from others included RPOC (3), normal endometrium (1), and placenta increta (1). Notably, of the patients with confirmed RPOC, (4/9) 45% had a negative b-HCG at presentation.

CLINICAL RELEVANCE/APPLICATION

This study questions the true incidence of acquired AVM in existing literature. Knowing how significant the overdiagnosis is can encourage consideration of D+C or direct visualization and removal of tissue with hysteroscopy prior to pursuing more invasive treatment with UAE or hysterectomy.

GU02-B

Genitourinary Monday Poster Discussions

Sub-Events

GU02-B2   **Bosniak Classification Version 2019: Validation And Comparison To Original Classification In Pathologically Confirmed Cystic Masses.**

Participants
Jin Hui Yan, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate Bosniak Classification v2019 definitions in pathologically confirmed cystic renal masses.*Methods and Materials IRB approved, cross-sectional study. 73 cystic (=25% solid) masses with histological confirmation (57 malignant, 16 benign) imaged by CT (N=28) or CT+MRI (N=56) between 2009-2019 were independently evaluated by three blinded radiologists using Bosniak v2019 and original classifications. Discrepancies were resolved by consensus with a fourth blinded radiologist. Overall class and v2019 features were compared to pathology.*Results Interobserver agreement was slightly improved comparing v2019 to Original Bosniak Classification (Kappa=0.26-0.47 versus 0.24-0.34 respectively). v2019 proportion of IIF and III masses (20.5% [15/73, 95% Confidence Interval [[CI]] 12.0-31.6%], 38.6% [28/73, 95%CI 27.2-50.5%]) differed from Original classification (6.8% [5/73, 95%CI 2.3-15.3%], 61.6% [45/73, 95%CI 49.5-72.8%]) with overlapping proportion of malignancy in each class. Mean septa number (7±4[range:1-10]) was not associated with malignancy (p=0.89). Mean wall, septa thickness were: 3±3(1-14) and 3±2(1-10) mm and higher in malignancies (p=0.03, 0.20 respectively). Area under receiver-operator-characteristic curve for wall, septa thickness were: 0.66 (95%CI 0.54-0.79) and 0.61 (95%CI 0.45- 0.78) with optimal cutpoint of =3 mm (sensitivity 33.3%, specificity 86.7% and sensitivity 53%, specificity 73% respectively). Proportion of malignancy occurring in masses with the v2019 features 'irregularity' (76.9% [10/13], 95% CI 46.2-94.9%) and 'nodule' (89.7% [26/29], 95%CI 72.7-97.8%) overlapped. Angle of 'nodule' (p=0.27) was not associated with malignancy.*Conclusions Bosniak v2019 definitions for wall/septa thickness and protrusions are associated with malignancy. Overall, Bosniak v2019 categorizes a higher proportion of malignant masses in Class IIF with slight improvement in inter-observer agreement.*Clinical Relevance/Application Overall Bosniak v2019 offers improvements to Original Classification and proposed definitions are associated with malignancy. Further simplifications to Bosniak v2019 may improve ease of use without compromising accuracy but will require further study.

RESULTS

Interobserver agreement was slightly improved comparing v2019 to Original Bosniak Classification (Kappa=0.26-0.47 versus 0.24-0.34 respectively). v2019 proportion of IIF and III masses (20.5% [15/73, 95% Confidence Interval [[CI]] 12.0-31.6%], 38.6% [28/73, 95%CI 27.2-50.5%]) differed from Original classification (6.8% [5/73, 95%CI 2.3-15.3%], 61.6% [45/73, 95%CI 49.5-72.8%]) with overlapping proportion of malignancy in each class. Mean septa number (7±4[range:1-10]) was not associated with malignancy (p=0.89). Mean wall, septa thickness were: 3±3(1-14) and 3±2(1-10) mm and higher in malignancies (p=0.03, 0.20 respectively). Area under receiver-operator-characteristic curve for wall, septa thickness were: 0.66 (95%CI 0.54-0.79) and 0.61 (95%CI 0.45- 0.78) with optimal cutpoint of =3 mm (sensitivity 33.3%, specificity 86.7% and sensitivity 53%, specificity 73% respectively). Proportion of malignancy occurring in masses with the v2019 features 'irregularity' (76.9% [10/13], 95% CI 46.2-94.9%) and 'nodule' (89.7% [26/29], 95%CI 72.7-97.8%) overlapped. Angle of 'nodule' (p=0.27) was not associated with malignancy.

CLINICAL RELEVANCE/APPLICATION

Overall Bosniak v2019 offers improvements to Original Classification and proposed definitions are associated with malignancy. Further simplifications to Bosniak v2019 may improve ease of use without compromising accuracy but will require further study.

Abstract Archives of the RSNA, 2021

Sub-Events

NR03-B10   **Molecular MRI Targeting Myeloperoxidase Activity Reveals Effects Of D-mannose On Host Response And Glioma Progression**

Participants
Negin Jalali Motlagh, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Host immune response in the tumor microenvironment plays key roles in tumorigenesis. We aimed to determine the effect D-mannose, a drug with anti-inflammatory properties, has on oxidative stress and glioma progression using molecular MRI targeting myeloperoxidase (MPO), a highly oxidizing enzyme secreted in host defense, in a mouse glioma model.*Methods and Materials Twenty-three immunocompetent C57BL/6J mice were intracranially implanted with CT-2A-luc mouse glioma stem cells. Three days after tumor implantation, mice were randomly divided into two groups (n= 11-12 per group) and treated intraperitoneally daily with 450mg/kg either D-mannose or with PBS as control. To evaluate MPO activity in vivo, mice were imaged on a 4.7T MRI scanner with 0.3mmol/kg of bis-5HT-DTPA-Gd (MPO-Gd) administered intravenously at 4 weeks after implantation. MPO activity assay and flowcytometry of brain leukocytes were also performed after MRI. Tumor size was tracked by bioluminescence (BLI) and MRI. In vitro MPO activity experiments were performed using activated leukocytes incubated with D-mannose (1 mg/ml, 2 mg/ml, 4 mg/ml). P<0.05 was considered statistically significance.*Results D-mannose treatment decreased the size of gliomas compared to those that were PBS-treated (mean ± SEM, p=0.0042 for BLI and p=0.0014 for MRI). Surprisingly, D-mannose increased MPO-Gd enhancement in the peritumoral brain parenchyma (p=0.015) a result corroborated by ex vivo MPO activity assays (mean ± SEM, p=0.0345 for MPO protein , p=0.0242 for MPO activity). On flowcytometry, D-mannose-treated glioma mice contained fewer MPO-containing cells compared to PBS-treated glioma mice (mean ± SEM, p<0.0001), revealing that D-mannose increased MPO secretion. In vitro experiments further confirmed that D-mannose increased MPO activity.*Conclusions Our results revealed that D-mannose unexpectedly increased secretion of active MPO from inflammatory leukocytes into the glioma microenvironment and this increased host immune response acted to reduce tumor size.*Clinical Relevance/Application Our study suggests that increasing MPO activity such as D-mannose administration may be potential new therapeutic direction for glioma treatment

RESULTS

D-mannose treatment decreased the size of gliomas compared to those that were PBS-treated (mean ± SEM, p=0.0042 for BLI and p=0.0014 for MRI). Surprisingly, D-mannose increased MPO-Gd enhancement in the peritumoral brain parenchyma (p=0.015) a result corroborated by ex vivo MPO activity assays (mean ± SEM, p=0.0345 for MPO protein , p=0.0242 for MPO activity). On flowcytometry, D-mannose-treated glioma mice contained fewer MPO-containing cells compared to PBS-treated glioma mice (mean ± SEM, p<0.0001), revealing that D-mannose increased MPO secretion. In vitro experiments further confirmed that D-mannose increased MPO activity.

CLINICAL RELEVANCE/APPLICATION

Our study suggests that increasing MPO activity such as D-mannose administration may be potential new therapeutic direction for glioma treatment

NR03-B11   **Spinal Cord Iatrogenesis!: Posttreatment Changes And Complications Of The Spinal Cord**

Participants
Sevcan Turk, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. With ongoing therapeutic advances, adverse health care induced effects in the central nervous system are being encountered more commonly. In some cases, these may result in severe morbidity. Radiologists who interpret neuroimaging exams must be aware of these entities in order to provide the correct diagnosis and help facilitate timely clinical management. 2. Our presentation will demonstrate common and rare iatrogenic injuries in the spinal cord that radiologists must recognize in routine practice.

TABLE OF CONTENTS/OUTLINE

1. Overview of imaging characteristics of a spectrum of common as well as rare spinal cord lesions after therapy with the review of acute/chronic complications- Post-radiation changeso Post-radiation changes may mimic tumor progression; DWI can provide additional information in the discrimination of radiation necrosis- Post-infectious changeso Post-infectious or post-chemotherapy enhancing lesions may mimic residual disease, however, decreasing edema may favor posttreatment sequela.- Changes after ischemiao Ischemia related myelopathy should always be considered after surgery and especially in patients with coagulopathy. DWI is the best sequence to diagnose.- Changes after trauma- Post-surgical spinal cord- Medication related spinal cord complicationso Medication related complications should always be considered in the differential for nonspecific spinal cord pathologies, especially when CSF is normal.- Immunosuppressed patients

NR03-B2   **Predictors Of Poor Functional Outcomes And Symptomatic Intracranial Hemorrhage After**

Endovascular Treatment In Early Versus Extended Time Windows

Participants
Sriharsha Voleti, BS, Mason, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

The safety profile of endovascular therapy (EVT) including incidence of symptomatic intracranial hemorrhage (sICH) is well studied in the early treatment window of 0-6 hours; however, there are limited data for extended windows of 6-24 hours. Our objective was to evaluate the risk factors for sICH after EVT for acute stroke treated in the early vs. extended time windows.*Methods and Materials We performed a retrospective review of our prospectively identified stroke registry at our Comprehensive Stroke Center. We included all patients receiving EVT between May 2016 to January 2019. We recorded demographics, clinical characteristics, procedure details, modified treatment in cerebral ischemia (mTICI) score, functional outcomes (mRS) and ICH on post-procedural head CT. Heidelberg Bleeding Classification was used to assign sICH. Multivariable regression analysis was performed to evaluate independent predictors for sICH.*Results Of the 424 patients who received EVT during the study period, 309 patients met our inclusion criteria. 205 (66.3%) patients received EVT in the early window and 104 (33.7%) patients received EVT in the extended window. Successful recanalization (mTICI 2B-3) was observed in 174 (84.9%) patients in the early window and 85 (81.7%) patients in the extended window. sICH was observed in 29 (14.1%) patients in the early window and 7 (6.7%) patients in the extended window. Differences in recanalization success (P = 0.53) and sICH (P = 0.055) were not statistically significant in early vs. extended window groups. Differences in favorable functional outcome (90-day mRS=2) in early vs. extended window groups (28.5% vs. 26.2%; P=0.675) were also not statistically significant. Pooled multivariable regression analysis showed >3 device passes (OR 5.64, 95% CI: 1.65-19.3, P = <0.05), initial NIHSS =21 (OR 4.66, 95% CI: 2.15-10.1, P = <0.05) and recanalization failure (OR 2.87, 95% CI: 1.11-7.38, P = <0.05) as independent predictors of poor outcomes (mRS >2) for all patients. In the extended window, NIHSS >10 was the only risk factor associated with poor functional outcome (NIHSS 11-20: OR 4.9, 95% CI: 1.67-14.4, P = <0.05; NIHSS =21: OR 7.02, 95% CI: 1.25-39.4, P = <0.05). There were no statistically significant predictors of sICH in either group.*Conclusions Incidence of sICH after EVT in the early vs extended windows is not significantly different. Poor functional outcomes are associated with >3 device passes, initial NIHSS =21, and recanalization failure for all patients receiving EVT.*Clinical Relevance/Application With the expanded EVT treatment windows for acute ischemic stroke, it is critical for radiologists and interventionalists to understand the predictors for symptomatic ICH.

RESULTS

Of the 424 patients who received EVT during the study period, 309 patients met our inclusion criteria. 205 (66.3%) patients received EVT in the early window and 104 (33.7%) patients received EVT in the extended window. Successful recanalization (mTICI 2B-3) was observed in 174 (84.9%) patients in the early window and 85 (81.7%) patients in the extended window. sICH was observed in 29 (14.1%) patients in the early window and 7 (6.7%) patients in the extended window. Differences in recanalization success (P = 0.53) and sICH (P = 0.055) were not statistically significant in early vs. extended window groups. Differences in favorable functional outcome (90-day mRS=2) in early vs. extended window groups (28.5% vs. 26.2%; P=0.675) were also not statistically significant. Pooled multivariable regression analysis showed >3 device passes (OR 5.64, 95% CI: 1.65-19.3, P = <0.05), initial NIHSS =21 (OR 4.66, 95% CI: 2.15-10.1, P = <0.05) and recanalization failure (OR 2.87, 95% CI: 1.11-7.38, P = <0.05) as independent predictors of poor outcomes (mRS >2) for all patients. In the extended window, NIHSS >10 was the only risk factor associated with poor functional outcome (NIHSS 11-20: OR 4.9, 95% CI: 1.67-14.4, P = <0.05; NIHSS =21: OR 7.02, 95% CI: 1.25-39.4, P = <0.05). There were no statistically significant predictors of sICH in either group.

CLINICAL RELEVANCE/APPLICATION

With the expanded EVT treatment windows for acute ischemic stroke, it is critical for radiologists and interventionalists to understand the predictors for symptomatic ICH.

NR03-B3   Likelihood Of Fluoroscopic Guided Lumbar Puncture Based On Patient Demographics And Consulting Service

Participants
Mark Oswood, MD,PhD, Shoreview, Minnesota (*Presenter*) Speakers Bureau, Koninklijke Philips NV

PURPOSE

Recent studies have demonstrated a shift of lumbar puncture performance from medicine services to the radiology department. The goal of this study is to examine the relationship of patient demographics and diagnosis to the likelihood that lumbar puncture would be performed with fluoroscopy (FLP) as well as assess trends over time.*Methods and Materials This is a retrospective study where all lumbar punctures performed at our institution over the span of 7 years were reviewed. Patients were divided into fluoroscopically assisted (FLP) and non-fluoroscopic groups. Variables such as age, BMI, HIV status, suspicion for MS and lumbar fusion history were compared between the groups. Patient location was also compared between emergency department and several outpatient clinics. The statistical significance of observed proportion differences was calculated using a ?2 test.*Results We identified a total of 2706 lumbar punctures during the study period. 541 (20%) lumbar punctures were performed by radiology. An overall higher percentage of elderly population (age>60) were FLP compared to other services (37.6% vs. 32.4%, p=0.03). Additionally, higher BMI (>30) significantly increased the likelihood of FLP (46.6% vs. 32.7%, p<0.001). Patients with prior lumbar spinal instrumentation or a suspicion for MS had a higher likelihood of FLP (4.1% vs. 0.7%, p<0.001; and 15.9% vs. 2.4%, p<0.001, respectively). Patients undergoing evaluation for HIV were also more likely to have FLP (9% vs. 6.2%, p=0.03). Patients from the neurology or oncology services were more likely to have FLP, compared to the ED (41.6% and 35% vs. 19.2%, p<0.001, respectively). The trend of procedures done in radiology increased over the study period, going from 6.3% in 2013 to 19.3% in 2019 (3%/year, r^2=0.58).*Conclusions Patients age>60 and BMI>30 were more likely to undergo FLP, which may be due to difficulties in bedside LP in these patients. Diagnosis associated with increased FLP included HIV and suspected MS. There was also a significantly increased likelihood of patients undergoing FLP when referred from the neurology or oncology services as opposed to patients treated in the ED. At our hospital, the ED makes an effort to train all providers in bedside LP. This training is not performed in other departments, which may result in increased use of radiology by other services. Finally, our data shows an increasing trend of FLP consistent with findings of Kroll et al (2015).*Clinical Relevance/Application At our institution, the use of FLP over this 7-year period resulted in approximately $541,000 of added costs for the patient and hospital. In a time with ever increasing healthcare costs, this could potentially be mitigated by additional training in bedside LP techniques.

RESULTS

We identified a total of 2706 lumbar punctures during the study period. 541 (20%) lumbar punctures were performed by radiology.

An overall higher percentage of elderly population (age>60) were FLP compared to other services (37.6% vs. 32.4%, p=0.03). Additionally, higher BMI (>30) significantly increased the likelihood of FLP (46.6% vs. 32.7%, p<0.001). Patients with prior lumbar spinal instrumentation or a suspicion for MS had a higher likelihood of FLP (4.1% vs. 0.7%, p<0.001; and 15.9% vs. 2.4%, p<0.001, respectively). Patients undergoing evaluation for HIV were also more likely to have FLP (9% vs. 6.2%, p=0.03). Patients from the neurology or oncology services were more likely to have FLP, compared to the ED (41.6% and 35% vs. 19.2%, p<0.001, respectively). The trend of procedures done in radiology increased over the study period, going from 6.3% in 2013 to 19.3% in 2019 (3%/year, r^2=0.58).

CLINICAL RELEVANCE/APPLICATION

At our institution, the use of FLP over this 7-year period resulted in approximately $541,000 of added costs for the patient and hospital. In a time with ever increasing healthcare costs, this could potentially be mitigated by additional training in bedside LP techniques.

NR03-B4   Prevalence Of White Matter Hyperintensities In Young Subjects With And Without Mild Traumatic Brain Injury

Participants
Eric Miller, MD, Columbus, Ohio (*Presenter*) Spouse, Employee, Boehringer Ingelheim GmbH

PURPOSE

White matter hyperintensities (WMH) on T2 FLAIR MRI are a frequently encountered neuroimaging finding of varying clinical significance. WMH have been found to be associated with an increased risk of adverse neurologic events, including impaired cognition, balance, dementia and mortality, and have been described in several neurological conditions such as migraine, cerebrovascular, and demyelinating diseases as well as the result of traumatic brain injury. These are also commonly reported in normal aging. Appropriate interpretation of WMH on young patients in the setting of mild Traumatic Brain Injury (mTBI) is currently a diagnostic challenge.*Methods and Materials All 412 mTBI patients and 182 healthy controls (ages 15-50) previously enrolled in Phase I and II of a large prospective multicenter clinical trial of advanced neuroimaging techniques in mTBI were included . MR imaging was performed utilizing 3T GE Signa MR750 (GE Healthcare, Waukesha, WI) scanners with a 32-channel brain radiofrequency coil (Nova Medical, Wilmington, MA). Imaging protocol included high resolution volumetric 3D T1 MPRAGE and T2 FLAIR CUBE sequences. MRI data was standardized by use of a uniform protocol, scanner manufacturer and model, radiofrequency (RF) coil, and sequences as well as centralized processing. MRI images were reviewed by 2 blinded board certified neuroradiologists. WMH were counted and classified as "abnormal" if =5 objective punctate white matter foci were present, any single lesion was >3 mm in maximal diameter were present, or if any lesion was located in atypical location (defined as outside the most commonly encountered subcortical locations of frontoparietal regions).*Results There was no significant difference in the mean age and gender among the healthy controls and mTBI patients (p=0.570 and 0.238). WMH were observed in 32% of mTBI patients and 39% of the controls (p=0.143). Abnormal WMH by any qualifier were seen in 33% mTBI patients and 41% of controls (p= 0.813). Subjects with WMH categorized as abnormal were significantly older than patients with WMH without abnormal features (27±12 vs 22±8, p<0.000).*Conclusions Our study found no statistical difference in the presence of WMH or in abnormal appearing WMH between mTBI population and healthy controls.*Clinical Relevance/Application This study is the largest-to-date on the incidence of WMH between patients with mTBI and healthy controls on high resolution 3T MRI. We used a highly standardized protocol for data acquisition, collection, interpretation, and analysis which are strengths of this study. Our findings also differs from the commonly held dogma of an association with WMH and mTBI from previously published underpowered or outdated studies.

RESULTS

There was no significant difference in the mean age and gender among the healthy controls and mTBI patients (p=0.570 and 0.238). WMH were observed in 32% of mTBI patients and 39% of the controls (p=0.143). Abnormal WMH by any qualifier were seen in 33% mTBI patients and 41% of controls (p= 0.813). Subjects with WMH categorized as abnormal were significantly older than patients with WMH without abnormal features (27±12 vs 22±8, p<0.000).

CLINICAL RELEVANCE/APPLICATION

This study is the largest-to-date on the incidence of WMH between patients with mTBI and healthy controls on high resolution 3T MRI. We used a highly standardized protocol for data acquisition, collection, interpretation, and analysis which are strengths of this study. Our findings also differs from the commonly held dogma of an association with WMH and mTBI from previously published underpowered or outdated studies.

NR03-B6   Automated Early Ischemic Change Segmentation And Aspects Scoring On Non-contrast Computed Tomography: A Comparison To Expert Neuroradiologists

Participants
Luis Souto Maior Neto, MSc, Calgary, Alberta (*Presenter*) Developer, Circle Cardiovascular Imaging Inc

PURPOSE

Non-Contrast Computed Tomography (NCCT) is used to diagnose and make treatment decisions in most patients with acute ischemic stroke (AIS). Estimating the extent of Early Ischemic Changes (EIC) on NCCT is therefore an important task. The Alberta Stroke Program Early Computed Tomography Score (ASPECTS) was introduced to standardize assessment of EIC extent. Due to the low contrast and signal-to-noise ratio, detecting EIC, and subsequently determining ASPECTS, is challenging. In this study, we present StrokeSENS ASPECTS: a deep-learning-based tool for EIC segmentation and automatic ASPECTS assessment and compare it to expert ratings.*Methods and Materials 538 subjects were included. StrokeSENS ASPECTS was used to segment EIC via a 3D convolutional neural network developed on 438 subjects. ASPECTS regions were segmented by means of atlas-based registration. ASPECTS regions were deemed affected via their overlap with the predicted EIC segmentation. The affected hemisphere is determined based on the side with greater overlap, and the ASPECTS is computed by subtracting the number of affected regions from 10. For the remaining unseen 100 subjects, data labelled by two expert neuro-radiologists was used as the inter-rater performance benchmark. EIC segmentation was evaluated using the Dice Similarity Coefficient (DSC), and lesion volumetric agreement by means of Intraclass Correlation Coefficient (ICC). Total ASPECT score was evaluated by means of ICC. ASPECT region-level classification performance is reported in terms of clustered Area-Under-the-Curve (AUC).*Results We compare Expert-2 vs. Expert-1, the model vs. Expert-1, and the model vs. Expert-2 on the test set of 100 patients; we report all the metrics for the combinations listed in this order. Median lesion DSC with Interquartile Range were 54.8% [41%-69%], 41.7% [22%-60%], and 42.3% [14%-59%] respectively. Lesion volume ICCs [95% Confidence Interval (CI)] were 94.9% [92%-97%], 83.8% [77%-89%], 80.8% [73%-87%]. Total ASPECTS ICCs [95% CI] were 94.1% [91%-96%], 75.5% [66%-83%], and 75.4% [66%-83%]. Region

level ASPECTS AUC [95% CI] were 91.2% [89%-93%], 84.7% [81%-89%], 84.0% [80%-88%].*Conclusions The proposed algorithm can segment EIC on NCCT and predict ASPECTS with reasonable accuracy when compared to the human gold standard i.e., an expert neuro-radiologist.*Clinical Relevance/Application This model has been integrated into the commercial StrokeSENS software and will be readily available for use by clinicians. This can be a valuable tool in assisting clinicians making rapid, accurate diagnosis and treatment decisions for AIS patients in hospitals and clinical centers. It can be especially useful in remote regions where clinical expertise and neuroimaging techniques may be limited.

RESULTS

We compare Expert-2 vs. Expert-1, the model vs. Expert-1, and the model vs. Expert-2 on the test set of 100 patients; we report all the metrics for the combinations listed in this order. Median lesion DSC with Interquartile Range were 54.8% [41%-69%], 41.7% [22%-60%], and 42.3% [14%-59%] respectively. Lesion volume ICCs [95% Confidence Interval (CI)] were 94.9% [92%-97%], 83.8% [77%-89%], 80.8% [73%-87%]. Total ASPECTS ICCs [95% CI] were 94.1% [91%-96%], 75.5% [66%-83%], and 75.4% [66%-83%]. Region level ASPECTS AUC [95% CI] were 91.2% [89%-93%], 84.7% [81%-89%], 84.0% [80%-88%].

CLINICAL RELEVANCE/APPLICATION

This model has been integrated into the commercial StrokeSENS software and will be readily available for use by clinicians. This can be a valuable tool in assisting clinicians making rapid, accurate diagnosis and treatment decisions for AIS patients in hospitals and clinical centers. It can be especially useful in remote regions where clinical expertise and neuroimaging techniques may be limited.

NR03-B9   Comparison Of Qualitative And Quantitative Assessment Of Hypoxic Ischemic Brain Injury Severity On MRI

Participants
Evan Calabrese, MD, PhD, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

To compare radiologists' subjective assessment of hypoxic ischemic brain injury severity in cardiac arrest patients with quantitative severity assessment based on volumetric analysis of diffusion weighted images.*Methods and Materials We retrospectively analyzed MR images from 100 patients who underwent radiologic assessment for neuroprognostication following cardiac arrest at a single hospital over a 5 year period. Neuroradiologist readers evaluated diffusion MRI using a previously published 4 point scale (no significant abnormality, mild abnormality, moderate abnormality, and severe abnormality).Diffusion weighted MR images (DWIs) were quantitatively evaluated using a custom image processing pipeline implemented in Python 3.7. Processing steps included diffeomorphic registration to a standard atlas space, skull stripping, and thresholding of brain parenchyma with apparent diffusion coefficient (ADC) less than 650×10^{-6} mm2/s to identify areas of injury.A data driven quantitative severity index was developed using k-means clustering of thresholded ADC data with k=4 corresponding to a 4 point qualitative scale. Qualitative and quantitative assessments of injury severity were compared using Spearman rank correlation and the Mann-Whitney U test with P < 0.05 considered significant.*Results Radiologists' qualitative assessment corresponded to median ± interquartile range of brain parenchyma with ADC < 650×10^{-6} mm2/s of 75 ± 44 mL for "no significant abnormality", 94 ± 11 mL for "mild abnormality", 156 ± 193 mL for "moderate abnormality", and 449 ± 330 mL for "severe abnormality". Radiologists' subjective severity index was moderately well correlated with the data driven severity index (Spearman rank correlation = 0.75). Subjective severity rank was lower than the data driven severity index by 0.05 ranks, on average, though this difference did not reach statistical significance (P = 0.29).*Conclusions Radiologists' subjective assessment of hypoxic ischemic brain injury severity on MRI was moderately well correlated with a quantitative data driven severity index and tended to underestimate severity, though this difference was not significant with a sample size of 100. Regional assessment of brain injury and correlation with functional outcomes are important remaining questions that will be addressed in future work.*Clinical Relevance/Application Imaging evaluation of hypoxic ischemic brain injury is important for neuroprognostication in cardiac arrest patients, yet quantitative validation of radiologists' subjective severity assessment is lacking.

RESULTS

Radiologists' qualitative assessment corresponded to median ± interquartile range of brain parenchyma with ADC < 650×10^{-6} mm2/s of 75 ± 44 mL for "no significant abnormality", 94 ± 11 mL for "mild abnormality", 156 ± 193 mL for "moderate abnormality", and 449 ± 330 mL for "severe abnormality". Radiologists' subjective severity index was moderately well correlated with the data driven severity index (Spearman rank correlation = 0.75). Subjective severity rank was lower than the data driven severity index by 0.05 ranks, on average, though this difference did not reach statistical significance (P = 0.29).

CLINICAL RELEVANCE/APPLICATION

Imaging evaluation of hypoxic ischemic brain injury is important for neuroprognostication in cardiac arrest patients, yet quantitative validation of radiologists' subjective severity assessment is lacking.

Abstract Archives of the RSNA, 2021

Sub-Events

GI01-B2   **Her-2 Differentiation In Gastric Cancer: The Value Of CT Perfusion And Spectral CT Quantitative Parameters**

Participants
Zhang Min, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of Revolution CT perfusion imaging combined with energy spectrum enhanced scanning in evaluating the status of HER-2 expression in gastric cancer.*Methods and Materials 68 patients confirmed of gastric cancer with gastroscopy were examined preoperative perfusion CT (PCT) and energy spectrum enhanced CT and curative gastrectomy. The enrolled cases were divided according to HER2 expression in term of positive (n=15)and negative group(n=53). Blood-flow (BF), blood volume (BV), mean transmit time (MTT), time to peak (TTP), permeability surface (PS) ,arterial phase and venous phase enhanced spectral CT quantitative indicators were compared were calculated. One-way analysis of variance (ANOVA) were performed in each group. A receiver operating characteristic (ROC) analysis was applied to evaluate the diagnostic performance of meaningful parameters.*Results There were statistical differences in PS and BV between HER2 positive group and negative group. The area under the ROC curve for the diagnosis of HER2 positive gastric cancer by BV and PS was 0.843(sensitivity, 73.6%; specificity, 93.3%) and 0.819(sensitivity, 77.4%; specificity, 80.0%), with the cut-off value of 38.25 ml/100g/min and 5.01ml/100g, respectively. volume iodine content and Slope of energy spectrum curve in both artery and venous phases were significantly different between HER2 positive group and negative group.(p<0.05)The area under the ROC curve for the diagnosis of HER2 positive gastric cancer by volume iodine content and Slope of energy spectrum curve in both artery and venous phases was 0.697(sensitivity, 84.9%; specificity, 66.7%) ,0.730 (sensitivity, 60.4%; specificity, 86.7%),0.786(sensitivity, 60.4%; specificity, 93.3%),0.787(sensitivity, 64.0%; specificity, 86.7%)with the cut-off value of 8.265(100 µg / mL),1.415 , 30.87(100 µg / mL)and 1.905.*Conclusions PCT and energy spectrum enhanced scanning can accurately evaluate the HER2 positive gastric cancer with certain quantitative indicators.*Clinical Relevance/Application The PCT and energy spectrum enhanced scanning can serve as alternative diagnosis method to distinguish HER2 positive gastric cancer.

RESULTS

There were statistical differences in PS and BV between HER2 positive group and negative group. The area under the ROC curve for the diagnosis of HER2 positive gastric cancer by BV and PS was 0.843(sensitivity, 73.6%; specificity, 93.3%) and 0.819(sensitivity, 77.4%; specificity, 80.0%), with the cut-off value of 38.25 ml/100g/min and 5.01ml/100g, respectively. volume iodine content and Slope of energy spectrum curve in both artery and venous phases were significantly different between HER2 positive group and negative group.(p<0.05)The area under the ROC curve for the diagnosis of HER2 positive gastric cancer by volume iodine content and Slope of energy spectrum curve in both artery and venous phases was 0.697(sensitivity, 84.9%; specificity, 66.7%) ,0.730 (sensitivity, 60.4%; specificity, 86.7%),0.786(sensitivity, 60.4%; specificity, 93.3%),0.787(sensitivity, 64.0%; specificity, 86.7%)with the cut-off value of 8.265(100 µg / mL),1.415 , 30.87(100 µg / mL)and 1.905.

CLINICAL RELEVANCE/APPLICATION

The PCT and energy spectrum enhanced scanning can serve as alternative diagnosis method to distinguish HER2 positive gastric cancer.

GI01-B4   **Bounding Box-based Radiomic Model For Detecting Occult Peritoneal Metastasis In Advanced Gastric Cancer: A Multicenter Study**

Participants
Dan Liu, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop a radiomic model based on the region of interest annotated by bounding box for the preoperative diagnosis of occult peritoneal metastasis (OPM) in patients with advanced gastric cancer(AGC), by taking both primary tumor and peritumoral tissues into consideration.*Methods and Materials A total of 599 patients with AGC from 3 centers were retrospectively enrolled in this study, and were divided into a training cohort, a validation cohort, and a testing cohort for externally validation purpose. The ROIs (the regions of interest for the largest tumor area), BBOX (minimum circumscribed rectangle of the ROIs), peritumoral or PERI (non-overlapping area between the ROIs and BBOX) and M_BBOX(the smallest rectangular that could completely contain the lesion determined by radiologist) were used as inputs to extract the radiomic features, respectively. Multivariate logistic regression was used to construct the radiomic classification model for evaluating prediction ability. A clinical model using multivariable logistic regression was also developed to estimate the pretest probability of OPM in patients with GC.*Results The BBOX radiomic model considering both primary tumour and near surrounding tissue performed highest area under the ROC curve (AUC) of 0.873[0.820-0.940], outperforming other radiomic models. The M_BBOX model was not significantly different from BBOX in the validation cohort (AUC: M_BBOX model 0.871 [0.814-0.940] vs. BBOX model 0.873 [0.820-0.940]; p = 0.937). The M_BBOX was used as the final radiomic model because of its extremely low annotation cost and superior discrimination performance of OPM, with a higher sensitivity of 85.7% and a higher specificity of 82.8% than that of the clinical model. Besides, the radiomic model showed

comparable diagnostic efficacy in the testing cohort.*Conclusions The bounding box is of low annotation cost. The proposed radiomic model based on the bounding box annotation containing both primary tumor and proximal peritumoral tissue achieved higher diagnostic accuracy for OPM diagnosis in AGC patients than the clinical model. And, the proposed radiomic model had potential generalization ability.*Clinical Relevance/Application The bounding box—an easy-to-use, time-saving and inexpensive procedure to annotate medical images, was of lower annotation cost than the manual delineation. The proposed radiomic model based on the bounding box annotation achieved satisfied diagnostic performance, and may have significant clinical implications in the early detection and diagnosis of OPM in patients with AGC.

RESULTS

The BBOX radiomic model considering both primary tumour and near surrounding tissue performed highest area under the ROC curve (AUC) of 0.873[0.820-0.940], outperforming other radiomic models. The M_BBOX model was not significantly different from BBOX in the validation cohort (AUC: M_BBOX model 0.871 [0.814-0.940] vs. BBOX model 0.873 [0.820-0.940]; p = 0.937). The M_BBOX was used as the final radiomic model because of its extremely low annotation cost and superior discrimination performance of OPM, with a higher sensitivity of 85.7% and a higher specificity of 82.8% than that of the clinical model. Besides, the radiomic model showed comparable diagnostic efficacy in the testing cohort.

CLINICAL RELEVANCE/APPLICATION

The bounding box—an easy-to-use, time-saving and inexpensive procedure to annotate medical images, was of lower annotation cost than the manual delineation. The proposed radiomic model based on the bounding box annotation achieved satisfied diagnostic performance, and may have significant clinical implications in the early detection and diagnosis of OPM in patients with AGC.

GI01-B7   Natural History Of Arterial Phase Hyperenhancing Lesions In Fontan Associated Liver Disease

Participants
Mariana Yalon, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To determine the natural history of arterial phase hyper enhancing (APHE) lesions developing in patients with Fontan-associated liver disease (FALD) on a long-term follow-up on CT and MRI.*Methods and Materials We retrospectively reviewed 259 post-Fontan patients with APHE at baseline CT/MRI. With exclusion criteria of at least one follow-up CT/MRI and >3months from baseline, the final study group comprised of 70 patients (M: F=42:28; median age, 35 years) with 349 lesions. APHE were classified into : a) Typical focal nodular hyperplasia (FNH)-like lesion when APHE lesion demonstrated isodensity/isointensity on portal venous phase (PVP) ± washout on delayed phase (DP); b) Atypical when there was washout in PVP ± washout on delayed phase (DP); and c) uncharacterizable when all three dynamic phases were not available for assessment. The size of lesion at baseline and at follow ups, change in size, duration of follow-up per lesion, and change in imaging characteristics were recorded.*Results Median APHE lesion size at baseline was 9mm (range 2-73mm) and had a median follow-up of 2.2 years (range 0.2-18.5) years. The majority (73%) of lesions did not show any increase in size during follow up: 77 lesions (22%) were stable, 69 lesions (20%) decreased in size, and 109 lesions (31%) disappeared during follow-up. Ninety-three lesions (27%) showed increase in size. 88% of all APHE lesions had typical features and 12% had atypical features. The lesion size at baseline or atypical/typical imaging features were not predictors of lesion growth or regression. Similarly, the size of the lesion was not determinant of characteristic of the lesion. A final diagnosis of HCC was made in 5 lesions (1.4%). All HCCs had atypical imaging features and showed interval increase in size.*Conclusions APHE lesions are common in patients with FALD. Majority of the APHE lesions remain stable, decrease in size, or completely disappear on follow up imaging with CT/MRI. Most APHE lesions show typical FNH like lesions. HCCs show atypical features on CT and MRI and increase in size. Serial imaging follow-up is important in this population to determine the nature of the lesion.*Clinical Relevance/Application Most APHE lesions in FALD tend to remain stable, regress, or disappear during long term follow up. Only a small number turn out to be HCCs. Imaging follow up is important in determining the nature of these lesions.

RESULTS

Median APHE lesion size at baseline was 9mm (range 2-73mm) and had a median follow-up of 2.2 years (range 0.2-18.5) years. The majority (73%) of lesions did not show any increase in size during follow up: 77 lesions (22%) were stable, 69 lesions (20%) decreased in size, and 109 lesions (31%) disappeared during follow-up. Ninety-three lesions (27%) showed increase in size. 88% of all APHE lesions had typical features and 12% had atypical features. The lesion size at baseline or atypical/typical imaging features were not predictors of lesion growth or regression. Similarly, the size of the lesion was not determinant of characteristic of the lesion. A final diagnosis of HCC was made in 5 lesions (1.4%). All HCCs had atypical imaging features and showed interval increase in size.

CLINICAL RELEVANCE/APPLICATION

Most APHE lesions in FALD tend to remain stable, regress, or disappear during long term follow up. Only a small number turn out to be HCCs. Imaging follow up is important in determining the nature of these lesions.

GI01-B9   Feasibility of Abdominal MRI in Patients With Residual Concentrated Enteric Contrast After Fluoroscopic Abdominal Examination

Participants
Bari Dane, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of our study was to evaluate the image quality, image artifacts, radiologist confidence, and ability to provide definitive diagnosis for all patients with MRI performed after an abdominal fluoroscopic examination, to determine the utility of MRI in this setting.*Methods and Materials Thirty-one MRI examinations performed median 2 days after fluoroscopic bowel evaluation, 20 within 3 days of MRI, were retrospectively reviewed. The image quality, artifact emanating from bowel, inhomogeneity artifact, radiologist confidence, ability to render a definitive diagnosis, and identification of emergent or important findings for all MRI examinations were assessed. These same features were evaluated on 5 CTs performed after fluoroscopy (prior to the MRI) in the same cohort.*Results All 31 MRI examinations performed after fluoroscopic studies with concentrated barium or iodine solutions were diagnostic for answering the clinical question according to radiologist and report review, regardless of magnet strength and type of fluoroscopic contrast ingested. MRI after fluoroscopy had excellent overall image quality (mean score 4.74/5), minimal to no artifact emanating from bowel (mean 4.63/5), minimal inhomogeneity artifact (mean 4.38/5), and excellent diagnostic confidence (mean 4.98/5). No additional imaging was necessary for diagnosis after MRI. CT after fluoroscopy had lower overall image quality, more image artifacts, and lower diagnostic confidence (p<0.05).*Conclusions MRI is a useful tool for evaluating patients with

retained concentrated enteric contrast from recent fluoroscopic examinations. In the absence of contraindication, MRI should be considered in the evaluation of urgent clinical problems in patients who recently underwent a fluoroscopic bowel evaluation.*Clinical Relevance/Application Abdominal MRI is a useful diagnostic clinical examination that can be performed immediately after the administration of high density orally administered contrast from a fluoroscopic procedure, without compromising exam quality. Although CT is readily available and often preferentially utilized in urgent settings, the streak artifact emanating from residual high-density concentrated enteric contrast from fluoroscopy may render CT examinations in this setting nondiagnostic.

RESULTS

All 31 MRI examinations performed after fluoroscopic studies with concentrated barium or iodine solutions were diagnostic for answering the clinical question according to radiologist and report review, regardless of magnet strength and type of fluoroscopic contrast ingested. MRI after fluoroscopy had excellent overall image quality (mean score 4.74/5), minimal to no artifact emanating from bowel (mean 4.63/5), minimal inhomogeneity artifact (mean 4.38/5), and excellent diagnostic confidence (mean 4.98/5). No additional imaging was necessary for diagnosis after MRI. CT after fluoroscopy had lower overall image quality, more image artifacts, and lower diagnostic confidence ($p < 0.05$).

CLINICAL RELEVANCE/APPLICATION

Abdominal MRI is a useful diagnostic clinical examination that can be performed immediately after the administration of high density orally administered contrast from a fluoroscopic procedure, without compromising exam quality. Although CT is readily available and often preferentially utilized in urgent settings, the streak artifact emanating from residual high-density concentrated enteric contrast from fluoroscopy may render CT examinations in this setting nondiagnostic.

Printed on: 06/28/22

CA03-B

Cardiac Tuesday Poster Discussions

Sub-Events

CA03-B1   **Early Detection And Serial Monitoring During Chemotherapy-radiation Therapy: Using T1 And T2 Mapping Cardiac Magnetic Resonance Imaging**

Participants
Yaotian Tian, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

The study aimed to explore the feasibility of Native T1 and T2 Mapping for detecting and monitoring the early changes in left ventricular function and tissue characteristics in patients with chemotherapy-radiation therapy.*Methods and Materials 45 participants were enrolled in this prospective study, 15 participants (40% women; mean age, 60 years; range, 48-71 years) received non-anthracycline chemotherapy and chest radiotherapy, 30 were age/gender matched controls. CMR scan were performed before, at 48 hours, at 3 months, and at 6 months after chest radiotherapy. Myocardial native T1 and T2 were measured in irradiated areas and nonirradiated areas and the parameters about left ventricular function were obtained.*Results There were no significant differences in left ventricular function, native T1 and T2 between patients and controls before chest radiotherapy. In 15 participants who were followed up for 6 months, left ventricular ejection fraction(LVEF) had a transient decline At 48 hours after chest radiotherapy compared with baseline (57.30±3.20 vs 62.25±4.55; P=0.005), but returned to normal level since 3 months after chest radiotherapy. Native T1 were elevated at 3 months and 6 months in irradiated areas compared with baseline (1288.72±21.06 vs 1212.51±14.36 ; 1348.01±17.13 vs 1212.51±14.36; P=0.001 for both). But T2 only changed at 3 months in irradiated areas compared with baseline (44.21±3.35 vs 39.13±1.43; P = 0.003). Neither the native T1 nor T2 changed in nonirradiated areas during the follow-up period (all P >0.1).*Conclusions Native T1 could detect the early persistent changes in myocardium at 3 months and 6 months after chest radiotherapy, whereas LVEF and T2 showed abnormality reversibly. But non-anthracycline chemotherapy may have no influence in changes in left ventricular tissue characteristics.*Clinical Relevance/Application Chest radiotherapy can increase the long-term risk of cardiac death in cancer survivors. However, early detecting markers are needed. Native T1 and T2 mapping could detect the early myocardial injuries of cardiotoxicity due to cancer-related treatment. Therefore, they may help identify the myocardial changes caused by chest radiotherapy.

RESULTS

There were no significant differences in left ventricular function, native T1 and T2 between patients and controls before chest radiotherapy. In 15 participants who were followed up for 6 months, left ventricular ejection fraction(LVEF) had a transient decline At 48 hours after chest radiotherapy compared with baseline (57.30±3.20 vs 62.25±4.55; P=0.005), but returned to normal level since 3 months after chest radiotherapy. Native T1 were elevated at 3 months and 6 months in irradiated areas compared with baseline (1288.72±21.06 vs 1212.51±14.36 ; 1348.01±17.13 vs 1212.51±14.36; P=0.001 for both). But T2 only changed at 3 months in irradiated areas compared with baseline (44.21±3.35 vs 39.13±1.43; P = 0.003). Neither the native T1 nor T2 changed in nonirradiated areas during the follow-up period (all P >0.1).

CLINICAL RELEVANCE/APPLICATION

Chest radiotherapy can increase the long-term risk of cardiac death in cancer survivors. However, early detecting markers are needed. Native T1 and T2 mapping could detect the early myocardial injuries of cardiotoxicity due to cancer-related treatment. Therefore, they may help identify the myocardial changes caused by chest radiotherapy.

PD04-D

Pediatric Wednesday Poster Discussions

Sub-Events

PD04-D1 **Performance And Dose Dependency Of Computer-aided Detection (CAD) Of Pulmonary Nodules In Tin-filtered Pediatric Ultra-low-dose Chest CT**

Participants
Philipp Josef Kuhl, MD, Wuerzburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic performance of a CAD system for pulmonary nodules and its dependence on radiation dose in pediatric ULDCT.*Methods and Materials 382 consecutive ULDCT scans were retrospectively reviewed. Scans with present inflammatory consolidations were excluded (n=128). Remaining 254 data sets were included, and 2 study groups were built based on the scan protocol applied: While tube voltage of 100kV was identical in both ULDCT protocols, the reference mAs (ref. mAs) was set to 30 mAs in 72 patients (m=34; mean age 11.0±4.8 years) whereas 182 patients (m=108; 11.6±5.1 years) were scanned using 96 ref. mAs. Three radiologists assessed the data sets regarding presence of pulmonary nodules in consensus reading and each nodule was categorized by size (2-3mm; >3mm). Their findings were compared to the CAD results and total CAD errors were quantified. Objective image noise (OIN) and measured and radiation dose was estimated using size-specific dose estimates (SSDE).*Results Using the 30 ref mAs setup, radiation dose was significantly lower when compared to the 96 ref. mAs group (0.15±0.09 vs. 0.49±0.19 mGy; p< 0.001). Image noise was significantly higher in all measured regions (all p<0.001). Detection rates differed significantly for pulmonary nodules 2-3mm (0.24 vs. 0.48, p=0.002) as well as >3mm (0.44 vs. 0.71, p=0.007). No significant difference was found regarding false positive findings per scan (0.33 vs. 0.39, p=0.53). No significant correlation between radiation dose and CAD errors was found for both nodule sizes.*Conclusions Lowering the parameters for automatic tube current modulation in pediatric ULDCT results in significant dose reduction but also in reduced detection rates of pulmonary nodules, suggesting a dose dependency of evaluated CAD system. Its performance was subpar especially for small pulmonary nodules. However, it can assist radiologists as second observer tool especially in detection of nodules >3mm even in tin-filtered ULDCT.*Clinical Relevance/Application Computer-aided detection (CAD) systems can assist in the detection of pulmonary nodules >3mm even in tin-filtered ULDCT but should be used with extreme care when reducing automatic tube current modulation.

RESULTS

Using the 30 ref mAs setup, radiation dose was significantly lower when compared to the 96 ref. mAs group (0.15±0.09 vs. 0.49±0.19 mGy; p< 0.001). Image noise was significantly higher in all measured regions (all p<0.001). Detection rates differed significantly for pulmonary nodules 2-3mm (0.24 vs. 0.48, p=0.002) as well as >3mm (0.44 vs. 0.71, p=0.007). No significant difference was found regarding false positive findings per scan (0.33 vs. 0.39, p=0.53). No significant correlation between radiation dose and CAD errors was found for both nodule sizes.

CLINICAL RELEVANCE/APPLICATION

Computer-aided detection (CAD) systems can assist in the detection of pulmonary nodules >3mm even in tin-filtered ULDCT but should be used with extreme care when reducing automatic tube current modulation.

Printed on: 06/28/22

BR02-B
Breast Monday Poster Discussions

Sub-Events

BR02-B1 Screening Analysis With Mammographic AI Of A Full Three Year Round. Standalone Performance In A Real World Study In A Novel Trusted Research Environment

Participants
Gerald Lip, MBBCh, Aberdeen, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

We detail use of a novel trusted research environment for the retrospective evaluation of a standalone artificial intelligence (AI) tool. The AI tool was evaluated on a new population and region not previously used for algorithmic development or training.*Methods and Materials We describe the evaluation of two sets of mammographic images stored within a trusted research environment hosted by a University. Data linkage was performed with a paperless breast screening reporting system. This environment allows for complete anonymisation of data to facilitate external analysis. The corresponding structured outcome data provides a high level of data integrity. The dataset comprises 3 years of consecutively acquired national breast screening activity at a medium-sized centre. Institutional permissions were also obtained.The AI tool analysis followed a standard machine learning (ML) format with a validation set of 12,120 cases and a final test set of 27,824 cases. No model alterations or re-training were conducted during or prior to the AI evaluation. Positive cases are defined as pathologically confirmed screen-detected breast cancers, not including cancers detected between screening rounds (interval cancers).*Results All cases were successfully analysed in the research environment.The number of cases in the 2016-17 year sample and 2017-19 sample respectively was 12,120 with 100 positives; and 27,824 with 229 positives. The AI results on the 2016-17 year sample revealed an AUC of 97.52; sensitivity of 91.00%; specificity of 91.11% and recall rate of 9.56%.The AI results on the 2017-19 year sample revealed an AUC of 95.69; sensitivity of 88.21%; specificity of 90.92% and recall rate of 9.73%.*Conclusions Successful use of a novel trusted research environment to conduct robust evaluation of an external AI tool was demonstrated on previously unseen, unenriched, sequential local data at-scale, whilst satisfying all regional governance and security requirements.The performance of the AI tool shows a high degree of sensitivity, specificity and an acceptable recall rate. The findings demonstrate generalisability of the AI tool to a previously unseen screening population.*Clinical Relevance/Application Use of a trusted research environment enabled close collaboration between academia, industry and clinical teams to enable a large-scale, real-world evaluation of an AI tool. This study demonstrates how an AI tool would perform as a standalone reader and its potential to contribute to the double reading workflow.

RESULTS

All cases were successfully analysed in the research environment.The number of cases in the 2016-17 year sample and 2017-19 sample respectively was 12,120 with 100 positives; and 27,824 with 229 positives. The AI results on the 2016-17 year sample revealed an AUC of 97.52; sensitivity of 91.00%; specificity of 91.11% and recall rate of 9.56%.The AI results on the 2017-19 year sample revealed an AUC of 95.69; sensitivity of 88.21%; specificity of 90.92% and recall rate of 9.73%.

CLINICAL RELEVANCE/APPLICATION

Use of a trusted research environment enabled close collaboration between academia, industry and clinical teams to enable a large-scale, real-world evaluation of an AI tool. This study demonstrates how an AI tool would perform as a standalone reader and its potential to contribute to the double reading workflow.

BR02-B10 New Horizons: Artificial Intelligence (AI) In Digital Breast Tomosynthesis (DBT)

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Julia Goldberg, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

DBT is a new standard of care in breast cancer screening with increased cancer detection and accuracy, though also brings new diagnostic challenges such as large quantity of images and doubling of reading time. While most current AI applications are for digital mammography (DM) rather than DBT, there are multiple potential opportunities for AI within the DBT breast imaging value chain. AI has been shown to improve radiologists' cancer detection rates and reduce reading time for DBT. Post-processing AI reconstruction techniques have been used to enhance the conspicuity of malignancies in DBT slices. Further development of AI models for DBT may facilitate prediction of breast cancer risk through analysis of health records, visual removal of normal dense breast tissue for improved cancer detection, and generation of synthetic images.

TABLE OF CONTENTS/OUTLINE

1. Technical overview of DBT. 2. Benefits and challenges of DBT within the breast imaging value chain. 3. Technical overview of DL models for DBT, especially in comparison to CAD. 4. Review literature of AI applications for DBT. 5. Identify technical challenges of AI for DBT. 6. Identify future opportunities of AI for DBT.

BR02-B11   Burnout And Stressors In Breast Radiologists Before Versus During The COVID-19 Pandemic

Participants
Grayson Baird, PhD, Providence, Rhode Island (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate burnout and stressors among breast radiologists during the COVID-19 pandemic compared with the year prior to COVID-19.*Methods and Materials Practicing members of the Society of Breast Imaging were electronically emailed a weblink to IRB-approved surveys in January 2021, 2020, and 2019. Surveys included questions from the Maslach Burnout Inventory(C) and specific stressors. Stressors evaluated included work pace, work-life balance, care of dependents, financial strain, job security, working in medicine. The 2021 survey also asked if radiologists were considering leaving their current practice and why. Data were compared between 2019-2021. Comparisons were made with generalized linear modeling.*Results The response rate for 2021 was 25% (261/1061) for those who opened the email. Of the respondents, 74% (194/261) were female, 82% (214/261) were white, 73% (191/261) were full time, 71% (185/261) were fellowship trained, 41% (106/261) had more than 20 years of experience, and 30% (79/261) were in academic practice. Respondents in 2021 reported levels of depersonalization (10.9) and emotional exhaustion (31.0) that exceed burnout thresholds while reporting high levels of personal accomplishment (42.0), a protective factor. These values were almost identical before the pandemic in 2020: (11.2 [10.2, 12.2], 31.1 [29.6, 32.6], 42.0 [41.3, 42.6], respectively, p=0.9). Respondents rated work/life balance as the highest stressor followed by having to practice faster than they would like (see Figure 1); however, 5 of the 6 stressors improved after the pandemic compared with in 2019 (p<.05). Conversely, when asked, participants perceived these stresses had gotten slightly worse since the pandemic p<.01). Almost 50% of respondents reported they were considering leaving their practice; the most common reason was work/life balance followed by interpersonal/cultural issues.*Conclusions Burnout rates amongst breast radiologists remain high but are unchanged during the COVID-19 pandemic. While participants perceived that some stressors were slightly worse during the pandemic, there was actually slight improvement in most measured stressors between the pre-pandemic and pandemic cohorts. Almost 50% of respondents reported they were considering leaving their current practice.*Clinical Relevance/Application Although symptoms of burnout and stressors are reported high in breast radiologists, they appeared to have not worsened during the COVID-19 pandemic. Nevertheless, almost 50% of respondents reported they were considering leaving their current practice.

RESULTS

The response rate for 2021 was 25% (261/1061) for those who opened the email. Of the respondents, 74% (194/261) were female, 82% (214/261) were white, 73% (191/261) were full time, 71% (185/261) were fellowship trained, 41% (106/261) had more than 20 years of experience, and 30% (79/261) were in academic practice. Respondents in 2021 reported levels of depersonalization (10.9) and emotional exhaustion (31.0) that exceed burnout thresholds while reporting high levels of personal accomplishment (42.0), a protective factor. These values were almost identical before the pandemic in 2020: (11.2 [10.2, 12.2], 31.1 [29.6, 32.6], 42.0 [41.3, 42.6], respectively, p=0.9). Respondents rated work/life balance as the highest stressor followed by having to practice faster than they would like (see Figure 1); however, 5 of the 6 stressors improved after the pandemic compared with in 2019 (p<.05). Conversely, when asked, participants perceived these stresses had gotten slightly worse since the pandemic p<.01). Almost 50% of respondents reported they were considering leaving their practice; the most common reason was work/life balance followed by interpersonal/cultural issues.

CLINICAL RELEVANCE/APPLICATION

Although symptoms of burnout and stressors are reported high in breast radiologists, they appeared to have not worsened during the COVID-19 pandemic. Nevertheless, almost 50% of respondents reported they were considering leaving their current practice.

BR02-B2   Differences And Similarities Between Ai Cad And Radiologist False Assessments In Screening Mammography

Participants
Mattie Salim, MD, Stockholm, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to evaluate the differences and similarities in false assessments between an artificial intelligence system (AI CAD) and a human reader in screening mammography.*Methods and Materials The retrospective study included 714 screening examinations for women diagnosed with breast cancer and 8,003 randomly selected healthy controls. Women flagged due to symptoms were excluded. Oversampling of controls was applied to attain a similar cancer proportion as in the source screening cohort. Cancer at screening or within 12 months defined positive ground truth. The abnormality threshold was predefined from a prior study. We examined how false positive (FP) and false negative (FN) assessments by AI CAD and the first radiologist (RAD), were associated with density and cancer invasiveness.*Results Among 113,120 screening examinations, there were 617 invasive and 83 in-situ cancers (14 missing). The FP assessments were 3,836 (33.9 per 1000) for AI CAD and 3,402 (30.1 per 1000) for RAD; FN were 125 (1.1 per 1000) for AI CAD and 163 (1.4 per 1000) for RAD. For both AI CAD and RAD, FN were more common for high-density than low-density women (p < 0.05) and, for radiologists only, for invasive than for in-situ (p = < 0.05). FP assessments were distributed between low- and high-density women with 1,820 (47%) and 2,016 (53%) for AI CAD; with 1,568 (46%) and 1,834 (54%) for RAD. FN assessments were distributed between low- and high-density women with 53 (42%) and 72 (58%) for AI CAD; with 59 (36%) and 104 (64%) for RAD; between in-situ and invasive cancer with 13 (11%) and 102 (89%) for AI CAD; 9 (6%) and 145 (94%) for RAD.*Conclusions False negative assessments were further biased towards high-density women for RAD compared to AI CAD; and towards in-situ compared to invasive cancer for AI CAD compared to RAD. False positive assessments were distributed similarly between high- and low-density women for AI CAD and RAD.*Clinical Relevance/Application Our findings support that AI can have an important complementary role when combined with radiologists - especially to increase sensitivity for high-density women.

RESULTS

Among 113,120 screening examinations, there were 617 invasive and 83 in-situ cancers (14 missing). The FP assessments were 3,836 (33.9 per 1000) for AI CAD and 3,402 (30.1 per 1000) for RAD; FN were 125 (1.1 per 1000) for AI CAD and 163 (1.4 per 1000) for RAD. For both AI CAD and RAD, FN were more common for high-density than low-density women (p < 0.05) and, for radiologists only, for invasive than for in-situ (p = < 0.05). FP assessments were distributed between low- and high-density women with 1,820 (47%) and 2,016 (53%) for AI CAD; with 1,568 (46%) and 1,834 (54%) for RAD. FN assessments were distributed between low- and high-density women with 53 (42%) and 72 (58%) for AI CAD; with 59 (36%) and 104 (64%) for RAD; between in-situ and invasive cancer with 13 (11%) and 102 (89%) for AI CAD; 9 (6%) and 145 (94%) for RAD.

CLINICAL RELEVANCE/APPLICATION

Our findings support that AI can have an important complementary role when combined with radiologists - especially to increase sensitivity for high-density women.

BR02-B4   Principles And Implications In The Selection Of Abnormality Threshold For An AI Algorithm As An Independent Reader Of Screening Mammography

Participants
Karin Dembrower, MD, Stockholm, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

AI algorithms are developed rapidly worldwide to improve efficiency and address the massive lack of breast radiologists. To prepare for a prospective study on replacing one of two readers in a double-reading setting, we explored a retrospective dataset to determine the implications of two alternative principles for choosing the abnormality threshold - above which an examination should go to consensus discussion.*Methods and Materials All women with breast cancer and randomly selected controls during 2012 to 2015 in our uptake area, who had mammograms from Philips equipment, were included. Mammograms were scored by a commercial AI (Insight MMG version 1.1.6, from Lunit Inc., South Korea). We evaluated two principles to decide the abnormality threshold. Principle one: The sensitivity of the AI algorithm should match the sensitivity of second-readers. Principle two: The sensitivity of combined AI and first-readers should match the sensitivity of combined first- and second-readers. We determined the sensitivity and abnormal interpretation rate (AIR) for each reader and combination of readers.*Results 1684 women were diagnosed with breast cancer and 5024 remained healthy. Observations of healthy women were upsampled to mimic the 0.5% proportion of screen-detected cancer in the source screening cohort. The overall sensitivity for first-readers, second-readers and combined was 69.7%, 75.6% and 78.6% respectively. The corresponding AIRs were 4.44%, 4.56% and 6.06% respectively. Principle one implied AI sensitivity 75.6%, and combined first-reader and AI sensitivity became 82.4% with AIR 12.6%. Principle two led to AI sensitivity 65.9%, with combined first-reader and AI sensitivity of 78.6% with AIR 6.99%.*Conclusions When implementing AI as an independent reader in a double-reading setting, the choice of abnormality threshold will have important consequences. If set to have AI operate at the same sensitivity as one radiologist, a marked increase in abnormal assessments must be accepted. If set to maintain the combined double-reader sensitivity, a lower sensitivity of AI alone compared to one radiologist must be accepted.*Clinical Relevance/Application A reasonable implementation of AI in a double-reading setting to maintain double-reader sensitivity will mean that AI operates at a markedly lower stand-alone sensitivity compared to one radiologist. The rationale must be clearly communicated to involved radiologists to avoid immediate distrust in AI before cancer detection results are available. This insight was valuable in a recent launch of a prospective clinical trial at our institution.

RESULTS

1684 women were diagnosed with breast cancer and 5024 remained healthy. Observations of healthy women were upsampled to mimic the 0.5% proportion of screen-detected cancer in the source screening cohort. The overall sensitivity for first-readers, second-readers and combined was 69.7%, 75.6% and 78.6% respectively. The corresponding AIRs were 4.44%, 4.56% and 6.06% respectively. Principle one implied AI sensitivity 75.6%, and combined first-reader and AI sensitivity became 82.4% with AIR 12.6%. Principle two led to AI sensitivity 65.9%, with combined first-reader and AI sensitivity of 78.6% with AIR 6.99%.

CLINICAL RELEVANCE/APPLICATION

A reasonable implementation of AI in a double-reading setting to maintain double-reader sensitivity will mean that AI operates at a markedly lower stand-alone sensitivity compared to one radiologist. The rationale must be clearly communicated to involved radiologists to avoid immediate distrust in AI before cancer detection results are available. This insight was valuable in a recent launch of a prospective clinical trial at our institution.

BR02-B5   Impact Of Extramammary Labels And Artifacts On Performance Of Deep Learning Algorithms In Mammography

Participants
Bonnie Joe, MD,PhD, San Francisco, California (*Presenter*) Institutional Research Grant, Kheiron Medical Technologies Institutional Research Agreement, GE Medical SystemsInstitutional Research Agreement, Siemens Healthineers

PURPOSE

To determine impact of objects external to breast tissue (laterality/view identifiers, jewelry, nonbreast body parts) on performance of deep learning algorithms for cancer detection at screening mammography.*Methods and Materials As part of an academic-industrial collaboration, a dataset from the academic institution of 82,398 de-identified screening 2D mammograms labelled with breast density, BI-RADS assessment and final pathology outcomes was collected as part of an IRB-approved, HIPAA-compliant study. A randomized holdout of 19,564 mammograms was set aside for benchmarking and not used for model training. No enrichment for cancers or any patient subgroup was performed. Using an automated process, the holdout was labeled as having (n=13231) or not having (n=6333) extramammary artifacts. Accuracy of the automated labeling was evaluated in a 2700 cancer-enriched subset of the holdout manually labelled for presence of artifacts. A research-only deep learning model naïve to academic institution's data was applied to the holdout. AUC performance on mammograms with and without artifacts was compared. Comparison was repeated after applying an automated segmentation algorithm to remove artifacts. Accuracy of this algorithm was evaluated against the 2700 mammogram subset. Demographics across total dataset, holdout, and subsets with/without artifacts were analyzed to confirm no confounding factors.*Results A range of extramammary artifacts were identified, most frequently a Lucite calibration phantom used to quantify breast density. Research-only model performance showed a 14.4% drop in AUC in mammograms with artifacts relative to those without. The drop was reduced to 4.4% with application of the segmentation algorithm. In the manually labelled 2700 case subset the segmentation algorithm demonstrated 99.8% accuracy for removing artifacts.*Conclusions Research-only model naïve to academic institution's data performed worse on mammograms with extramammary artifacts compared to mammograms without. Processing images with segmentation algorithm to remove artifacts mitigated but did not eliminate the drop in AUC performance. Investigation to understand impact of segmentation algorithm is ongoing.*Clinical Relevance/Application Deep learning algorithms can support screening mammography interpretation. Understanding how extramammary artifacts can impact model performance is key to avoid inadvertent bias.

RESULTS

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algorithm demonstrated 99.8% accuracy for removing artifacts.

CLINICAL RELEVANCE/APPLICATION

Deep learning algorithms can support screening mammography interpretation. Understanding how extramammary artifacts can impact model performance is key to avoid inadvertent bias.

BR02-B6   Comparison Of Performance Metrics Of Prevalence Versus Incidence Screening Contrast Enhanced Mammograms

Participants
Janice S. Sung, MD, New York, New York (*Presenter*) Research Grant, General Electric Company

PURPOSE

To compare the performance of contrast enhanced digital mammograms (CEDM) on prevalence versus incidence rounds of breast cancer screening.*Methods and Materials IRB approved retrospective review was performed to identify women who had their first CEDM performed for breast cancer screening between December 2012 -April 2016. Medical records were reviewed for risk factors (family history or personal history of breast cancer, BRCA status, high risk lesion, or thoracic radiation). The number of subsequent screening studies performed per women and the recall, short-term interval follow-up, biopsy recommendation, and cancer detection (CDR) rates were determined.*Results To date, the results of 803 screening CEDMs in 315 women have been reviewed. 177 women had a FH of breast cancer in a 1stdegree relative and 113 a PH of breast cancer. 188 women had 1 screening CEDM, and 127 between 2-8 studies (mean: 3.8). On the prevalence screen, the recall rate was 10% (32/315), BI-RADS 3 rate 2% (6/315), and biopsy recommendation rate 5% (16/315), compared to 12% (59/488), 3% (16/488), and 3%(17/488) respectively on incidence screens. For contrast only findings, the recall rate on the prevalence screen was 5% (16/315), compared to 3% (16/488) on incidence screens. Cancer was detected in 9 women, 4 on the prevalence screen (CDR: 13/1000) and 5 on incidence screens (CDR: 10/1000). The PPV3 of biopsy on prevalence screens was 25% (17% for contrast only findings), compared to 19% (20% for contrast only findings) on incidence screens.*Conclusions A high cancer detection rate is maintained with screening CEDM beyond the prevalence screen. Recall rate and PPV3 of biopsy related to contrast only findings improved with the availability of comparison studies.*Clinical Relevance/Application Screening CEDM maintains high performance beyond the prevalence screen. This is the first study to report on the performance of CEDM on subsequent screening rounds.

RESULTS

To date, the results of 803 screening CEDMs in 315 women have been reviewed. 177 women had a FH of breast cancer in a 1stdegree relative and 113 a PH of breast cancer. 188 women had 1 screening CEDM, and 127 between 2-8 studies (mean: 3.8). On the prevalence screen, the recall rate was 10% (32/315), BI-RADS 3 rate 2% (6/315), and biopsy recommendation rate 5% (16/315), compared to 12% (59/488), 3% (16/488), and 3%(17/488) respectively on incidence screens. For contrast only findings, the recall rate on the prevalence screen was 5% (16/315), compared to 3% (16/488) on incidence screens. Cancer was detected in 9 women, 4 on the prevalence screen (CDR: 13/1000) and 5 on incidence screens (CDR: 10/1000). The PPV3 of biopsy on prevalence screens was 25% (17% for contrast only findings), compared to 19% (20% for contrast only findings) on incidence screens.

CLINICAL RELEVANCE/APPLICATION

Screening CEDM maintains high performance beyond the prevalence screen. This is the first study to report on the performance of CEDM on subsequent screening rounds.

BR02-B8   Differentiating Malignant From Benign Breast Lesions Using Quantitative Analysis In Contrast-enhanced Spectral Mammography

Participants
Huizhi Cao, PhD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To quantitatively analyze the enhancement of breast lesions in contrast-enhanced spectral mammography (CESM) to improve the differential diagnosis ability.*Methods and Materials A total of 283 patients with breast lesions admitted from August 2020 to May 2021 were retrospectively analyzed. Quantitative analysis of all enhancing lesions was performed to measure the gray values of the lesion area of interest (ROI), tissue surrounding the lesion (ROI1), tissue away from the lesion and close to the chest (ROI2), and the tissue at the level of the maximum diameter of the normal pectoralis major muscle on the ipsilateral side of the lesion (ROI3). rROI1, rROI2 and rROI3 were relative gray value between (ROI1,ROI2 and ROI3) and ROI . Differences in gray values between different ROIs of benign and malignant lesions were compared. Taking the pathological results as the gold standard, we used the receiver operating characteristic (ROC) curve to evaluate the diagnostic efficacy of the ROI gray value and rROI for the lesions.*Results A total of 299 lesions were found in 283 patients, including 101 benign lesions and 198 malignant lesions. The ROI gray value, rROI1, rROI2, and rROI3 of malignant lesions were all significantly greater than those of benign lesions. For gray values of benign and malignant lesions of ROI, rROI1, rROI2 and rROI3 , AUC was 0.795, 0.833, 0.812 and 0.741, respectively. The statistically significant difference in the AUC was only found between rROI1 and ROI gray value, and rROI1 had the greatest diagnostic value.*Conclusions The gray value of malignant breast lesions was higher than that of benign lesions. The quantitative analysis of the gray value was useful in the differential diagnosis of benign and malignant breast lesions.*Clinical Relevance/Application Quantitative analysis in Contrast-enhanced spectral mammography has the potential value in the differential diagnosis of benign and malignant breast lesions.

RESULTS

A total of 299 lesions were found in 283 patients, including 101 benign lesions and 198 malignant lesions. The ROI gray value, rROI1, rROI2, and rROI3 of malignant lesions were all significantly greater than those of benign lesions. For gray values of benign and malignant lesions of ROI, rROI1, rROI2 and rROI3 , AUC was 0.795, 0.833, 0.812 and 0.741, respectively. The statistically significant difference in the AUC was only found between rROI1 and ROI gray value, and rROI1 had the greatest diagnostic value.

CLINICAL RELEVANCE/APPLICATION

Quantitative analysis in Contrast-enhanced spectral mammography has the potential value in the differential diagnosis of benign and malignant breast lesions.

Abstract Archives of the RSNA, 2021

Sub-Events

MK01-B2   Imaging Findings Of False Negative Lesions In Patients With Negative CT-guided Bone Biopsy

Participants
Eun ji Choi, seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Differentiating benign bone lesions with secondary bone malignancies (including hematologic malignancies) in imaging may be challenging and lead to pathological misclassification of these lesions. This study aimed to differentiate true negative lesions from false negative lesions in patients with a negative CT-guided bone biopsy in the spine or pelvic bone using imaging findings and clinical data.*Methods and Materials Of the 1205 patients who had undergone initial spine or pelvic bone biopsy between November 2008 and November 2019, 66 patients with negative bone biopsy results for suspected secondary bone malignancy were included. At least 6 months of imaging follow-up or re-biopsy were necessary for final diagnosis. Exclusion criteria were when infectious or inflammatory lesion was suspected, primary bone tumor, other benign conditions including fracture such as metallosis, osteoarthritis et al., or when CT guided biopsy was failed due to patient's non-cooperation. Two independent readers analyzed the MRI and CT images. Clinical data and formal reports of FDG-PET/CT and bone scans were collected. Univariate logistic regression analysis was performed for each finding, and statistically significant covariates were assessed using multivariate logistic regression.*Results Sixty-six lesions consisted of 38 true negative lesions and 28 false negative lesions. Grade 0 (lowest T1WI and highest T1WI of the lesion higher than that of undegenerated disc or muscle) T1WI (P < 0.001), isointense signal T2WI (P = 0.03), no or faint enhancement (P = 0.03), occult lesion on CT (P < 0.001), absence of cortical breakage or fracture (P < 0.001), maximum Standard Uptake Value below 3.6 (P = 0.001), and neutrophil to lymphocyte ratio lower than 3 (P = 0.042) were the variables associated with true negative lesions. Grade 0 T1WI and occult lesion on CT were the two most significant variables in the multivariate analysis. The odds ratio for the multivariable logistic regression model for the grade of T1-weighted signal and CT density of the lesions were 1.7 (95% CI: 0.4-3.1) and 2.6 (95% CI: 0.4-4.7), respectively.*Conclusions The lesions with grade 0 T1WI and unidentifiable CT lesions were associated with true negative lesions. Lesions without these imaging characteristics require vigorous imaging follow-up.*Clinical Relevance/Application Determining whether a negative biopsy result of spine or pelvis lesions is a true negative or a false negative based on imaging characteristics enables to decide optimal strategy including follow-up or rebiopsy.

RESULTS

Sixty-six lesions consisted of 38 true negative lesions and 28 false negative lesions. Grade 0 (lowest T1WI and highest T1WI of the lesion higher than that of undegenerated disc or muscle) T1WI (P < 0.001), isointense signal T2WI (P = 0.03), no or faint enhancement (P = 0.03), occult lesion on CT (P < 0.001), absence of cortical breakage or fracture (P < 0.001), maximum Standard Uptake Value below 3.6 (P = 0.001), and neutrophil to lymphocyte ratio lower than 3 (P = 0.042) were the variables associated with true negative lesions. Grade 0 T1WI and occult lesion on CT were the two most significant variables in the multivariate analysis. The odds ratio for the multivariable logistic regression model for the grade of T1-weighted signal and CT density of the lesions were 1.7 (95% CI: 0.4-3.1) and 2.6 (95% CI: 0.4-4.7), respectively.

CLINICAL RELEVANCE/APPLICATION

Determining whether a negative biopsy result of spine or pelvis lesions is a true negative or a false negative based on imaging characteristics enables to decide optimal strategy including follow-up or rebiopsy.

MK01-B3   Mri Lumbar Vertebrae Trabecular Parameters Correlates With Bone Mineral Density, But Not With Fragility Fractures

Participants
Jamilly Maciel, Fortaleza, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

Evaluate trabecular bone parameters extracted from magnetic resonance imaging (MRI) of the L3 vertebra of volunteers with and without fragility fractures (FF) in the spine and to evaluate potential correlations with lumbar spine (LS) bone mineral density (BMD).*Methods and Materials 64 volunteers performed Dual X-ray Absorptiometry of LS, being classified as: normal (CG), osteopenia and osteoporosis. Whole spine radiographs were performed for the diagnosis of subclinical vertebral FF. Gradient-echo (FFE) MRI sequence was acquired from L3 vertebra: TR/TE (ms): 7.9 / 3.9; flip angle: 25 °; FOV (mm): 50 x 60 x 50; 7:43 min, spatial resolution: 260 x 260 x 500 μm. Segmentation and image binarization were performed using 3D slicer and trabecular parameters were extracted with the Image J software: Euler (E), connectivity (C), trabecular thickness, trabecular spacing, bone volume and trabecular bone volume. Statistical difference between the groups was evaluated using the ANOVA and Duncan post-test. Correlation analyzes were performed using Spearman's correlation coefficient (r).*Results E and C showed significant differences between the CG (E = -89.31 ± 33.57, C = 60.81 ± 24.06) compared to the other groups (osteopenia without FF, E = -60,00 ± 18.04, C = 26.70 ± 20.97), (osteopenia with FF, E = -70.08 ± 25.84, C = 51.36 ± 27.42), (osteoporosis without FF, E = -81.92 ± 24.57, C = 44.60 ± 30.39) and (osteoporosis with FF, E = -62.50 ± 23.01, C = 37.60 ± 29.86). There was no significant difference in C and E between groups with and without FF, and nonsignificant difference between the groups in relation to the other trabecular parameters. We observed a negative correlation between BMD and E (r = -0.26) and a positive correlation

between BMD and C (r = 0.26). We did not observe a significant correlation between BMD and the other trabecular parameters. MRI extracted trabecular parameters did not differ between groups with and without FF.*Conclusions MRI trabecular parameters (E and C) correlated with BMD and showed significant difference between the CG and osteopenia/osteoporosis groups.*Clinical Relevance/Application Demonstrate the potential role of MRI to assess bone fragility.

RESULTS

E and C showed significant differences between the CG (E = -89.31 ± 33.57, C = 60.81 ± 24.06) compared to the other groups (osteopenia without FF, E = -60,00 ± 18.04, C = 26.70 ± 20.97), (osteopenia with FF, E = -70.08 ± 25.84, C = 51.36 ± 27.42), (osteoporosis without FF, E = -81.92 ± 24.57, C = 44.60 ± 30.39) and (osteoporosis with FF, E = -62.50 ± 23.01, C = 37.60 ± 29.86). There was no significant difference in C and E between groups with and without FF, and nonsignificant difference between the groups in relation to the other trabecular parameters. We observed a negative correlation between BMD and E (r = -0.26) and a positive correlation between BMD and C (r = 0.26). We did not observe a significant correlation between BMD and the other trabecular parameters. MRI extracted trabecular parameters did not differ between groups with and without FF.

CLINICAL RELEVANCE/APPLICATION

Demonstrate the potential role of MRI to assess bone fragility.

MK01-B4   Qualitative And Quantitative MR Imaging Features Of Syndromic Versus Sporadic Benign Peripheral Nerve Sheath Tumors

Participants
Shivani Ahlawat, MD, Ellicott City, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To compare the qualitative and quantitative magnetic resonance imaging (MRI) features of syndrome-related (associated with Neurofibromatosis type 1 (NF1), NF2, and Schwannomatosis) versus sporadic benign peripheral nerve sheath tumors (PNSTs).*Methods and Materials In this retrospective IRB-approved, HIPPA-compliant study, our pathology database was searched for "neurofibroma or schwannoma" from 2014-2019. Exclusion criteria were lack of available MRI and intradural or plexiform PNSTs. Qualitative and quantitative features (location, size, relationship with the nerve, shape, tumoral signal characteristics, peritumoral edema, target sign, fascicular sign, extra-compartmental extension, muscle denervation, early arterial enhancement on time-resolved perfusion sequence, ADC) were recorded. Imaging characteristics and clinical findings of sporadic and SR tumors were compared. Statistical significance was assumed for p< 0.05.*Results Eighty-three histologically-proven PNSTs (schwannomas [64/83, 77.1%] and neurofibromas [19/83, 22.9%]) were included. Of those, 42 schwannomas (65,6%) and 7 neurofibromas (36.8%) were sporadic, and 22 schwannomas (34.3%) and 12 neurofibromas (63.1%) were syndrome-related (SR) PNSTs. Sporadic schwannomas tended to be similar in size to SR schwannomas (2.9±1.2cm vs. 3.7±3.2cm, p=0.6), with greater heterogeneity on T2W (p=0.02) and static post-contrast sequences (p=0.01). Sporadic neurofibromas tended to be larger (4.6±1.5cm vs. 3.4±2.4cm, p=0.03), more heterogeneous on T2W (7/7(100%) vs. 2/12(16.4%),p=0.03), with decreased contrast enhancement (25-75%:4/5(80%) vs. 50-100%:11/12(91.7%), p=0.04) compared with SR neurofibromas. Skeletal muscle denervation (sporadic vs. SR schwannomas: 1/42(2.3%) vs. 3/22(13.6%) p=0.9; sporadic and SR neurofibroma: 0 vs. 0, p=1.0) was rarely present with schwannomas. SR PNSTs often had multiple additional lesions along an affected nerve (sporadic vs. SR schwannomas: 0 vs. 7/22(31.8%), p=0.08; sporadic and SR neurofibroma: 0 vs. 5/12(41.7%), p=0.55). Pain as an isolated symptom was more often associated with SR-schwannomas (sporadic vs. SR schwannomas: 21/42(50%) vs. 14/22(63.6%), p=0.005; sporadic and SR neurofibroma: 4/7(57.1%) vs. 5/12(41.7%), p=0.1).*Conclusions Although sporadic and syndrome-related schwannomas and neurofibromas overlap in their MRI appearance, isolated pain, homogeneity on T2W, and presence of multiple lesions along a nerve are characteristic features of syndrome-related PNSTs referred for histologic work-up.*Clinical Relevance/Application In patients with PNST on MRI, detection of small lesions along a nerve may indicate an underlying nerve tumor syndrome and impact patient management.

RESULTS

Eighty-three histologically-proven PNSTs (schwannomas [64/83, 77.1%] and neurofibromas [19/83, 22.9%]) were included. Of those, 42 schwannomas (65,6%) and 7 neurofibromas (36.8%) were sporadic, and 22 schwannomas (34.3%) and 12 neurofibromas (63.1%) were syndrome-related (SR) PNSTs. Sporadic schwannomas tended to be similar in size to SR schwannomas (2.9±1.2cm vs. 3.7±3.2cm, p=0.6), with greater heterogeneity on T2W (p=0.02) and static post-contrast sequences (p=0.01). Sporadic neurofibromas tended to be larger (4.6±1.5cm vs. 3.4±2.4cm, p=0.03), more heterogeneous on T2W (7/7(100%) vs. 2/12(16.4%),p=0.03), with decreased contrast enhancement (25-75%:4/5(80%) vs. 50-100%:11/12(91.7%), p=0.04) compared with SR neurofibromas. Skeletal muscle denervation (sporadic vs. SR schwannomas: 1/42(2.3%) vs. 3/22(13.6%) p=0.9; sporadic and SR neurofibroma: 0 vs. 0, p=1.0) was rarely present with schwannomas. SR PNSTs often had multiple additional lesions along an affected nerve (sporadic vs. SR schwannomas: 0 vs. 7/22(31.8%), p=0.08; sporadic and SR neurofibroma: 0 vs. 5/12(41.7%), p=0.55). Pain as an isolated symptom was more often associated with SR-schwannomas (sporadic vs. SR schwannomas: 21/42(50%) vs. 14/22(63.6%), p=0.005; sporadic and SR neurofibroma: 4/7(57.1%) vs. 5/12(41.7%), p=0.1).

CLINICAL RELEVANCE/APPLICATION

In patients with PNST on MRI, detection of small lesions along a nerve may indicate an underlying nerve tumor syndrome and impact patient management.

Abstract Archives of the RSNA, 2021

Sub-Events

CH03-D1 Highly Robust Deep Learning Model For Lung-RADS Category 4X Classification

Participants
Joonhyung Lee, MENG, Seoul, Korea, Republic Of (*Presenter*) Research Scientist, VUNO

PURPOSE

Substantial inter-reader variability in Lung CT Screening Reporting and Data System (Lung-RADS) 4X categorization necessitates a robust decision support tool. We aimed to evaluate the agreement between radiologists and a deep learning (DL) model for identification of two features of pulmonary malignancy: spiculation and air bronchogram.*Methods and Materials For this retrospective study, low-dose chest CT scans for 406 malignant lung nodules were obtained. Five board-certified thoracic radiologists recorded the existence and confidence rate in a 5-point scale for spiculation and air bronchogram for each nodule. The ground truth (GT) for each feature was determined when at least three out of the five thoracic radiologists scored four or higher regarding the presence of each feature. A 3D patch-based convolutional neural network(CNN) model was used for the prediction of spiculation and air bronchogram separately from a single model. The input to the model was the concatenation of five 3D patches with various Hounsfield unit(HU) ranges to better capture the nodules' characteristics represented in different HU ranges. The nodules predicted as having any of the two features were categorized to 4X. The data was split into training and validation sets with a ratio of 80:20. The performance of each radiologist and the DL model were evaluated against the GT using Cohen ?.*Results The agreement for spiculation, air bronchogram, and 4X findings were 0.61±0.04, 0.54±0.23, and 0.53±0.21 between the radiologists and GT, and 0.47, 0.68, and 0.58 between DL and GT. DL exhibited comparable sensitivity (81.5% vs. 84.7±15.1%) and specificity (78.6% vs. 27.6±36.8%) to the radiologists. In addition, heatmaps based on the integrated gradient method demonstrated that the proposed model properly classified the nodular features based on the border characteristics.*Conclusions The proposed DL model showed comparable agreement to those of experienced radiologists in classification of 4X category findings (spiculation and air bronchogram). Furthermore, the high specificity of the DL model can be helpful to reduce unnecessary invasive diagnostic procedures.*Clinical Relevance/Application The robust DL model proposed in this study can assist to determine the presence of 4X features in lung cancer CT screening by providing visual explanation and consistent results.

RESULTS

The agreement for spiculation, air bronchogram, and 4X findings were 0.61±0.04, 0.54±0.23, and 0.53±0.21 between the radiologists and GT, and 0.47, 0.68, and 0.58 between DL and GT. DL exhibited comparable sensitivity (81.5% vs. 84.7±15.1%) and specificity (78.6% vs. 27.6±36.8%) to the radiologists. In addition, heatmaps based on the integrated gradient method demonstrated that the proposed model properly classified the nodular features based on the border characteristics.

CLINICAL RELEVANCE/APPLICATION

The robust DL model proposed in this study can assist to determine the presence of 4X features in lung cancer CT screening by providing visual explanation and consistent results.

CH03-D3 Pre-surgical Assessment Of Mediastinal Lymph Node Metastases In Stage Ia Non Small Cell Lung Cancers

Participants
Ye Qing Zhu, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

As the frequency of MLN metastases differs markedly by the cancer consistency on CT, and clinical staging determines the possible treatment choices, particularly surgery, we decided to assess the sensitivity and specificity of CT and FDG-PET for predicting MLN metastases in a prospectively clinical Stage IA NSCLC cohort.*Methods and Materials We reviewed all patients enrolled in the Mount Sinai Health System, prospective cohort between 2016 and 2020, who had pre-surgical FDG-PET and underwent surgery with mediastinal lymph node resection and/or pre-operative endobronchial ultrasound (EBUS) for a fist primary clinical Stage IA NSCLC= 30 mm in maximum diameter on pre-surgical CT. For each patient, the maximum short-axis diameter cutoff values for MLNs on the pre-surgical CT images was classified as: = 10.0 mm, 10.1-15.0 mm, 15.1-20.0 mm, and >20.0 mm. The highest SUVmax of any MLN for each patient were classified as: = 2.5, 2.6-3.0, 3.1-4.0 or >4.0.*Results Of the 470 patients, 58.1% (n=273) were women and the median age at time of surgery was 68 years (IQR: 63.0-74.0), 466 had MLN resections and 4 has EBUS alone. NSCLC consistency was solid in 81.7% (n=384), part-solid in 13.4% (n=63), and nonsolid in 4.9% (n=23). Median maximum diameter of the tumor on CT of solid, part-solid, or nonsolid NSCLCs was not significantly different (16.7 mm vs. 19.0 mm vs. 17.0 mm, p=0.10). Histology was adenocarcinoma for all 63 part-solid and 23 nonsolid NSCLCs. Cell-type among the 384 solid NSCLCs was adenocarcinoma for 272 (70.8%), squamous-cell for 49 (12.8%), typical carcinoids for 48 (12.5%), and other NSCLC cell-types for 15 (3.9%). Among the 470 patients, none with part-solid (n=63) or nonsolid (n=23) NSCLCs had MLN metastases. No solid NSCLC = 10 mm (n=47) in maximum diameter or diagnosed as typical carcinoid (n=48) had MLN metastases. Among the remaining 297 patients with solid NSCLCs 11-30 mm, 7 (2.4%) had MLN metastases. Area-under-the curve (AUC) for predicting MLN metastases in solid NSCLCs, using the CT maximum short-axis MLN diameter was 0.62 (95% CI: 0.44-0.81, p=0.18) and using the highest SUVmax of any MLN, AUC was 0.58 (95% CI: 0.39-0.78, p=0.41). Neither AUCs were significantly different from chance alone. Optimal

cutoff for prediction of MLN metastases was = 18.9 mm for CT maximum short-axis diameter [sensitivity 14.3% (95% CI: 0.0% - 57.9%); specificity 100.0% (95% CI:98.9%-100.0)] and for highest SUVmax was = 11.7 [sensitivity 14.3% (95% CI: 0.0% - 57.9%); specificity 99.7% (95% CI:98.3%-100.0)].*Conclusions CT and SUVmax had low sensitivity but high specificity for predicting MLN metastases in solid NSCLCs 11-30 mm.*Clinical Relevance/Application Clinical Stage IA NSCLCs=30 mm should be based on CT maximum tumor diameter and MLN maximum short-axis diameter=20 mm.

RESULTS

Of the 470 patients, 58.1% (n=273) were women and the median age at time of surgery was 68 years (IQR: 63.0-74.0), 466 had MLN resections and 4 has EBUS alone. NSCLC consistency was solid in 81.7% (n=384), part-solid in 13.4% (n=63), and nonsolid in 4.9% (n=23). Median maximum diameter of the tumor on CT of solid, part-solid, or nonsolid NSCLCs was not significantly different (16.7 mm vs. 19.0 mm vs. 17.0 mm, p=0.10). Histology was adenocarcinoma for all 63 part-solid and 23 nonsolid NSCLCs. Cell-type among the 384 solid NSCLCs was adenocarcinoma for 272 (70.8%), squamous-cell for 49 (12.8%), typical carcinoids for 48 (12.5%), and other NSCLC cell-types for 15 (3.9%). Among the 470 patients, none with part-solid (n=63) or nonsolid (n=23) NSCLCs had MLN metastases. No solid NSCLC = 10 mm (n=47) in maximum diameter or diagnosed as typical carcinoid (n=48) had MLN metastases. Among the remaining 297 patients with solid NSCLCs 11-30 mm, 7 (2.4%) had MLN metastases. Area-under-the-curve (AUC) for predicting MLN metastases in solid NSCLCs, using the CT maximum short-axis MLN diameter was 0.62 (95% CI: 0.44-0.81, p=0.18) and using the highest SUVmax of any MLN, AUC was 0.58 (95% CI: 0.39-0.78, p=0.41). Neither AUCs were significantly different from chance alone. Optimal cutoff for prediction of MLN metastases was = 18.9 mm for CT maximum short-axis diameter [sensitivity 14.3% (95% CI: 0.0% -57.9%); specificity 100.0% (95% CI:98.9%-100.0)] and for highest SUVmax was = 11.7 [sensitivity 14.3% (95% CI: 0.0% -57.9%); specificity 99.7% (95% CI:98.3%-100.0)].

CLINICAL RELEVANCE/APPLICATION

Clinical Stage IA NSCLCs=30 mm should be based on CT maximum tumor diameter and MLN maximum short-axis diameter=20 mm.

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MK03-A

Musculoskeletal Tuesday Poster Discussions

Sub-Events

MK03-A1   **Deep Learning-based Prediction For Osteoporotic Compression Fracture In Lumbar Spine Radiographs: Can It Be Better Than FRAX?**

Participants
Jaewon Lee, Seoul, Korea, Republic Of (*Presenter*) Employee, VUNO Inc

PURPOSE

To evaluate the feasibility of osteoporotic compression fracture risk prediction using a convolutional neural network in a longitudinal cohort.*Methods and Materials A total of 1,595 patients were included for this study from the retrospective cohort including images and clinical information of 12,281 patients who took at least two lumbar spine radiographs(anteroposterior and lateral) from 2010 to 2015.Exclusion criteria were as follows: younger than 50 years old (n=4,980), compression fracture at the baseline (n=1,982), those who visited only once (n=2,899), those without lateral x-rays of neutral position (n=697), follow-up periods less than 6 months (n=113), and radiographs of poor image quality (n=439). As a result, 1,595 participants were eligible and divided into training/tuning (n=1416) and validation set (n=179).A convolutional neural network (CNN) based prediction algorithm was trained to predict hazard rates in follow-up studies given baseline radiographs and clinical information. A key-point detection network was trained to extract region of interest (ROI) patches corresponding to L1-L5 vertebral bodies, and the extracted ROIs were aligned vertically and horizontally using geometric transformations. Another CNN was then trained to predict osteoporotic fractures from ROI patches and clinical information.A Fracture Risk Assessment Tool (FRAX) and Cox proportional hazard (CoxPH) model predicting osteoporotic fracture risk using only the subject's clinical information were also assessed. Three model's prediction performance in Experiment A (using age, sex, and BMI for clinical information) and Experiment B (using age, sex, BMI, glucocorticoids, and secondary osteoporosis) were evaluated using the concordance index (C-Index).*Results During follow-up, fragility vertebral fractures occurred in 7.3 % (117/1595) participants. CNN-based prediction algorithm showed higher performance (C-Index) than FRAX and CoxPH in both experiment A (FRAX, 0.547; CoxPH, 0.553 [0.552, 0.555]; CNN, 0.610 [0.0.576, 0.644]) and B (FRAX 0.547; CoxPH, 0.594 CI [0.584, 0.604]; CNN, 0.612 CI [0.571, 0.653]).*Conclusions A CNN-based prediction algorithm using baseline image and clinical information outperformed FRAX and a Cox proportional hazard model in predicting osteoporotic fracture in lumbar spine radiographs in a longitudinal cohort.*Clinical Relevance/Application CNN-based prediction algorithms can potentially be used as an alternative or complementary tool to FRAX in predicting osteoporotic fracture in lumbar spine radiographs.

RESULTS

During follow-up, fragility vertebral fractures occurred in 7.3 % (117/1595) participants. CNN-based prediction algorithm showed higher performance (C-Index) than FRAX and CoxPH in both experiment A (FRAX, 0.547; CoxPH, 0.553 [0.552, 0.555]; CNN, 0.610 [0.0.576, 0.644]) and B (FRAX 0.547; CoxPH, 0.594 CI [0.584, 0.604]; CNN, 0.612 CI [0.571, 0.653]).

CLINICAL RELEVANCE/APPLICATION

CNN-based prediction algorithms can potentially be used as an alternative or complementary tool to FRAX in predicting osteoporotic fracture in lumbar spine radiographs.

MK03-A2   **Radial Multiplanar Reformatting Of Isotropic 3D Sequences Improves Diagnostic Accuracy For Ulnar-sided TFCC Lesions In Magnetic Resonance Arthrography Of The Wrist**

Participants
Henner Huflage, MD, Wuerzburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Triangular fibrocartilage complex (TFCC) injuries induce ulnar-sided wrist pain and can cause distal radioulnar joint instability. Due to its complex three-dimensional composition, diagnosis of TFCC lesions remains a challenging task even in MR arthrograms. The goal of this study was to assess the added diagnostic value of radial reformations of isotropic 3D MRI compared to standard planes after direct arthrography of the wrist.*Methods and Materials Ninety-three patients underwent fluoroscopy-guided arthrography of the wrist with subsequent MRI. Two radiologists analyzed two datasets for each MR arthrogram, with one set containing standard reconstructions of a T2-weighted 3D thin-slice sequence in axial, coronal and sagittal orientation, while the other set comprised an additional radial multiplanar reconstruction with the rotating center positioned at the ulnar styloid. Surgical reports (available in 35 patients) or radiological reports combined with clinical follow-up served as standard of reference. Diagnostic confidence and assessability of the central disc and ulnar-sided insertions were subjectively evaluated.*Results Injuries of the articular disc, styloid and foveal ulnar insertion were present in 20 (23.7%), 10 (10.8%) and 9 (9.7%) patients. Additional radial planes increased diagnostic accuracy for lesions of the styloid (0.83 vs. 0.90; p=0.016) and foveal (0.86 vs. 0.94; p=0.039) insertion, whereas no improvement was identified for alterations of the central cartilage disc. Readers' confidence (p<0.001) and assessability of the ulnar-sided insertions (p<0.001) were superior with ancillary radial reformatting available.*Conclusions Access to radial plane view of isotropic 3D sequences in MR arthrography improves diagnostic accuracy and confidence for ulnar-sided TFCC lesions.*Clinical Relevance/Application The reconstruction of radial planes in post-processing of isotropic 3D MRI requires little time and effort while providing substantial benefits for peripheral TFCC assessment.

RESULTS

Injuries of the articular disc, styloid and foveal ulnar insertion were present in 20 (23.7%), 10 (10.8%) and 9 (9.7%) patients. Additional radial planes increased diagnostic accuracy for lesions of the styloid (0.83 vs. 0.90; p=0.016) and foveal (0.86 vs. 0.94; p=0.039) insertion, whereas no improvement was identified for alterations of the central cartilage disc. Readers' confidence (p<0.001) and assessability of the ulnar-sided insertions (p<0.001) were superior with ancillary radial reformatting available.

CLINICAL RELEVANCE/APPLICATION

The reconstruction of radial planes in post-processing of isotropic 3D MRI requires little time and effort while providing substantial benefits for peripheral TFCC assessment.

MK03-A4   Osseous Tumor Reporting And Data System (OT-RADS) - Multi-reader Validation Study

Participants
Anurag Gupta, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate an Osseous Tumor Reporting and Data System (OT-RADS) with the hypothesis that the proposed guideline is reliable and assists in separating benign from malignant osseous tumors with a good area under the curve that could outline further patient management.*Methods and Materials In this multi-reader cross-sectional validation study, an agreement was reached for OT-RADS categories based on previously described MRI features and consensus of expert musculoskeletal radiologists. WHO classification was used, and a wide spectrum of benign and malignant osseous tumors were evaluated. MRI categories were: OT-RADS 0 - incomplete imaging; OT-RADS I - negative; OT-RADS II - definitely benign; OT-RADS III - probably benign; OT-RADS IV - suspicious for malignancy or indeterminate; OT-RADS V - highly suggestive of malignancy; and OT-RADS VI - known biopsy-proven malignancy or recurrent malignancy in the tumor bed. Four blinded readers categorized each tumor according to OT-RADS classification. Intraclass correlation (ICC) and Conger's Kappa were used. Diagnostic performance measures including area under the receiver operating curve (AUC) were reported. OT-RADS was dichotomized as benign (I-III) and malignant (IV and V) for calculating sensitivity and specificity.*Results Inter-reader agreement for OT-RADS (ICC = 0.78) and binary distinction of benign versus malignant (kappa = 0.67) were good to excellent, while agreement for individual tumor signal characteristics were poor to fair (ICC = 0.25 - 0.36; kappa = 0.16 - 0.39). The sensitivities, specificities and AUC of the readers ranged from 0.93 - 1.0, 0.71 - 0.86, and 0.92 - 0.97, respectively.*Conclusions OT-RADS lexicon is reliable and helps stratify tumors into benign and malignant categories.*Clinical Relevance/Application OT-RADS can be practically used by radiologists to guide patient management, improve multi-disciplinary communications, and potentially impact outcomes. The OT-RADS classification will be a dynamic document, and changes can be made as more evidence becomes available.

RESULTS

Inter-reader agreement for OT-RADS (ICC = 0.78) and binary distinction of benign versus malignant (kappa = 0.67) were good to excellent, while agreement for individual tumor signal characteristics were poor to fair (ICC = 0.25 - 0.36; kappa = 0.16 - 0.39). The sensitivities, specificities and AUC of the readers ranged from 0.93 - 1.0, 0.71 - 0.86, and 0.92 - 0.97, respectively.

CLINICAL RELEVANCE/APPLICATION

OT-RADS can be practically used by radiologists to guide patient management, improve multi-disciplinary communications, and potentially impact outcomes. The OT-RADS classification will be a dynamic document, and changes can be made as more evidence becomes available.

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GU03-A

Genitourinary Tuesday Poster Discussions

Sub-Events

GU03-A1   Comparison Of Bosniak Classification Of Cystic Renal Masses Version 2019 Assessed By CT And MRI

Participants
Jason Chan, Ottawa, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

The Bosniak classification of Cystic Renal masses version 2019 (Bosniak.v2019) formally incorporates MRI. Studies evaluating this change are conflicting to date. This study explores the differences between Bosniak.v2019 and original Bosniak classification (Bosniak.original) comparing masses imaged with CT and MRI.*Methods and Materials IRB approved, cross-sectional study. 65 consecutively identified cystic masses imaged with CT and MRI between 2009-2019 were identified. Thirty-five masses had histologic diagnosis and 30 masses were classified as Bosniak.v2019 Class 2 and Class 2F by an expert radiologist (R1) and had minimum 5-year stability.Three radiologists (R2-R4) independently evaluated the cystic renal masses with CT, followed by MRI using Original.Bosniak followed by Bosniak.v2019 in two sessions separated by =two months. Radiologists also assessed for the presence and number of septa, septa/wall thickness, and presence and size of protrusions.*Results With MRI, there was an upward shift from Class 2 to Class 2F for both classification systems (Bosniak.original N=7, Bosniak.v2019 N=10) and from Class 2/2F to Class 3 only in the original classification system (N=2). A higher number of septa (p<0.001) and number of protrusions (p=0.034) were noted on MRI, with no differences in septa/wall thickness (p=0.067, 0.855) or protrusion size (p=0.467).For both CT and MRI, Bosniak.v2019 had improved specificity (79.0% [95%CI 71.0-87.0%] CT, 70% [62.0-77.0%] MRI) compared to Bosniak.original (63.0% [56.0-69.0%] CT, 66.0% [58.0-74.0%] MRI), with maintained sensitivity and higher overall accuracy. Inter-observer agreement was similar-to-slightly higher for Bosniak.v2019 (K=0.44 CT, 0.39 MRI) versus Bosniak.original (K=0.35 CT, 0.37 MRI).*Conclusions There are persistent differences comparing cystic masses imaged with CT and MRI in Bosniak version 2019 akin to the Original Classification. Overall, Bosniak.v2019 had improved specificity for cancer diagnosis with similar-to-slightly higher inter-observer agreement.*Clinical Relevance/Application Our study emphasizes important differences in imaging features and class assignments between CT and MRI using Bosniak classification systems, including version 2019.

RESULTS

With MRI, there was an upward shift from Class 2 to Class 2F for both classification systems (Bosniak.original N=7, Bosniak.v2019 N=10) and from Class 2/2F to Class 3 only in the original classification system (N=2). A higher number of septa (p<0.001) and number of protrusions (p=0.034) were noted on MRI, with no differences in septa/wall thickness (p=0.067, 0.855) or protrusion size (p=0.467).For both CT and MRI, Bosniak.v2019 had improved specificity (79.0% [95%CI 71.0-87.0%] CT, 70% [62.0-77.0%] MRI) compared to Bosniak.original (63.0% [56.0-69.0%] CT, 66.0% [58.0-74.0%] MRI), with maintained sensitivity and higher overall accuracy. Inter-observer agreement was similar-to-slightly higher for Bosniak.v2019 (K=0.44 CT, 0.39 MRI) versus Bosniak.original (K=0.35 CT, 0.37 MRI).

CLINICAL RELEVANCE/APPLICATION

Our study emphasizes important differences in imaging features and class assignments between CT and MRI using Bosniak classification systems, including version 2019.

GU03-A2   Clinical Applications Of High-resolution Photon-counting Detector CT For Urolithiasis

Participants
Andrea Ferrero, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Whole-body photon-counting-detector CT (PCD-CT) combined with advances in deep-learning medical imaging processing, promises to enable high-resolution (HR) CT in the abdomen at routine radiation dose. We sought to explore the benefit of HR-PCD-CT for patients with urinary stone disease (USD).*Methods and Materials An investigational dual-source PCD-CT scanner (NAEOTOM Alpha, Siemens Healthcare) was used to image 8 urinary stones of various compositions (mean size 9 mm, range 4.5-13.4 mm) in an anthropomorphic water tank, with each stone placed immediately adjacent to a silicone urinary stent (Coloplast). The phantom was scanned in HR mode at routine clinical dose (140 kV, 7 mGy), with routine clinical (QR40, 1 mm) and HR images (Qr76, 0.2 mm) reconstructed. Subsequently, five USD patients were recruited following their clinical CT exam and were scanned on the HR-PCD-CT at matched radiation dose. A deep-learning-based denoising algorithm for stone quantification was applied to the HR datasets to reduce noise while maintaining quantification accuracy. An in-house stone analysis software (qSAS 1.4) was used to automatically segment and quantify urinary stones in both ex vivo and in vivo datasets.*Results For the stent-adjacent stones in the ex vivo phantom study, accurate segmentation with stone-stent separation and stone quantification occurred in only 1 of 8 case at clinical resolution and in 4 of 8 cases at HR with denoising. For the patient studies, HR-PCD-CT acquisition combined with the deep-learning-based denoising algorithm allowed identification of two stones as mixed in composition, an observation that was not appreciated during the clinical scans. It also allowed identification of contiguous-appearing stone material on conventional scan as layering clustered tiny discrete stones. Another stone was determined to be subepithelial and was better characterized in the HR data, with a 75% reduction in stone volume compared to the clinical exam (3.9 mm3 vs 15 mm3), owing to reduced partial volume effects from improved spatial resolution.*Conclusions HR-PCD-CT demonstrates improved ability to identify mixed stones, tiny

clustered layering stones, and stones adjacent to stents. In order to leverage the high-resolution capability of PCD-CT, the use of advanced denoising algorithms is required.*Clinical Relevance/Application HR-PCD-CT has improved ability to characterize mixed stones, tiny clustered layering stones, and stones adjacent to stents compared to conventional CT, extending benefits of treatment planning and monitoring in USD patients.

RESULTS

For the stent-adjacent stones in the ex vivo phantom study, accurate segmentation with stone-stent separation and stone quantification occurred in only 1 of 8 case at clinical resolution and in 4 of 8 cases at HR with denoising. For the patient studies, HR-PCD-CT acquisition combined with the deep-learning-based denoising algorithm allowed identification of two stones as mixed in composition, an observation that was not appreciated during the clinical scans. It also allowed identification of contiguous-appearing stone material on conventional scan as layering clustered tiny discrete stones. Another stone was determined to be subepithelial and was better characterized in the HR data, with a 75% reduction in stone volume compared to the clinical exam (3.9 mm3 vs 15 mm3), owing to reduced partial volume effects from improved spatial resolution.

CLINICAL RELEVANCE/APPLICATION

HR-PCD-CT has improved ability to characterize mixed stones, tiny clustered layering stones, and stones adjacent to stents compared to conventional CT, extending benefits of treatment planning and monitoring in USD patients.

GU03-A3 Pelvic Organ Prolapse, What Fell Vs What Broke: Shifting Attention From Organ Descent To Identifying Failed Support Structures

Awards
Certificate of Merit

Participants
Katherine Bojicic, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Current pelvic floor diagnostic strategies assess which organs have fallen. Using MRI, it is possible to identify the structural failures that result in prolapse.- This exhibit aims to refocus radiologists' attention to the structures that 'break', resulting in shifting anatomic relationships and functional loss.- The cardinal ligaments, perineal membrane, anterior vaginal wall, and levator ani are all key structures in pelvic floor integrity and are identifiable on pelvic MR.- Identifying anterior vaginal wall elongation, damage to the cardinal ligaments, and injuries of both the levator complex and perineal membrane are key to diagnosing the cause of specific types of pelvic organ prolapse, assisting clinicians in direction for treatment options.

TABLE OF CONTENTS/OUTLINE

IntroductionScaffolding of the pelvic floor: Cardinal ligaments; Perineal membrane; Anterior vaginal wall; LevatorPathology/structural damage: Cardinal ligament damage; Vaginal wall elongation; Levator injury; Perineal membrane injuryWhat do urogynecologists need from a radiology report? In the future, rather than measuring results (prolapse) which can be identified on clinical exam, radiologists will focus on identifying the structural damage underlying these changes.Current and future treatment options: As therapies become available for specific structural defects, it will be necessary to know whether a failure in that structure exists.Conclusion: Radiologists can have a future role in identifying the cause of prolapse, not just what organ fell.

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GI04-C

Gastrointestinal Wednesday Poster Discussions

Sub-Events

GI04-C10   Fly-In: A Robust Visualization Approach For CT Colonography

Participants
Aly Farag, MS,PhD, Louisville, Kentucky (*Presenter*) Nothing to Disclose

PURPOSE

A CTC visualization methodology, known as Fly-In (FI), is introduced for examination of the luminal surface from abdominal CT scans of prepped patients. FI enables robust polyp detection and editing.*Methods and Materials FI involves a desk-like rig of virtual cameras centered on the centerline of reconstructed colon, providing 360 degrees visualization of a cylindrical region of interest (ROI) which, when projected, provides a "filet"-like display of the ROI. By moving the ROI along the centerline of the colon, radiologists are able to examine the luminal surface and detect colonic polyps. FI does not require two-pass (retrograde and antegrade) as in the Fly-Through method, and does not suffer from occlusions, especially at haustral folds. FI enables registration of prone and supine visualization and easier correspondence with the 2D CT slices. In addition, a novel camera transformation was incorporated to stabilize the virtual cameras movement, which yields a smooth image sequence in the ROI as visualization is performed. A font-end CTC system was created involving the pipe-line of CTC (Segmentation, 3D Reconstruction, Centerline extraction, Visualization and Polyp detection), which enabled empirical and clinical evaluation of FI.*Results Evaluation using 20 CTC patients' data was performed by two senior and board-certified radiologists who validated the accuracy of FI and provided crucial input for improving its performance with respect to CT workflow. A follow-up clinical evaluation was then conducted using 49 CTC patients by three senior board-certified radiologists. Thirty-six of the 49 patients (73%) had at least one 6-mm or larger abnormalities. A total of 57 polyps/lesions existed in the 36 cases. Two radiologists compared FI vs the TeraRecon system which provides a filet representation of the colon, the third radiologist read the CTC data using only FI. Radiologist 1 reported 72% sensitivity and 93% specificity using FI vs 81% sensitivity and 87% specificity using TeraRecon. Radiologist 2 reported 65% sensitivity and 81% specificity using FI vs 63% sensitivity and 81% specificity using TeraRecon. Radiologist 3 provided similar results using FI.*Conclusions FI visualization using a rig of virtual cameras which navigates inside the colon around the centerline, provides a natural and distortionless filet visualization of the luminal surface, and state of the art sensitivity and specificity for small-size polyp detection.*Clinical Relevance/Application Robust polyp detection is necessary for screening colorectal cancer (CRC), and synchronization of CTC and Optical Colonoscopy (OC), for their removal, holds best promise for combating CRC. FI visualization enables robust polyp detection, locally and on the cloud; thus easier to sync with OC.

RESULTS

Evaluation using 20 CTC patients' data was performed by two senior and board-certified radiologists who validated the accuracy of FI and provided crucial input for improving its performance with respect to CT workflow. A follow-up clinical evaluation was then conducted using 49 CTC patients by three senior board-certified radiologists. Thirty-six of the 49 patients (73%) had at least one 6-mm or larger abnormalities. A total of 57 polyps/lesions existed in the 36 cases. Two radiologists compared FI vs the TeraRecon system which provides a filet representation of the colon, the third radiologist read the CTC data using only FI. Radiologist 1 reported 72% sensitivity and 93% specificity using FI vs 81% sensitivity and 87% specificity using TeraRecon. Radiologist 2 reported 65% sensitivity and 81% specificity using FI vs 63% sensitivity and 81% specificity using TeraRecon. Radiologist 3 provided similar results using FI.

CLINICAL RELEVANCE/APPLICATION

Robust polyp detection is necessary for screening colorectal cancer (CRC), and synchronization of CTC and Optical Colonoscopy (OC), for their removal, holds best promise for combating CRC. FI visualization enables robust polyp detection, locally and on the cloud; thus easier to sync with OC.

GI04-C11   Portal Venous Phase Discordance Between Ceus And Mri: A Valuable Predictor Of Intrahepatic Cholangiocarcinoma?

Participants
Stephanie Wilson, MD, Calgary, Alberta (*Presenter*) Equipment support, Koninklijke Philips NV;Equipment support, Siemens AG;Equipment support, Samsung Electronics Co, Ltd;Research support, Samsung Electronics Co, Ltd;

PURPOSE

Accurate differentiation of intrahepatic cholangiocarcinoma (ICC) from hepatocellular carcinoma (HCC) is important given different management strategies and prognosis. On CEUS, performed with a purely intravascular microbubble contrast agent, ICC (along with other non-hepatocellular malignancies) shows arterial phase enhancement followed by marked and rapid washout. This pattern of enhancement on CEUS allows for the accurate diagnosis of ICC, and its differentiation from HCC. In addition, this enhancement is discordant with the classically described appearance of ICC on CT/MRI, where ICC shows progressive enhancement, owing to slow diffusion of interstitial contrast into the fibrous stroma of the tumor. This specific type of portal venous phase (PVP) discordance, characterized by marked, rapid washout on CEUS and sustained/progressive enhancement on CT and MRI was initially identified in cases of ICC and has since occasionally been observed with other pathologies. Our study aims to evaluate the incidence of this type of discordance in ICC and determine its utility as a diagnostic sign. Its relationship to other pathologies is also

explored.*Methods and Materials This retrospective IRB approved study recruited adult patients with a diagnosis of ICC from pathology records and weekly multidisciplinary hepatobiliary rounds. In addition, patients were recruited if our specifically defined type of PVP discordance was noted at CEUS examination. 64 patients were recruited. CEUS and CT/MRI examinations were reviewed by a non-blinded research assistant with consultation from primary investigators with CEUS and CT/MRI expertise. The enhancement characteristics in the arterial, portal venous and late phase were recorded. Data was analyzed to assess for the frequency of specific PVP discordance in cases of ICC. Final pathology for non-ICC lesions was reviewed.*Results PVP discordance as defined by marked rapid washout on CEUS and sustained/progressive enhancement on CT/MRI is identified in 43/51 cases of ICC (84%). The difference between the PVP appearance of ICC on CT/MRI and CEUS was significant (p<0.0001). Discordance was also identified in cases of lymphoma (n=5), sclerosed hemangioma (n=3), HCC (n=3) and metastases (n=2).*Conclusions Discordant portal venous phase imaging between CEUS and CT/MRI, whereby CEUS shows marked rapid washout and CT/MRI shows sustained/progressive enhancement, is a common observation in patients with ICC and occurs occasionally in other tumors. Recognition of this discordance aids in the diagnosis of ICC.*Clinical Relevance/Application Interpretation of CEUS in conjunction with MRI, particularly in cases of discordant imaging, improves diagnostic accuracy, reducing time to diagnosis and treatment.

RESULTS

PVP discordance as defined by marked rapid washout on CEUS and sustained/progressive enhancement on CT/MRI is identified in 43/51 cases of ICC (84%). The difference between the PVP appearance of ICC on CT/MRI and CEUS was significant (p<0.0001). Discordance was also identified in cases of lymphoma (n=5), sclerosed hemangioma (n=3), HCC (n=3) and metastases (n=2).

CLINICAL RELEVANCE/APPLICATION

Interpretation of CEUS in conjunction with MRI, particularly in cases of discordant imaging, improves diagnostic accuracy, reducing time to diagnosis and treatment.

GI04-C3   Accelerated Pancreatobiliary MRI For Surveillance In Patients With Pancreas Cystic Neoplasms

Participants
Jeong Hee Yoon, MD, Seoul, Korea, Republic Of (*Presenter*) Speaker, Bayer AG

PURPOSE

To establish an accelerated MRI protocol for pancreas cancer surveillance and test the performance for lesion characterization in participants with pancreas cystic neoplasms.*Methods and Materials This prospective study recruited thirty participants who were on follow-up for pancreas intraductal papillary mucinous neoplasm or newly diagnosed pancreas cyst of unknown character (= 10 mm) and scheduled for contrast-enhanced CT (CECT) or had a recent CECT. Accelerated MRI was performed at 3T which targeted 15min of table time, consisting of heavily T2WI, breath-hold 3D MRCP, two-point Dixon, dynamic T1WI and breath-hold DWI. In-room time and table time were measured. Seven radiologists independently reviewed the presence of high-risk stigmata and worrisome features in addition to the diagnostic confidence. The performance of accelerated MRI was compared with those of CECT and the non-contrast part of accelerated MRI (abbreviated MRI) using a composite reference standard.*Results Thirty participants (male = 17, mean age 67 ± 7 years) were enrolled and four had surgically or clinically diagnosed pancreas cancer in 29 participants with follow-up imaging or histologic results. The in-room time was 18.5 ± 2.6 min (range: 13.7 - 24.9 min) and table time was 13.9 ± 1.9 min (range: 10.7 - 17.5). The diagnostic performance did not show significant difference between accelerated MRI (area under the curve: 0.85), CECT (0.83) and abbreviated MRI (0.78, P = 0.23), with the highest diagnostic confidence of accelerated MRI (4.2 ± 0.1, P < 0.001). At accelerated MRI, the inter-observer agreement was fair to excellent for high-risk stigmata (? = 0.34 - 0.98).*Conclusions Accelerated MRI protocol allows the table time of 15 min which may be eligible for the cancer surveillance in patients at risk of developing pancreas cancer.*Clinical Relevance/Application This study shows an accelerated PB MRI can be achieved within 15 minutes of the table time. The fast acquisition may allow the indication of PB MRI for pancreas cancer surveillance.

RESULTS

Thirty participants (male = 17, mean age 67 ± 7 years) were enrolled and four had surgically or clinically diagnosed pancreas cancer in 29 participants with follow-up imaging or histologic results. The in-room time was 18.5 ± 2.6 min (range: 13.7 - 24.9 min) and table time was 13.9 ± 1.9 min (range: 10.7 - 17.5). The diagnostic performance did not show significant difference between accelerated MRI (area under the curve: 0.85), CECT (0.83) and abbreviated MRI (0.78, P = 0.23), with the highest diagnostic confidence of accelerated MRI (4.2 ± 0.1, P < 0.001). At accelerated MRI, the inter-observer agreement was fair to excellent for high-risk stigmata (? = 0.34 - 0.98).

CLINICAL RELEVANCE/APPLICATION

This study shows an accelerated PB MRI can be achieved within 15 minutes of the table time. The fast acquisition may allow the indication of PB MRI for pancreas cancer surveillance.

GI04-C6   Compressed Sensing Versus View-sharing Techniques For Triple Hepatic Arterial Phase Acquisition In Gadoxetic Acid-enhanced Liver MRI: Comparison Of Image Quality And Arterial Enhancing Lesion Detectability In HCC High-risk Patients

Participants
Jae Hyun Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether triple arterial phase acquisition via compressed sensing (CS) technique can improve image quality and lesion detectability than View-sharing (VS) technique gadoxetic acid-enhanced magnetic resonance imaging (MRI) in patients at high-risk for hepatocellular carcinoma (HCC).*Methods and Materials A total of 387 high-risk patients who underwent gadoxetic acid-enhanced MRI, either CS (n = 225) or VS (n = 162) techniques were retrospective included. Among them, 121 patients had 183 arterial enhancing hepatic nodules (LR-4 or LR-5: 146, LR-3: 9, LR-1 or LR-2: 18, LR-M: 8, and LR-TR viable: 2). Two abdominal radiologists blindly assessed the presence or absence of proper late arterial phase (1 or 0) and image quality (1-4 Likert scales). The conspicuity (1-4) of lesions detected by reviewers was also evaluated. The ?2 test, Mann-Whitney U test, and generalized estimating equation were used for statistical analysis.*Results CS compared with VS demonstrated significantly improved overall image quality (mean 3.56 vs. 3.36 and 3.13 vs. 2.78, P = 0.0002 and <0.0001 in reviewers 1 and 2, respectively) and less motion artifact (mean 3.58 vs. 3.36 and 3.15 vs. 2.81, P = 0.0001 and <0.0001 for reviewers 1 and 2, respectively). However, CS compared with VS showed no significant difference in proper late arterial phase acquisition rate (95.1% vs. 94.4% and 92.9% vs. 93.8%, P = 0.77 and 0.72 for reviewers 1 and 2, respectively) and lesion conspicuity (mean 3.21 vs. 3.39 and 2.77 vs. 2.74, P =

0.27 and 0.34 for reviewers 1 and 2, respectively). Furthermore, there was no significant difference in pooled per-patient sensitivity (40.1% vs. 44.6%, P = 0.487) and specificity (94% vs. 97%, P = 0.185) for lesion detection between CS and VS techniques.*Conclusions Although applying CS technique for gadoxetic acid-enhanced MRI in high-risk patients significantly improved image quality compared with VS technique, there were no differences in proper late arterial phase acquisition rate, lesion detection performance, and lesion conspicuity between the two techniques.*Clinical Relevance/Application The CS technique could be helpful in improving the quality of arterial phase image in gadoxetic acid-enhanced MRI, but it might not have a significant effect on lesion detection in high-risk patients.

RESULTS

CS compared with VS demonstrated significantly improved overall image quality (mean 3.56 vs. 3.36 and 3.13 vs. 2.78, P = 0.0002 and <0.0001 in reviewers 1 and 2, respectively) and less motion artifact (mean 3.58 vs. 3.36 and 3.15 vs. 2.81, P = 0.0001 and <0.0001 for reviewers 1 and 2, respectively). However, CS compared with VS showed no significant difference in proper late arterial phase acquisition rate (95.1% vs. 94.4% and 92.9% vs. 93.8%, P = 0.77 and 0.72 for reviewers 1 and 2, respectively) and lesion conspicuity (mean 3.21 vs. 3.39 and 2.77 vs. 2.74, P = 0.27 and 0.34 for reviewers 1 and 2, respectively). Furthermore, there was no significant difference in pooled per-patient sensitivity (40.1% vs. 44.6%, P = 0.487) and specificity (94% vs. 97%, P = 0.185) for lesion detection between CS and VS techniques.

CLINICAL RELEVANCE/APPLICATION

The CS technique could be helpful in improving the quality of arterial phase image in gadoxetic acid-enhanced MRI, but it might not have a significant effect on lesion detection in high-risk patients.

GI04-C8   Reliability Of Lirads V.2018 And Easl Criteria In Small Liver Observations Using Extracellular And Hepatobiliary Contrast Agents. A Head-to Head Comparative Study.

Participants
Jordi Rimola, MD, Barcelona, Spain (*Presenter*) Consultant, Alimentiv Health Trust;Speaker, Takeda Pharmaceutical Company Limited;Consultant, Johnson & Johnson;Consultant, Boehringer Ingelheim GmbH;Grant, AbbVie Inc

PURPOSE

To assess the interreader agreement of LI-RADS v.2018 and EASL criteria for the diagnosis of hepatocellular carcinoma (HCC) with extracellular agents (ECA) and hepato-biliary contrast agents (HBA) enhanced MR imaging, and to determine the effect of ancillary features (AF) and reader expertise on LI-RADS categorization.*Methods and Materials 92 observations <3cm explored with both ECA and HBA-MRI acquired =1 month were reviewed by 9 independent readers. Representative images for each observation were presented in random order in a digital atlas. Readers assessed EASL criteria, LI-RADS v.2018 categories (with and without ancillary features [AF]) and LI-RADS major features for each observation. Intraclass correlation coefficients (ICC) were calculated for LI-RADS categorization and Cohen's kappa was assessed for major features and EASL criteria.*Results Kappa and ICC for EASL, LI-RADS category and LI-RADS re-categorization with AF were 0.72 (95%CI 0.63-0.8), 0.67 (0.62-0.70), and 0.65 (0.59-0.69) for ECA-MRI, and 0.69 (0.60-0.77), 0.67 (0.64-0.70) and 0.65 (0.61-0.68) for HBA-MRI, respectively. Kappa of ECA-MRI and HBA-MRI were 0.71 (0.42-1.0) and 0.68 (0.47 - 0.89) for non-rim arterial phase hyperenhancement; 0.5 (0.32-0.68) and 0.73 (0.61 - 0.85) for nonperipheral washout; and 0.57 (0.45-0.69) and 0.53 (0.40-0.66) for enhancing capsule. AF for LI-RADS categorization were applied in 17% (8.7-19.6%) and 28.3% (22.8-33.7%) of observations for ECA and HBA respectively (p-value=0.004). LI-RADS categorization adjusted by expertise was similar on both contrast agents 0.66 (0.62-0.7) and 0.67 (0.63-0.69) for ECA and HBA.*Conclusions Inter-reader agreement for EASL and LI-RADS categorization was substantial. No appreciable differences were observed between contrast agent, AF application or reader expertise.*Clinical Relevance/Application In this head-to-head comparison we identified a good reliability of both EASL and LIRADS categorization that justifies their use in clinical practice. However, according to our observations, the benefits of the use of subjective ancillary features are debatable.

RESULTS

Kappa and ICC for EASL, LI-RADS category and LI-RADS re-categorization with AF were 0.72 (95%CI 0.63-0.8), 0.67 (0.62-0.70), and 0.65 (0.59-0.69) for ECA-MRI, and 0.69 (0.60-0.77), 0.67 (0.64-0.70) and 0.65 (0.61-0.68) for HBA-MRI, respectively. Kappa of ECA-MRI and HBA-MRI were 0.71 (0.42-1.0) and 0.68 (0.47 - 0.89) for non-rim arterial phase hyperenhancement; 0.5 (0.32-0.68) and 0.73 (0.61 - 0.85) for nonperipheral washout; and 0.57 (0.45-0.69) and 0.53 (0.40-0.66) for enhancing capsule. AF for LI-RADS categorization were applied in 17% (8.7-19.6%) and 28.3% (22.8-33.7%) of observations for ECA and HBA respectively (p-value=0.004). LI-RADS categorization adjusted by expertise was similar on both contrast agents 0.66 (0.62-0.7) and 0.67 (0.63-0.69) for ECA and HBA.

CLINICAL RELEVANCE/APPLICATION

In this head-to-head comparison we identified a good reliability of both EASL and LIRADS categorization that justifies their use in clinical practice. However, according to our observations, the benefits of the use of subjective ancillary features are debatable.

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Abstract Archives of the RSNA, 2021

GU03-B

Genitourinary Tuesday Poster Discussions

Sub-Events

GU03-B1   **CT-based Bosniak Classification Of Cystic Renal Lesions: Is The Version 2019 An Improvement On Version 2005?**

Participants
Jérémy Dana, MD, Clichy, France (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic performance and inter-reader agreement of CT-based version 2019 with version 2005 of the Bosniak classification system.*Methods and Materials This retrospective study included patients with complex cystic renal lesions (CRL) between 2005 and 2018. The standard of reference was histopathology or 4-year imaging follow-up. The study cases were reviewed using a reading map and assigned to versions 2005 and 2019 Bosniak categories, independently, blinded to pathology results and imaging follow-up, by five reviewers (three senior and two junior). Final category was assigned if two of the three senior reviewers agreed. Diagnostic performance of versions 2005 and 2019 Bosniak classification system for distinguishing benign from malignant lesion was calculated by regrouping into positive (categories III-IV) or negative (categories I-IIF) diagnostic test results and reported metrics included sensitivity and specificity. Inter-reader agreement was calculated by Light's Kappa.*Results 149 CRL (139 patients) were included - 32 Bosniak I (0% malignancy), 40 Bosniak II (0%), 34 Bosniak IIF (8.8%), 15 Bosniak III (40%) and 28 Bosniak IV (85.7%) using 2005 version. Sensitivity and specificity of version 2005 was 0.89 and 0.91 versus 0.88 and 0.91 for version 2019. Fewer lesions were classified in categories IIF (15) and III (9) in version 2019 in favor of categories II and IV. However, 1 of the 3 malignant 2005 Bosniak IIF lesions was reclassified as 2019 Bosniak II and 1 of the malignant 2005 Bosniak III lesions was reclassified as 2019 Bosniak IIF. Inter-reader agreement was moderate to substantial for versions 2005 and 2019 between seniors (? = 0.61 vs 0.60) or juniors (? = 0.53 vs 0.58). It was slight to moderate for each evaluated criterion of version 2019, particularly for the measurement of the wall thickness (? = 0.36 between seniors and 0.16 between juniors).*Conclusions Diagnostic performance was comparable between version 2005 and 2019 but with fewer lesions in categories IIF and III in version 2019 resulting in fewer active surveillance. However, this lesser use of active surveillance presents a risk of underdiagnosing malignant lesions.*Clinical Relevance/Application 2019 Bosniak classification aims to improve grading of lesion complexity between categories IIF and III and reduce active surveillance but may present a risk of underdiagnosing malignant lesions.

RESULTS

149 CRL (139 patients) were included - 32 Bosniak I (0% malignancy), 40 Bosniak II (0%), 34 Bosniak IIF (8.8%), 15 Bosniak III (40%) and 28 Bosniak IV (85.7%) using 2005 version. Sensitivity and specificity of version 2005 was 0.89 and 0.91 versus 0.88 and 0.91 for version 2019. Fewer lesions were classified in categories IIF (15) and III (9) in version 2019 in favor of categories II and IV. However, 1 of the 3 malignant 2005 Bosniak IIF lesions was reclassified as 2019 Bosniak II and 1 of the malignant 2005 Bosniak III lesions was reclassified as 2019 Bosniak IIF. Inter-reader agreement was moderate to substantial for versions 2005 and 2019 between seniors (? = 0.61 vs 0.60) or juniors (? = 0.53 vs 0.58). It was slight to moderate for each evaluated criterion of version 2019, particularly for the measurement of the wall thickness (? = 0.36 between seniors and 0.16 between juniors).

CLINICAL RELEVANCE/APPLICATION

2019 Bosniak classification aims to improve grading of lesion complexity between categories IIF and III and reduce active surveillance but may present a risk of underdiagnosing malignant lesions.

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Abstract Archives of the RSNA, 2021

Sub-Events

GU01-B1   Multi-specialties Observer Performance Study For Bladder Cancer Treatment Response Assessment In CT Urography With And Without Computerized Decision Support

Participants
Di Sun, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the impact of a computerized decision support system for bladder cancer treatment response assessment (CDSS-T) on physicians' performance in identifying patients with complete response after neoadjuvant chemotherapy for bladder cancer.*Methods and Materials With IRB approval, we collected the pre- and post-chemotherapy CTU scans of 123 patients (157 pre- and post-treatment lesion pairs). The pathological cancer stage after treatment was collected as reference standard for determining if a patient had complete response to treatment. Forty out of 157 lesion pairs were determined to have complete response (stage T0) after chemotherapy based on the standard. We have developed a CDSS-T system combining DL-CNN and radiomics features to identify cases with complete response. The CDSS-T has a specialized graphic user interface that allows the observer to compare the pre-post treatment CTU pairs side by side. Five abdominal radiologists, 4 radiology residents, 1 urologist, and 3 oncologists read all the cases in different randomized order and provided estimates of the likelihood of each lesion being stage T0 after treatment without and then with the CDSS-T aid. The multi-reader, multi-case (MRMC) receiver operating characteristic (ROC) methodology was used to analyze the observers' assessments. The area under the curve (AUC) and the statistical significance of the difference were calculated. AUC values were compared for observers from different specialties (radiologists, oncologists, and urologist).*Results For 9 radiologists, the AUC for estimation of T0 disease after treatment increased from 0.75 without CDSS-T to 0.77 with CDSS-T, with a significant difference (p = 0.014). For 3 oncologists, the AUC increased from 0.71 without CDSS-T to 0.76 with CDSS-T, with a significant difference (p = 0.004). For the single urologist, the AUC increased from 0.74 without CDSS-T to 0.76 with CDSS-T, without reaching significance (p = 0.244).*Conclusions Our study demonstrates that the CDSS-T system can improve the physicians' performance on the assessment of complete response to bladder cancer treatment, and there are differences in the effectiveness of CDSS-T on physicians from different specialties.*Clinical Relevance/Application CDSS-T has the potential to improve physicians' accuracy in bladder cancer treatment response assessment, which is vital for identifying non-responders and allowing them to seek alternative therapy.

RESULTS

For 9 radiologists, the AUC for estimation of T0 disease after treatment increased from 0.75 without CDSS-T to 0.77 with CDSS-T, with a significant difference (p = 0.014). For 3 oncologists, the AUC increased from 0.71 without CDSS-T to 0.76 with CDSS-T, with a significant difference (p = 0.004). For the single urologist, the AUC increased from 0.74 without CDSS-T to 0.76 with CDSS-T, without reaching significance (p = 0.244).

CLINICAL RELEVANCE/APPLICATION

CDSS-T has the potential to improve physicians' accuracy in bladder cancer treatment response assessment, which is vital for identifying non-responders and allowing them to seek alternative therapy.

GU01-B3   Kidney Cancers, Not Kidding Around: Rcc Subtyping On Imaging

Participants
Melvy Mathew, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the unique imaging features of the most common renal cell carcinoma (RCC) subtypes. 2. To discuss staging and scoring of RCC on imaging.

TABLE OF CONTENTS/OUTLINE

Typical CT and MR imaging protocols utilized for RCC identification Heidelberg classification of RCC Characteristic imaging features of clear cell, papillary, and chromophobe RCCs, respectively Scoring of RCC, e.g., RENAL nephrometry scoring system Staging of RCC, e.g., TNM staging Metastatic disease Summary

IR04-B

Interventional Radiology Wednesday Poster Discussions

Sub-Events

IR04-B1   Clinical Outcomes Of Transjugular Intrahepatic Portosystemic Shunt With Ptfe-covered Stents After Liver Transplantation And Technical Results In Split And Whole Liver Graft Recipients

Participants
Luigi Maruzzelli, MD, Palermo, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To assess the clinical outcomes of transjugular intrahepatic portosystemic shunt (TIPS) creation using PTFE-covered stents in liver transplant (LT) recipients and to analyze the technical result of TIPS creation in split grafts (SG) compared with whole liver grafts (WG).*Methods and Materials Single-center, retrospective study, analyzing LT patients who underwent TIPS using a PTFE-covered stent. Clinical and technical variables were analyzed. Survival curves were constructed using the Kaplan-Meier method.*Results Between 2004 and 2018, TIPS was created using a PTFE-covered stent in 44 LT patients at a median of 43 months (range, 17 days - 16 years) after LT. TIPS indications were refractory ascites (RA) in 30 patients (68%), variceal bleeding in 8 patients (18%), others in 6 (14%). Eight patients (18%) received a SG such as right extended liver lobe (n = 4), right liver lobe (n = 2) and left lateral segment (n = 2). Thirty-six patients (82%) received a WG. Pre-TIPS median MELD score was 12 (range, 6 - 22). Ultimate technical success rate was 100% in both groups: after an initial technical failure, in one WG recipient (3%) a second attempt was successfully accomplished. An unconventional approach (combined transjugular/percutaneous transhepatic or transplenic access) was needed in 2 WG (6%) and 2 SG recipients (25%). One procedure-related death occurred in the WG group. Overall, during a median follow up of 22 months (range 4 days - 12 years), 15 patients (50%) in RA group did not require post-TIPS paracentesis and 5 patients (17%) underwent only one paracentesis, while in the VB group rebleeding occurred in 3 patients (37.5%) because of stent dysfunction. Fourteen patients (32%) underwent TIPS revision. Overt hepatic encephalopathy occurred in 13 patients (29.5%). Three patients (6.8%) required re-transplantation at 25, 27, and 56 months after TIPS. Patient survival at 6 months, 1 year, and 3 years was 75%, 62%, and 45%, respectively.*Conclusions Although technically demanding, the feasibility and safety of TIPS creation in split liver grafts is comparable to that of whole grafts. TIPS creation using PTFE-covered stents represents a viable option to treat portal hypertensive complications in LT recipients.*Clinical Relevance/Application Results from this study may help to refine the management of LT patients with recurrent portal hypertensive complications encouraging physicians to consider TIPS creation as treatment option in both SG and WG recipients.

RESULTS

Between 2004 and 2018, TIPS was created using a PTFE-covered stent in 44 LT patients at a median of 43 months (range, 17 days - 16 years) after LT. TIPS indications were refractory ascites (RA) in 30 patients (68%), variceal bleeding in 8 patients (18%), others in 6 (14%). Eight patients (18%) received a SG such as right extended liver lobe (n = 4), right liver lobe (n = 2) and left lateral segment (n = 2). Thirty-six patients (82%) received a WG. Pre-TIPS median MELD score was 12 (range, 6 - 22). Ultimate technical success rate was 100% in both groups: after an initial technical failure, in one WG recipient (3%) a second attempt was successfully accomplished. An unconventional approach (combined transjugular/percutaneous transhepatic or transplenic access) was needed in 2 WG (6%) and 2 SG recipients (25%). One procedure-related death occurred in the WG group. Overall, during a median follow up of 22 months (range 4 days - 12 years), 15 patients (50%) in RA group did not require post-TIPS paracentesis and 5 patients (17%) underwent only one paracentesis, while in the VB group rebleeding occurred in 3 patients (37.5%) because of stent dysfunction. Fourteen patients (32%) underwent TIPS revision. Overt hepatic encephalopathy occurred in 13 patients (29.5%). Three patients (6.8%) required re-transplantation at 25, 27, and 56 months after TIPS. Patient survival at 6 months, 1 year, and 3 years was 75%, 62%, and 45%, respectively.

CLINICAL RELEVANCE/APPLICATION

Results from this study may help to refine the management of LT patients with recurrent portal hypertensive complications encouraging physicians to consider TIPS creation as treatment option in both SG and WG recipients.

IR04-B2   Intra-articular Application Of Sluijter-teixera Poisson Pulsed Radiofrequency In Symptomatic Patients With Knee Osteoarthritis: Focus Upon Clinical Efficacy And Safety

Participants
Nikolaos Arkoudis, MD,MSc, Athens, Greece (*Presenter*) Nothing to Disclose

PURPOSE

To retrospectively evaluate the effectiveness of intra-articular application of Sluijter-Teixera Poisson pulsed radiofrequency (STP PRF) in knee osteoarthritis symptomatic patients with chronic pain refractory to conservative therapies.*Methods and Materials Institutional database research of two centers identified 39 cases of knee osteoarthritis patients treated with intra-articular STP PRF. Pain prior, one week, one, three, six and 12 months post STP PRF was compared by means of a numeric visual scale (NVS) questionnaire. Cardiovascular and Interventional Radiological Society of Europe (CIRSE) classification system was used for complications reporting. Mean patient age was 71.59±11.99 years, mean body mass index was 30.23±4.69 and male/female ratio was 9/30.*Results Mean baseline pain score was 8.31 ± 1.70 NVS units. This was reduced to a mean value of 0.90 ± 1.50 NVS units one week post-RF, 1.08 ± 1.53 at one month, 1.54 ± 1.88 at three months, 2.33 ± 2.17 at six months, and 3.23 ± 2.23 at 12

months of follow-up (p<0.01). Pain decrease of more than 4 NVS units was noticed in 35/39 knees (89.7%) at first week, 36/39 knees (92.3%) at first month, 35/39 knees (89.7%) at three months, 32/39 knees (82.1%) at six months and 25/39 knees (64.1%) at one year. There was no recurrence during the follow-up. No complication was observed.*Conclusions Percutaneous, intra-articular application of STP PRF is an effective and safe technique for chronic pain reduction in patients with knee osteoarthritis. Results seem to be reproducible and long lasting with significant patient satisfaction at 12 months follow-up.*Clinical Relevance/Application The present study demonstrates that intra-articular application of pulsed RF constitutes a safe and effective technique for pain palliation in knee osteoarthritis.

RESULTS

Mean baseline pain score was 8.31 ± 1.70 NVS units. This was reduced to a mean value of 0.90 ± 1.50 NVS units one week post-RF, 1.08 ± 1.53 at one month, 1.54 ± 1.88 at three months, 2.33 ± 2.17 at six months, and 3.23 ± 2.23 at 12 months of follow-up (p<0.01). Pain decrease of more than 4 NVS units was noticed in 35/39 knees (89.7%) at first week, 36/39 knees (92.3%) at first month, 35/39 knees (89.7%) at three months, 32/39 knees (82.1%) at six months and 25/39 knees (64.1%) at one year. There was no recurrence during the follow-up. No complication was observed.

CLINICAL RELEVANCE/APPLICATION

The present study demonstrates that intra-articular application of pulsed RF constitutes a safe and effective technique for pain palliation in knee osteoarthritis.

IR04-B3   Combined Transarterial Embolization And Percutaneous Sclerotherapy For Refractory And Non-resectable Aneurysmal Bone Cysts

Participants
Max Masthoff, MD, Muenster, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate safety, outcome and quality of life after combined transarterial embolization and percutaneous sclerotherapy for refractory and non-resectable aneurysmal bone cysts (ABCs).*Methods and Materials In this retrospective single center study n=16 consecutive patients (f=9, m=7; age: 17 (6-25) years) undergoing combined transarterial embolization and percutaneous sclerotherapy for refractory and non-resectable ABCs were included. 9/16 patients had history of previous therapies, all of them with no treatment response. Median follow-up was 27.3 months (range 6.7-47.5 months). Imaging data was assessed regarding volume of viable lesion (volumetry of contrast enhancing tissue), grade of mineralization (five-point Likert-scale) and fluid-fluid levels (four-point Likert-scale) of ABCs. Quality of life was analyzed using Musculoskeletal Tumor Society (MSTS) Score and 36-Item Short Form Survey (SF-36) health questionnaire.*Results No adverse events were observed after interventional procedures. All patients showed either partial or complete response to treatment. Mean viable lesion volume significantly decreased compared to baseline. Grade of mineralization and grade of fluid-fluid levels significantly improved compared to baseline. MSTS and SF-36 showed a significant quality of life improvement leaving most patients without relevant constraints. 14/16 patients did not need further ABC therapy. No patient showed ABC recurrence.*Conclusions Combined treatment of refractory and non-resectable ABCs by transarterial embolization and percutaneous sclerotherapy showed good response in treated patients regarding a decrease in lesion size, fostered bone mineralization and significant improvement of patients' quality of life.*Clinical Relevance/Application Combined transarterial embolization and percutaneous sclerotherapy is a minimal-invasive, safe and effective treatment option for refractory and non-resectable ABCs.

RESULTS

No adverse events were observed after interventional procedures. All patients showed either partial or complete response to treatment. Mean viable lesion volume significantly decreased compared to baseline. Grade of mineralization and grade of fluid-fluid levels significantly improved compared to baseline. MSTS and SF-36 showed a significant quality of life improvement leaving most patients without relevant constraints. 14/16 patients did not need further ABC therapy. No patient showed ABC recurrence.

CLINICAL RELEVANCE/APPLICATION

Combined transarterial embolization and percutaneous sclerotherapy is a minimal-invasive, safe and effective treatment option for refractory and non-resectable ABCs.

IR04-B4   Evaluation Of A Deep Learning-based Noise Reduction Algorithm For Use During CT-guided Ablation Procedures

Participants
Christopher Favazza, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate deployment feasibility and efficacy of a deep convolution neural network (DCNN) denoising algorithm to improve images containing metal devices during CT-guided ablation procedures.*Methods and Materials CT image data (Philips Big Bore) containing either cryoablation or microwave needles from 35 soft tissue ablation procedures were collected and reconstructed with 3 different iterative reconstruction algorithms (iDose, IMR strength of 1 and IMR strength of 3). Additionally, iDose images were denoised with an in-house DCNN, yielding a total of 4 sets of images/patient. Three radiologists performed a blinded review and scored each individual dataset for overall image quality, noise texture, metal artifact, and local tissue/iceball conspicuity (scale 1-5). Pairwise comparisons of reader-averaged scores between image sets was performed using a Wilcoxon signed rank test. Finally, the DCNN was deployed to the image production chain for use during ablation procedures, in which iDose images are: (1) automatically transferred to a GPU-based server hosting the DCNN, (2) denoised and (3) automatically transferred to the radiologist image review tool. Denoising times were assessed and compared with IMR reconstruction times as means ± standard deviations.*Results Denoised images were scored significantly higher than iDose images for image quality, noise texture and tissue/iceball conspicuity (all p<1e-04) and scored significantly higher than IMR images across all metrics, including metal artifact appearance (all p<6.4e-03). IMR(1) scores were significantly higher than iDose for noise texture only (p=4e-4); IMR(3) image quality scores were significantly worse than iDose (p=0.03). IMR reconstructions required an average of 349±95ms/image, as compared to 177±68ms/image for iDose reconstructions. Timing measurements showed that denoising added 58±22ms/image to the iDose reconstructions.*Conclusions Application of a DCNN to denoise image data acquired during CT-guided ablations significantly improves image quality over standard and more sophisticated iterative reconstruction algorithms, while requiring less processing time than IMR reconstructions.*Clinical Relevance/Application A DCNN can denoise images during CT-guided ablations with modest time penalty and could be used to improve image quality, reduce dose, or enable low-kV imaging for improved contrast-enhanced

imaging intraprocedurally.

RESULTS

Denoised images were scored significantly higher than iDose images for image quality, noise texture and tissue/iceball conspicuity (all p<1e-04) and scored significantly higher than IMR images across all metrics, including metal artifact appearance (all p<6.4e-03). IMR(1) scores were significantly higher than iDose for noise texture only (p=4e-4); IMR(3) image quality scores were significantly worse than iDose (p=0.03). IMR reconstructions required an average of 349±95ms/image, as compared to 177±68ms/image for iDose reconstructions. Timing measurements showed that denoising added 58±22ms/image to the iDose reconstructions.

CLINICAL RELEVANCE/APPLICATION

A DCNN can denoise images during CT-guided ablations with modest time penalty and could be used to improve image quality, reduce dose, or enable low-kV imaging for improved contrast-enhanced imaging intraprocedurally.

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Abstract Archives of the RSNA, 2021

Sub-Events

PH03-C1   Dual-task Convolutional Neural Network Based Virtual Non-calcium Imaging For Bone Marrow Diseases Detection In Dual Energy Muscular Skeletal CT

Participants
Hao Gong, PhD, Rochester,, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Virtual non-calcium (VNCa) images derived from dual energy CT (DECT) can be used to detect bone marrow diseases (e.g. post-traumatic edema, multiple myeloma). However, current techniques are limited in diagnostic image quality, due to amplified noise / artifacts. To overcome the limitation, we have developed a dual task convolutional neural network (CNN) based material decomposition technique to generate VNCa images.*Methods and Materials The CNN used an in-house-designed bifurcated architecture to simultaneously perform two tasks: material decomposition and classification. The classification branch shared features with material decomposition branch, meanwhile provided auxiliary regularization at output layer. CNN parameters were optimized with two customized loss functions: material decomposition - two fidelity terms in material maps and DECT data domain, and regularization terms for structure consistency and texture validity; classification - cross entropy. CNN training used image patches of tissue mimicking phantom materials (e.g. hydroxyapatite (HA), adipose, etc.). Numerical phantom materials with various mass densities were simulated to boost training sample diversity. The trained CNN was tested with phantom images at routine (17.2mGy) and lower dose (8.5mGy), and patients with suspected multiple myeloma, with all data acquired from a clinical DECT. In phantom study, bias and variance of material decomposition accuracy was gauged with normalized mean absolute error (NMAE). Patient images were evaluated by a fellowship-trained MSK radiologist for diagnostic image quality in terms of noise, artifact, and lesion conspicuity compared the presented method with a commercial technique over patient exam.*Results CNN generalized well over testing phantom materials with unseen mass densities and real anatomy. In phantom study, CNN consistently yielded high material decomposition accuracy at both dose levels: NMAE of testing HA (400 & 800 mg/cc) < 6%, and NMAE of testing soft tissues (e.g. lung, blood, & liver) < 3%. In patient exam, CNN yielded much less image noise (~50% reduction) and artifacts than commercial technique. There is improved conspicuity of intramedullary and cortical myeloma lesions on the CNN images compared to the commercial product.*Conclusions The presented dual task CNN has demonstrated accurate VNCa images with reduced noise and artifacts, and improve lesion conspicuity compared to commercial solution, enabling potential improvement in bone marrow diseases detection.*Clinical Relevance/Application Diagnostic acceptability of commercial VNCa is limited by amplified noise / artifacts. Our method can potentially improve the quality and clinical adoption of VNCa in diagnosis of bone marrow diseases.

RESULTS

CNN generalized well over testing phantom materials with unseen mass densities and real anatomy. In phantom study, CNN consistently yielded high material decomposition accuracy at both dose levels: NMAE of testing HA (400 & 800 mg/cc) < 6%, and NMAE of testing soft tissues (e.g. lung, blood, & liver) < 3%. In patient exam, CNN yielded much less image noise (~50% reduction) and artifacts than commercial technique. There is improved conspicuity of intramedullary and cortical myeloma lesions on the CNN images compared to the commercial product.

CLINICAL RELEVANCE/APPLICATION

Diagnostic acceptability of commercial VNCa is limited by amplified noise / artifacts. Our method can potentially improve the quality and clinical adoption of VNCa in diagnosis of bone marrow diseases.

PH03-C10   Clinical Pitfalls In The Selection Of Grids In Digital Radiography: Image Artifacts Produced By X-ray Scatter Rejection Grids Of Various Grid Line Frequencies Due To The Interaction Of The Grid Line Frequency With The Pixel Pitch.

Participants
Joseph Meier, PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

Anti-scatter grids are used in x-ray imaging to improve image contrast by the removal of scattered radiation that adds a relatively uniform haze to the image. Grid specifications must be carefully selected to best address exam type, SID, alignment accuracy, etc. One specification that is typically misunderstood and incorrectly selected is the line frequency of the grid septa. This talk addresses the artifacts encountered by the wrong selection of grid line frequency and methods for proper grid selection to avoid these artifacts, which can manifest as moiré or beating patterns in the image.*Methods and Materials A Carestream Health DRX-Evolution digital detector was used with pixel spacing of 0.139 x 0.139 mm, corresponding to a Nyquist frequency of 3.60 mm-1 (91.4 inch-1). Focused grids with nominal grid frequencies from 60 to 215 lines per inch (lpi), were imaged with the grid placed directly on top of the detector. The images were assessed visually for grid line artifacts and analyzed using a 2D Fourier transform (2DFT) to identify the spatial frequencies of these artifacts. These frequencies were direct imaging of the grid lines when below the Nyquist frequency, and imaged as aliased frequencies when above the Nyquist frequency.*Results Using the 2DFT analysis we were able to identify the direct imaging of the grid lines for the 4 lowest frequency grids. For the 3 highest frequency grids, the grid line frequency appeared in the image as a lower frequency alias of the grid frequency. All grids contained some identifiable frequencies

in the images that were below 2.0 mm-1, which would be difficult to remove with grid suppression software. In most of the grids these low frequencies were strong enough to be apparent in clinical images, making these grids unsuitable for optimal clinical use. To help in the proper selection of grid frequencies, we have developed a table indicating the best range of grid line frequencies that can be selected for different image receptor pixel sizes, with or without the use of grid suppression software.*Conclusions This work shows that the choice of a grid cannot be based solely on having a grid line frequency greater than the detector Nyquist frequency, or by relying on a grid line suppression algorithm to remove the artifacts produced by the interaction between the grid frequency and pixel spacing of the detector. Severe aliasing artifacts, that cannot be corrected with grid line suppression algorithms, can appear when using grids with improper line frequencies.*Clinical Relevance/Application To avoid clinically relevant artifacts, careful methods must be used to select the correct grid line frequency for a specific pixel spacing of the digital image receptor.

RESULTS

Using the 2DFT analysis we were able to identify the direct imaging of the grid lines for the 4 lowest frequency grids. For the 3 highest frequency grids, the grid line frequency appeared in the image as a lower frequency alias of the grid frequency. All grids contained some identifiable frequencies in the images that were below 2.0 mm-1, which would be difficult to remove with grid suppression software. In most of the grids these low frequencies were strong enough to be apparent in clinical images, making these grids unsuitable for optimal clinical use. To help in the proper selection of grid frequencies, we have developed a table indicating the best range of grid line frequencies that can be selected for different image receptor pixel sizes, with or without the use of grid suppression software.

CLINICAL RELEVANCE/APPLICATION

To avoid clinically relevant artifacts, careful methods must be used to select the correct grid line frequency for a specific pixel spacing of the digital image receptor.

PH03-C2   An Ultra-Low-Dose, Stationary, Tomographic Molecular Breast Imaging System Using Depth-Of-Interaction Sensitive CZT Detectors

Participants
Alexander Cherlin, PhD, Durham, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Molecular Breast Imaging (MBI) has been shown to have high sensitivity in cancer detection, even in patients with dense breast tissue. However, long imaging time and radiation dose that is higher than mammography impede its wide adoption. Improved lesion detection has been demonstrated using tomography, but it usually involves complex motion mechanics. Kromek is developing an ultra-low-dose stationary tomographic MBI system with at least the same sensitivity for lesion detection as planar MBI, but with the patient dose similar to mammography.*Methods and Materials The proposed system is comprised of CZT detectors with 2x2 sub-pixelisation and depth of interaction (DOI) capability, combined with densely packed multi-pinhole collimators. It allows tomographic image reconstruction but results in significant multiplexing. De-multiplexing algorithms have been developed to mitigate the adverse multiplexing artefacts by taking advantage of DOI. GATE simulations were used to evaluate the feasibility of the design and to compare it to a published planar MBI camera performance. The first prototype has been built at Kromek with 2x2 array of 7.3 mm thick CZT detectors with 2 mm pixels and a 3D printed tungsten collimator. It is being evaluated using an "activity-painting" setup incorporating an XYZ motorised stage assembly and a point 57Co source.*Results The reconstructed images from an array of simulated lesions at 1.5 cm depth in the phantom demonstrate a significant improvement in contrast and axial resolution obtained by using the DOI. Analysis of contrast to noise ratios confirmed that the administered activity could be decreased by at least a factor of 5 compared to the normal activity used in planar MBI. At the reduced dose, 100% of the simulated lesions reached a detection threshold on the proposed system compared to only 50% for the planar MBI. The first imaging results taken with the "activity-painting" setup demonstrated that the tomographic resolution is better than 7 mm in the direction normal to the detector plane. More complex "activity-painted" phantoms are currently being used to quantify the performance improvement of the prototype.*Conclusions Our results demonstrate that design of a stationary MBI system with the targeted radiation dose reduction is feasible. The next steps will include full evaluation of the image quality and the dose reduction followed by optimisation and construction of a larger scale prototype.*Clinical Relevance/Application The reduction of patient dose and scanning time will encourage the widespread adoption of MBI, providing a very quick and effective tool for cancer screening of patients with dense breast tissue. The added advantage of the tomographic system is the 3D localisation which could aid biopsy and cancer staging.

RESULTS

The reconstructed images from an array of simulated lesions at 1.5 cm depth in the phantom demonstrate a significant improvement in contrast and axial resolution obtained by using the DOI. Analysis of contrast to noise ratios confirmed that the administered activity could be decreased by at least a factor of 5 compared to the normal activity used in planar MBI. At the reduced dose, 100% of the simulated lesions reached a detection threshold on the proposed system compared to only 50% for the planar MBI. The first imaging results taken with the "activity-painting" setup demonstrated that the tomographic resolution is better than 7 mm in the direction normal to the detector plane. More complex "activity-painted" phantoms are currently being used to quantify the performance improvement of the prototype.

CLINICAL RELEVANCE/APPLICATION

The reduction of patient dose and scanning time will encourage the widespread adoption of MBI, providing a very quick and effective tool for cancer screening of patients with dense breast tissue. The added advantage of the tomographic system is the 3D localisation which could aid biopsy and cancer staging.

PH03-C4   Comparison Of Peak Skin Dose And Dose Map Obtained With A Real-time Software And Radiochromic Films On Phantom And In Patients Undergoing Abdominal Embolizations

Participants
Joel Greffier, PhD, Nimes, France (*Presenter*) Nothing to Disclose

PURPOSE

To compare the peak skin dose (PSD) and dose map calculated by the Dose Tracking System (DTS) software and measured with radiochromic films on 13 phantom configurations and in patients undergoing abdomen-pelvis embolizations.*Methods and Materials The PSD measured by radiochromic films (PSDFilm) or calculated by the DTS software (PSDDTS) were compared on 13 simple and complex configurations and in patients who underwent abdomen-pelvis embolization between September 2020 and April 2021. The

statistical concordance between PSDFilm and PSDDTS was computed using the Lin's concordance correlation coefficient and the clinical concordance using the Bland and Altman graphic; values were compared using the paired Mann-Whitney-Wilcoxon test.*Results Among 93 eligible consecutive patients, 53 were excluded (forgotten/non-centered films, late DTS use?) and 40 patients were included (32 men, 73.0±14.6 years). On phantom, the median difference between PSDFilm and PSDDTS was -9% (-10%; -3%; p<0.05). This result was confirmed in patients, with a median difference of -5% (-10%; 0%; p<0.05), a median PSDFilm of 756 (390; 1094) mGy and 768 (421; 1076) mGy for PSDDTS. The concordance between PSDFilm and PSDDTS was strong both on the phantom (0.928 [0.840; 0.968]) and in patients (0.986 [0.977; 0.992]). Bland and Altman plots showed that the PSDDTS was underestimated compared to PSDFilm by approximately -36 mGy [-68; -4]. Similar dose maps were found with DTS and films.*Conclusions The real-time DTS software allows to compute the PSD with accuracy and generate an adequate dose map. The PSDDTS was weakly underestimated compared to the PSDFilm requiring the use of a correction factor for the PSDDTS as to avoid lacking follow up for some patients.*Clinical Relevance/Application The magnitude and location of maximum peak skin dose (PSD) need to be assessed, for complex interventional procedures in order to improve the therapeutic follow-up of patients at risk of skin injuries.

RESULTS

Among 93 eligible consecutive patients, 53 were excluded (forgotten/non-centered films, late DTS use?) and 40 patients were included (32 men, 73.0±14.6 years). On phantom, the median difference between PSDFilm and PSDDTS was -9% (-10%; -3%; p<0.05). This result was confirmed in patients, with a median difference of -5% (-10%; 0%; p<0.05), a median PSDFilm of 756 (390; 1094) mGy and 768 (421; 1076) mGy for PSDDTS. The concordance between PSDFilm and PSDDTS was strong both on the phantom (0.928 [0.840; 0.968]) and in patients (0.986 [0.977; 0.992]). Bland and Altman plots showed that the PSDDTS was underestimated compared to PSDFilm by approximately -36 mGy [-68; -4]. Similar dose maps were found with DTS and films.

CLINICAL RELEVANCE/APPLICATION

The magnitude and location of maximum peak skin dose (PSD) need to be assessed, for complex interventional procedures in order to improve the therapeutic follow-up of patients at risk of skin injuries.

PH03-C6 Deep Silicon-based Photon Counting CT: A Virtual Clinical Study For Assessing Perceptual Benefits Of Improved Spatial Resolution Across Multiple Anatomies

Participants
Shobhit Sharma, MSc, BEng, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To assess the perceptual quality of deep silicon-based photon-counting CT (Si-PCCT) with improved spatial resolution performance over conventional CT across multiple anatomies in lungs, liver, head-and-neck, and inner auditory canal.*Methods and Materials High resolution computational human models (0.1 mm voxel size) representing diverse anatomies and pathologies of interest (lesions in the liver and lungs, mastoids in inner auditory canal, and stenosis in carotid artery) were integrated with a simulation platform for CT (DukeSim) modeling the scanner-specific geometry and components of a prospective Si-PCCT system. The simulation process involved incorporating energy-dependent response and crosstalk characteristics of the Si detector (pixel size: 0.2-0.4 mm in x, 0.5-0.7 mm in z), energy-binning of photon counts, addition of Poisson noise, generation of energy-summed grayscale images, and correcting for effects of beam hardening. The human models were "imaged" using helical scans (120 kV, pitch 1) with the largest pixel size (0.4 mm in x, 0.7 mm in z) at clinically representative dose levels. Corresponding images for an energy-integrating CT (ECT) system (Revolution CT, GE Healthcare) (pixel size: 1.1 mm in both x and z) were also simulated using the same platform. The images from the two systems were reconstructed using matched FOV, image size, slice thickness, and kernel, which were then reviewed by four experienced radiologists to evaluate differences in the appearance of clinically relevant diagnostic features across the modeled pathologies.*Results Images for Si-PCCT offered improved visualization of details over ECT across all anatomies. The lung images offered enhanced low contrast visualization and improved representation of fine details such as the secondary pulmonary lobules and lesion boundary. The liver images displayed improved appearance of noise texture, better low contrast visualization, and enhanced visualization of the lesion and portal vein. The head-and-neck images offered enhanced visualization for both soft plaque and a high contrast calcified plaque. The inner auditory canal images offered improved visualization of the mastoid geometry.*Conclusions The assessment revealed superior perceptual quality of Si-PCCT over ECT across a variety of clinical applications. The higher spatial resolution offered by Si-PCCT resulted in improved visualization of fine details and desirable noise textures due to reduced noise aliasing across all imaged anatomies.*Clinical Relevance/Application To effectively launch Si-PCCT for clinical use, its performance needs to be assessed in a task-specific manner. In absence of a prototype system, virtual studies help ascertain the potential clinical utility of the new technology.

RESULTS

Images for Si-PCCT offered improved visualization of details over ECT across all anatomies. The lung images offered enhanced low contrast visualization and improved representation of fine details such as the secondary pulmonary lobules and lesion boundary. The liver images displayed improved appearance of noise texture, better low contrast visualization, and enhanced visualization of the lesion and portal vein. The head-and-neck images offered enhanced visualization for both soft plaque and a high contrast calcified plaque. The inner auditory canal images offered improved visualization of the mastoid geometry.

CLINICAL RELEVANCE/APPLICATION

To effectively launch Si-PCCT for clinical use, its performance needs to be assessed in a task-specific manner. In absence of a prototype system, virtual studies help ascertain the potential clinical utility of the new technology.

PH03-C7 Metal Artifact Reduction In Head And Neck Cone Beam CT Using Synthetic Paired Images With And Without Artifacts Through Generative Adversarial Networks

Participants
JiHeon Jeong, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To train better metal artifact reduction (MAR) model with generative adversarial network (GAN) using with synthetic paired dataset with or without artifact.*Methods and Materials Metal free CT scans of 110 patients from Yonsei Severance Dental Hospital were enrolled. First, we randomly drew artificial metal using tooth segmentation in 447 CT images, which was reconstructed into CT images with metal artifacts in Figure 1 using Radon transform.Two doctors of dental surgery (DDSs) were requested to evaluate the quality of these image pairs with or without metal artifacts.Next, we trained high-quality MAR model with Pix2PixHD GAN, which can

translate from CT images with metal artifact into those with no artifact. To increase the stability of learning and reduce checkerboard artifacts in Figure 2 which is a chronic problem during convolution transpose`s upsampling process, DiffAugment, spectral normalization, and convolution with pixel shuffle were used. Sixty pairs of images with or without metal artifact (30 vs 30) of an external test set were translated into images without metal artifact. Structural similarity index measure (SSIM), peak signal-to-noise ratio (PSNR), root mean squared error (RMSE), and visual scoring on MAR quality of these images were evaluated. Wilcoxon test was performed.*Results Visual scoring of two DDSs on the gold-standard pair images were 4.55 and 4.57. Both SSIM and PSNR are increased by about 10% compared to those of the original model, and checkerboard artifact no longer appeared in all images. SSIM, PSNR and RMSE of original model with or without artifact was 0.97, 35.53, and 0.02 HU and, 0.99, 46.34, and 0.01 HU, respectively. Those of our model was 0.98, 38.37 and 0.02 HU and 1.00, 50.25, and 0.01 HU. All of the measures in our model are significantly better (Wilcoxson rank sum test). In addition, visual scorings on the quality of the original were 1.88 and 2.58 and our models were 2.98 and 3.65. Also, visual scroring in our model is significantly better (Wilcoxson rank sum test)*Conclusions Our Supervised GAN based MAR shows significantly better than the original, which could be useful in actual clinical setting.*Clinical Relevance/Application This work could lead for human readers to better diagnose CBCT images and for image processing algorithm including segmentation and classification to be better performed.

RESULTS

Visual scoring of two DDSs on the gold-standard pair images were 4.55 and 4.57. Both SSIM and PSNR are increased by about 10% compared to those of the original model, and checkerboard artifact no longer appeared in all images. SSIM, PSNR and RMSE of original model with or without artifact was 0.97, 35.53, and 0.02 HU and, 0.99, 46.34, and 0.01 HU, respectively. Those of our model was 0.98, 38.37 and 0.02 HU and 1.00, 50.25, and 0.01 HU. All of the measures in our model are significantly better (Wilcoxson rank sum test). In addition, visual scorings on the quality of the original were 1.88 and 2.58 and our models were 2.98 and 3.65. Also, visual scroring in our model is significantly better (Wilcoxson rank sum test)

CLINICAL RELEVANCE/APPLICATION

This work could lead for human readers to better diagnose CBCT images and for image processing algorithm including segmentation and classification to be better performed.

PH03-C9   Technical Performance Metrics Compared In The New Generation Of Small Pixel Size Detectors For General Radiography

Participants
Hilde Bosmans, PhD, Leuven, Belgium (*Presenter*) Stockholder, Qaelum NV

PURPOSE

To establish whether new small pixel detectors with different design and technology for general radiography applications have improved technical image quality performance.*Methods and Materials Seven CsI-based flat panel detectors named A to G, with pixel size 175µm (A175) down to 76µm (G76) were evaluated at IEC RQA3 beam quality. Modulation transfer function (MTF) was measured along with detective quantum efficiency (DQE) at a detector air kerma (DAK) of 2.38µGy. Threshold contrast (CT) for 250µm diameter discs was measured using the TO20 test object at 70 kV, 1mm Cu added filter at DAK levels of 1.10µGy, 2.28µGy and 5.88µGy. Four observers scored the images. A Fourier non-prewhitening with eye filter (NPWE) detectability index (d') for a disc signal spectrum of a 250µm circular disc was calculated at the three DAK levels. Detector E124 was used as a reference and a t-test applied to determine whether CT was for each detector significantly different.*Results Spatial frequency for an MTF value of 0.1 for detectors A to G was: 3.21mm-1 for A175, 3.79mm-1 for B150, 3.59 for C148, 3.85 mm-1 for D125, 3.63 mm-1 for E124, 4.51 mm-1 for F100, 4.70 mm-1 for G76, indicating better MTF performance for the smaller pixel detectors (F100 and G76). DQE at 0.5mm-1 ranged from 0.46 to 0.62, with an average of 0.52, and was highest for detector F100. DQE at 2.5 mm-1 was 0.08 for detector A175, 0.27 for B150, 0.21 for C148, 0.27 for D125, 0.24 for E124, 0.34 for F100 and 0.31 for G76, indicating low performance for A175 and highest DQE for F100. A linear correlation was found between Log(CT) and log(d'), with R2 = 0.96. No significant difference in CT at 2.28µGy was found in comparison to reference detector E124, with two exceptions: threshold contrast was significantly worse for detector C148 and significantly better for F100. Improved MTF performance for the smaller pixel detectors did not directly translate into improved CT performance for 250µm circular details. DQE, even at low spatial frequencies (0.5 mm-1), has an important influence on small detail detection.*Conclusions DQE had a stronger influence on small detail detectability than pixel size.*Clinical Relevance/Application The use of small pixel flat panel detectors for general radiographic applications does not guarantee improved small detail detectability compared to the flat panel detectors currently in use.

RESULTS

Spatial frequency for an MTF value of 0.1 for detectors A to G was: 3.21mm-1 for A175, 3.79mm-1 for B150, 3.59 for C148, 3.85 mm-1 for D125, 3.63 mm-1 for E124, 4.51 mm-1 for F100, 4.70 mm-1 for G76, indicating better MTF performance for the smaller pixel detectors (F100 and G76). DQE at 0.5mm-1 ranged from 0.46 to 0.62, with an average of 0.52, and was highest for detector F100. DQE at 2.5 mm-1 was 0.08 for detector A175, 0.27 for B150, 0.21 for C148, 0.27 for D125, 0.24 for E124, 0.34 for F100 and 0.31 for G76, indicating low performance for A175 and highest DQE for F100. A linear correlation was found between Log(CT) and log(d'), with R2 = 0.96. No significant difference in CT at 2.28µGy was found in comparison to reference detector E124, with two exceptions: threshold contrast was significantly worse for detector C148 and significantly better for F100. Improved MTF performance for the smaller pixel detectors did not directly translate into improved CT performance for 250µm circular details. DQE, even at low spatial frequencies (0.5 mm-1), has an important influence on small detail detection.

CLINICAL RELEVANCE/APPLICATION

The use of small pixel flat panel detectors for general radiographic applications does not guarantee improved small detail detectability compared to the flat panel detectors currently in use.

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Abstract Archives of the RSNA, 2021

NR04-C

Neuroradiology Wednesday Poster Discussions

Sub-Events

NR04-C2   Short-term Gadolinium Elimination Kinetics For Gadoteridol, Gadoterate Meglumine And Gadobutrol, Following Repeated Intravenous Administration To Rats.

Participants
Simona Bussi, BMedSc, Colleretto Giacosa, Italy (*Presenter*) Employee, Bracco Group

PURPOSE

To compare gadolinium (Gd) levels in rat tissues at 1, 2, 3 and 5 weeks after repeated intravenous administration of macrocyclic gadolinium-based contrast agents (GBCAs).*Methods and Materials One-hundred eighty male Sprague-Dawley rats were randomized to three exposure groups to receive 20 intravenous injections of gadoteridol, gadoterate meglumine or gadobutrol at a dose of 0.6 mmol/kg over 5 weeks (cumulative dose of 12 mmol/kg). Animals were sacrificed 1, 2, 3 or 5 weeks after the last injection (15 animals per group per timepoint) and tissues harvested for Gd determination by inductively coupled plasma-mass spectrometry (ICP-MS).*Results Gd levels in cerebellum, cerebrum and skin were significantly (p=0.01) lower after administration of gadoteridol than after administration of gadoterate and gadobutrol at all timepoints, and decreased more rapidly over time. The mean cerebellum Gd concentrations after administration of gadoteridol, gadoterate and gadobutrol decreased from 0.693, 0.878 and 1.011 nmol Gd/g tissue, respectively, at 1 week to 0.144, 0.282 and 0.297 nmol Gd/g tissue, respectively, at 5 weeks after injection (Figure 1). Similar findings were noted for the cerebrum (decreases from 0.675, 0.860 and 0.843 nmol Gd/g tissue at 1 week to 0.129, 0.311 and 0.309 nmol Gd/g tissue at 5 weeks, respectively) and skin (2.939, 9.744 and 8.799 nmol Gd/g tissue at 1 week to 0.305, 0.525 and 0.518 nmol Gd/g tissue at 5 weeks, for gadoteridol, gadoterate and gadobutrol, respectively). Conversely, significantly (p< 0.01) higher Gd levels were noted in blood after gadoteridol than after gadoterate at all timepoints and after gadobutrol at 1, 2 and 3 weeks after injection.*Conclusions Our study confirms that gadoteridol is eliminated more rapidly than gadoterate and gadobutrol in the first days and weeks after administration in rats. Gd levels in cerebellum, cerebrum and skin were significantly (p=0.01) lower after administration of gadoteridol at all timepoints investigated and decreased more rapidly over the course of the study.*Clinical Relevance/Application Lower levels of Gd in the first 5 weeks after administration to rats are seen with gadoteridol than with gadoterate and gadobutrol, confirming that this GBCA is eliminated more rapidly in this species.

RESULTS

Gd levels in cerebellum, cerebrum and skin were significantly (p=0.01) lower after administration of gadoteridol than after administration of gadoterate and gadobutrol at all timepoints, and decreased more rapidly over time. The mean cerebellum Gd concentrations after administration of gadoteridol, gadoterate and gadobutrol decreased from 0.693, 0.878 and 1.011 nmol Gd/g tissue, respectively, at 1 week to 0.144, 0.282 and 0.297 nmol Gd/g tissue, respectively, at 5 weeks after injection (Figure 1). Similar findings were noted for the cerebrum (decreases from 0.675, 0.860 and 0.843 nmol Gd/g tissue at 1 week to 0.129, 0.311 and 0.309 nmol Gd/g tissue at 5 weeks, respectively) and skin (2.939, 9.744 and 8.799 nmol Gd/g tissue at 1 week to 0.305, 0.525 and 0.518 nmol Gd/g tissue at 5 weeks, for gadoteridol, gadoterate and gadobutrol, respectively). Conversely, significantly (p< 0.01) higher Gd levels were noted in blood after gadoteridol than after gadoterate at all timepoints and after gadobutrol at 1, 2 and 3 weeks after injection.

CLINICAL RELEVANCE/APPLICATION

Lower levels of Gd in the first 5 weeks after administration to rats are seen with gadoteridol than with gadoterate and gadobutrol, confirming that this GBCA is eliminated more rapidly in this species.

NR04-C3   Prediction Of Parkinson Tremor Improvement After Mrgfus Thalamotomy Using Pretherapeutic Functional Connectivity Of Tractography-based Ventral Intermediate Nucleus

Participants
Yongqin Xiong, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Parkinson disease (PD) tremor is one of the most common tremors, causing significant disability. Magnetic resonance-guided focused ultrasound (MRgFUS) thalamotomy of ventral intermediate nucleus (Vim) is a novel minimally invasive treatment for tremor. This study aimed to explore whether pretherapeutic resting-state functional connectivity of tractography-based Vim (T-VIM) predicts tremor improvement after MRgFUS thalamotomy in PD.*Methods and Materials Data were collected from nine participants with PD, who underwent unilateral MRgFUS thalamotomy. T-VIM was defined by tracking the pyramidal and medial lemniscus tracts using diffusion tractography. Lesioning area (L-VIM) was delineated on the post 24-hour T1-weighted images. The overlapping volume and center distance between L-VIM and T-VIM were calculated and correlated with post 12-months tremor improvement. The relationship between the pretherapeutic functional connectivity of T-VIM or L-VIM and tremor improvement were investigated using both ROI connectivity analysis and whole-brain seed-to-voxel connectivity analysis.*Results The overlapping volume between T-VIM and L-VIM was positively correlated with tremor improvement (r = 0.788, P = 0.012). The center distance was negatively correlated with tremor improvement ratio (r = -0.696, P = 0.037). Pretherapeutic functional connectivity of T-VIM with ipsilateral sensorimotor cortex (r = 0.876, P = 0.002), subthalamic nucleus (r = 0.700, P = 0.036) and visual area (r = 0.911, P = 0.001) significantly correlated with tremor improvement, with greater connectivity relating to greater tremor improvement. For L-VIM functional connectivity analysis, L-VIM - ipsilateral sensorimotor cortex functional connectivity was correlated with tremor improvement (r = 0.752,P = 0.019).*Conclusions T-VIM method may improve clinical responses of MRgFUS thalamotomy. The pretherapeutic resting-state functional connectivity T-VIM with ipsilateral sensorimotor cortex, subthalamic nucleus and visual area might predict tremor improvement after MRgFUS thalamotomy in PD, although this should be validated by prospective studies with larger number of patients.*Clinical Relevance/Application The method of directly targeting Vim using tractography may improve tremor responses of MRgFUS thalamotomy in PD. The pretherapeutic resting-state functional connectivity T-VIM might predict tremor improvement after MRgFUS thalamotomy in PD.

RESULTS

The overlapping volume between T-VIM and L-VIM was positively correlated with tremor improvement (r = 0.788, P = 0.012). The center distance was negatively correlated with tremor improvement ratio (r = -0.696, P = 0.037). Pretherapeutic functional connectivity of T-VIM with ipsilateral sensorimotor cortex (r = 0.876, P = 0.002), subthalamic nucleus (r = 0.700, P = 0.036) and visual area (r = 0.911, P = 0.001) significantly correlated with tremor improvement, with greater connectivity relating to greater tremor improvement. For L-VIM functional connectivity analysis, L-VIM - ipsilateral sensorimotor cortex functional connectivity was correlated with tremor improvement (r = 0.752,P = 0.019).

CLINICAL RELEVANCE/APPLICATION

The method of directly targeting Vim using tractography may improve tremor responses of MRgFUS thalamotomy in PD. The pretherapeutic resting-state functional connectivity T-VIM might predict tremor improvement after MRgFUS thalamotomy in PD.

NR04-C4   Intracranial Abnormalities And Epilepsy In Patients With Parry-Romberg Syndrome

Participants
Cynthia De la Garza Ramos, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

PURPOSE

Parry-Romberg syndrome (PRS) is a rare disorder characterized by progressive hemifacial atrophy affecting the skin and underlying subcutaneous tissues. Concomitant intracranial abnormalities have been reported, frequently resulting in epilepsy, but the incidence and spectrum of intracranial involvement is not well established. This study aimed to characterize the frequency and severity of the most common intracranial abnormalities in PRS and determine associations with epilepsy.*Methods and

Materials This is a single-center, retrospective review of patients diagnosed with PRS from 2000-2020. MRI studies were reviewed by two board-certified neuroradiologists for intracranial abnormalities. Degree of hemispheric atrophy, white matter disease (WMD), hemorrhage, and leptomeningeal enhancement were graded as none, mild, moderate, or severe. Other abnormalities were also qualitatively reported. Findings were considered potentially PRS-related when occurring asymmetrically on side affected by PRS. Categorical variables were compared using the Chi-square or Fischer's exact test, as appropriate.*Results Eighty-six patients were identified, with a median age at PRS diagnosis of 20 years. Hemifacial involvement was left-sided in 44 (52%) cases. Thirty-six (41%) had intracranial abnormalities, and 27 (31.4%) were ipsilateral to the hemifacial atrophy, 7 (8.1%) contralateral, and 2 (2.3) bilateral. Nineteen (22%) had epilepsy, of which 18 (95%) had intracranial abnormalities. Fifteen (83%) of epileptic patients had abnormalities ipsilateral to facial hemiatrophy, therefore considered likely related to PRS. Neuroimaging findings were present in 18 (27%) patients in the non-epilepsy group. Unilateral WMD was the predominant finding in both epilepsy (47%) and non-epilepsy (22%) patients. When comparing between groups, WMD and hemispheric atrophy had a higher incidence and severity in epilepsy patients (p<0.001). Hemorrhage was also found to be more severe in the epilepsy group (p=0.026).*Conclusions Lateralized brain abnormalities are common in PRS patients, with a much higher incidence and greater severity in those with epilepsy. The most common findings in both groups are WMD and hemispheric atrophy, while hemorrhage is uncommon in those without epilepsy.*Clinical Relevance/Application Recognition of the incidence and spectrum of brain abnormalities related to PRS is vital for radiologists. Such asymmetric findings can be mistaken for other etiologies, such as Rasmussen encephalitis, leading to an erroneous diagnosis.

RESULTS

Eighty-six patients were identified, with a median age at PRS diagnosis of 20 years. Hemifacial involvement was left-sided in 44 (52%) cases. Thirty-six (41%) had intracranial abnormalities, and 27 (31.4%) were ipsilateral to the hemifacial atrophy, 7 (8.1%) contralateral, and 2 (2.3) bilateral. Nineteen (22%) had epilepsy, of which 18 (95%) had intracranial abnormalities. Fifteen (83%) of epileptic patients had abnormalities ipsilateral to facial hemiatrophy, therefore considered likely related to PRS. Neuroimaging findings were present in 18 (27%) patients in the non-epilepsy group. Unilateral WMD was the predominant finding in both epilepsy (47%) and non-epilepsy (22%) patients. When comparing between groups, WMD and hemispheric atrophy had a higher incidence and severity in epilepsy patients (p<0.001). Hemorrhage was also found to be more severe in the epilepsy group (p=0.026).

CLINICAL RELEVANCE/APPLICATION

Recognition of the incidence and spectrum of brain abnormalities related to PRS is vital for radiologists. Such asymmetric findings can be mistaken for other etiologies, such as Rasmussen encephalitis, leading to an erroneous diagnosis.

NR04-C5 Machine Learning-based Prediction Of Pseudoprogression In High Grade Gliomas

Participants
Burak Akkurt, MD, Muenster, Germany (Presenter) Nothing to Disclose

PURPOSE

Differentiation of post-treatment pseudoprogression from true progression in patients with high grade glioma (HGG) remains a diagnostic challenge and often requires hybrid imaging and/or invasive biopsies. A reliable and non-invasive differentiation between these two entities would be highly desirable. In this study we evaluate the prognostic value of Radiomics in HGG for the assessment of pseudoprogression development after multimodal therapy.*Methods and Materials We retrospectively screened 193 patients with histologically-proven HGG that presented to our tertiary referral center between 2015 and 2020. After exclusion of patients with missing or non-diagnostic preoperative imaging, clinical data and/ or histopathology, 131 patients remained for further analysis. Of the 131 included patients, 64 patients had a histopathological proven progress and 68 patients had a mixed or pure pseudoprogression (58 females, 44 %).Segmentation of the T1 TSE GD enhancing parts of the tumor was manually performed by experienced neuroradiologists using the 3D Slicer software. For computation of Radiomics features the open source PyRadiomics plugin was used. In order to prevent overfitting, 20 % of the data was reserved as a validation data set. Data preprocession involved Yeo-Johnson- and Z-Transformation followed by a bagged-tree classifier with 10-fold cross validation and a 95% correlation matrix (Figure 1) for dimension reduction. The resulting 25 Radiomics features were used in a machine learning classifier based on Generalized Boosted Regression Modeling (GBM).The final variables were: "diag.Image.orig.Mean","orig.shape.Elongation","diag.Image.intpol.Mean","diag.Mask.orig.VoxelNum","diag.Image.orig.Max.","orig.glcm.ClusterShade","orig.ngtdm.Strength" and "orig.fst.ord.RobustMeanAbsoluteDeviation".*Results Based on the test dataset the GBM classifier was able to predict a pseudoprogression development with a positive predictive value of 80%, a negative predictive value of 73,3% and an accuracy of 76%. The AUC ROC showed a value of 0.81 (Figure 2).*Conclusions The Radiomics approach shows promising results for pseudoprogression prediction in HGG and may add value to post treatment imaging after multimodal therapy.*Clinical Relevance/Application Differentiation of pseudoprogression from true progression in high grade glioma after multimodal therapy

RESULTS

Based on the test dataset the GBM classifier was able to predict a pseudoprogression development with a positive predictive value of 80%, a negative predictive value of 73,3% and an accuracy of 76%. The AUC ROC showed a value of 0.81 (Figure 2).

CLINICAL RELEVANCE/APPLICATION

Differentiation of pseudoprogression from true progression in high grade glioma after multimodal therapy

NR04-C6 Automated Detection Of Large Vessel Occlusion Using Relative Vessel Density: One Year Experience In A Multihospital Integrated Delivery Network

Participants
Warren Chang, MD,MBA, Pittsburgh, Pennsylvania (Presenter) Nothing to Disclose

PURPOSE

Several new techniques have emerged for automated detection of anterior circulation large vessel occlusion (LVO) by quantifying MCA territory relative vessel density (RVD) compared to the contralateral side, including RAPID-CTA, which may allow faster triage and decreased time to mechanical thrombectomy. We present our one year experience in a multihospital health system on the accuracy of RAPID-CTA for LVO detection in patients with stroke symptoms and its effect on treatment time and clinical outcomes.*Methods and Materials The study was supervised by the local institutional review board. 1203 patients presenting with stroke symptoms receiving CTAs with RAPID-CTA analysis were included. RAPID CTA examinations were considered positive at RVD < 60% (red or yellow color) and negative at RVD >60%. Radiology exams were considered positive if LVO (ICA/M1 or M2 occlusion) or high grade stenosis were documented in the radiology report. All positive cases were reviewed by a second reader with 100% concordance. The consensus expert reads were used as the gold standard and sensitivity, specificity, PPV (positive predictive value) and NPV (negative predictive value) were calculated.Patients eligible for mechanical thrombectomy were transported to a comprehensive stroke center for treatment. CTA to groin puncture time was calculated during one year time intervals before and after RAPID-CTA installation for patients undergoing mechanical thrombectomy. 90 day Modified Rankin Scores were obtained for patients undergoing treatment in each cohort.*Results 126 patients had M1/ICA occlusion, 71 had M2 occlusion, and 134 had high grade stenosis of the ICA or MCA. RAPID-CTA had sensitivities of 90%, 82%, and 82%, specificities of 82%, 85%, and 95%, PPV of 37%, 52%.,and 87% and NPV of 99%, 96%, and 93% in the detection of M1 occlusion, LVO, or high grade stenosis/LVO, respectively.CTA to groin puncture time was significantly lower after deployment of RAPID-CTA (93 minutes vs 68 minutes, p<0.05).Average 90 day mRS was lower in the RAPID CTA group with a higher percentage of patients with functional independence (mRS = 2), although the data was not statistically significant.*Conclusions RAPID CTA had high accuracy for detection of high grade stenosis or LVO in patients presenting with stroke symptoms. After implementation of RAPID-CTA, time to treatment was significantly lower and clinical outcomes were improved, including both average modified Rankin score and percentage of patients demonstrating functional independence.*Clinical Relevance/Application RAPID CTA demonstrated high accuracy for the detection of high grade stenosis or LVO in patients presenting with stroke symptoms, significantly decreased time from imaging to treatment, and improved clinical outcomes.

RESULTS

126 patients had M1/ICA occlusion, 71 had M2 occlusion, and 134 had high grade stenosis of the ICA or MCA. RAPID-CTA had sensitivities of 90%, 82%, and 82%, specificities of 82%, 85%, and 95%, PPV of 37%, 52%.,and 87% and NPV of 99%, 96%, and 93% in the detection of M1 occlusion, LVO, or high grade stenosis/LVO, respectively.CTA to groin puncture time was significantly lower after deployment of RAPID-CTA (93 minutes vs 68 minutes, p<0.05).Average 90 day mRS was lower in the RAPID CTA group with a higher percentage of patients with functional independence (mRS = 2), although the data was not statistically significant.

CLINICAL RELEVANCE/APPLICATION

RAPID CTA demonstrated high accuracy for the detection of high grade stenosis or LVO in patients presenting with stroke symptoms, significantly decreased time from imaging to treatment, and improved clinical outcomes.

NR04-C8 Evaluation Ofdeep Learning-based Computer Aided Diagnostic System In Measuring The Intracerebral Hemorrhagevolumein Clinical Practice

Participants
Jiandong Lai, Ankang, China (Presenter) Nothing to Disclose

PURPOSE

To explore and validate the performance of deep learning-based computer aided diagnostic system (DL-CAD) in measuring the intracerebral hemorrhage (ICH) volume in clinical practice.*Methods and Materials One hundred and eighty patients at different ICH stages were retrospectively collected, in particular, 60 cases for each stage, including hyperacute, acute, and subacute stages. The ICH volume of each patient was measured by DL-CAD, two residents using the ABC/2 method, and two senior physicians using the computer assisted volumetric analysis (CAVA) method. The measuring time-consumptions were recorded and the results from the CAVA method were used as gold standard. The volumetric measurement consistency between the two residents was studied, and the absolute percentage error (APE) of DL-CAD approach and the ABC/2 method was calculated and compared. A paired sample t test was used for normally distributed data; otherwise the Wilcoxon signed rank test would be used. P <0.05 was considered statistically significant.*Results Statistically significant differences were found between the two residents in measuring the volume of ICH at all stages when using ABC/2 method. For ICH at hyperacute, acute, and subacute stages, the APE of DL-CAD approach and ABC/2 method was 3.891±4.806%, 6.776±6.567%, 8.561±7.630% and 14.809±10.936%, 14.132±11.276%,17.412±14.484%, respectively, showing statistically significant differences between them (P<0.05). Additionally, no significant difference was observed between the measured values of DL-CAD and the gold standard (P> 0.05). In terms of time-consumption, the average volumetric measurement time of DL-CAD for ICH at hyperacute, acute, and subacute stages were 53.77±0.89s, 53.39±0.80s, and 53.60±0.47s, respectively, which were significantly lower than the ones of the ABC/2 method (95.43±17.60s, 116.86±38.40s, and 112.73±43.71s, respectively, P<0.05) and CAVA method (282.43±103.85s, 270.40±63.17s, and 232.37±93.13s, respectively, P<0.05).*Conclusions For ICH at any stage studied above, DL-CAD was able to measure its volume more accurately and more quickly than the traditional ABC/2 method.*Clinical Relevance/Application comparing with the traditional ABC/2 method, DL-CAD can automatically measure the volume of ICH at all stages more accurately and efficiently. By reducing the human errors and the measurement time, the DL-CAD is of important application value in clinical work.

RESULTS

Statistically significant differences were found between the two residents in measuring the volume of ICH at all stages when using ABC/2 method. For ICH at hyperacute, acute, and subacute stages, the APE of DL-CAD approach and ABC/2 method was 3.891±4.806%, 6.776±6.567%, 8.561±7.630% and 14.809±10.936%, 14.132±11.276%,17.412±14.484%, respectively, showing statistically significant differences between them (P<0.05). Additionally, no significant difference was observed between the measured values of DL-CAD and the gold standard (P> 0.05). In terms of time-consumption, the average volumetric measurement time of DL-CAD for ICH at hyperacute, acute, and subacute stages were 53.77±0.89s, 53.39±0.80s, and 53.60±0.47s, respectively, which were significantly lower than the ones of the ABC/2 method (95.43±17.60s, 116.86±38.40s, and 112.73±43.71s, respectively, P<0.05) and CAVA method (282.43±103.85s, 270.40±63.17s, and 232.37±93.13s, respectively, P<0.05).

CLINICAL RELEVANCE/APPLICATION

comparing with the traditional ABC/2 method, DL-CAD can automatically measure the volume of ICH at all stages more accurately and efficiently. By reducing the human errors and the measurement time, the DL-CAD is of important application value in clinical work.

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Sub-Events

GI03-B10   Volumetric Pancreas Segmentation On CT With A Convolutional Neural Network (CNN): Comparison Of Accuracy And Efficiency Versus NVIDIA Module In 3D Slicer® In The Context Of Inter-reader Variability Of Expert Manual Segmentation

Participants
Hala Khasawneh, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Accurate & efficient pancreas segmentation is necessary for translation of pancreas morphometrics and radiomics for applications such as early detection of pancreas cancer & opportunistic detection of diabetes. Our purpose was to compare the accuracy & time of volumetric pancreas segmentation with our previously published automated CNN vs the boundary-points based NVIDIA segmentation module in 3D Slicer® in the context of inter-reader variability of expert manual segmentation.*Methods and Materials CNN-derived & Slicer® NVIDIA module-derived pancreas segmentations on a curated cohort of 89 abdomen CTs (portal venous phase, slice thickness =3.75 mm) with normal pancreas were independently corrected [corrected AI (cAI) and corrected NVIDIA (cNVIDIA)] by two radiologists (R1 and R2). Both R1 & R2 also independently performed manual pancreas segmentations on each CT using "Fill between Slices" tool on Slicer®. Segmentation time for each CT was recorded and compared between the 3 sets (cAI, cNVIDIA and manual). Manual segmentation by the radiologist with more experience (R1) was ground truth (GT) for calculation of Dice-Sorenson coefficient (DSC) and Jaccard coefficient (JC).*Results When compared with GT segmentations of R1, manual segmentations by R2 had mean (SD) DSC 0.83 (0.03) and JC 0.70 (0.05). CNN-derived automated segmentation had DSC 0.78 (0.06) and JC 0.64 (0.07). DSC and JC were identical for both readers for cAI [DSC: 0.80 (0.04); JC:0.67 (0.06)] and cNVIDIA [DSC: 0.82 (0.04); JC 0.70 (0.06)]. Compared to pancreatic volumes derived from GT [68.42 cc (35.6)], all other methods tended to over-segment the pancreas but the differences in volumes were non-inferior (p<0.05). Mean (SD) automated segmentation time for AI (with CPU) was 1.2 (0.3) minutes. Time for cAI, cNVIDIA, and manual method tended to be longer for R2 than R1 (R1: 1.22 (0.55), 3.27 (1.44) and 2.26 (0.49) minutes; R2: 1.57 (1.36), 3.50 (2.35) & 4.38 (1.46) minutes, respectively). Even after accounting for corrections of automated AI segmentations, there was significant time savings with AI compared to both manual (R1 46%; R2 64%; p<0.0001) & cNVIDIA (R1 63%; R2 55%; p-value <0.0001) sets.*Conclusions CNN-derived pancreas segmentation is accurate and has performance comparable to inter-reader variability. It delivers substantial time savings compared with both manual & NVIDIA module even after accounting for review of initial output of automated segmentations & with more pronounced effect for relatively inexperienced reader.*Clinical Relevance/Application AI-powered volumetric pancreas segmentation offers an accurate and scalable discovery tool for potential clinical translation of insights from quantitative pancreas imaging for endocrine and exocrine pancreas diseases.

RESULTS

When compared with GT segmentations of R1, manual segmentations by R2 had mean (SD) DSC 0.83 (0.03) and JC 0.70 (0.05). CNN-derived automated segmentation had DSC 0.78 (0.06) and JC 0.64 (0.07). DSC and JC were identical for both readers for cAI [DSC: 0.80 (0.04); JC:0.67 (0.06)] and cNVIDIA [DSC: 0.82 (0.04); JC 0.70 (0.06)]. Compared to pancreatic volumes derived from GT [68.42 cc (35.6)], all other methods tended to over-segment the pancreas but the differences in volumes were non-inferior (p<0.05). Mean (SD) automated segmentation time for AI (with CPU) was 1.2 (0.3) minutes. Time for cAI, cNVIDIA, and manual method tended to be longer for R2 than R1 (R1: 1.22 (0.55), 3.27 (1.44) and 2.26 (0.49) minutes; R2: 1.57 (1.36), 3.50 (2.35) & 4.38 (1.46) minutes, respectively). Even after accounting for corrections of automated AI segmentations, there was significant time savings with AI compared to both manual (R1 46%; R2 64%; p<0.0001) & cNVIDIA (R1 63%; R2 55%; p-value <0.0001) sets.

CLINICAL RELEVANCE/APPLICATION

AI-powered volumetric pancreas segmentation offers an accurate and scalable discovery tool for potential clinical translation of insights from quantitative pancreas imaging for endocrine and exocrine pancreas diseases.

GI03-B12   Artificial Intelligence In Crohn's Disease Imaging: From Concept To Clinical Application

Awards
Certificate of Merit

Participants
Mahmoud M. Al-Hawary, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Review machine learning (ML) methods and techniques to develop automated Crohn's disease (CD) features extraction• Review efficacy and feasibility of models with traditional predictors in assessing qualitative and quantitative features with examples • Review bias, explainable AI and challenges in application of ML models in bowel imaging

TABLE OF CONTENTS/OUTLINE

1. Overview of defined qualitative imaging features in CD with clinical implications 2. Explore concept of ML applications with

emphasis on supervised shallow machine learning methods (Random Forest) and deep learning methods (convoluted Neural network). 3. Discuss inherent challenges in bowel analysis using machine learning 4. Step wise approach to machine learning methods in CD- Identify cohort, data acquisition and cleanup; split data into training, validation and test; establish criteria for ground truth and labelling; define your problem (classification or regression) based on your data and outcome (binary, ordinal, continuous, longitudinal or time series); understand which model works best on your data; evaluate model performance 5. Extraction of hidden (explainable) features (Radiomics/texture analysis) towards quantitative assessment - a path towards personalized/precision medicine 6. Case examples 7. Conclusion: ML in CD may have the potential to improve reproducibility and efficiency in qualitative imaging features with a capability to extract hidden quantitative features that can impact treatment plan and patient related outcome

GI03-B3   The Experiment Research Of Ivim-dwi And 3d-asl Quantitative Parameters To Evaluate Regulating Mettl14 On Xenograft Growth And Angiogenesis In Nude Mice With Human Colorectal Cancer Cells

Participants
Zhongyuan Zhang, hefei, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the feasibility of intravoxel incoherent motion diffusion weighted imaging (IVIM-DWI) and three-dimensional arterial spin labeling (3D-ASL) perfusion imaging technique dynamically evaluating the regulation of METTL14 on the cell proliferation and angiogenesis of subcutaneous xenograft in nude mice of human colorectal cancer.*Methods and Materials Divided into experimental group (Mettl14 knockdown group) and control group and 10 mice in each group, 20 5-week-old nude mice were used to established xenograft models. After that these mice carrying subcutaneous tumor preoperatively underwent plain MRI for IVIM-DWI and 3D-ASL examinations. IVIM-DWI quantitative parameters (ADC, D, D*, f) and 3D-ASL parameters(blood flow, BF)value were measured and optimal maps were reconstructed. Correlation analysis was conducted between all parameters and subcutaneous tumor volume, mass, Ki-67 and CD34 staining indices.*Results Compared with control group, the volume and mass of subcutaneous xenograft in the experimental group were much greater, with statistically significant differences (t value was 5.312, 5.535, P <0.05). Besides, the values of ADC and D in the experimental group were lower than those in the control group, while D*, F and BF values were higher than the counterpart, and the differences were statistically significant (t values were -2.802, -4.311, 4.992, 4.141 and 6.498, respectively, all P <0.05). Ki-67 and CD34 immunohistochemical results showed that the proliferation index and the MVD count of xenograft in the experimental group was significantly higher than that in the control group, and the difference was statistically significant (t value 9.387, 7.3, P <0.05). Pearson correlation analysis showed that D* and BF values of the experimental group were positively correlated with MVD count, xenograft volume and weight (P<0.05), while ADC values and D values were negatively correlated with Ki67 proliferation index, xenograft tumor volume and weight (P<0.05).*Conclusions The microcirculation and molecular diffusion movement of water of xenografts in nude mice can be evaluated quantitatively via IVIM-DWI and 3D-ASL technology, reflecting the microvascular formation and cell density of tumor tissues, noninvasively monitoring the regulation of METTL14 on the growth of xenograft of human CRC cells. Therefore, IVIM-DWI and 3D-ASL can be used as a useful tool for tumor experimental research.*Clinical Relevance/Application Quantitative parameters of IVIM-DWI and 3D-ASL can noninvasively monitor the regulation of metTL14 on the growth of subcutaneous transplanted tumor in nude mice with human colorectal cancer.

RESULTS

Compared with control group, the volume and mass of subcutaneous xenograft in the experimental group were much greater, with statistically significant differences (t value was 5.312, 5.535, P <0.05). Besides, the values of ADC and D in the experimental group were lower than those in the control group, while D*, F and BF values were higher than the counterpart, and the differences were statistically significant (t values were -2.802, -4.311, 4.992, 4.141 and 6.498, respectively, all P <0.05). Ki-67 and CD34 immunohistochemical results showed that the proliferation index and the MVD count of xenograft in the experimental group was significantly higher than that in the control group, and the difference was statistically significant (t value 9.387, 7.3, P <0.05). Pearson correlation analysis showed that D* and BF values of the experimental group were positively correlated with MVD count, xenograft volume and weight (P<0.05), while ADC values and D values were negatively correlated with Ki67 proliferation index, xenograft tumor volume and weight (P<0.05).

CLINICAL RELEVANCE/APPLICATION

Quantitative parameters of IVIM-DWI and 3D-ASL can noninvasively monitor the regulation of metTL14 on the growth of subcutaneous transplanted tumor in nude mice with human colorectal cancer.

GI03-B7   Evaluation Of The Quantitative Prediction Study Of Extracorporeal Shock Wave Lithotripsy For The Treatment Of Pancreatic Duct Stones Based On Energy Spectrum CT Effective Atomic Number Measurement Technology

Participants
Qingyu Ji, Baotou, China (*Presenter*) Nothing to Disclose

PURPOSE

The effective atomic number analysis of pancreatic duct stones (PDS) was performed by energy spectral plain computed tomography (CT) to find potential predictors of extracorporeal shock wave lithotripsy (ESWL) for the treatment of PDS.*Methods and Materials Fifty-six patients with chronic pancreatitis and pancreatic duct stones (stone diameter 0.5cm-1.2cm) were enrolled. Before and after ESWL treatment, energy spectrum plain scan CT was performed. All patients were treated with ESWL using an electromagnetic lithotripter. According to the effective atomic number (EAN) and mean stone density (MSD), the stone clearance rate (SCR) was obtained. The patients were divided into three groups, and the thresholds were respectively >90%, 50-90% and <50% of SCR. Factors include EAN and MSD. These factors were analyzed with ESWL, and their impact on SCR was evaluated through univariate and multivariate analysis. The diagnostic threshold of the independent predictive index was further calculated, and the relationship with SCR and ESWL was analyzed by drawing a trend line.*Results Both EAN and MSD can be the important predictors of ESWL for PDS (p <0.05), but the prediction effect of EAN is better than MSD (AUC is 0.915, 0.812, p <0.001). PDS patients with EAN higher than the cut-off value of 1.52e+3 but relatively low SCR (average 44.87 vs 89.57%) require more courses of ESWL treatment.*Conclusions The EAN obtained by energy spectrum CT plain scan can be an independent predictor of ESWL treatment of PDS patients. Using a cut-off value of 1.52e+3, patients with low stone EAN are good candidates for ESWL treatment of PDS.*Clinical Relevance/Application The study of the composition of pancreatic duct stones through energy spectrum CT, and the evaluation before and after extracorporeal shock wave lithotripsy combined with endoscopic treatment of pancreatic duct stones, instead of traditional imaging methods, more accurate analysis of the composition of pancreatic duct stones in patients with pancreatic duct stones. Optimize the lithotripsy plan, and guide clinicians to formulate "individualized treatment plan" according

to the patient's condition, pay attention to early diagnosis and treatment, so that patients can obtain better clinical effects.

RESULTS

Both EAN and MSD can be the important predictors of ESWL for PDS (p <0.05), but the prediction effect of EAN is better than MSD (AUC is 0.915, 0.812, p <0.001). PDS patients with EAN higher than the cut-off value of 1.52e+3 but relatively low SCR (average 44.87 vs 89.57%) require more courses of ESWL treatment.

CLINICAL RELEVANCE/APPLICATION

The study of the composition of pancreatic duct stones through energy spectrum CT, and the evaluation before and after extracorporeal shock wave lithotripsy combined with endoscopic treatment of pancreatic duct stones, instead of traditional imaging methods, more accurate analysis of the composition of pancreatic duct stones in patients with pancreatic duct stones. Optimize the lithotripsy plan, and guide clinicians to formulate "individualized treatment plan" according to the patient's condition, pay attention to early diagnosis and treatment, so that patients can obtain better clinical effects.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

CA02-B

Cardiac Monday Poster Discussions

Sub-Events

CA02-B3   **Heartaches Of A Different Kind: Comprehensive Review Of Infections**

Awards
Certificate of Merit

Participants
Sevcan Turk, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Infections have a broad spectrum of imaging appearance based on the pathogen (viral, bacterial, fungal, and parasitic) and site of primary involvement (myocardium, pericardium, endocardium).-Cross-sectional imaging is commonly utilized for the evaluation of infections, particularly cardiac MR in the setting of suspected myocarditis and FDG PET in prosthetic valve endocarditis. Similarly, CT can play an important role in the assessment of complications like thromboembolism, pseudoaneurysms, and prosthetic valve endocarditis.-Role of imaging in cardiac infections has become particularly important during the current COVID pandemic. Understanding the value of MR in diagnosis and management is important.-Awareness of common as well as uncommon cardiac infections and their complications can help direct appropriate care. After reviewing this exhibit, the reader will become familiar with the spectrum of cardiac infections and the role of different qualitative and quantitative imaging parameters in the diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Overview of imaging characteristics of a spectrum of common as well as rare cardiac infections: Viral (including SARS-CoV 2, HIV), Bacterial (ranging from common infections like Streptococcus, Staphylococcus to rarer entities like Mycobacterium tuberculosis), Fungal, Parasitic: e.g. Echinococcus, Chagas. 2. Learn the role of state of the art imaging with emphasis on qualitative and quantitative imaging parameters (e.g. T1 and T2 mapping). 3. Review of acute and chronic complications.

Printed on: 06/28/22

GU02-A

Genitourinary Monday Poster Discussions

Sub-Events

GU02-A3   The Gamut Of Extratesticular Scrotal Masses: An Anatomic Approach To Differential Diagnosis

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Rocio Marquez, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: 1. Discuss the gamut of extratesticular (ET) masses which are common lesions that may be clinically significant and can pose diagnostic and management dilemmas 2. Review scrotal anatomy 3. Recognize mimics of paratesticular masses 4. Outline the differential diagnoses of ET masses defined by specific anatomic compartments 5. Describe imaging findings of benign ET lesions 6. Illustrate findings suggestive of malignant ET lesions and suggestions for management 7. Delineate conditions in which US findings are diagnostic and those in which MRI can serve an adjunctive role.

TABLE OF CONTENTS/OUTLINE

1-Introduction 2-Review of ET Scrotal Anatomy 3-Mimics of Paratesticular Masses (torsion knot, focal epididymitis/abscess, hematoma) 4-Benign ET Masses By Anatomical Compartment a)Skin (cysts, abscess, hematoma) b)Tunica (fibrous pseudotumor, mesothelioma) c)Testis (polyorchidism, appendage) d)Rete Testis (epididymal cyst, spermatocele, sperm cell granuloma, cystadenoma) e)Epididymis (adenomatoid tumor, cystadenoma, epidermoid) f)Spermatic Cord (lipoma, liposarcoma, metastases) g)Paratesticular (mesenchymal lesions, hernia) 5-Malignant ET Masses (sarcomas, lymphoma, metastases, amongst others) 6-Problem-solving role of MRI 7-Conclusions

Printed on: 06/28/22

Sub-Events

VA02-B1   **Factors Affecting The Incidence Of The Thoracic Aortic Aneurysm Dissection Or Rupture: Initial Diameter And Patient Age**

Participants
Rokas Liubauskas, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

In patients with thoracic aortic aneurysm (TAA), the decision of surgical or endovascular repair relies primarily on its diameter. A threshold of 5.5cm is recommended for patients with a degenerative aneurysm, but the majority of acute aortic events occur below this threshold. Association between patients' age and the diameter of the TAA at the time of diagnosis and incidence of aortic aneurysm rupture (AAR) and acute aortic dissection (AAD) was investigated.*Methods and Materials Single-center IRB-approved study of patients with a TAA who underwent computed tomography (CT) that included thoracic imaging between October 4th, 2002 and February 18th, 2021. Patient demographic data and the diameter of the TAA at the time of diagnosis (initial TAA diameter) were recorded from online medical records. For this study, Rupture or dissection of TAA was defined as an aortic event. Association between patients' age and the initial TAA diameter and incidence of aortic events was investigated. Mann-Whitney test, t-test, and logistic regression were used to investigate the association of age and the initial diameter with AAR and AAD.*Results 6269 patients were included. 4102 (65%) patients were male, median age 71 (IQR 63-80, range 20-104). The median initial TAA diameter was 44.4 mm (IQR 40-46). The overall aortic event rate was 4.5% (282/6269). Younger age and larger initial diameter were associated with a higher rate of AAR or AAD (both p<0.0001). Patients with the initial TAA diameter 45 mm or greater experienced an aortic event rate of 4%. There was a trend of aortic event rate increasing with the initial TAA diameter increasing and plateauing at the diameter of 55 mm or greater at the rate of 13%. There was a trend of decreasing aortic event rate with increasing age, declining from more than 10% to 2%. Patients younger than 40 years old had an event rate of 10.7%. Patients 40 years old and older had an event rate of 4.4%. The highest event rate was demonstrated in the age group of 30-40 years old (11.8%). Age was demonstrated to affect the event rate independently from the initial aortic diameter.*Conclusions Patients with the diameter of the TAA 45 mm or greater suffer an aortic event more often than those with smaller aneurysms. There is also a tendency of younger patients to experience an aortic event more often than the older patients, peaking at the age 30-40 years old.*Clinical Relevance/Application The diameter of the thoracic aortic aneurysm and age, jointly and independently affect the rate of thoracic aneurysm rupture and dissection and should be taken into consideration when planning surgical or endovascular repair.

RESULTS

6269 patients were included. 4102 (65%) patients were male, median age 71 (IQR 63-80, range 20-104). The median initial TAA diameter was 44.4 mm (IQR 40-46). The overall aortic event rate was 4.5% (282/6269). Younger age and larger initial diameter were associated with a higher rate of AAR or AAD (both p<0.0001). Patients with the initial TAA diameter 45 mm or greater experienced an aortic event rate of 4%. There was a trend of aortic event rate increasing with the initial TAA diameter increasing and plateauing at the diameter of 55 mm or greater at the rate of 13%. There was a trend of decreasing aortic event rate with increasing age, declining from more than 10% to 2%. Patients younger than 40 years old had an event rate of 10.7%. Patients 40 years old and older had an event rate of 4.4%. The highest event rate was demonstrated in the age group of 30-40 years old (11.8%). Age was demonstrated to affect the event rate independently from the initial aortic diameter.

CLINICAL RELEVANCE/APPLICATION

The diameter of the thoracic aortic aneurysm and age, jointly and independently affect the rate of thoracic aneurysm rupture and dissection and should be taken into consideration when planning surgical or endovascular repair.

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Abstract Archives of the RSNA, 2021

Sub-Events

NPM05-A1 **Diversity, Equity And Inclusion: Analysis Of IMG Applicants Experience In The 2020 Diagnostic Radiology Residency Match**

Participants
Melina Hosseiny, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

1) analyze the proportion of the Diagnostic Radiology (DR) residency positions filled by International Medical School Graduates (IMG), American Medical School Graduates (AMG MD), and Doctor of Osteopathic Medicine (DO) applicants, 2) compare these values with other specialties and 3) analyze DR residency match results for IMGs in each state.*Methods and Materials The official published data of national residency match program (NRMP) for the 2020 Main Residency Match were accessed and reviewed from NRMP website (https://www.nrmp.org/main-residency-match-data/). The proportions of DR residency positions filled by US citizen and non-US citizen IMGs were compared with the overall match results for all applicants and all specialties. Match data were reviewed state-wise to assess the distribution of IMGs ranked into DR residency spots.*Results Overall, 990 PGY2 and 123 PGY1 DR residency positions were offered, of which 967 PGY2 and 116 PGY1 spots were filled. Of filled PGY2 spots, the proportion of AMG MD, DO, non-US IMGs and US IMG applicants were 72.1%,14.8%, 8%, and 5.1%, respectively. The share of IMG applicants from the filled DR spots was lower compared to the average of all specialties. (Fig. 1a) Among applicants who ranked DR as their only choice , 60.4% of non-US and 67.9% of US IMGs were matched, compared to a match rate of 97.8% for AMG MD and 97% for DO applicants whose only choice for specialty was DR. (Fig. 1b)At state-wise level, the ratio of matched IMGs/total DR residency spots was highest at AZ (62.5%, 5/8) followed by MI (38%, 8/21), MA (25%, 15/60), FL (25%, 13/52) and NY (19.1%, 26/136). There were 19 states who did not have any IMGs match into their DR Residency spots. Of these, NC (28), GA (23), VA (21) had the highest number of eligible DR residency spots.*Conclusions IMGs filled 14.8% of the DR residency positions in 2020 main residency match, compared to 21.7% of total residency positions filled by IMGs in all specialties. Overall, AZ, MI, MA, FL and NY were the most IMG-friendly states, while in 19 states with DR residency spots, no IMG applicants were matched. The findings have implications on the goals of diversity, equity and inclusion in the Diagnostic Radiology specialty.*Clinical Relevance/Application Less proportion of DR residency spots were filled by IMG applicants compared to the proportion for all specialties. This proportion heavily varies between different states and influences the diversity of the physician population in DR.

RESULTS

Overall, 990 PGY2 and 123 PGY1 DR residency positions were offered, of which 967 PGY2 and 116 PGY1 spots were filled. Of filled PGY2 spots, the proportion of AMG MD, DO, non-US IMGs and US IMG applicants were 72.1%,14.8%, 8%, and 5.1%, respectively. The share of IMG applicants from the filled DR spots was lower compared to the average of all specialties. (Fig. 1a) Among applicants who ranked DR as their only choice , 60.4% of non-US and 67.9% of US IMGs were matched, compared to a match rate of 97.8% for AMG MD and 97% for DO applicants whose only choice for specialty was DR. (Fig. 1b)At state-wise level, the ratio of matched IMGs/total DR residency spots was highest at AZ (62.5%, 5/8) followed by MI (38%, 8/21), MA (25%, 15/60), FL (25%, 13/52) and NY (19.1%, 26/136). There were 19 states who did not have any IMGs match into their DR Residency spots. Of these, NC (28), GA (23), VA (21) had the highest number of eligible DR residency spots.

CLINICAL RELEVANCE/APPLICATION

Less proportion of DR residency spots were filled by IMG applicants compared to the proportion for all specialties. This proportion heavily varies between different states and influences the diversity of the physician population in DR.

NPM05-A2 **Sterotactic Radiation Therapy In Oligometastatic Cancers: A Long-term Cost-effectiveness Evaluation**

Participants
Dirk Mehrens, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

In certain malignancies, patients with oligometastatic disease benefit from radical ablative or surgical treatment. The SABR-COMET trial demonstrated a survival benefit for oligometastatic patients randomized to local stereotactic ablative radiation (SABR) compared to patients receiving standard care (SC) alone. Our aim was to determine the cost-effectiveness of SABR for oligometastatic cancer patients over a long-term horizon.*Methods and Materials A decision model based on partitioned survival simulations estimated costs and quality-adjusted life years (QALY) associated with both strategies in a United States setting from a health care perspective. Analyses were performed over the trial duration of six-years as well as a long-term horizon of 16 years. Model input parameters were based on the SABR-COMET trial data as well as best available and most recent data provided in the published literature. A discount of 3% for costs was implemented in the analysis. All costs were adjusted to 2019 US Dollars according to United States Consumer Price Index. SABR costs were reported with an average of $11,700 per treatment. Deterministic sensitivity analyses were performed. Incremental costs, effectiveness, and cost-effectiveness ratios (ICER) were calculated. The willingness-to-pay (WTP) threshold was set to $100,000/QALY.*Results Based on increased overall and progression-free survival, the SABR group showed 0.78 incremental QALYs over the trial duration and 1.34 incremental QALYs for long-term analysis. Treatment with SABR led to a marginal increase in costs compared to SC alone (SABR: $304,656; SC: $303,523

of 6 years; ICER $1,446/QALY and SABR: $402,888; SC: $350,708 for long term analysis; ICER $38,874/QALY). Therapy with SABR remained cost-effective until unit costs of $88,969 over the trial duration (i.e. 7.6 times the average cost). Sensitivity analysis identified a strong model impact for cost parameters of oligo- and polymetastatic disease states.*Conclusions Our analysis suggests that local treatment with SABR adds QALYs for patients with certain oligometastatic cancers and represents an intermediate- and long-term cost-effective treatment strategy.*Clinical Relevance/Application SABR is increasingly used as a therapy for oligometastatic disease. Based on this cost-effectiveness analysis, further investments in local ablative treatments for oligometastatic patients appear justified.

RESULTS

Based on increased overall and progression-free survival, the SABR group showed 0.78 incremental QALYs over the trial duration and 1.34 incremental QALYs for long-term analysis. Treatment with SABR led to a marginal increase in costs compared to SC alone (SABR: $304,656; SC: $303,523 of 6 years; ICER $1,446/QALY and SABR: $402,888; SC: $350,708 for long term analysis; ICER $38,874/QALY). Therapy with SABR remained cost-effective until unit costs of $88,969 over the trial duration (i.e. 7.6 times the average cost). Sensitivity analysis identified a strong model impact for cost parameters of oligo- and polymetastatic disease states.

CLINICAL RELEVANCE/APPLICATION

SABR is increasingly used as a therapy for oligometastatic disease. Based on this cost-effectiveness analysis, further investments in local ablative treatments for oligometastatic patients appear justified.

Abstract Archives of the RSNA, 2021

Sub-Events

SDP-BR-1 **Ultrafast Dynamic Contrast-enhanced Breast MRI: Association With Pathologic Complete Response In Neoadjuvant Treatment Of Breast Cancer**

Participants
Ji Hee Kim, Goyang, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to investigate whether pretreatment kinetic features from ultrafast dynamic contrast enhanced (DCE)-MRI are associated with pathologic complete response (pCR) in patients with invasive breast cancer and according to immunohistochemistry (IHC) subtype.*Methods and Materials Between August 2018 and June 2019, 256 consecutive breast cancer patients (mean age, 50.2 years; range, 25-86 years) who underwent both ultrafast and conventional DCE-MRI and surgery following neoadjuvant chemotherapy were included. DCE-MRI kinetic features were obtained from pretreatment MRI data. Time-to-enhancement, maximal slope (MS), and volumes at U1 and U2 (U1, time point at which the lesion starts to enhance; U2, subsequent time point after U1) were derived from ultrafast MRI. To identify factors associated with pCR, logistic regression analysis was performed.*Results Overall, 41.4% of all patients achieved pCR. None of the kinetic features were associated with pCR when including all cancers. Among ultrafast DCE-MRI kinetic features, a higher MS (OR, 0.982; P = 0.040) was associated with pCR at univariate analysis in hormone receptor (HR)-positive cancers. In triple-negative cancers, a higher volume ratio U1/U2 was associated with pCR at univariate (OR, 11.787; P = 0.006) and multivariate analysis (OR, 14.811; P = 0.005). Among conventional DCE-MRI kinetic features, higher peak enhancement (OR, 0.993; P = 0.031) and a higher percentage of washout (OR, 0.904; P = 0.039) was associated with pCR only in HR-positive cancers at univariate analysis.*Conclusions A higher volume ratio of U1/U2 derived from ultrafast DCE-MRI was independently associated with pCR in triple-negative invasive breast cancer.*Clinical Relevance/Application Ultrafast DCE-MRI can aid in pCR prediction. Especially, a tailored approach of applying different parameters according to IHC subtype would be beneficial.

RESULTS

Overall, 41.4% of all patients achieved pCR. None of the kinetic features were associated with pCR when including all cancers. Among ultrafast DCE-MRI kinetic features, a higher MS (OR, 0.982; P = 0.040) was associated with pCR at univariate analysis in hormone receptor (HR)-positive cancers. In triple-negative cancers, a higher volume ratio U1/U2 was associated with pCR at univariate (OR, 11.787; P = 0.006) and multivariate analysis (OR, 14.811; P = 0.005). Among conventional DCE-MRI kinetic features, higher peak enhancement (OR, 0.993; P = 0.031) and a higher percentage of washout (OR, 0.904; P = 0.039) was associated with pCR only in HR-positive cancers at univariate analysis.

CLINICAL RELEVANCE/APPLICATION

Ultrafast DCE-MRI can aid in pCR prediction. Especially, a tailored approach of applying different parameters according to IHC subtype would be beneficial.

SDP-BR-10 **An Independent Evaluation Of A Breast Artificial Intelligence Product As A Stand-alone Reader On A Dataset Representative Of Two Uk Breast Screening Centres**

Participants
Lucy Warren, PhD, Guildford, United Kingdom (*Presenter*) Institutional Research Grant, Alphabet Inc

PURPOSE

To independently evaluate the stand-alone performance of a breast AI product on multi-centre UK breast screening data.*Methods and Materials An evaluation of a CE marked breast AI product (Lunit INSIGHT MMG, Seoul, South Korea) was performed independently from the vendor. Images from 30,000 women from the OPTIMAM image database (OMI-DB) formed a dataset representative of all women attending two UK breast screening centres in 2016. OMI-DB is continually updated with subsequent images and clinical information for the women collected. This allowed the inclusion of a representative number of prior images to interval and screen-detected cancers in the dataset. Images from OMI-DB have been shared with many AI developers. The vendor has had access to a subset of OMI-DB. These women were not used in this evaluation. The vendor did not have access to the product during the evaluation. The study aimed at assessing non-inferiority of the AI product (at an operating point defined prior to study) to first, second and consensus human readers. A positive case was defined as a woman diagnosed with a screen-detected cancer within 39 months or interval cancer within 36months of the screening mammogram. McNemar methods compared the AI product and human performance, with a non-inferiority range of 5 percentage points.*Results The AI was non-inferior to first and second human readers and consensus in terms of sensitivity and specificity, within a non-inferiority range of 5 percentage points. The sensitivity (95% confidence interval in brackets) of the AI product was 7.6 (3.7, 11.5), 2.9 (-0.6, 6.4) and 4.4 (0.9, 7.9) percentage points higher than first, second and consensus human readers respectively. The specificity of the AI product was 0.7 (0.3, 1.1), 1.2 (0.8, 1.6) and 3.6 (3.2, 3.9) percentage points lower than first, second and consensus human readers respectively. The disagreement between first human reader and AI product was 11%, significantly higher than the 4% disagreement between first and second human readers. This may be due to the AI product and human recalling different types of cases. The AI recalled 88% of screen-detected cancers, 34% priors to interval cancer and 23% prior to screen-detected cancer. The second human

reader recalled 97% of screen-detected cancers, 15% of priors to interval cancer and 11% of priors to screen-detected cancer. The impact of this after consensus needs to be investigated further.*Conclusions This study demonstrated that the breast AI product was non-inferior to human readers in terms of specificity and sensitivity, within a 5 percentage point non-inferiority range.*Clinical Relevance/Application Independent evaluation of CE marked breast AI product on representative multi-centre data from UK breast screening programme.

RESULTS

The AI was non-inferior to first and second human readers and consensus in terms of sensitivity and specificity, within a non-inferiority range of 5 percentage points. The sensitivity (95% confidence interval in brackets) of the AI product was 7.6 (3.7, 11.5), 2.9 (-0.6, 6.4) and 4.4 (0.9, 7.9) percentage points higher than first, second and consensus human readers respectively. The specificity of the AI product was 0.7 (0.3, 1.1), 1.2 (0.8, 1.6) and 3.6 (3.2, 3.9) percentage points lower than first, second and consensus human readers respectively. The disagreement between first human reader and AI product was 11%, significantly higher than the 4% disagreement between first and second human readers. This may be due to the AI product and human recalling different types of cases. The AI recalled 88% of screen-detected cancers, 34% priors to interval cancer and 23% prior to screen-detected cancer. The second human reader recalled 97% of screen-detected cancers, 15% of priors to interval cancer and 11% of priors to screen-detected cancer. The impact of this after consensus needs to be investigated further.

CLINICAL RELEVANCE/APPLICATION

Independent evaluation of CE marked breast AI product on representative multi-centre data from UK breast screening programme.

SDP-BR-11 Utility Of A Full Waveform Inversion Reconstruction Algorithm For Speed-of-sound Images On Ultrasound Computed Tomography For Breast Cancer

Participants
Fumi Kato, Sapporo, Japan (*Presenter*) Research Grant, Hitachi, Ltd;Research Grant, FUJIFILM Holdings Corporation;

PURPOSE

Ultrasound computed tomography (USCT) can generate speed-of-sound images (SSI) with a ring-shaped transducer array surrounding the breast in a water tank. High-resolution (HR)-SSI is obtained using a full waveform inversion reconstruction algorithm. Breast cancer (BC) may be more distinguishable from background parenchyma (BP) on HR-SSI. We evaluated the visibility and speed-of-sound value (SSV) of BC on SSI.*Methods and Materials BC patients (pts) who were scheduled to receive surgery between August and December 2018 and between August 2019 and March 2020 were eligible for the study for scanning with prototype USCT. Thirty-four lesions in 30 pts were included and received USCT. Six lesions in five pts were excluded due to being outside of the scanned area. Moreover, one lesion in one pt was excluded due to poor image quality. Finally, 27 lesions in 24 pts were analyzed.Visibility of BC on C-SSI and HR-SSI by reference to magnetic resonance (MR) images was evaluated using a 5-point scoring (1; invisible, 2; probably invisible, 3; not sure, 4; probably visible, 5; visible) by two radiologists (R1 and R2) independently, and compared using Wilcoxon signed ranks test. SSV of BC and BP on C-SSI and HR-SSI were measured and compared using paired samples t-test. The ratio of SSV of BC to BP was compared between C-SSI and HR-SSI using paired samples t-test. The correlation between SSV and apparent diffusion coefficient (ADC) value on MR imaging was investigated using Spearman's correlation coefficients.*Results By R1, all lesions (100%) were visible (score 4 or 5) on HR-SSI, and 12 lesions (44.4%) on C-SSI. By R2, 26 lesions (96.3%) were visible on HR-SSI and seven lesions (25.9%) on C-SSI. Scores for visibility by both radiologists on HR-SSI were significantly higher than those on C-SSI (p < 0.0001).SSV of BC was significantly higher than that of BP both on C-SSI and HR-SSI. The ratio of SSV of BC to BP on HR-SSI was significantly higher than that on C-SSI (p = 0.0009). There was no significant correlation between SSV and ADC value.*Conclusions HR-SSI provides better visibility of BC than C-SSI, and the SSV of BC is higher than BP.*Clinical Relevance/Application A full waveform inversion reconstruction algorithm for speed-of-sound imaging provides a high-resolution image and good visibility of breast cancer on ultrasound computed tomography.

RESULTS

By R1, all lesions (100%) were visible (score 4 or 5) on HR-SSI, and 12 lesions (44.4%) on C-SSI. By R2, 26 lesions (96.3%) were visible on HR-SSI and seven lesions (25.9%) on C-SSI. Scores for visibility by both radiologists on HR-SSI were significantly higher than those on C-SSI (p < 0.0001).SSV of BC was significantly higher than that of BP both on C-SSI and HR-SSI. The ratio of SSV of BC to BP on HR-SSI was significantly higher than that on C-SSI (p = 0.0009). There was no significant correlation between SSV and ADC value.

CLINICAL RELEVANCE/APPLICATION

A full waveform inversion reconstruction algorithm for speed-of-sound imaging provides a high-resolution image and good visibility of breast cancer on ultrasound computed tomography.

SDP-BR-12 The Performance Of Quantitative And Volumetric Enhancement Measurement To Assess Tumor Response In Patients With Breast Cancer After Early Neoadjuvant Chemotherapy

Participants
Jie Ding, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of quantitative enhancing lesion volume (ELV) for evaluating the responsiveness of breast cancer patients to early neoadjuvant chemotherapy (NAC) using dynamic contrast- enhanced magnetic resonance imaging (DCE-MRI).*Methods and Materials Seventy-five women with breast cancer underwent DCE-MRI before and after NAC. Lesions were assessed by ELV, response evaluation criteria in solid tumors 1.1 (RECIST 1.1), and total lesion volume (TLV). The diagnostic and pathological predictive performances of the methods were compared and color maps were compared with pathological results.*Results ELV identified 29%, 67%, and 4% of cases with partial response, stable disease, and progressive disease, respectively. There was no significant difference in evaluation performances among the methods. The sensitivity, specificity, positive predictive value, negative predictive value (NPV), and accuracy of ELV for predicting pathologic response were 72%, 92%, 81.8%, 86.8%, and 85.3%, respectively, with the highest sensitivity, NPV, and accuracy of the three methods. The area under the receiver operating characteristic curve was also highest for ELV. Pre- and post- NAC color maps reflecting tumor activity were consistent with pathological necrosis.*Conclusions ELV may help evaluate the responsiveness of breast cancer patients to NAC, and may provide a good tumor-response indicator through the ability to indicate tumor viability.*Clinical Relevance/Application ELV is a more effective method to assess breast tumor therapy response after early NAC.

RESULTS

ELV identified 29%, 67%, and 4% of cases with partial response, stable disease, and progressive disease, respectively. There was no significant difference in evaluation performances among the methods. The sensitivity, specificity, positive predictive value, negative predictive value (NPV), and accuracy of ELV for predicting pathologic response were 72%, 92%, 81.8%, 86.8%, and 85.3%, respectively, with the highest sensitivity, NPV, and accuracy of the three methods. The area under the receiver operating characteristic curve was also highest for ELV. Pre- and post- NAC color maps reflecting tumor activity were consistent with pathological necrosis.

CLINICAL RELEVANCE/APPLICATION

ELV is a more effective method to assess breast tumor therapy response after early NAC.

SDP-BR-14 The Performance Of Automated Breast Ultrasound Versus Hand-held Ultrasound In The Visualization And Characterization Of Axillary Lymph Node In Recent Diagnosed Breast Cancer Patients.

Participants
Sung Kim, MD, Sungnam-si, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to evaluate automated breast ultrasound (ABUS) and compare it to handheld ultrasound (HHUS) in the visualization and characterization of axillary lymph nodes (LNs) in recently diagnosed breast cancer patients.*Methods and Materials We retrospectively reviewed the medical records of 388 women (396 cancers) with recently diagnosed breast cancer (aged 53.0 ± 11.1 years) who underwent ABUS and HHUS examinations from September 2017 to May 2018. The findings of ABUS and HHUS were reviewed and compared using pathologic results as a reference. Their diagnostic performances in predicting axillary LN metastasis and heavy nodal (=3 LNs) metastasis were analyzed. The agreement between ABUS and HHUS was estimated using percent agreement and ? statistic.*Results Among the 396 breast cancers, 109 had axillary LN metastases (84 in N1, 17 in N2, and 8 in N3) and 35 had =3 LN metastases. Of the 396 ipsilateral axillae of breast cancer sites, 257 axillae (64.9%) had an axillary LN (average 1.4 ± 0.8, median 1, range 1-8) based on ABUS. Among the 139 axillae with no visualized LNs on ABUS, 12 had axillary LN metastases (8.6%; all in N1; one LN metastasis: 11, two LN metastases: 1). ABUS and HHUS showed ultrasonographically suspicious LNs in 63 (24.5%, 63/257) and 60 (15.2%, 60/396) axillae, respectively. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of ABUS in predicting axillary LN metastases were 45.0, 95.1, 77.8, 82.0, and 81.3%, respectively, and those of HHUS were 42.2, 95.1, 76.7, 81.3, and 80.6%, respectively; while those of ABUS in predicting heavy nodal metastases were 71.4, 89.5, 39.7, 97.0, and 88.2%, and those of HHUS were 65.7, 89.8, 38.3, 96.4, and 87.9%, respectively (p > 0.05). The overall agreement between HHUS and ABUS in the included LNs of 257 axillae was 94.9%; kappa = 0.86.*Conclusions Although over one-third of axillae in recently diagnosed breast cancer site LN were not visualized on ABUS, ABUS could be used in the characterization of axillary LN. Moreover, in all heavy nodal metastasis cases, LNs were visualized on ABUS*Clinical Relevance/Application 1. ABUS showed axillary LNs in 64.9% of the recently diagnosed breast cancer patients. 2. Of the ABUS that did not visualize the axillary LNs of recently diagnosed breast cancer patients, 8.6% showed only one or two axillary LN metastasis. 3. The ABUS and HHUS findings of axillary LN showed almost perfect agreement.

RESULTS

Among the 396 breast cancers, 109 had axillary LN metastases (84 in N1, 17 in N2, and 8 in N3) and 35 had =3 LN metastases. Of the 396 ipsilateral axillae of breast cancer sites, 257 axillae (64.9%) had an axillary LN (average 1.4 ± 0.8, median 1, range 1-8) based on ABUS. Among the 139 axillae with no visualized LNs on ABUS, 12 had axillary LN metastases (8.6%; all in N1; one LN metastasis: 11, two LN metastases: 1). ABUS and HHUS showed ultrasonographically suspicious LNs in 63 (24.5%, 63/257) and 60 (15.2%, 60/396) axillae, respectively. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of ABUS in predicting axillary LN metastases were 45.0, 95.1, 77.8, 82.0, and 81.3%, respectively, and those of HHUS were 42.2, 95.1, 76.7, 81.3, and 80.6%, respectively; while those of ABUS in predicting heavy nodal metastases were 71.4, 89.5, 39.7, 97.0, and 88.2%, and those of HHUS were 65.7, 89.8, 38.3, 96.4, and 87.9%, respectively (p > 0.05). The overall agreement between HHUS and ABUS in the included LNs of 257 axillae was 94.9%; kappa = 0.86.

CLINICAL RELEVANCE/APPLICATION

1. ABUS showed axillary LNs in 64.9% of the recently diagnosed breast cancer patients. 2. Of the ABUS that did not visualize the axillary LNs of recently diagnosed breast cancer patients, 8.6% showed only one or two axillary LN metastasis. 3. The ABUS and HHUS findings of axillary LN showed almost perfect agreement.

SDP-BR-15 Improve Preoperative Evaluation Of Axillary Lymph Node Involvement With Combination Of Grayscale And Contrast Enhanced Ultrasound In Clinical Node Negative Early Breast Cancer

Participants
Zihan Niu, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic value of contrast-enhanced ultrasound (CEUS) combined with grayscale ultrasound for preoperative diagnosis of ALN metastatic involvement in patients with early-stage breast cancer and negative clinical palpation.*Methods and Materials A total of clinically node-negative early breast cancer 232 patients with 235 axillae were enrolled in this study. All patients underwent preoperative conventional US and CEUS examinations. The CEUS enhanced patterns were analyzed and further classified into four patterns, including homogeneous, featured inhomogeneous, focal defect, and no enhancement. The diagnostic value of conventional US and CEUS for the diagnosis of ALN tumor burden (ALN+(>=3) v.s. ALN+(1-2)) and ALN status (ALN+ v.s. ALN-) were evaluated. Moreover, at 3:2 ratio, 155 and 80 axillae were divided as the modeling and external validation groups. Two nomograms combined with gray-scale US and CEUS were constructed for the diagnosis of ALN status.*Results The ALN-, ALN+(1-2) and ALN+(=3)were observed in 164, 48, and 23 axillae, respectively. The identification rate of CEUS was 97.9%. Of them, 96.4% SLN with homogeneous enhancement and 92.5% SLN with special enhancement showed ALN-. And 99.2% with the above two patterns showed ALN+(1-2). Compared with the conventional US, the CEUS showed a higher AUC (tumor burden: 0.773 v.s 0.715, ALN metastasis: 0.815 v.s. 0.681) and NPV (tumor burden: 99.19% v.s. 97.48%, ALN metastasis: 94.31% v.s. 84.03%) for ALN status. Moreover, the nomogram further increased the diagnostic efficiency while keeping high NPV in both ALN tumor burden(AUC:0.828, NPV:97.92%) and ALN metastasis(AUC:0.857, NPV:94.74%) in the validation group.1111MicrosoftInternetExplorer402DocumentNotSpecified7.8 &7;Normal0*Conclusions The combination of CEUS and gray-scale US as a novel method could improve the diagnostic performance while keeping the high NPV for the diagnosis of ALN metastatic

status for clinically negative ALN in early breast cancer.*Clinical Relevance/Application This study further classified the enhancement patterns of SLN and explore the value of different US characteristics for ALN status diagnosis. Compared with the conventional US, CEUS further improved the negative prediction value of ALN status. Moreover, this study first developed and validated the nomogram based on nodal imaging methods combined with the gray-scale US and CEUS and showed high NPV and stable efficiency. The application of CEUS combined with the gray-scale US provides valuable information for the preoperative diagnosis of ALN status, and it might be helpful to the select the subgroups patients who would safely exempt for SLNB and/or ALN in early breast cancer patients with negative palpation ALN.

RESULTS

The ALN-, ALN+(1-2) and ALN+(=3)were observed in 164, 48, and 23 axillae, respectively. The identification rate of CEUS was 97.9%. Of them, 96.4% SLN with homogeneous enhancement and 92.5% SLN with special enhancement showed ALN-. And 99.2% with the above two patterns showed ALN+(1-2). Compared with the conventional US, the CEUS showed a higher AUC (tumor burden: 0.773 v.s 0.715, ALN metastasis: 0.815 v.s. 0.681) and NPV (tumor burden: 99.19% v.s. 97.48%, ALN metastasis: 94.31% v.s. 84.03%) for ALN status. Moreover, the nomogram further increased the diagnostic efficiency while keeping high NPV in both ALN tumor burden(AUC:0.828, NPV:97.92%) and ALN metastasis(AUC:0.857, NPV:94.74%) in the validation group.1111MicrosoftInternetExplorer402DocumentNotSpecified7.8 &7;Normal0

CLINICAL RELEVANCE/APPLICATION

This study further classified the enhancement patterns of SLN and explore the value of different US characteristics for ALN status diagnosis. Compared with the conventional US, CEUS further improved the negative prediction value of ALN status. Moreover, this study first developed and validated the nomogram based on nodal imaging methods combined with the gray-scale US and CEUS and showed high NPV and stable efficiency. The application of CEUS combined with the gray-scale US provides valuable information for the preoperative diagnosis of ALN status, and it might be helpful to the select the subgroups patients who would safely exempt for SLNB and/or ALN in early breast cancer patients with negative palpation ALN.

SDP-BR-16   The Impact Of Slice Thickness On The Interpretation Of Digital Breast Tomosynthesis

Participants
Yen Zhi Tang, MBBS,FRCR, Hamilton, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the impact of slice thickness on the diagnostic accuracy and recall rates of Digital Breast Tomosynthesis (DBT).*Methods and Materials In this retrospective study, two readers (breast radiologist and fellow) interpreted 150 DBT studies performed between October 2017-November 2020, 125 normal cases and 25 with pathology-proven cancer. The DBT studies were randomized and reviewed independently by the two reader, who were blinded to the histopathology. DBT studies were reviewed using the standard protocol (1-mm slices with no overlap along with synthetic 2D-mammography (SM)). The presence/absence of an abnormality and a BIRADS score was recorded by each reader. After a 4-week washout period, the same DBT studies were interpreted using an experimental protocol (10-mm slabs with 5-mm overlap and SM). The results were then compared in terms of diagnostic accuracy and recall rates. Interobserver and intraobserver agreement was calculated (Cohen's Kappa). For diagnostic accuracy, the reference standard was histopathology or a normal follow-up mammogram at 2 years.*Results The cohort characteristics are listed in Table 1. Reader 1 had 97.6% intraobserver agreement (Cohen's Kappa [? 0.95] and reader 2 had 96.4% intraobserver agreement [? 0.92] when assessing the standard and experimental protocols. There was 90.5% agreement between reader 1 and 2 for the standard protocol [? 0.80]. There was 90.9% agreement between reader 1 and 2 for the experimental protocol [? 0.81]. Of the 25 DBT studies with pathology-proven cancer, one cancer was missed by both readers using both protocols.*Conclusions The diagnostic accuracy and recall rates were similar between the standard and experimental DBT protocols, demonstrating excellent interobserver and intraobserver agreement. This suggests that 10-mm thick slabs can be used in place of the 1-mm thin slices in the interpretation of DBT.*Clinical Relevance/Application Thick slab DBT reconstructions may be used in place of thin slice images with no effect on the diagnostic accuracy of DBT. The reduction in the number of images to be reviewed will improve efficiency and decrease interpretation time.

RESULTS

The cohort characteristics are listed in Table 1. Reader 1 had 97.6% intraobserver agreement (Cohen's Kappa [? 0.95] and reader 2 had 96.4% intraobserver agreement [? 0.92] when assessing the standard and experimental protocols. There was 90.5% agreement between reader 1 and 2 for the standard protocol [? 0.80]. There was 90.9% agreement between reader 1 and 2 for the experimental protocol [? 0.81]. Of the 25 DBT studies with pathology-proven cancer, one cancer was missed by both readers using both protocols.

CLINICAL RELEVANCE/APPLICATION

Thick slab DBT reconstructions may be used in place of thin slice images with no effect on the diagnostic accuracy of DBT. The reduction in the number of images to be reviewed will improve efficiency and decrease interpretation time.

SDP-BR-17   Clinical Outcomes And Imaging Features Of Microinvasive Carcinoma And Ductal Carcinoma In Situ: A Matched Cohort Study

Participants
Ga Young Yoon, MD, Gangwon-do, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the differences in clinical outcomes between microinvasive carcinoma (mIC) and ductal carcinoma in situ (DCIS) and compare imaging features of two diseases by using mammography, US and MRI.*Methods and Materials This retrospective study was approved by the institutional review board. Between January 2011 and December 2013, 516 women with mIC or DCIS confirmed by surgery were included. Patients were matched with propensity score matching to compare recurrence-free survival (RFS). RFS were compared using Cox proportional hazards model. Imaging features were also compared between two groups.*Results Among 516 women, 219 mIC and 297 DCIS tumors were identified. After matching, 132 women were allocated into each group. The mean follow-up duration was 80.2 months. In the matched cohort, no statistically significant association was observed between DCIS and mIC group of total recurrence (hazard ratio [HR]: 1.737; 95% confidence interval [CI]: 0.755-3.994; P = 0.194), local-regional recurrence (HR: 3.359; CI: 0.914-12.344, P = 0.068), or contralateral recurrence (HR: 0.992; CI: 0.295-2.88, P = 0.888). Non-mass lesions at US (P = 0.004), moderate or marked background parenchymal enhancement (P = 0.039), higher peak enhancement (P = 0.021) at MRI were more commonly seen in mIC group than in the DCIS group.*Conclusions Microinvasive carcinomas are distinct

from DCIS in terms of imaging features but are similar to DCIS in terms of clinical outcomes.*Clinical Relevance/Application Microinvasive carcinomas are distinct from DCIS in terms of imaging features but are similar to DCIS in terms of clinical outcomes. Our results suggest that mIC might be treated and followed up as DCIS.

RESULTS

Among 516 women, 219 mIC and 297 DCIS tumors were identified. After matching, 132 women were allocated into each group. The mean follow-up duration was 80.2 months. In the matched cohort, no statistically significant association was observed between DCIS and mIC group of total recurrence (hazard ratio [HR]: 1.737; 95% confidence interval [CI]: 0.755-3.994; P = 0.194), local-regional recurrence (HR: 3.359; CI: 0.914-12.344, P = 0.068), or contralateral recurrence (HR: 0.992; CI: 0.295-2.88, P = 0.888). Non-mass lesions at US (P = 0.004), moderate or marked background parenchymal enhancement (P = 0.039), higher peak enhancement (P = 0.021) at MRI were more commonly seen in mIC group than in the DCIS group.

CLINICAL RELEVANCE/APPLICATION

Microinvasive carcinomas are distinct from DCIS in terms of imaging features but are similar to DCIS in terms of clinical outcomes. Our results suggest that mIC might be treated and followed up as DCIS.

SDP-BR-18   Comparison Of Reader Performance Of Synthesized Mammograms Versus Original Digital Mammograms Alone And In Combination With Tomosynthesis Images

Participants
Takayoshi Uematsu, MD, PhD, Nagaizumi, Japan (*Presenter*) Research collaboration, FUJIFILM Holdings Corporation;

PURPOSE

To assess reader performance when synthesized mammograms (SM) versus original full-field digital mammograms (DM) are used alone or in combination with digital tomosynthesis images (Tomo).*Methods and Materials A fully crossed, mode-balanced multicase (n = 388), multireader (n = 4), retrospective observer performance study was performed by using deidentified images acquired from one institution with institutional review board approved protocols, during which each patient signed informed consent. The cohort included 84 cases of biopsy-proven cancer, 83 cases of biopsy-proven benign lesions, and 221 normal or benign cases (Breast Imaging Reporting and Data System [BI-RADS] score of 1 or 2) with negative 1-year follow-up results. Accuracy of sequentially reported probability of malignancy ratings and five-category forced BI-RADS ratings was evaluated by using areas under the receiver operating characteristic curve (AUCs) in the random-reader analysis.*Results Probability of malignancy based mean AUCs for SM and DM images alone was 0.902 and 0.871, respectively (P = .002). Mean AUC for SM with Tomo and DM with Tomo was 0.909 and 0.895, respectively (P = .082). In terms of the reader specific AUCs, all four readers performed better with SM alone versus DM alone, and three readers performed better with combined SM and Tomo. Similar results were obtained by using a nonparametric analysis of forced BI-RADS ratings. The mean interpretation time was 42.37 seconds for SM and 41.36 seconds for DM. The mean interpretation time with combined Tomo and SM (91.87 seconds) was 7.21 seconds shorter compared with DM with Tomo (99.08 seconds) (P < .001).*Conclusions SM alone is superior to DM alone and SM in combination with Tomo is comparable in performance to DM in combination with Tomo. SM may replace DM in both screening and clinical setting.*Clinical Relevance/Application Two-dimensional synthesized mammograms alone or in combination with tomosynthesis can be used as an acceptable replacement for directory acquired full-field digital mammograms in both screening and clinical setting.

RESULTS

Probability of malignancy based mean AUCs for SM and DM images alone was 0.902 and 0.871, respectively (P = .002). Mean AUC for SM with Tomo and DM with Tomo was 0.909 and 0.895, respectively (P = .082). In terms of the reader specific AUCs, all four readers performed better with SM alone versus DM alone, and three readers performed better with combined SM and Tomo. Similar results were obtained by using a nonparametric analysis of forced BI-RADS ratings. The mean interpretation time was 42.37 seconds for SM and 41.36 seconds for DM. The mean interpretation time with combined Tomo and SM (91.87 seconds) was 7.21 seconds shorter compared with DM with Tomo (99.08 seconds) (P < .001).

CLINICAL RELEVANCE/APPLICATION

Two-dimensional synthesized mammograms alone or in combination with tomosynthesis can be used as an acceptable replacement for directory acquired full-field digital mammograms in both screening and clinical setting.

SDP-BR-19   Intraductal Mass And Complex Cystic And Solid Mass On Breast Ultrasound: Are They Dangerous?

Participants
Andrei Alves de Queiroz, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to analyze intraductal masses (IM) and complex cystic and solid masses (CCSM) detected by ultrasound and submitted to ultrasound guided biopsy, describing its malignancy rate, the association with papillary lesions and other diagnosis.*Methods and Materials Methods: We reviewed the database of the breast imaging department in our tertiary hospital and retrieved data from all ultrasound-guided breast biopsies from January 1, 2019 until December 31,2020. Lymph node biopsies and fine needle aspiration were excluded. Data retrieved included age, lesion characteristics (size and ultrasound characteristics) and method for tissue sample: core biopsy (CB) or vacuum assisted biopsy (VAB). Pathology was determined assessing the pathology reports. All ultrasound findings were re-classified according to ACR-BIRADS® lexicon by two breast imaging specialists with 8+ years of experience and over 15.000 ultrasounds performed. All statistics were done using R software. T student test, Fisher exact test and chi square test were used when appropriated.*Results A total of 483 breast lesions were submitted to ultrasound guided biopsy. The mean age was 47.7 years. CB was performed in 363 (75.2%) lesions and VAB in 120 (24.8%). Forty-nine lesions (10.1%) were IM or CCSM. The mean age was significantly higher compared to patients without these lesions (51.1 vs 47.3, p=0.03). There was no difference on mass size (1.26 vs 1.56, p=0.08). VAB was the choice for these masses in 57.1%, which is significantly higher (p<0.001) than for other lesions (21.2%). Papilloma without atypia was the most common specified pathology (24.5%), but miscellaneous and unspecified benign findings represented 51.0%. Breast malignancy was less common in IM or CCSM when compared with other lesions, (6.1% vs 23.0%; p=0.01). In total, 52.2% of breast papilloma were IM or CCSM.*Conclusions Intraductal mass and complex cystic and solid mass comprehend 10.1% of biopsied lesions of the breast, it is correlated with breast papilloma, and VAB was the sampling-method of choice. Although lower estimated malignancy (6.1%) than other lesions, it still in the ACR-BIRADS® 4 category.*Clinical Relevance/Application This study shows that intraductal mass or complex cystic and solid mass are frequently submitted to vaccum assisted biopsy and it they are related to breast papillomas

RESULTS

A total of 483 breast lesions were submitted to ultrasound guided biopsy. The mean age was 47.7 years. CB was performed in 363 (75.2%) lesions and VAB in 120 (24.8%). Forty-nine lesions (10.1%) were IM or CCSM. The mean age was significantly higher compared to patients without these lesions (51.1 vs 47.3, p=0.03). There was no difference on mass size (1.26 vs 1.56, p=0.08). VAB was the choice for these masses in 57.1%, which is significantly higher (p<0.001) than for other lesions (21.2%). Papilloma without atypia was the most common specified pathology (24.5%), but miscellaneous and unspecified benign findings represented 51.0%. Breast malignancy was less common in IM or CCSM when compared with other lesions, (6.1% vs 23.0%; p=0.01). In total, 52.2% of breast papilloma were IM or CCSM.

CLINICAL RELEVANCE/APPLICATION

This study shows that intraductal mass or complex cystic and solid mass are frequently submitted to vaccum assisted biopsy and it they are related to breast papillomas

SDP-BR-2   Non-mass Enhancement At Breast MR Imaging: The Added Value Of Radiomics Signature

Participants
Yan Li, MD,MD, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To assess the additional value of radiomics signature to patients for differentiating benign from malignant non-mass enhancement lesions (NMEs) at breast MR imaging.*Methods and Materials The discriminative model was developed in a primary cohort that consisted of 232 patients with 247 NMEs at breast dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI), and data was collected from December 2017 to October 2020. Radiomic features were extracted from DCE images at the very early phase (90 seconds) after contrast media injection. The least absolute shrinkage and selection operator (LASSO) regression model was applied for dimensionality reduction, feature selection, and radiomics signature building. We used multivariable logistic regression analysis to develop a clinical conventional discriminative model at first, and added the radiomics signature into the clinical model and developed a radiomics nomogram. The performance of the clinical model and radiomics nomogram was assessed. The internal validation was evaluated. An independent validation cohort consisted of 72 consecutive patients from November 2020 to April 2021.*Results The clinical model, which contained discriminative factors including the time-intensity curve (TIC) types and MR-reported Axillary Lymph Nodes (ALN) status, showed a high sensitivity of 0.942 (95%CI, 0.906 to 0.974) and a low specificity of 0.589 (95%CI, 0.464 to 0.714). Consisted of 6 selected features, the radiomics signatures was significantly associated with malignancy (P<0.001 for both primary and validation cohorts). Finally, the individual radiomics nomogram, which contained factors including TIC types and radiomics signatures, showed good discrimination, with an acceptable sensitivity of 0.869 (95%CI, 0.816 to 0.916) and improved specificity of 0.839(95%CI, 0.750 to 0.929), and good calibration. We applied the nomogram to the validation cohort and still reached good discrimination, with a sensitivity of 0.820 (95%CI, 0.700 to 0.920) and 0.864 (95%CI,0.682 to 1.000) and good calibration. The radiomics nomogram was clinically helpful demonstrated by decision curve analysis.*Conclusions Our study added radiomics signatures into the conventional clinical model and developed a radiomic nomogram including radiomics signatures and TIC types, which could be helpfully applied to differentiate benign NMEs from malignant NMEs for patients with suspicious lesions at breast MR imaging.*Clinical Relevance/Application Adding radiomics signatures into the conventional clinical model could help to differentiate benign NMEs from malignant NMEs for patients with suspicious lesions at breast MR imaging, especially improving the specificity, which may decrease the negative biopsy rates.

RESULTS

The clinical model, which contained discriminative factors including the time-intensity curve (TIC) types and MR-reported Axillary Lymph Nodes (ALN) status, showed a high sensitivity of 0.942 (95%CI, 0.906 to 0.974) and a low specificity of 0.589 (95%CI, 0.464 to 0.714). Consisted of 6 selected features, the radiomics signatures was significantly associated with malignancy (P<0.001 for both primary and validation cohorts). Finally, the individual radiomics nomogram, which contained factors including TIC types and radiomics signatures, showed good discrimination, with an acceptable sensitivity of 0.869 (95%CI, 0.816 to 0.916) and improved specificity of 0.839(95%CI, 0.750 to 0.929), and good calibration. We applied the nomogram to the validation cohort and still reached good discrimination, with a sensitivity of 0.820 (95%CI, 0.700 to 0.920) and 0.864 (95%CI,0.682 to 1.000) and good calibration. The radiomics nomogram was clinically helpful demonstrated by decision curve analysis.

CLINICAL RELEVANCE/APPLICATION

Adding radiomics signatures into the conventional clinical model could help to differentiate benign NMEs from malignant NMEs for patients with suspicious lesions at breast MR imaging, especially improving the specificity, which may decrease the negative biopsy rates.

SDP-BR-20   Is Chest CT Scan Still Not Good Enough For Predicting Axillary Response To Neoadjuvant Chemotherapy In Patients With Clinically Node Positive Breast Cancer

Participants
Myoung Won Song, HWASUN GUN, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

According to ACR appropriateness criteria, US is the primary method for assessment of residual axillary lymph node (LN) metastasis after neoadjuvant chemotherapy (NAC), although other imaging modalities such as breast MRI and CT can show extensive visualization of the axilla and enable to node-to-node comparison. We investigated whether chest CT scan, which has been constantly advanced during the decades but depreciated in evaluating axillary nodal disease burden, can predict residual axillary LN metastasis after NAC in patients with node-positive breast cancer.*Methods and Materials In this retrospective pilot study, women with clinically node-positive breast cancer who were treated with NAC following surgery between January 2019 and December 2019 were included. Clinically-positive node was defined to have one of followings: palpability at physical examination; suspicious imaging features; or biopsy-proven malignancy. We defined the suspicious CT features of axillary LNs as follows: eccentric cortex, loss of fatty hilum, round shape (long/short axis ratio of <1.6), complete or partial tumoral replacement of node, and irregular margins or perinodal infiltration. Univariable and multivariable logistic regression analyses were performed to evaluate the independent predictors of residual axillary LN metastasis.*Results A total of 94 women were included (mean age = 51.7 years). The axillary pathologic complete response (pCR) rate was 56.4% (53 of 94). Independent predictors of residual axillary LN metastasis were luminal A breast cancer based on immunohistochemical (IHC) staining, primary tumor size reduction less than 30% at MRI, eccentric cortical thickness more than 2.5mm and the total numbers of suspicious LNs (= 2) on post-NAC chest CT scan (all, p < 0.05). The

area under the receiver operating characteristic (AUC) with using CT parameters was 0.650 (95% confidence interval: 0.518, 0.781). When adding the information about IHC subtype and tumor reduction at MRI, the AUC increased as 0.790 (95% confidence interval: 0.682, 0.898).*Conclusions Conventional chest CT features, while informative, could not be used as a reliable parameter alone to predict residual axillary nodal metastasis after NAC. However, our findings suggest that the combined use of CT features and other clinical and radiological data might provide better information regarding the nodal burden before surgery.*Clinical Relevance/Application In case of no routine use of post-NAC/preoperative axillary US, chest CT features of axillary LN with other clinical/radiological data could pick up the slack for predicting residual axillary LN metastasis. The quantitative (radiomics) feature analysis and deep learning approach based on CT are currently under investigation.

RESULTS

A total of 94 women were included (mean age = 51.7 years). The axillary pathologic complete response (pCR) rate was 56.4% (53 of 94). Independent predictors of residual axillary LN metastasis were luminal A breast cancer based on immunohistochemical (IHC) staining, primary tumor size reduction less than 30% at MRI, eccentric cortical thickness more than 2.5mm and the total numbers of suspicious LNs (= 2) on post-NAC chest CT scan (all, $p < 0.05$). The area under the receiver operating characteristic (AUC) with using CT parameters was 0.650 (95% confidence interval: 0.518, 0.781). When adding the information about IHC subtype and tumor reduction at MRI, the AUC increased as 0.790 (95% confidence interval: 0.682, 0.898).

CLINICAL RELEVANCE/APPLICATION

In case of no routine use of post-NAC/preoperative axillary US, chest CT features of axillary LN with other clinical/radiological data could pick up the slack for predicting residual axillary LN metastasis. The quantitative (radiomics) feature analysis and deep learning approach based on CT are currently under investigation.

SDP-BR-21 Quantitative Dual Energy CT (DECT) For Predicting Immunohistochemical Biomarkers In Breast Cancer.

Participants
Jumanah Altwalah, MBBS, Riyadh, Saudi Arabia (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the possibility of quantitative parameters derived from DECT to detect breast cancer and discriminate immunohistochemical (IHC) biomarkers of invasive breast cancer.*Methods and Materials This retrospective study included a total of 49 patients (49.3 ± 10.5 years) with biopsy-proven breast cancer who had contrast enhanced DECT as initial staging from August 2017 to November 2020. The DECT quantitative parameters, including Iodine Concentration, normalized iodine concentration (NIC), fat percentage, the relative electron density (Rho), and the effective atomic number (Zeff), were obtained from the images of the tumor tissue, metastatic lymph nodes, breast tissue and normal lymph nodes. The breast tumors were classified according to their histopathology.*Results A total of 52 tumors were found on DECT for 49 patients. Iodine Concentration, NIC, Rho and Z values all showed significant difference between normal breast tissue and primary tumor (p < 0.001 for all). The AUC for ROC curves were 0.99 (CI 0.99 - 1), 0.98 (CI 0.96 - 1), 0.742 (CI 0.66 - 0.82) and 0.98 (CI 0.96 - 0.99) for Iodine Concentration, NIC, Rho and Zeff respectively. An Iodine Concentration Cut-off value of 1.5 mg/ml or greater was able to detect breast tumor with a Sensitivity and Specificity of 100% (CI 93.2% - 100%) and 98.1% (CI 93.26% - 99.66%) respectively. Iodine Concentration values were also able to discriminate between metastatic and normal lymph nodes (p < 0.0001) with an AUC for the ROC curve of 0.88 (CI 0.82 - 0.95). A value of 1.75 mg/ml or lower provided a Sensitivity and Specificity of 94.74% (CI 75.36% - 99.73%) and 70.19% (CI 60.81% - 78.14%) respectively. A Spearman Correlation analysis failed to demonstrate any significant correlation between the Iodine concentration or NIC results and any of the IHC biomarkers (ER, PR, HER2, Ki-67) or SBR Grade. There was moderate negative correlation between Tumor Fat percentage and Ki-67 expression (r = -0.76, p = 0.006) and moderate correlation with PR expression (r = 0.68, p = 0.02). Rho showed moderate correlation with Ki-67 expression (r = 0.69, p = 0.016). Zeff showed moderate to weak negative correlation with ER expression (r = -0.65, p = 0.026).*Conclusions DECT quantitative parameters can reliably detect breast cancer and metastatic lymph nodes. Some DECT parameters showed correlation to IHC biomarkers. However, the remaining DECT parameters do not show a significant correlation with any of the IHC biomarkers at this time. A larger study population is needed to validate the results.*Clinical Relevance/Application DECT has a role in predicting metastatic lymph nodes which could reduce the need for their removal and associated complications. DECT may have a role in predicting IHC biomarkers which could help treatment planning.

RESULTS

A total of 52 tumors were found on DECT for 49 patients. Iodine Concentration, NIC, Rho and Z values all showed significant difference between normal breast tissue and primary tumor (p < 0.001 for all). The AUC for ROC curves were 0.99 (CI 0.99 - 1), 0.98 (CI 0.96 - 1), 0.742 (CI 0.66 - 0.82) and 0.98 (CI 0.96 - 0.99) for Iodine Concentration, NIC, Rho and Zeff respectively. An Iodine Concentration Cut-off value of 1.5 mg/ml or greater was able to detect breast tumor with a Sensitivity and Specificity of 100% (CI 93.2% - 100%) and 98.1% (CI 93.26% - 99.66%) respectively. Iodine Concentration values were also able to discriminate between metastatic and normal lymph nodes (p < 0.0001) with an AUC for the ROC curve of 0.88 (CI 0.82 - 0.95). A value of 1.75 mg/ml or lower provided a Sensitivity and Specificity of 94.74% (CI 75.36% - 99.73%) and 70.19% (CI 60.81% - 78.14%) respectively. A Spearman Correlation analysis failed to demonstrate any significant correlation between the Iodine concentration or NIC results and any of the IHC biomarkers (ER, PR, HER2, Ki-67) or SBR Grade. There was moderate negative correlation between Tumor Fat percentage and Ki-67 expression (r = -0.76, p = 0.006) and moderate correlation with PR expression (r = 0.68, p = 0.02). Rho showed moderate correlation with Ki-67 expression (r = 0.69, p = 0.016). Zeff showed moderate to weak negative correlation with ER expression (r = -0.65, p = 0.026).

CLINICAL RELEVANCE/APPLICATION

DECT has a role in predicting metastatic lymph nodes which could reduce the need for their removal and associated complications. DECT may have a role in predicting IHC biomarkers which could help treatment planning.

SDP-BR-22 Yield Of Flow Cytometry In Addition To Cytology For Lymph Node Sampling In Patients With Incidental Axillary Adenopathy Without A Concurrent Diagnosis Of Primary Breast Malignancy

Participants
Roberto Lo Gullo, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Non-specific lymphadenopathy is increasingly being reported especially given COVID-19 vaccination campaign and is a diagnostic

dilemma especially in oncology patients where it raises concern for malignancy. When axillary lymphadenopathy persists, biopsy is performed to rule out malignancy. Fine needle aspiration (FNA) with flow cytometry (FC) can confidently rule out lymphoma although FC may be costly and requires additional sampling. We hypothesized that FNA with cytology alone without ancillary techniques is sufficient to assess non-specific axillary lymphadenopathy and rule out lymphoproliferative disease*Methods and Materials In this IRB-approved retrospective study, 222 eligible patients who underwent screening or diagnostic axillary ultrasound yielding unilateral lymphadenopathy without concurrent diagnosis of breast cancer and who had subsequent image-guided axillary FNA and flow cytometry were included. Diagnostic accuracy, sensitivity, specificity, positive and negative predictive value (PPV and NPV) were reported for FNA with cytology alone, and FC alone and in combination. Discordance rate between FNA cytology and FC was also assessed. Discordant cases (FNA positive for malignancy but FC negative, or vice versa) were evaluated with histology performed on core biopsy or surgical excision or follow up*Results Overall diagnostic sensitivity, specificity, PPV, NPV, and diagnostic accuracy were 88%, 92%, 77%, 96%, and 91%, for FNA alone, 98%, 98%, 92%, 99%, and 98%, for FC alone and 100%, 92%, 79%, 100%, and 94% for combined FNA/FC. Overall discordance rate between FNA and FC was 7% (16/222). 7/16 (44%) patients with discordant FNA/FC results were diagnosed with lymphoma. 6/7 patients had positive flow cytometry but negative FNA, 1 patient had suspicious FNA but negative FC. The one patient who was misdiagnosed on FC had Hodgkin lymphoma. 9/16 (56%) patients with discordant results had benign findings. All 9 patients had suspicious FNA and negative FC; benign etiology was confirmed with histology by means of core biopsy in 3 patients, follow up greater that 3 years in 4 patients, and 2/6 were lost at follow up*Conclusions With an overall diagnostic accuracy of 91%, FNA with cytology alone. FC is sufficient to screen patients with indeterminate and incidental lymphadenopathy. Flow cytometry could be initially deferred in patients with low pretest probability of lymphoma*Clinical Relevance/Application FNA with cytology is an accurate first-line standalone diagnostic procedure for assessing incidental nonspecific axillary lymphadenopathy in the breast cancer screening population. A positive/suspicious FNA result can be used to triage specimens for flow cytometry and/or tissue biopsy to characterize hematologic malignancy

RESULTS

Overall diagnostic sensitivity, specificity, PPV, NPV, and diagnostic accuracy were 88%, 92%, 77%, 96%, and 91%, for FNA alone, 98%, 98%, 92%, 99%, and 98%, for FC alone and 100%, 92%, 79%, 100%, and 94% for combined FNA/FC. Overall discordance rate between FNA and FC was 7% (16/222). 7/16 (44%) patients with discordant FNA/FC results were diagnosed with lymphoma. 6/7 patients had positive flow cytometry but negative FNA, 1 patient had suspicious FNA but negative FC. The one patient who was misdiagnosed on FC had Hodgkin lymphoma. 9/16 (56%) patients with discordant results had benign findings. All 9 patients had suspicious FNA and negative FC; benign etiology was confirmed with histology by means of core biopsy in 3 patients, follow up greater that 3 years in 4 patients, and 2/6 were lost at follow up

CLINICAL RELEVANCE/APPLICATION

FNA with cytology is an accurate first-line standalone diagnostic procedure for assessing incidental nonspecific axillary lymphadenopathy in the breast cancer screening population. A positive/suspicious FNA result can be used to triage specimens for flow cytometry and/or tissue biopsy to characterize hematologic malignancy

SDP-BR-23   Added Value Of Mammography Or Tomosynthesis To Breast Cancer Detection In Women Undergoing Breast MR For Screening - A Systematic Meta-analysis

Participants
Toni Vomweg, Koblenz, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Most research on breast MRI screening investigates its use as a supplement to mammography, and/or includes cohorts of women pre-selected to have normal mammograms. In view of the superior performance of breast MRI for screening, there is reason to re-address the role of mammography in women who have access to breast MRI. We performed a meta-analysis to investigate the published evidence on the additional cancer yield of mammography or DBT (Mx/DBT) in women undergoing breast MRI for screening.*Methods and Materials The Web of Science was searched for studies on the use of breast MRI for screening where participants had undergone mammography or DBT and breast MRI for screening, and where the cancer detection rates were analyzed separately. We recorded the number of participants and screening rounds, their individual level of risk, and stage of cancers detected (invasive vs. DCIS).*Results A total 9 studies were identified; 7 on high-risk (37,964 screening rounds), and 2 studies on average risk (3,185 screening rounds). The mean overall cancer detection rate (CDR) was 20.4 per 1000 screens. Of the total 672 cancers observed in the cohorts, 47 (6.9%) were only detected by Mx/DBT. Thus, additional Mx/DBT increased CDR only marginally compared to the use of MRI alone, from 19.1 per 1000 (with MRI alone) to 20.4 per 1000 (MRI plus Mx/DBT). Stratified by personal risk, the contribution of Mx/DBT to CDR was similarly low in women at high risk (from 21.3 to 22.9 per 1000 screens) as in average risk (from 11.4 to 11.7 per 1000). Among cancers detected by Mx/DBT alone, i.e. in addition to MRI, DCIS was over-represented (53%). Thus, adding Mx/DBT to MRI led to an only minute increase of invasive cancer detection (from 14.7 to 15.2 per 1000 screens) overall, and this was only observed in high risk women at all (where it increased invasive cancer detection from 16.3 to 16.9 per 1000 screens), but not in average risk women (where invasive cancer detection was 9.05 per 1000 screens with or without Mx/DBT).*Conclusions The added value of mammography to overall cancer detection, and in particular to invasive cancer detection, is limited in women undergoing MRI for screening in general, and appears to be particularly low in women at average risk. Beyond issues of cost-effectiveness, this should prompt a careful and comprehensive reappraisal of the risk/benefit ratio associated with the systematic use of Mx/DBT in women who have access to breast MRI*Clinical Relevance/Application Given the low cancer detection rates attributable to Mx/DBT in women undergoing MRI screening, the cumulative dose of ionizing radiation needed to detect one additional cancer, or needed to save one additional woman's life, may be prohibitively high

RESULTS

A total 9 studies were identified; 7 on high-risk (37,964 screening rounds), and 2 studies on average risk (3,185 screening rounds). The mean overall cancer detection rate (CDR) was 20.4 per 1000 screens. Of the total 672 cancers observed in the cohorts, 47 (6.9%) were only detected by Mx/DBT. Thus, additional Mx/DBT increased CDR only marginally compared to the use of MRI alone, from 19.1 per 1000 (with MRI alone) to 20.4 per 1000 (MRI plus Mx/DBT). Stratified by personal risk, the contribution of Mx/DBT to CDR was similarly low in women at high risk (from 21.3 to 22.9 per 1000 screens) as in average risk (from 11.4 to 11.7 per 1000). Among cancers detected by Mx/DBT alone, i.e. in addition to MRI, DCIS was over-represented (53%). Thus, adding Mx/DBT to MRI led to an only minute increase of invasive cancer detection (from 14.7 to 15.2 per 1000 screens) overall, and this was only observed in high risk women at all (where it increased invasive cancer detection from 16.3 to 16.9 per 1000 screens), but not in average risk women (where invasive cancer detection was 9.05 per 1000 screens with or without Mx/DBT).

CLINICAL RELEVANCE/APPLICATION

Given the low cancer detection rates attributable to Mx/DBT in women undergoing MRI screening, the cumulative dose of ionizing

radiation needed to detect one additional cancer, or needed to save one additional woman's life, may be prohibitively high

SDP-BR-24   Immunogenic Response And Abnormal Axillary Node Morphology In Triple Negative Breast Cancer Patients

Participants
Rosalind P. Candelaria, MD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

We have observed a segment of triple-negative breast cancer (TNBC) patients with grossly abnormal axillary lymph node (AXLN) morphology and subsequent benign histopathology. We hypothesize that these sonographically-abnormal, benign AXLNs result from an immunogenic tumor response. The goal of this study is to investigate the relationship between AXLN appearance on ultrasound and the following immune response biomarkers: 1) sTIL levels and 2) PD-L1 expression.*Methods and Materials This imaging substudy was part of an active, single-institution, IRB-approved clinical trial of TNBC patients. The analysis included 289 patients who were enrolled between 11/2015 and 04/2019. All patients had pretreatment ultrasound evaluation of the AXLNs as part of their staging evaluation. The criteria for defining a sonographically-abnormal AXLN was having at least one of the following: absence of normal fatty hilum, cortex >3 mm, round shape, focal cortical lobulation. All patients with sonographically-abnormal AXLNs underwent biopsy. Pathology results were obtained from ultrasound-guided FNA ± core needle biopsy of the index abnormal AXLNs. sTIL levels were defined as low <20% and high =20%. Fisher's exact tests were used to compare between groups. P<0.05 was considered statistically significant.*Results There were 95/289 (33%) patients with sonographically-normal, benign AXLNs; 112/289 (39%) patients with sonographically-abnormal, biopsy-proven malignant AXLNs; and 82/289 (28%) patients with sonographically-abnormal, biopsy-proven benign AXLNs. There was a significant difference in the sTIL levels in patients with sonographically-normal AXLNs and sonographically-abnormal AXLNs (p=0.00014). Uniquely identified in patients with sonographically-abnormal, benign AXLNs was a combination of having both a much higher likelihood of tumors with increased sTIL levels (p<0.0001) and a higher likelihood of PD-L1 expression in the tumor microenvironment immune cells (p=0.02) when compared to patients with sonographically-normal, benign AXLNs.*Conclusions The sTIL levels and the PD-L1 expression in the immune cells are associated with AXLN morphology in TNBC patients. Benign AXLNs in TNBC patients with high-sTIL tumors and with PD-L1 expression in the immune cells can manifest with abnormal appearance because of an immune response rather than metastatic infiltration.*Clinical Relevance/Application To our knowledge, this is the first study to demonstrate an association between immunogenic response and abnormal ultrasound appearance of benign AXLNs. Radiologic-pathologic concordance can be accepted with a benign biopsy of a sonographically-abnormal AXLN in TNBC patients with high-sTIL tumors and with PD-L1 expression in the immune cells.

RESULTS

There were 95/289 (33%) patients with sonographically-normal, benign AXLNs; 112/289 (39%) patients with sonographically-abnormal, biopsy-proven malignant AXLNs; and 82/289 (28%) patients with sonographically-abnormal, biopsy-proven benign AXLNs. There was a significant difference in the sTIL levels in patients with sonographically-normal AXLNs and sonographically-abnormal AXLNs (p=0.00014). Uniquely identified in patients with sonographically-abnormal, benign AXLNs was a combination of having both a much higher likelihood of tumors with increased sTIL levels (p<0.0001) and a higher likelihood of PD-L1 expression in the tumor microenvironment immune cells (p=0.02) when compared to patients with sonographically-normal, benign AXLNs.

CLINICAL RELEVANCE/APPLICATION

To our knowledge, this is the first study to demonstrate an association between immunogenic response and abnormal ultrasound appearance of benign AXLNs. Radiologic-pathologic concordance can be accepted with a benign biopsy of a sonographically-abnormal AXLN in TNBC patients with high-sTIL tumors and with PD-L1 expression in the immune cells.

SDP-BR-25   Multimodal Artificial Intelligence For Breast Cancer Detection In A Population Of Women With Predominantly Dense Breasts

Participants
Tianyu Zhang, AMSTERDAM, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

To assess the stand-alone and combined performance of artificial intelligence (AI) detection systems for digital mammography (DM) and automated 3D breast ultrasound (ABUS) in detecting breast cancer in women with dense breasts.*Methods and Materials 430 paired cases of DM and ABUS examinations from an Asian population with dense breasts were retrospectively collected. All cases were analyzed by two AI systems, one for DM exams and one for ABUS exams. Outputs were combined with different weights (ranging from 0.01 to 0.99, the sum of 1). A selected subset (n=152) was read by four radiologists. The performance of AI systems was based on analysis of the area under the receiver operating characteristic curve (AUC). The maximum Youden's index and its associated sensitivity and specificity were also reported for each AI systems. Detection performance of human readers in the sub-cohort of the reader study was measured in terms of sensitivity and specificity.*Results In the full cohort, the performance of the AI systems in a multimodal setting was significantly better when the weights of AI-DM and AI-ABUS were 0.25 and 0.75, respectively, than each system individually in a single-modal setting (AUC-AI-Multimodal = 0.865; AUC-AI-DM=0.832, P=0.026; AUC-AI-ABUS=0.841, P=0.041). The maximum Youden's index for AI-DM was 0.650 (sensitivity and specificity of 76.1% and 88.9%), for AI-ABUS was 0.680 (sensitivity and specificity of 80.8% and 87.2%), and for AI-Multimodal was 0.707 (sensitivity and specificity of 79.4% and 91.2%). The AUC of AI systems was similar in the full cohort and the sub-cohort that also underwent human reading. The panel of 4 readers achieved a sensitivity of 93.2% and specificity of 32.7%. When the receiver operating characteristic curve of AI systems overlayed with the operating points of radiologists, it was observed that AI-multimodal achieves superior or equal sensitivity than single human readers at the same specificity operating points.*Conclusions In women with dense breasts, the automated AI readings on DM and ABUS exams perform better than radiologists. Multimodal (ABUS+DM) AI systems for detecting breast cancer in women with dense breasts are a potential solution for breast screening in radiologist-scarce regions.*Clinical Relevance/Application This research helps detect breast cancer in women with dense breasts. Multimodal AI systems for detecting breast cancer in women with dense breasts may be a potential solution for breast screening in radiologist-scarce regions.

RESULTS

In the full cohort, the performance of the AI systems in a multimodal setting was significantly better when the weights of AI-DM and AI-ABUS were 0.25 and 0.75, respectively, than each system individually in a single-modal setting (AUC-AI-Multimodal = 0.865; AUC-AI-DM=0.832, P=0.026; AUC-AI-ABUS=0.841, P=0.041). The maximum Youden's index for AI-DM was 0.650 (sensitivity and specificity of 76.1% and 88.9%), for AI-ABUS was 0.680 (sensitivity and specificity of 80.8% and 87.2%), and for AI-Multimodal

was 0.707 (sensitivity and specificity of 79.4% and 91.2%). The AUC of AI systems was similar in the full cohort and the sub-cohort that also underwent human reading. The panel of 4 readers achieved a sensitivity of 93.2% and specificity of 32.7%. When the receiver operating characteristic curve of AI systems overlayed with the operating points of radiologists, it was observed that AI-multimodal achieves superior or equal sensitivity than single human readers at the same specificity operating points.

CLINICAL RELEVANCE/APPLICATION

This research helps detect breast cancer in women with dense breasts. Multimodal AI systems for detecting breast cancer in women with dense breasts may be a potential solution for breast screening in radiologist-scarce regions.

SDP-BR-26   Prediction Of Pathologic Complete Response In Triple Negative Breast Cancer Using Baseline Tumor MRI Characteristics And Patterns Of Response During Neoadjuvant Chemotherapy

Participants
Mary Guirguis, MD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To investigate if pre-treatment breast MRI morphological characteristics and response patterns during neoadjuvant chemotherapy (NAT) predict pathologic complete response (pCR) in triple negative breast cancer (TNBC) patients.*Methods and Materials As part of a prospective IRB-approved clinical trial (ARTEMIS, NCT02276443), 199 patients with biopsy-proven stage I-III TNBC received NAT and were classified as pCR or non-pCR based on histopathology at surgery. Patients underwent 3T breast MRI at baseline (BL), and after 2 cycles (C2) and 4 cycles (C4) of Adriamycin-based chemotherapy (AC). Subsequently, patients received either taxane-based NAT or targeted therapy guided by mid-treatment imaging response. MRI studies were reviewed by two fellowship-trained breast radiologists who were blinded to the pathology results. ACR MRI BIRADS lexicon (5th Ed) was used to describe BL tumor morphology. Imaging response pattern at C2 and C4 MRI was classified as follows: type 0 (complete), type 1 (concentric shrinkage), type 2 (crumble), type 3 (diffuse enhancement), type 4 (stable), or type 5 (progression). Morphological features and response patterns were summarized and compared to the pCR status using Fisher's exact test. P values less than 0.05 were considered statistically significant.*Results Median patient age was 53 years, range 24-79. Of 199 patients, 95 (48%) had pCR and 104 (52%) had non-pCR. At BL MRI, an irregularly-shaped mass and homogenous or clumped non-mass enhancement were associated with pCR (p=0.026 and p=0.013, respectively). Multifocality, peritumoral edema, and intratumoral necrosis were independent of pCR. Following NAT, the most common MRI response pattern was type 1, seen with equal frequency in pCR and non-pCR at C2 (58% and 42%, respectively) and C4 (47% and 53%, respectively). The following response pattern associations were found: type 0 was associated with pCR at both C2 and C4 timepoints (p<0.001), while types 4 and 5 were associated with non-pCR at C2, (p<0.001). The four patterns: types 2, 3, 4, 5, were associated with non-pCR at C4 (p<0.001).*Conclusions Baseline MRI tumor morphological characteristics and MRI imaging response patterns during NAT may be valuable markers for pCR prediction in TNBC.*Clinical Relevance/Application Qualitative Breast MRI assessment may serve as an accessible clinical tool before and during NAT to identify TNBC patients who are unlikely to achieve pCR and may benefit from targeted therapies.

RESULTS

Median patient age was 53 years, range 24-79. Of 199 patients, 95 (48%) had pCR and 104 (52%) had non-pCR. At BL MRI, an irregularly-shaped mass and homogenous or clumped non-mass enhancement were associated with pCR (p=0.026 and p=0.013, respectively). Multifocality, peritumoral edema, and intratumoral necrosis were independent of pCR. Following NAT, the most common MRI response pattern was type 1, seen with equal frequency in pCR and non-pCR at C2 (58% and 42%, respectively) and C4 (47% and 53%, respectively). The following response pattern associations were found: type 0 was associated with pCR at both C2 and C4 timepoints (p<0.001), while types 4 and 5 were associated with non-pCR at C2, (p<0.001). The four patterns: types 2, 3, 4, 5, were associated with non-pCR at C4 (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Qualitative Breast MRI assessment may serve as an accessible clinical tool before and during NAT to identify TNBC patients who are unlikely to achieve pCR and may benefit from targeted therapies.

SDP-BR-27   Women's Experience With Screening Mammography During The COVID-19 Pandemic: A Multi-institutional Prospective Study

Participants
Laura Parra, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate patients' anxiety and experience with screening mammography during the COVID-19 pandemic.*Methods and Materials An anonymous 19-question survey was administered to women receiving screening mammography patients at six sites in two countries, one in Singapore and five in the United States. Surveys were offered between 10/7/2020 and 3/11/2021 in either paper or electronic (QR code access) format. Women rated their level of pre- and post-visit anxiety (Likert scale, 1-5) and ranked the level of importance of various COVID-19 related precautions observed during their appointment. Demographic data, including risk factors for breast cancer and severe COVID-19 illness, were also collected. Multivariable logistic regression was used to evaluate and test associations of pre-visit anxiety (at least slightly anxious) with risk factors, race, and other factors.*Results The survey was completed by 1086 women with median age of 56 years (range: 29-84); 338 (31%) were of non-white race or ethnicity. Most had >1 breast cancer risk factors (N=628, 58%); fewer had >1 COVID-19 risk factors (N=282; 26%). Of the 1065 women who rated their anxiety level, 445 (42%) reported pre-visit anxiety. Anxiety decreased during their visits, with 272 (26%) reporting post-visit anxiety (p<0.001). The COVID-19 precautions ranked very important, in decreasing order, were: masking (88%), institution reputation (84%), physical distancing (79%), signs that the rooms/equipment was clean (79%), seeing staff clean hands (73%), pre-visit symptom screening (63%), temperature screening (58%), pre-visit information regarding precautions in place (57%), staff wearing eye protection (41%). Pre-visit anxiety was independently associated with the number of risk factors for severe COVID-19 illness (odds ratio [OR] for >2 vs. 0 risk factors: 2.0, 95% CI: 1.1-3.8) and breast cancer (OR for >2 vs. 0 risk factors: 1.7, 95% CI: 1.2-2.5) after adjusting for age, site, and race/ethnicity.*Conclusions Women presenting for screening mammography during the COVID-19 pandemic were frequently anxious, with higher levels of anxiety observed in patients with multiple risk factors for either severe COVID-19 illness or breast cancer. Masking and physical distancing were the most important actions that clinics may take to reduce anxiety during screening mammography visits.*Clinical Relevance/Application Understanding women's experiences can help to prioritize interventions to reduce patient anxiety and support return to care during the ongoing COVID-19 and future pandemics.

RESULTS

The survey was completed by 1086 women with median age of 56 years (range: 29-84); 338 (31%) were of non-white race or ethnicity. Most had >1 breast cancer risk factors (N=628, 58%); fewer had >1 COVID-19 risk factors (N=282; 26%). Of the 1065 women who rated their anxiety level, 445 (42%) reported pre-visit anxiety. Anxiety decreased during their visits, with 272 (26%) reporting post-visit anxiety (p<0.001). The COVID-19 precautions ranked very important, in decreasing order, were: masking (88%), institution reputation (84%), physical distancing (79%), signs that the rooms/equipment was clean (79%), seeing staff clean hands (73%), pre-visit symptom screening (63%), temperature screening (58%), pre-visit information regarding precautions in place (57%), staff wearing eye protection (41%). Pre-visit anxiety was independently associated with the number of risk factors for severe COVID-19 illness (odds ratio [OR] for >2 vs. 0 risk factors: 2.0, 95% CI: 1.1-3.8) and breast cancer (OR for >2 vs. 0 risk factors: 1.7, 95% CI: 1.2-2.5) after adjusting for age, site, and race/ethnicity.

CLINICAL RELEVANCE/APPLICATION

Understanding women's experiences can help to prioritize interventions to reduce patient anxiety and support return to care during the ongoing COVID-19 and future pandemics.

SDP-BR-28 Hematoma Complication Rate With Anticoagulation Therapy During Image-guided Core Needle Breast Biopsy

Participants
Vilert A. Loving, MD, Gilbert, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

Core needle breast biopsies carry bleeding complication risk. Anticoagulation medications increase bleeding risk. This study assessed if anticoagulation medications impact hematoma incidence in patients undergoing image-guided core needle breast biopsies.*Methods and Materials This was a retrospective study of image-guided core needle breast biopsies performed at 12 breast centers within a large integrated health system between 4/2019-4/2021. Post biopsy hematomas were recorded by the radiologist at the time of biopsy according to a standardized definition as either (1) newly palpable lump at the biopsy site or (2) new mass = 2 cm at the biopsy site on post-procedure mammogram. Patient demographic information, anticoagulation type, biopsy type, and clinical outcomes were collected.*Results From 4/2019-4/2021, 2378 image-guided core needle breast biopsies were performed in 2337 patients. 333 biopsies (14.0%) were in patients on anticoagulation, including 42 (12.6%) rivaroxaban, apixaban, or dabigatran (Factor Xa and thrombin inhibitors), 24 (7.2%) warfarin, 20 (6.0%) dual-antiplatelet therapy (DAPT), 17 (5.1%) daily 325 mg aspirin, and 230 (69.1%) daily 81 mg aspirin.Hematomas occurred in 28/333 (8.4%) of biopsies with anticoagulation versus 145/2045 (7.1%) of biopsies without anticoagulation (p=0.39). Post biopsy hematomas developed in 4 (9.5%) using Factor Xa/thrombin inhibitor, 2 (8.3%) warfarin, 4 (20.0%) DAPT, 2 (11.8%) 325 mg aspirin, and 16 (7.0%) 81 mg aspirin. DAPT was significantly more likely to result in hematomas versus no anticoagulation therapy (p=0.03). No other anticoagulants significantly increased hematoma risk.Post-biopsy adverse clinical events did not significantly differ in anticoagulation patients versus no anticoagulation (p=0.14). One patient on warfarin developed a pseudoaneurysm treated with thrombin injection, and one patient not on anticoagulation was referred for emergent bleeding management.*Conclusions DAPT significantly increases hematoma risk after breast biopsy. No other anticoagulation medications were associated with increased hematoma risk.*Clinical Relevance/Application Patients undergoing image-guided breast biopsies may continue taking most anticoagulation medications without significant bleeding risk.

RESULTS

From 4/2019-4/2021, 2378 image-guided core needle breast biopsies were performed in 2337 patients. 333 biopsies (14.0%) were in patients on anticoagulation, including 42 (12.6%) rivaroxaban, apixaban, or dabigatran (Factor Xa and thrombin inhibitors), 24 (7.2%) warfarin, 20 (6.0%) dual-antiplatelet therapy (DAPT), 17 (5.1%) daily 325 mg aspirin, and 230 (69.1%) daily 81 mg aspirin.Hematomas occurred in 28/333 (8.4%) of biopsies with anticoagulation versus 145/2045 (7.1%) of biopsies without anticoagulation (p=0.39). Post biopsy hematomas developed in 4 (9.5%) using Factor Xa/thrombin inhibitor, 2 (8.3%) warfarin, 4 (20.0%) DAPT, 2 (11.8%) 325 mg aspirin, and 16 (7.0%) 81 mg aspirin. DAPT was significantly more likely to result in hematomas versus no anticoagulation therapy (p=0.03). No other anticoagulants significantly increased hematoma risk.Post-biopsy adverse clinical events did not significantly differ in anticoagulation patients versus no anticoagulation (p=0.14). One patient on warfarin developed a pseudoaneurysm treated with thrombin injection, and one patient not on anticoagulation was referred for emergent bleeding management.

CLINICAL RELEVANCE/APPLICATION

Patients undergoing image-guided breast biopsies may continue taking most anticoagulation medications without significant bleeding risk.

SDP-BR-29 Artificial Intelligence As A Support To The Radiologists' Screen Reading Of Mammograms-A Retrospective Study

Participants
Solveig S. Hofvind, Oslo, Norway (*Presenter*) Nothing to Disclose

PURPOSE

To explore the performance of an artificial intelligence (AI)-system on cancer detection in a population based screening program using independent double reading with consensus, and describe histopathological characteristics of the cancers detected.*Methods and Materials We included data from 65,983 screening examinations including 421 screen-detected and 114 interval cancers, resulting in a program sensitivity of 79% (421/535). The screening examinations were performed as a part of the regular screening setting in two counties in BreastScreen Norway, 2014-2018. We retrospectively processed the mammograms using an AI-system (Transpara version 1.7.0 beta, ScreenPoint Medical) which gives each examination a score from 1 to 10. We present the number of breast cancers that were given a threshold value of 9.01 (score=10) and 9.63 by the AI-system. The latter corresponded to a recall rate of 3.5%, which represent the average for the population studied. Median tumor diameter and the proportion of lymph node positive tumors (LN+) were described for cancers with a score of 10 and a score below 10.*Results The AI-system scored 10 for 81% (341/421) of the screen-detected and 41% (47/114) of the interval cancers. Using a threshold of 9.63, 70% (294/421) of the screen-detected and 20% (23/114) of the interval cancers were marked. Screen-detected cancers with an AI-score 10 had a median tumor diameter of 13mm (IQR: 9-20) and 18% were LN+, while those with a score below 10 had a median diameter of 10mm (IQR: 7-18) and 12% were LN+. Interval cancers with an AI-score of 10 had a median tumor diameter of 18m (IQR: 13-25) while those with a score below 10 were 15mm (IQR: 10-20).*Conclusions AI marks a substantial number of the screen-detected and

interval cancer and could potentially aid radiologists in their screen-reading and increase the sensitivity of the screening program. Prior to implementation of AI-systems in mammographic screening, more studies, retrospective as well as prospective, including analyses of the cost-benefit, are needed.*Clinical Relevance/Application Using AI as a support or replacement for radiologists in screen-reading mammograms requires analyses on retrospective data to ensure the sensitivity and specificity and to calibrate the systems.

RESULTS

The AI-system scored 10 for 81% (341/421) of the screen-detected and 41% (47/114) of the interval cancers. Using a threshold of 9.63, 70% (294/421) of the screen-detected and 20% (23/114) of the interval cancers were marked. Screen-detected cancers with an AI-score 10 had a median tumor diameter of 13mm (IQR: 9-20) and 18% were LN+, while those with a score below 10 had a median diameter of 10mm (IQR: 7-18) and 12% were LN+. Interval cancers with an AI-score of 10 had a median tumor diameter of 18m (IQR: 13-25) while those with a score below 10 were 15mm (IQR: 10-20).

CLINICAL RELEVANCE/APPLICATION

Using AI as a support or replacement for radiologists in screen-reading mammograms requires analyses on retrospective data to ensure the sensitivity and specificity and to calibrate the systems.

SDP-BR-3   Clinical Outcomes And Effectiveness Of A High Risk Breast MRI Screening Program

Participants
Wahida Rahman, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

Evaluate effectiveness, performance, and outcomes of a clinical breast MRI screening program in high risk women without prior history of breast cancer. Inform high risk women expected outcomes of screening breast MRI when risk-reducing prophylactic mastectomy is not elected.*Methods and Materials IRB approved, HIPAA-compliant retrospective study of 3821 MRI studies at an NCCN cancer center from 1/1/2015 - 12/31/2019. Included patients were asymptomatic with elevated lifetime risk of breast cancer, no prior history of breast cancer, and had follow up with a histopathological diagnosis or 12-month imaging or clinical follow up. Of 3821 studies, 1695 MRI examinations in 835 women were included. Patient age range 18-81 years, median age 50 years. Full contrast-enhanced breast MR protocol obtained using a 3 Tesla magnet and dedicated 16-channel breast coil, was interpreted by one of 13 MQSA-certified, fellowship-trained breast imagers with 1-13 years experience. Outcomes and pathologic characteristics of prevalent and incident screen detected cancers were reviewed. Sensitivity, specificity, PPV, NPV, FNR, and CDR were calculated.*Results Of 1695 MRIs, there were 37 (2.2%, CDR 22/1000) screen detected cancers- 23 (62.1%) invasive, 14 (37.8%) DCIS. Overall and incident screened median size was 7.0 and 8.0 mm for invasive, respectively, 9.0 mm for both for DCIS. 94.6% (35/37) of cancers were stage 0 or 1. 2 cases were stage 2A and 3A. All 16 incident cancers were stage 0 or 1. Overall node negativity rate was 89.2% (33/37). All 14 DCIS cases were node negative. 90.0% (9/10) of incident invasive carcinomas were node negative. The positive case had 1 lymph node with isolated tumor cells. Considering BI-RADS 3 studies as a positive result, sensitivity, specificity, PPV, NPV, FNR, and CDR were 95%, 83%, 12%, 100%, 0.12%, and 22/1000, respectively. When BI-RADS 3 studies were considered a negative result, these metrics were 74%, 92%, 17%, 99%, 0.59% and 17/1000.*Conclusions Screening breast MRI in the clinical setting in a high risk population without prior breast cancer detected cancers at low stage, with high CDR, and very low FNR. All incident cancers were stage 0 or 1. Effectiveness was similar to prior efficacy studies with favorable outcomes, further informing women considering management decisions and alternatives to risk-reducing mastectomy.*Clinical Relevance/Application High risk screening breast MRI in the clinical setting led to high CDR and favorable outcomes, providing information for women considering alternatives to risk-reducing mastectomy.

RESULTS

Of 1695 MRIs, there were 37 (2.2%, CDR 22/1000) screen detected cancers- 23 (62.1%) invasive, 14 (37.8%) DCIS. Overall and incident screened median size was 7.0 and 8.0 mm for invasive, respectively, 9.0 mm for both for DCIS. 94.6% (35/37) of cancers were stage 0 or 1. 2 cases were stage 2A and 3A. All 16 incident cancers were stage 0 or 1. Overall node negativity rate was 89.2% (33/37). All 14 DCIS cases were node negative. 90.0% (9/10) of incident invasive carcinomas were node negative. The positive case had 1 lymph node with isolated tumor cells. Considering BI-RADS 3 studies as a positive result, sensitivity, specificity, PPV, NPV, FNR, and CDR were 95%, 83%, 12%, 100%, 0.12%, and 22/1000, respectively. When BI-RADS 3 studies were considered a negative result, these metrics were 74%, 92%, 17%, 99%, 0.59% and 17/1000.

CLINICAL RELEVANCE/APPLICATION

High risk screening breast MRI in the clinical setting led to high CDR and favorable outcomes, providing information for women considering alternatives to risk-reducing mastectomy.

SDP-BR-30   High Risk Lesions Of The Breast: Development Of Presurgical Nomogram For Prediction Of Upgrade To Malignancy

Participants
Jennifer Schopp, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To develop a predictive nomogram to estimate surgical cancer upgrade of high-risk breast lesions (HRL) identified on imaging-guided needle biopsy.*Methods and Materials In an IRB approved, HIPAA compliant study, we retrospectively reviewed all atypical ductal hyperplasia (ADH), atypical lobular hyperplasia (ALH), lobular carcinoma in situ (LCIS), and atypical papilloma (AP) diagnosed by image guided biopsy in our institution between 06/2014 and 04/2020, collecting HRL type, number of cores, needle gauge, mode of detection, patient age, breast density, surgical excision and cancer upgrade. Data was separated into training (n=235) and testing sets (n=102). A logistic regression model was built using the training set. Variables were selected by stepwise selection algorithm. The trained model was applied to the testing dataset. ROC and AUC for the model under training and testing sets were reported with 95% CIs.*Results Of 337 HRL that underwent surgery, upgrade rate of ADH lesions was 24.7 % (190/337), LCIS 13.6% (44/337), ALH 5.1% (78/337), and AP 64.0% (25/337), (p<0.001). Mean age was 55.4yrs (+-SD 10.3yrs), mean lesion size 1.7 cm(+_SD 1.9cm). Surgical excision showed DCIS in 16% of patients (53/337) and invasive carcinoma for 6 % (20/337). Screening detection (p<0.001), stereo biopsy (p<0.008) and small needle gauge (greater than 11gauge, p less 0.002) were associated with higher upgrade. Multivariate logistic regression showed AUC 0.74 for training (with 95% CI of 0.66 and 0.83) and 0.75 for testing set (with 95% CI of 0.63 and 0.87), with an optimal sensitivity of 85%, specificity of 56%. Of testing set with 102 patients, 13 were removed due to lack of size measurement, leaving 25 patients with malignancy (DCIS or invasive) within test set. Using 85%

sensitivity, the model has NPV= 89 and PPV =36. At 90% sensitivity, model has NPV=89 and PPV=32 .*Conclusions High risk lesion nomogram is able to predict upgrade based on lesion variables. Testing and training data sets demonstrated similar AUCs, with only small variation. In collaboration with radiologic pathologic correlation, the model can be valuable in management decisions. With 85% sensitivity, surgery would be avoided in 24 patients, with 3 invasive cancers missed. Using 90% sensitivity, surgery would be avoided in 16 patients and 2 invasive cancers missed. Using 85 and 90% sensitivity in the model, no DCIS cases were missed.*Clinical Relevance/Application Prediction of upgrade rate to malignancy upon surgical excision for high risk lesions utilizing the nomogram technique can provide valuable pre-surgical management evaluation to inform patients and clinicians of risk of upgrade to malignancy. This can be particularly for pre-surgical planning and timing for patients with multiple co-morbidities.

RESULTS

Of 337 HRL that underwent surgery, upgrade rate of ADH lesions was 24.7 % (190/337), LCIS 13.6% (44/337), ALH 5.1% (78/337), and AP 64.0% (25/337), (p<0.001). Mean age was 55.4yrs (+-SD 10.3yrs), mean lesion size 1.7 cm(+_SD 1.9cm). Surgical excision showed DCIS in 16% of patients (53/337) and invasive carcinoma for 6 % (20/337). Screening detection (p<0.001), stereo biopsy (p<0.008) and small needle gauge (greater than 11gauge, p less 0.002) were associated with higher upgrade. Multivariate logistic regression showed AUC 0.74 for training (with 95% CI of 0.66 and 0.83) and 0.75 for testing set (with 95% CI of 0.63 and 0.87), with an optimal sensitivity of 85%, specificity of 56%. Of testing set with 102 patients, 13 were removed due to lack of size measurement, leaving 25 patients with malignancy (DCIS or invasive) within test set. Using 85% sensitivity, the model has NPV= 89 and PPV =36. At 90% sensitivity, model has NPV=89 and PPV=32 .

CLINICAL RELEVANCE/APPLICATION

Prediction of upgrade rate to malignancy upon surgical excision for high risk lesions utilizing the nomogram technique can provide valuable pre-surgical management evaluation to inform patients and clinicians of risk of upgrade to malignancy. This can be particularly for pre-surgical planning and timing for patients with multiple co-morbidities.

SDP-BR-31   Peritumoral Fat Content Using Iterative Decomposition Of Water And Fat With Echo Asymmetry And Least-squares Estimation (ideal) Correlates With Lymph Node Metastasis And Relapse-free Survival In Breast Carcinoma: A Preliminary Comparative Study.

Participants
Natsumi Hirano, MD, Kitakyushu, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Breast cancer cells express receptors for adipokines secreted by adipocytes, which can affect tumor growth. In vitro and in vivo data indicate that adipocytes are modified by cancer cells to acquire characteristics different from naive adipocytes (cancer-associated adipocytes: CAAs). Histologically, CAAs located around breast cancer display smaller sizes and are less lipid, and peritumoral edema caused by the release of cytokines from CAAs can conduce to decrease the peritumoral fat proportion. The purpose of this study is to correlate peritumoral fat content using IDEAL with lymph node metastasis and relapse-free survival in breast carcinoma and to compare with T2-weighted (T2WI) and diffusion weighted (DWI) images.*Methods and Materials This study consisted of 83 patients who were diagnosed with invasive carcinoma of breast and underwent MRI including IDEAL before surgery. The scan time of IDEAL fat fraction (FF) map imaging was 33s. Four regions of interests (ROIs), which are a distance of 5 mm from the tumor edge, and one ROI in the mammary fat of the healthy side were set on the FF map. Then average peritumoral FF values (FFt), average FF values in the healthy side (FFh), and peritumoral fat ratio (pTFR: defined as FFt/FFh) were calculated. Tumor apparent diffusion coefficient (ADC) values were measured on ADC map obtained by DWI. Peritumoral edema was classified into 3 grades based on the degree of signal intensity around the tumor in T2WI (T2 edema) according to the previously described grading method (Cheon H, et al. Radiology. 2018). The presence of lymph node metastasis was histologically evaluated by 2 pathologists.*Results Result of stepwise logistic regression analysis for 4 variables (FF, pTFR, T2 edema and ADC) indicated that FF and T2 edema were significant factors of lymph node metastasis (p<0.01). Recurrence-free survival was significantly associated with FF (p<0.01), and 60 of 62 (96.8%) patients with FF more than 90% were alive without recurrence.*Conclusions Peritumoral fat content using IDEAL-IQ is associated with lymph node metastasis and relapse-free survival, and may therefore be a useful prognostic biomarker for breast carcinoma.*Clinical Relevance/Application In vivo IDEAL imaging is simple to perform without extrinsic contrast agent and the quantification of the peritumoral FF using IDEAL may be useful for therapeutic strategy for breast carcinoma.

RESULTS

Result of stepwise logistic regression analysis for 4 variables (FF, pFTR, T2 edema and ADC) indicated that FF and T2 edema were significant factors of lymph node metastasis (p<0.01). Recurrence-free survival was significantly associated with FF (p<0.01), and 60 of 62 (96.8%) patients with FF more than 90% were alive without recurrence.

CLINICAL RELEVANCE/APPLICATION

In vivo IDEAL imaging is simple to perform without extrinsic contrast agent and the quantification of the peritumoral FF using IDEAL may be useful for therapeutic strategy for breast carcinoma.

SDP-BR-32   Predictors Of Tumor Progression During Neoadjuvant Chemotherapy In Triple-negative Breast Cancer

Participants
Heera Yoen, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Little is known on the predictors of progressive disease (PD) during neoadjuvant chemotherapy (NAC) in triple-negative breast cancer (TNBC). We investigated the clinicopathological and MRI variables associated with PD and distant metastasis-free survival (DMFS) after NAC in patients with TNBC.*Methods and Materials In this single center retrospective study, 252 women (mean age, 48±10 [standard deviation]) with TNBC who underwent NAC between January 2010 and December 2019 were included. Pre-NAC clinicopathological data (age, clinical stage, histology/grade/Ki-67 from needle biopsy samples), NAC regimen, surgery method, surgical pathology (lymphovascular invasion [LVI], pathologic stage), and adjuvant treatment data were collected. BI-RADS lexicon-based pre-NAC MRI findings plus edema (no/peritumoral alone/prepectoral/subcutaneous) and necrosis (no/<25%/25-50%/50-75%/>75% of tumor volume) were analyzed by two breast radiologists in consensus. PD was defined as increase in tumor size (>20%) or the development of new lesions. Logistic regression and Cox proportional hazard regression were performed to

identify factors associated with PD and DMFS, respectively: variables with P <0.1 on univariable analysis were entered into multivariable analysis.*Results Of 252 women, 211 (84%) had complete or partial response, 15 (6%) had stable disease, and 26 (10%) had PD. Of the 26 women with PD, 20 had progression in primary breast tumors, 5 had progression in both breast and nodal lesions, and 1 had new lung metastasis. Of pre-NAC clinicopathological and MRI data, prepectoral (odds ratio [OR] 8.8, P=0.045) or subcutaneous (OR, 17.2, P = .013) edema was the only independent predictor of PD. Distant metastasis occurred in 66 (26%) women during a median follow-up period of 44 months. LVI (hazard ratio [HR], 2.5, P=0.003) and residual tumor in both breast and nodes (ypTis/inv and ypN+) (HR, 6.4, P=0.006) were independent negative predictors of DMFS. Edema and PD were not independently associated with DMFS (P <0.05).*Conclusions Prepectoral or subcutaneous edema was an independent predictor of PD. However, neither edema nor PD were independently associated with DMFS.*Clinical Relevance/Application Prepectoral or subcutaneous edema predicted PD during NAC, but its presence does not seem to strongly suggest the need of a first-line surgical approach or a novel or more aggressive chemotherapy.

RESULTS

Of 252 women, 211 (84%) had complete or partial response, 15 (6%) had stable disease, and 26 (10%) had PD. Of the 26 women with PD, 20 had progression in primary breast tumors, 5 had progression in both breast and nodal lesions, and 1 had new lung metastasis. Of pre-NAC clinicopathological and MRI data, prepectoral (odds ratio [OR] 8.8, P=0.045) or subcutaneous (OR, 17.2, P = .013) edema was the only independent predictor of PD. Distant metastasis occurred in 66 (26%) women during a median follow-up period of 44 months. LVI (hazard ratio [HR], 2.5, P=0.003) and residual tumor in both breast and nodes (ypTis/inv and ypN+) (HR, 6.4, P=0.006) were independent negative predictors of DMFS. Edema and PD were not independently associated with DMFS (P <0.05).

CLINICAL RELEVANCE/APPLICATION

Prepectoral or subcutaneous edema predicted PD during NAC, but its presence does not seem to strongly suggest the need of a first-line surgical approach or a novel or more aggressive chemotherapy.

SDP-BR-33   Preliminary Evaluation Of Fat Fraction In Differential Diagnosis Of MR BI-RADS 4 Breast Tumors

Participants
Qi Wu, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the value of fat fraction (FF) derived from CS2-mDIXON-Quant sequence differential diagnosis of BI-RADS 4 malignant and benign breast tumors.*Methods and Materials This retrospective study enrolled 20 women patients (23 lesions) with suspected BI-RADS 4 breast tumors and performed CS2-mDIXON-Quant and Dynamic contrast enhancement (DCE) MR imaging (Table1). Based on the histopathology results, patients were divided into group 1 with malignant breast tumors (n=13) and group 2 with benign breast tumors (n=10). The measured image parameters (lesion volume, maximum diameter, the mean FF value of lesion and contralateral normal fibroglandular tissue) were compared between the two groups, and the diagnostic performance based on these parameters was quantified with ROC curve. Sensitivity and specificity of CS2-mDixon-Quant were calculated from ROC.*Results Twenty women patients (mean age 42.5±6.05 years, range 32-62 years) were analyzed. The intraclass correlation coefficients indicated a good inter-observer agreement of the measured lesion and normal tissue FF value(ICC=0.971,0.987,respectively) (fig1, 2). There was no significant difference in lesion volume,maximum lesion diameter and menopause between the two groups(p=0.292, 0.385, 0.059, respectively). The mean FF value of malignant group was significantly higher than that of benign group. There was significant difference in mean FF value of lesion and contralateral normal fibroglandular tissue between the Group1 or Group2 (p=0.022, 0.018,respectively)(table 2). There was also significant difference of mean FF of lesion and contralateral normal fibroglandular tissue between the two groups(p?0.01)(table 2). A cut-off of 18.99% was obtained to differentiate malignant from benign breast tumors with sensitivity, specificity and AUC of 61.5%, 90%, and 0.797, respectively (Figure 3).*Conclusions FF derived from CS2-mDIXON-Quant imaging yielded better diagnosis performance in discriminating MR BI-RADS 4 benign and malignant breast tumors with a sensitivity of 61.5% and a specificity of 90%, provided supplement information on tumor-fat contents in different breast tumors.*Clinical Relevance/Application Compression sensing combining with mDIXON Quant technique was used to measure the fat fraction of breast lesions. Studies shown Lipids orchestrate signal transduction cascades can be broken down into bioactive lipid mediators, which regulate a variety of carcinogenic processes, including cell growth,cell migration and metastasis formation. The increased fat content with proliferation rate of breast malignant tumors was shown in our study. FF derived from CS2-mDIXON-Quant imaging can provide supplement information on tumor-fat contents in different breast tumors.

RESULTS

Twenty women patients (mean age 42.5±6.05 years, range 32-62 years) were analyzed. The intraclass correlation coefficients indicated a good inter-observer agreement of the measured lesion and normal tissue FF value(ICC=0.971,0.987,respectively) (fig1, 2). There was no significant difference in lesion volume,maximum lesion diameter and menopause between the two groups(p=0.292, 0.385, 0.059, respectively). The mean FF value of malignant group was significantly higher than that of benign group. There was significant difference in mean FF value of lesion and contralateral normal fibroglandular tissue between the Group1 or Group2 (p=0.022, 0.018,respectively)(table 2). There was also significant difference of mean FF of lesion and contralateral normal fibroglandular tissue between the two groups(p?0.01)(table 2). A cut-off of 18.99% was obtained to differentiate malignant from benign breast tumors with sensitivity, specificity and AUC of 61.5%, 90%, and 0.797, respectively (Figure 3).

CLINICAL RELEVANCE/APPLICATION

Compression sensing combining with mDIXON Quant technique was used to measure the fat fraction of breast lesions. Studies shown Lipids orchestrate signal transduction cascades can be broken down into bioactive lipid mediators, which regulate a variety of carcinogenic processes, including cell growth,cell migration and metastasis formation. The increased fat content with proliferation rate of breast malignant tumors was shown in our study. FF derived from CS2-mDIXON-Quant imaging can provide supplement information on tumor-fat contents in different breast tumors.

SDP-BR-34   Potential Of Tumor Adjacent Feeding Vessels To Predict Pathological Tumor Response In Breast Cancer Patients Receiving Neoadjuvant Chemotherapy

Participants
Julia Carmona-Bozo, MD, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

To assess the ability of the number of tumor-adjacent feeding vessels (AFV) to predict pathological response to neoadjuvant

chemotherapy (NAC) in breast cancer*Methods and Materials Women >18 years undergoing NAC prior to surgery for breast cancer underwent DCE-MRI examinations on a 3T MRI scanner at baseline, post cycle 1, mid-treatment, and at the end of NAC. Tumor vascularity was assessed by counting the number of adjacent feeding vessels (AFV) in contact with or penetrating the cancer on maximum intensity projections generated from subtractions of unenhanced and peak-enhancing images of the DCE-MRI series. Tumor size was estimated according to RECIST 1.1. Pathological complete response (pCR) was defined as no residual invasive cancer in the breast but allowing for the presence of residual in situ carcinoma. Negative binomial mixed-effects models with random intercepts and slopes for subjects were used to assess changes in the number of AFV among response groups (pCR vs non-pCR) during NAC.*Results Images from 82 patients (53 ± 10 years) with 86 cancers were analyzed. The majority were invasive ductal cancers (71/86, 83%), positive for hormone receptors (57/86, 66%), with 31% also HER2 positive. All tumours were either grade 2 or 3. pCR was observed in 27/86 (31%) lesions. There was a significant decrease in the number of AFV per NAC cycle (-8.8 ± 3.1%, p<0.001), which was independent of tumour histology, grade, molecular subtype or the presence of in situ carcinoma (all p>0.05), while a positive association was observed with tumour size (p<0.001). The mean number of AFV during NAC showed a statistically significant difference between response groups (pCR vs non-pCR: 16 ± 2 vs 21 ± 1 vessels, p=0.02), with cancers displaying pCR showing a larger reduction in AFV on average in comparison with partial responders (pCR vs non-pCR: -22.3 ± 1.8 vs -19.7 ± 3.6 % change/cycle).*Conclusions Tumour AFVs can differentiate pathological complete response from partial response in breast cancer patients.*Clinical Relevance/Application Afferent feeding vessels indicating peritumoral vascularity derived from DCE-MRI may enable response prediction to neoadjuvant therapy in breast cancer.

RESULTS

Images from 82 patients (53 ± 10 years) with 86 cancers were analyzed. The majority were invasive ductal cancers (71/86, 83%), positive for hormone receptors (57/86, 66%), with 31% also HER2 positive. All tumours were either grade 2 or 3. pCR was observed in 27/86 (31%) lesions. There was a significant decrease in the number of AFV per NAC cycle (-8.8 ± 3.1%, p<0.001), which was independent of tumour histology, grade, molecular subtype or the presence of in situ carcinoma (all p>0.05), while a positive association was observed with tumour size (p<0.001). The mean number of AFV during NAC showed a statistically significant difference between response groups (pCR vs non-pCR: 16 ± 2 vs 21 ± 1 vessels, p=0.02), with cancers displaying pCR showing a larger reduction in AFV on average in comparison with partial responders (pCR vs non-pCR: -22.3 ± 1.8 vs -19.7 ± 3.6 % change/cycle).

CLINICAL RELEVANCE/APPLICATION

Afferent feeding vessels indicating peritumoral vascularity derived from DCE-MRI may enable response prediction to neoadjuvant therapy in breast cancer.

SDP-BR-35 The Relationship Between Radiological Descriptors Of Local And Whole-breast Vascularity And PET/MR Imaging Metrics Of Hypoxia And Vascular Function In Breast Cancer

Participants
Julia Carmona-Bozo, MD, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

To explore associations between imaging parameters of peritumoral and ipsilateral whole-breast vascularity, and quantitative metrics of tumor hypoxia and vascularity derived from combined PET/MRI with 18F-fluoro-misonidazole (18F-FMISO)*Methods and Materials Women aged >18 years with biopsy-confirmed breast cancer underwent a 60-min PET/MR scan after injection of 300 MBq of 18F-FMISO and a 2-hour uptake period. Pharmacokinetic parameters were derived from DCE-MRI using the extended Tofts' model (Ktrans, kep, ve, vp), while tumor hypoxia was assessed using the 18F-FMISO influx rate constant Ki determined by Patlak-plot analysis. Peritumoral vascularity was analyzed by counting the vessels in contact with or penetrating the lesion (adjacent feeding vessels, AFV) while whole-breast vascularity was assessed by counting significant vessels in the ipsilateral breast (=3 cm in length and =2 mm in maximal diameter). Pathological correlates included tumor type, grade, and molecular subtype. Linear or log-linear regression analysis was used for assessing associations between imaging and pathological variables*Results Overall, 32 lesions were assessed with the majority being ductal cancers (21/32; 66%), grade 2 or 3 (16/32; 50%), and positive for hormone receptors (31/32; 97%). The number of AFV associated positively with mean tumor Ktrans (R2=0.20, p=0.04) and ve (R2=0.41, p=0.001) after adjusting for the effect of tumor volume in regression analyses. Conversely, a negative association was found between AFV and 18F-FMISO Ki (R2=0.15, p=0.04). The number of significant vessels in the ipsilateral breast showed positive associations with Ktrans (R2=0.41, p<0.001), ve (R2=0.32, p=0.02) and vp (R2=0.45, p=<0.001), while a negative relationship was observed with 18F-FMISO Ki (R2= 0.19, p=0.02). No association was observed between the number of AFV or significant breast vessels and tumor histology, grade or molecular subtype (all p>0.05).*Conclusions Peritumoral and ipsilateral whole-breast vascularity negatively correlated with tumor hypoxia measured by 18F-FMISO-PET, whereas positive associations were observed with DCE-MRI parameters of vascularity in breast cancer*Clinical Relevance/Application Inadequate tumor vascularity and hypoxia are influenced by poor peritumoral and whole- breast vascularity hence, these radiological descriptors have potential in characterizing the tumor macroenvironment

RESULTS

Overall, 32 lesions were assessed with the majority being ductal cancers (21/32; 66%), grade 2 or 3 (16/32; 50%), and positive for hormone receptors (31/32; 97%). The number of AFV associated positively with mean tumor Ktrans (R2=0.20, p=0.04) and ve (R2=0.41, p=0.001) after adjusting for the effect of tumor volume in regression analyses. Conversely, a negative association was found between AFV and 18F-FMISO Ki (R2=0.15, p=0.04). The number of significant vessels in the ipsilateral breast showed positive associations with Ktrans (R2=0.41, p<0.001), ve (R2=0.32, p=0.02) and vp (R2=0.45, p=<0.001), while a negative relationship was observed with 18F-FMISO Ki (R2= 0.19, p=0.02). No association was observed between the number of AFV or significant breast vessels and tumor histology, grade or molecular subtype (all p>0.05).

CLINICAL RELEVANCE/APPLICATION

Inadequate tumor vascularity and hypoxia are influenced by poor peritumoral and whole- breast vascularity hence, these radiological descriptors have potential in characterizing the tumor macroenvironment

SDP-BR-36 A Composite Model For Pathologic Complete Response (pCR) Prediction In Triple Negative Breast Cancer (TNBC)

Participants
Gaiane M. Rauch, MD, PhD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

TNBC constitutes an aggressive and heterogeneous group of tumors with variable response to neoadjuvant therapy (NAT) that currently lacks clinically available profiling strategies for prediction. We aimed to develop a composite predictive model based on imaging, pathological and clinical data to address this unmet need.*Methods and Materials 125 Stage I-III TNBC patients enrolled in an IRB approved prospective clinical trial (NCT02276433) who had DCE-MRI (temporal-resolution: 9-12 sec) at baseline (BL) and post 2 cycles (C2) of NAT, and had surgery were included in this analysis. Tumor volume was calculated using 3D measurements at BL and C2, during the early (9-12 sec) and late (360 sec) phases of the DCE-MRI. Percent tumor volume reduction (TVR) between BL and C2 was calculated. Demographic, clinical, and pathologic data (age, T and N stage, histology, androgen receptor expression, Ki-67, stromal tumor infiltrating lymphocytes level (sTIL), and PD-L1 expression), and treatment response at surgery (pCR vs non-pCR) were documented. Recursive partitioning was used to identify TVR cutoff value. Multivariate logistic regression and ROC analysis were used to assess associations and build and evaluate predictive models.*Results 61 (49%) TNBC pts showed pCR at surgery, and 64 (51%) non-pCR. Recursive partitioning analysis identified =65% TVR at early and = 55% TVR at late phase DCE-MRI as the optimal cutoff values for pCR prediction at C2. TVR, N stage and sTIL were significantly associated with pCR in the multivariate analyses (p<0.002, p<0.01, p<0.001, respectively). Composite model containing TVR (=65% vs <65% for early phase and =55% vs <55% for late phase DCE-MRI), N stage (N0 vs N+) and sTIL (=20% vs <20%) was predictive of pCR with AUC 0.85 (90% CI:0.78-0.92) for early phase DCE-MRI and 0.84 (95% CI:0.77-0.91) for late phase DCE-MRI. Composite model performance was significantly better than TVR only or clinical (sTIL, and N stage) model only (p<0.001).*Conclusions A composite model integrating imaging (DCE-MRI TVR), clinical (N stage) and pathological (sTIL) data showed high accuracy for prediction of pCR in TNBC patients. Validation of these results in a larger prospective study is ongoing.*Clinical Relevance/Application A composite predictive model using readily available imaging, clinical and pathological data may serve as a clinical tool for appropriate treatment strategy selection for TNBC patients.

RESULTS

61 (49%) TNBC pts showed pCR at surgery, and 64 (51%) non-pCR. Recursive partitioning analysis identified =65% TVR at early and = 55% TVR at late phase DCE-MRI as the optimal cutoff values for pCR prediction at C2. TVR, N stage and sTIL were significantly associated with pCR in the multivariate analyses (p<0.002, p<0.01, p<0.001, respectively). Composite model containing TVR (=65% vs <65% for early phase and =55% vs <55% for late phase DCE-MRI), N stage (N0 vs N+) and sTIL (=20% vs <20%) was predictive of pCR with AUC 0.85 (90% CI:0.78-0.92) for early phase DCE-MRI and 0.84 (95% CI:0.77-0.91) for late phase DCE-MRI. Composite model performance was significantly better than TVR only or clinical (sTIL, and N stage) model only (p<0.001).

CLINICAL RELEVANCE/APPLICATION

A composite predictive model using readily available imaging, clinical and pathological data may serve as a clinical tool for appropriate treatment strategy selection for TNBC patients.

SDP-BR-37   Early Prediction Of Chemoresistance Versus Excellent Response In Triple Negative Breast Cancer Patients (TNBC) With DCE-MRI

Participants
Gaiane M. Rauch, MD, PhD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

TNBC is a heterogeneous disease with distinct molecular subtypes that convey diverse clinical behavior and response to NAT. The aim of this study was to determine if DCE-MRI after two cycles of NAT can identify patients with high likelihood to achieve pathologic complete response (pCR) to standard NAT - excellent responders, triaging them to standard of care (SOC), or when appropriate to de-escalation trials, and select chemoresistant patients who are unlikely to achieve pCR - nonresponders, for targeted therapeutic trials.*Methods and Materials This prospective IRB approved study (NCT02276443) included 100 patients with stage I-III TNBC who underwent DCE-MRI (temporal-resolution: 9-12 sec) at baseline (BL), and after 2 cycles (C2) of Adriamycin-based NAT. Tumor volume was calculated using 3D measurements of the index lesion at BL and C2, during the early phase of the DCE-MRI (9-12 sec) and late phase (360 sec). Percent tumor volume reduction (TVR) between BL and C2 was calculated. Pathologic response was assessed at the surgery after completing standard of care (SOC) anthracycline/taxane-based NAT. The relationship between pCR and TVR by MRI was evaluated using ROC analysis.*Results 50% (50/100) of TNBC achieved pCR. TVR =75% after C2 during early phase DCE-MRI predicted pCR with PPV 80% (31/39 patients), and TVR = 50% predicted non-pCR with NPV 90% (29/32 patients, AUC 0.82, 95% CI:0.74-0.91). During late phase DCE-MRI after C2 =75% TVR predicted pCR with PPV 78% (28/36 patients), and = 50% TVR had NPV 81% (30/37 patients) for prediction of non-pCR after NAT (AUC 0.80, 95% CI:0.71-0.89). Therefore, almost 60% of TNBC were correctly classified as pCR or non-pCR by both early and late phase DCE-MRI, while only 8% and 3% were misclassified as pCR and non pCR respectively by early phase DCE-MRI; 8% and 7% respectively by late phase DCE-MRI.*Conclusions DCE-MRI after 2 cycles of AC-based NAT was able to correctly classify 60% of TNBC patients either as excellent responders or nonresponders with high accuracy at early and late phases of imaging (AUC 0.82; 0.80). These results are being further validated in an ongoing large prospective trial for clinical implementation.*Clinical Relevance/Application DCE MRI after 2 cycles of NAT can identify TNBC patients with high or low likelihood of pCR, triaging them to SOC NAT with option for de-escalation trials or to targeted therapies respectively.

RESULTS

50% (50/100) of TNBC achieved pCR. TVR =75% after C2 during early phase DCE-MRI predicted pCR with PPV 80% (31/39 patients), and TVR = 50% predicted non-pCR with NPV 90% (29/32 patients, AUC 0.82, 95% CI:0.74-0.91). During late phase DCE-MRI after C2 =75% TVR predicted pCR with PPV 78% (28/36 patients), and = 50% TVR had NPV 81% (30/37 patients) for prediction of non-pCR after NAT (AUC 0.80, 95% CI:0.71-0.89). Therefore, almost 60% of TNBC were correctly classified as pCR or non-pCR by both early and late phase DCE-MRI, while only 8% and 3% were misclassified as pCR and non pCR respectively by early phase DCE-MRI; 8% and 7% respectively by late phase DCE-MRI.

CLINICAL RELEVANCE/APPLICATION

DCE MRI after 2 cycles of NAT can identify TNBC patients with high or low likelihood of pCR, triaging them to SOC NAT with option for de-escalation trials or to targeted therapies respectively.

SDP-BR-38   Breast Parenchyma Topology As A Predictive Biomarker For Neoadjuvant Chemotherapy Treatment In Breast Cancer

Participants

Prateek Prasanna, PhD, Stony Brook, New York (*Presenter*) Nothing to Disclose

PURPOSE

Radiomics and deep learning approaches have been recently used to learn prognostic signatures from breast tumors and surrounding peritumoral regions. Although promising, such features cannot explicitly model the complex and subtle parenchymal tissue structures. Therefore, the learning outcome lacks sufficient interpretability. We present a novel topological biomarker for breast DCE-MRI and evaluate its efficacy in predicting pathological complete response (pCR) to neoadjuvant chemotherapy (NAC). Our method bridges the two extremes, i.e, hand-crafted imaging features vs. completely data-driven convolutional neural networks (CNNs). The key idea is to direct the model's attention to a much smaller set of 'biologically relevant' voxels. This way, the CNNs can be efficiently trained with limited MRI data.*Methods and Materials We validate our method in a 5-fold cross-validation setting on the task of pCR prediction with ISPY-1 post-contrast DCE-MRI. A total of 162 patients are considered - 47 achieving pCR (mean age 48.8 years), 115 non-pCR (mean age 48.5 years). We compute salient topological structures from the input image based on the theory of persistent homology. Topological structures of dimensions 1 and 2, i.e., loops and bubbles, can both correspond to important tissue structures. 1D topological structures capture curvelinear constructs such as ducts and vessels. 2D structures represent voids enclosed by the tissue and their attached glands. These structures directly delineate the critical tissue structure with high biological relevance. By focusing on these tissue structures and their affinity, we have relevant contextual information for response prediction. We explicitly mask the input image so that only voxels of the extracted topological structures and their vicinity regions are visible. We then train a 3D CNN on this masked image. We compare our method against a Random Forests (RF) based textural radiomics model.*Results We observe that direct application of a 3D CNN does not perform well (area under the curve AUC=0.63), presumably due to the lack of phenotypically relevant data. Our proposed approach (AUC=0.85) also outperforms the radiomics model (AUC=0.56). Unlike the non-PCR breasts, the pCR breasts were found to have more scattered fibroglandular density with minimal background parenchymal enhancement.*Conclusions We developed and validated a topological prognostic biomarker based on the persistent homology to explicitly direct the attention of CNNs.*Clinical Relevance/Application The extracted topological structures capture the breast tissue structures. Learning directly on these structures and their vicinity provides the opportunity for interpreting the learning outcomes and drawing novel biological insights.

RESULTS

We observe that direct application of a 3D CNN does not perform well (area under the curve AUC=0.63), presumably due to the lack of phenotypically relevant data. Our proposed approach (AUC=0.85) also outperforms the radiomics model (AUC=0.56). Unlike the non-PCR breasts, the pCR breasts were found to have more scattered fibroglandular density with minimal background parenchymal enhancement.

CLINICAL RELEVANCE/APPLICATION

The extracted topological structures capture the breast tissue structures. Learning directly on these structures and their vicinity provides the opportunity for interpreting the learning outcomes and drawing novel biological insights.

SDP-BR-39 **Synchronous Contralateral Breast Cancer Detected By Contrast-enhanced Mammography**

Participants
Maya Grisaru, MD, London, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

Contrast-enhanced mammography (CEM) utilizes a dual-energy technique after the administration of intravenous contrast iodine, and similar to magnetic resonance imaging (MRI) relies on tumor angiogenesis. Preoperative CEM is increasingly used in the replacement of MRI for staging women with breast cancer. This study aims to evaluate the yield of CEM in detecting incidental synchronous contralateral disease, in patients with newly diagnosed breast cancer, in comparison to what was previously reported with MRI.*Methods and Materials A retrospective study was approved by our institutional ethical board. The consecutive records of 2732 patients who underwent contrast-enhanced mammography (CEM) exam between 0ctober 2017 and December 2020 were reviewed. A total of 1110 patients who underwent CEM as part of their initial assessment of unilateral cancer were eligible for the study. The imaging reports, histopathology results, and follow-up records were reviewed. The diagnosis of CEM-detected cancer was confirmed by means of biopsy. The absence of breast cancer was determined by means of biopsy, or the absence of positive findings on repeat imaging at 1 year of follow-up, if available.*Results Out of 1110 patients, 116 (10.4%) patients required contralateral biopsy due to suspicious lesions detected by CEM; 59 (50.86%) of those were malignant. In 39 out of 1100 (3.5%) cases, the contralateral cancer was detected solely based on enhancement; of those 34 (87.2%) invasive (mean diameter of 11 mm) and 5 (12.8%) ductal carcinoma in situ (DCIS). A total of 757 patients completed at least a one-year follow-up after the CEM, 2 presented with contralateral invasive malignancy (average size 8mm), yielding sensitivity of 94.87%, specificity of 95.49%, positive predictive value (PPV) of 52.11% and negative predictive value (PNV) of 99.72%.*Conclusions CEM detected additional clinically and mammographically occult synchronous contralateral cancer in 3.5% of the patients, similar to what was previously reported with MRI.*Clinical Relevance/Application CEM detects contralateral lesions in a substantial proportion of women at high specificity.

RESULTS

Out of 1110 patients, 116 (10.4%) patients required contralateral biopsy due to suspicious lesions detected by CEM; 59 (50.86%) of those were malignant. In 39 out of 1100 (3.5%) cases, the contralateral cancer was detected solely based on enhancement; of those 34 (87.2%) invasive (mean diameter of 11 mm) and 5 (12.8%) ductal carcinoma in situ (DCIS). A total of 757 patients completed at least a one-year follow-up after the CEM, 2 presented with contralateral invasive malignancy (average size 8mm), yielding sensitivity of 94.87%, specificity of 95.49%, positive predictive value (PPV) of 52.11% and negative predictive value (PNV) of 99.72%.

CLINICAL RELEVANCE/APPLICATION

CEM detects contralateral lesions in a substantial proportion of women at high specificity.

SDP-BR-40 **Development And Validation Of A Deep Learning Method For Breast Cancer Diagnosis Using Ultrasound**

Participants
Huiling Xiang, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop/validate a deep learning (DL) model for breast cancer diagnosis*Methods and Materials From 2011 to 2020, B-mode and color Doppler images of pathology-proven lesions were included to develop and validate a DL model for breast cancer diagnosis in this retrospective, multicohort, diagnostic study. We assessed the diagnostic value of three DL models (DL-C, DL-B, DL-internal), which were developed using color Doppler images, B-mode images, and a combination of both, respectively. The performance of the DL model was compared with that of radiologists. Area under the curve (AUC), accuracy, sensitivity, specificity, positive predictive value, negative predictive value, precision, F1 score and kappa score were evaluated.*Results This DL model included 31,856 B-mode and color Doppler images of 6.492 lesions and was tested using 8,086 images of 1,604 lesions in the internal set. External validation included 2,651 images of 118 lesions, 2,453 images of 650 lesions in H2, and 1,035 images of 418 lesions in H3. Lesion-level performance was superior to image-level performance, with AUCs of 0.934 (95% confidence interval [CI]: 0.921 to 0.946) with the internal set, 0.913 (95% CI: 0.894 to 0.933) with H1, 0.922 (95% CI: 0.901 to 0.942) with H2, and 0.955 (95% CI: 0.936 to 0.975) with H3. The DL model was at least non-inferior to senior radiologists, but outperformed junior radiologists significantly. DL-internal demonstrated better diagnostic accuracy compared with DL-B and DL-C (AUC = 0.937 [95% CI: 0.925 to 0.949]) in the test set with combined images.*Conclusions Our DL model achieved expert-level diagnostic accuracy with B-mode and color Doppler images combined in an internal and three independent external validation sets. *Clinical Relevance/Application With satisfying performance, our DL model could potentially serve as an efficient, non-invasive, and cost-effective tool to assist radiologists in diagnosing breast tumor.

RESULTS

This DL model included 31,856 B-mode and color Doppler images of 6.492 lesions and was tested using 8,086 images of 1,604 lesions in the internal set. External validation included 2,651 images of 118 lesions, 2,453 images of 650 lesions in H2, and 1,035 images of 418 lesions in H3. Lesion-level performance was superior to image-level performance, with AUCs of 0.934 (95% confidence interval [CI]: 0.921 to 0.946) with the internal set, 0.913 (95% CI: 0.894 to 0.933) with H1, 0.922 (95% CI: 0.901 to 0.942) with H2, and 0.955 (95% CI: 0.936 to 0.975) with H3. The DL model was at least non-inferior to senior radiologists, but outperformed junior radiologists significantly. DL-internal demonstrated better diagnostic accuracy compared with DL-B and DL-C (AUC = 0.937 [95% CI: 0.925 to 0.949]) in the test set with combined images.

CLINICAL RELEVANCE/APPLICATION

With satisfying performance, our DL model could potentially serve as an efficient, non-invasive, and cost-effective tool to assist radiologists in diagnosing breast tumor.

SDP-BR-41 Explainable Deep Learning Algorithm Of Standard Mammography Phantom Images For Medical Image Quality Management

Participants
Hyug-Gi Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

An image quality assessment of mammography phantom is essential to reduce patient radiation exposure and ensure proper and consistent patient image quality. The purpose of this study was to develop an explainable deep learning algorithm (explainable AI, XAI) to evaluate the quality of an ACR mammography phantom image.*Methods and Materials For the study, we use the standard mammography phantom image database in KIAMI (Korean Institute for Accreditation of Medical Imaging) of South Korea. A total of 3,000 mammography phantom images were divided into training (70%), validation (15%) and test (15%) sets to develop a deep learning algorithm. Phantom images were independently labeled as three steps- 1) classified as fiber, speck and mass, 2) scoring for each subject (0, 0.5, 1) and 3) pass or fail of the phantom images which is based on the ACR mammography QC manual. We implemented optimized U-net based convolutional neural network and learning algorithm was conducted by three pre-processing: First is inverted input image as 'black' background, second is target cropping (patched image) using object detection deep learning model and third is image resize to reduce cost function of computing (fig1 A-D). Each object was segmented and extracted using U-net model. We used curriculum learning method which means that knowledge transfer learning was performed on the computed radiography (CR) after learning digital radiography (DR). Area under the receiver operating characteristics curve (AUC), accuracy, sensitivity, and specificity of the algorithm and 5 radiologists were assessed.*Results The performance showed 0.88 AUC (p value<0.003), 87.45 accuracy, 100 sensitivity and 75 specificity and showed statistically significantly higher AUC, sensitivity than radiologists in test sets. The model with phantom evaluator can provide lesion location as well as more reasonable/explainable lesion detection (Fig 1 E-G).*Conclusions Deep learning algorithm for mammography phantom image can be used to improve the accuracy for quality control study for medical phantom image with superior AUC and comparable sensitivity and specificity to those of radiologists.*Clinical Relevance/Application Deep learning algorithm with phantom image evaluator can demonstrate to be used to assess quality control for mammography, CT and MRI as a practical method for early and precision diagnosis.

RESULTS

The performance showed 0.88 AUC (p value<0.003), 87.45 accuracy, 100 sensitivity and 75 specificity and showed statistically significantly higher AUC, sensitivity than radiologists in test sets. The model with phantom evaluator can provide lesion location as well as more reasonable/explainable lesion detection (Fig 1 E-G).

CLINICAL RELEVANCE/APPLICATION

Deep learning algorithm with phantom image evaluator can demonstrate to be used to assess quality control for mammography, CT and MRI as a practical method for early and precision diagnosis.

SDP-BR-42 Contrast Enhanced Mammography-A Functional Imaging Modality Decoding Obscured Shadows Of Digital Mammography In HER 2 Positive Breast Cancer.

Participants
Palak Popat, MBBS, MD, Mumbai, India (*Presenter*) Nothing to Disclose

PURPOSE

Contrast-enhanced mammography (CEM), a novel emerging technique, combining digital mammography (DM) with functional imaging is based on principle of neoangiogenesis. Aim-To assess incremental value of Dual-Energy Contrast-Enhanced Mammography over Digital Mammography in HER 2 positive breast cancer patients.*Methods and Materials Low energy, subtracted images of CEM are acquired between 2 to 8 minutes in the standard Craniocaudal and Mediolateral projections, post intravenous administration of iodinated contrast agent on a full field DM unit. A retrospective analysis was performed on HER 2 positive patients undergoing CEM

during the pandemic between November'20 and April'21 in a tertiary cancer referral center. Comparative analysis between DM and CEM to assess for concordance with histopathology, additional lesion, asymmetries, and post neoadjuvant chemotherapy viability.*Results 184 patients underwent CEM in our hospital, of which 46 were positive for HER-2/neu receptor status. Among these 46 patients, 63 lesions were detected, of which 56 lesions were malignant, while 7 were benign. The sensitivity and specificity of DM in detecting malignancy is 89.2% and 66.7 % respectively with a diagnostic accuracy of 87.1%. The sensitivity and specificity of CEM are 98.2 and 66.7 % respectively with a diagnostic accuracy of 95.2 %. CEM was discordant in 34 patients (74%) with superior benefit in 32 patients (69.5%), and not beneficial in 2 patients (4%). CEM was concordant with DM with no additional benefit in 12 (26%) patients. CEM was beneficial over DM in 32(69.5%) patients. The distribution of the benefit is in terms of extent of disease in 16(50%) patients, additional lesion detection in 15 (46%) patients, ruling out asymmetries as possible lesions in 6 (18%) patients, characterizing in 6(18%) patients. Out of 3 patients post neoadjuvant chemotherapy, CEM was 100% beneficial in evaluating viability status post neoadjuvant chemotherapy. CEM was not beneficial over DM in 2(4%) patients where the extent was more on DM than CEM due to microcalcifications.*Conclusions Our findings conclude that the CEM is certainly more superior to DM in evaluating the extent of disease, additional satellite lesion detection, post neoadjuvant chemotherapy viability assessment, and ruling out ambiguous findings(asymmetries) in HER 2 positive breast cancer.*Clinical Relevance/Application Judicious use of CEM in selected cases helps in better estimation of the extent of disease and satellite lesion detection, enhancing appropriate management of breast cancer. CEM disease extent with a concurrent assessment of the extent of microcalcifications on DM in HER 2 positive breast cancer enhances management with greater accuracy, compared to DM alone.

RESULTS

184 patients underwent CEM in our hospital, of which 46 were positive for HER-2/neu receptor status. Among these 46 patients, 63 lesions were detected, of which 56 lesions were malignant, while 7 were benign. The sensitivity and specificity of DM in detecting malignancy is 89.2% and 66.7 % respectively with a diagnostic accuracy of 87.1%. The sensitivity and specificity of CEM are 98.2 and 66.7 % respectively with a diagnostic accuracy of 95.2 %. CEM was discordant in 34 patients (74%) with superior benefit in 32 patients (69.5%), and not beneficial in 2 patients (4%). CEM was concordant with DM with no additional benefit in 12 (26%) patients. CEM was beneficial over DM in 32(69.5%) patients. The distribution of the benefit is in terms of extent of disease in 16(50%) patients, additional lesion detection in 15 (46%) patients, ruling out asymmetries as possible lesions in 6 (18%) patients, characterizing in 6(18%) patients. Out of 3 patients post neoadjuvant chemotherapy, CEM was 100% beneficial in evaluating viability status post neoadjuvant chemotherapy. CEM was not beneficial over DM in 2(4%) patients where the extent was more on DM than CEM due to microcalcifications.

CLINICAL RELEVANCE/APPLICATION

Judicious use of CEM in selected cases helps in better estimation of the extent of disease and satellite lesion detection, enhancing appropriate management of breast cancer. CEM disease extent with a concurrent assessment of the extent of microcalcifications on DM in HER 2 positive breast cancer enhances management with greater accuracy, compared to DM alone.

SDP-BR-43   Commercially Available AI System For Breast Cancer Detection Shows Promise For Risk Prediction, Including Among Women With Dense Breasts

Participants
Celine Vachon, Rochester, Minnesota (*Presenter*) Research funded, GRAIL

PURPOSE

AI algorithms have been developed to improve detection of breast cancer at the time of mammography. Whether these algorithms can assist in risk prediction has not been well-studied.*Methods and Materials We identified 3,387 women with invasive breast cancer (n=462 interval, 2309 screen-detected) and 7,140 controls, matched on age and date of mammogram, from two US mammography cohorts between 2007 and 2017. We obtained 2D full-field digital mammograms an average 3.6 years (6 months to 10 years) prior to cancer diagnosis and assessed a malignancy risk score using a commercially available AI system (Transpara v1.7.0, ScreenPoint Medical) and volumetric density using Volpara (version 1.5.4). We used conditional logistic regression (odds ratios (OR) and 95% confidence (CI) intervals), adjusted for age and BMI, and C-statistics (AUC), to describe the association of the continuous AI risk score (per 1 unit increase) with invasive breast cancer. We performed analyses stratified by dense breasts (BI-RADS density a-b vs. c-d), time to cancer (=3.6 years vs. >3.6 years), and interval vs. screen-detected breast cancer.*Results Adjusted for age and BMI, a one unit increase in AI risk score was associated with 23% greater odds of invasive breast cancer [OR=1.23 (1.21-1.25); AUC=0.65 (0.64-0.67)]. Associations were similar among women with dense [OR=1.24 (1.20-1.27)] and non-dense breasts [OR=1.20 (1.18-1.23)](p=0.30) [AUCs 0.65-0.66] and for interval and screen detected cancers [ORs both 1.24, (p=0.98) and AUCs both 0.66]. There were stronger associations for AI risk score assessed on mammograms within 3.6 years prior to breast cancer diagnosis [OR=1.30 (1.26-1.33)][AUC=0.68 (0.67-0.70)] vs. greater than 3.6 years [OR=1.18 (1.15-1.20)(P<0.001)][AUC=0.63 (0.61-0.64)]. Inclusion of volumetric density measures in models with the AI risk score improved discrimination, but the increase was only statistically significant for prediction of interval cancers; the AUC increased from 0.66 to 0.72 (change in AUC=0.06 (0.03-0.09)) with inclusion of percent volumetric density.*Conclusions AI imaging-based measures combined with volumetric density improved discrimination of invasive breast cancer. Including these measures in risk models could better inform tailored screening and supplemental imaging strategies.*Clinical Relevance/Application AI algorithms developed for detection can inform risk prediction, including among women with dense breasts and women at risk of interval cancers.

RESULTS

Adjusted for age and BMI, a one unit increase in AI risk score was associated with 23% greater odds of invasive breast cancer [OR=1.23 (1.21-1.25); AUC=0.65 (0.64-0.67)]. Associations were similar among women with dense [OR=1.24 (1.20-1.27)] and non-dense breasts [OR=1.20 (1.18-1.23)](p=0.30) [AUCs 0.65-0.66] and for interval and screen detected cancers [ORs both 1.24, (p=0.98) and AUCs both 0.66]. There were stronger associations for AI risk score assessed on mammograms within 3.6 years prior to breast cancer diagnosis [OR=1.30 (1.26-1.33)][AUC=0.68 (0.67-0.70)] vs. greater than 3.6 years [OR=1.18 (1.15-1.20) (P<0.001)][AUC=0.63 (0.61-0.64)]. Inclusion of volumetric density measures in models with the AI risk score improved discrimination, but the increase was only statistically significant for prediction of interval cancers; the AUC increased from 0.66 to 0.72 (change in AUC=0.06 (0.03-0.09)) with inclusion of percent volumetric density.

CLINICAL RELEVANCE/APPLICATION

AI algorithms developed for detection can inform risk prediction, including among women with dense breasts and women at risk of interval cancers.

SDP-BR-44   Ductal Carcinoma In Situ Presenting As Screen-detected Calcifications: Patient, Imaging, And Pathological Features Associated With Surgical Upstaging

Participants
Manisha Bahl, MD,MPH, Boston, Massachusetts (*Presenter*) Consultant, Lunit Inc;Advisory Board, Accolade Inc

PURPOSE

Several clinical trials are underway across the world to evaluate the safety and efficacy of active surveillance (AS) for women with ductal carcinoma in situ (DCIS) presenting as screen-detected calcifications. The variable with the greatest risk of mortality for AS versus standard treatment is understaging invasive disease at time of diagnosis. The purpose of this study is to identify patient, imaging, and pathological features associated with surgical upstaging of DCIS to any invasive disease or non-microinvasive disease, in order to inform eligibility criteria for AS trials.*Methods and Materials In this HIPAA-compliant and IRB-approved retrospective study, medical records were reviewed of consecutive women presenting from 2007-2016 with screen-detected calcifications who were diagnosed with pure DCIS at image-guided core needle biopsy and then underwent surgery. Two multiply imputed multivariable logistic regression models were fit to assess features associated with risk of upstaging to (1) any invasive disease (microinvasive disease [less than or equal to 1 mm of invasive disease] or non-microinvasive disease) or (2) non-microinvasive disease only. Prespecified features with p<0.2 in univariable analyses were included in the multivariable models. For each model, adjusted odds ratios, 95% confidence intervals (CI), and corresponding Wald p-values were calculated. Optimism-corrected area under the receiver operating characteristic curves (AUC) were also estimated.*Results 1,029 women (average age 58, range 28-89 years) with DCIS presenting as screen-detected calcifications underwent surgery. The surgical upstaging rate of DCIS to invasive disease was 16% (n=161). Of 161 upgrades, 35% (n=57) were upstaged to microinvasive disease and 65% (n=104) to non-microinvasive disease. The features associated with upstaging to any invasive disease (microinvasive or non-microinvasive) were menopause above the age of 50, breast MR imaging, and intermediate or high nuclear grade of DCIS at biopsy (all p<0.05). The only feature associated with upstaging to non-microinvasive disease was breast MR imaging (p=0.004). The optimism-corrected AUCs for both models were 0.63 (95% CI of 0.56-0.67 and 95% CI of 0.56-0.69, respectively).*Conclusions In women with DCIS presenting as screen-detected calcifications, features associated with higher surgical upstaging risk to invasive disease include menopause above the age of 50, breast MR imaging, and intermediate or high nuclear grade of DCIS at biopsy.*Clinical Relevance/Application Identification of patient, imaging, and pathological features associated with higher surgical upstaging risk of DCIS could be used to exclude certain women with high-risk DCIS from AS trials.

RESULTS

1,029 women (average age 58, range 28-89 years) with DCIS presenting as screen-detected calcifications underwent surgery. The surgical upstaging rate of DCIS to invasive disease was 16% (n=161). Of 161 upgrades, 35% (n=57) were upstaged to microinvasive disease and 65% (n=104) to non-microinvasive disease. The features associated with upstaging to any invasive disease (microinvasive or non-microinvasive) were menopause above the age of 50, breast MR imaging, and intermediate or high nuclear grade of DCIS at biopsy (all p<0.05). The only feature associated with upstaging to non-microinvasive disease was breast MR imaging (p=0.004). The optimism-corrected AUCs for both models were 0.63 (95% CI of 0.56-0.67 and 95% CI of 0.56-0.69, respectively).

CLINICAL RELEVANCE/APPLICATION

Identification of patient, imaging, and pathological features associated with higher surgical upstaging risk of DCIS could be used to exclude certain women with high-risk DCIS from AS trials.

SDP-BR-45   Contrast Enhanced Spectral Mammography Guided Biopsy: Single Institute Initial Clinical Experience

Participants
Maya Grisaru, MD, London, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

Contrast Enhanced Spectral Mammography (CESM) relies on dual-energy exposure after contrast Iodine is injected intravenously. Suspicious enhancing lesions detected by CESM, and not seen on ultrasound or mammography, are typically biopsied under breast Magnetic Resonance Imaging (MRI) guidance. A new biopsy technique which was recently developed enables dual-energy exposure to be combined with stereotactic guided biopsy (namely, CESM-guided biopsy) with either a vertical or horizontal approach. The purpose of this abstract is to describe our initial clinical experience with 34 patients. This prospective study was approved by Health Canada and the Western University Research Ethics Board and is funded by GE Healthcare.*Methods and Materials A total of 905 CESM exams June 2020- April 2021 were performed on 874 women. Thirty-four/874 women with 35 lesions were enrolled in this trial. Three lesions were initially detected by MRI and then by CESM.*Results Patients ages ranged between 38-82. Average breast density was heterogeneous (BI-RADS category C). Lesion size ranged 3-24 mm (mean 14 mm; 7 foci, 4 masses, 24 non-mass enhancement). CESM-guided biopsy was completed in 30/35 lesions (86%, 6 malignant, 7 high risk, 17 benign), 22 (63%) were subjectively less enhancing compared to the reference CESM exam. Horizontal approach was used in 19/30 lesions. Five lesions (14%) did not enhance (4 benign lesions were subsequently biopsied/excised, 1 lost for follow-up). In 17 patients standard ipsilateral CESM exam was used instead of standard mammography to confirm the placement of tissue markers, at 21-46 minutes after the injection; in 14 lesions (82%) enhancement was still noted.*Conclusions Satisfactory initial experience using CESM-guided biopsy. Lesions that did not enhance were usually benign. Cancellation rate is similar to what is reported with the use of MRI-guided biopsy.*Clinical Relevance/Application Initial experience with the use of a CESM-guided biopsy for enhancing lesions detected by CESM exam appears promising, showing similar results to what has previously been reported with breast MRI-guided biopsy.

RESULTS

Patients ages ranged between 38-82. Average breast density was heterogeneous (BI-RADS category C). Lesion size ranged 3-24 mm (mean 14 mm; 7 foci, 4 masses, 24 non-mass enhancement). CESM-guided biopsy was completed in 30/35 lesions (86%, 6 malignant, 7 high risk, 17 benign), 22 (63%) were subjectively less enhancing compared to the reference CESM exam. Horizontal approach was used in 19/30 lesions. Five lesions (14%) did not enhance (4 benign lesions were subsequently biopsied/excised, 1 lost for follow-up). In 17 patients standard ipsilateral CESM exam was used instead of standard mammography to confirm the placement of tissue markers, at 21-46 minutes after the injection; in 14 lesions (82%) enhancement was still noted.

CLINICAL RELEVANCE/APPLICATION

Initial experience with the use of a CESM-guided biopsy for enhancing lesions detected by CESM exam appears promising, showing similar results to what has previously been reported with breast MRI-guided biopsy.

SDP-BR-46   Performance Of Automated Breast Ultrasound Versus Handheld Breast Ultrasound In The Diagnostic Breast Imaging Clinic

Participants

Shinnhuey Chou, MD, Boston, Massachusetts (*Presenter*) Institutional research support, General Electric Company

PURPOSE

To compare performance between automated breast ultrasound (ABUS) and handheld breast ultrasound (HHUS) in the diagnostic breast imaging clinic.*Methods and Materials This IRB-approved HIPAA-compliant study included consecutive ABUS and HHUS diagnostic exams performed in patients referred to our diagnostic clinic from August 2020 to January 2021. Diagnostic ultrasound was performed on an ABUS unit (Invenia, GE Healthcare) by a trained sonographer or mammography technologist or on an HHUS unit (Logiq E9, GE Healthcare) by a sonographer or radiologist. All exams were interpreted by 1 of 7 fellowship-trained radiologists. Final Breast Imaging Reporting and Data System (BIRADS) assessments 0, 3, 4 and 5 were considered positive to calculate the abnormal interpretation rate (AIR), positive predictive values (PPV1), PPV2, PPV3, and cancer detection rate (CDR). Multivariable logistic regression models were fit to assess the association of performance metrics with ABUS and HHUS, adjusting for patient age, breast density, and exam indication. *Results A total of 900 exams in 894 women (61.6% symptomatic, e.g. lump, pain, nipple discharge; 38.4% asymptomatic, e.g. recall from screening, short-term follow-up) included 227 ABUS exams in 227 women (mean age 46.1±15.2 years) and 673 HHUS exams in 667 women (mean age 48.6±15.7 years, p=0.05). There was no evidence of differences in exam indication, breast density, and BIRADS assessments between ABUS and HHUS (all p>0.05). There was no evidence that performance metrics were different between ABUS and HHUS: AIR (31.3% [71/227] vs. 33.1% [223/673], p=0.61), PPV1 (18.3% [13/71] vs. 16.6 [37/223], p=0.74), PPV2 (50.0% [13/26] vs. 43.0% [37/86], p=0.53), PPV3 (50.0% [13/26] vs. 43.5% [37/85], p=0.56), and CDR (5.7% [13/227] vs. 5.5% [37/673], p=0.90). These results persisted after estimation of multivariable models (p>0.05).*Conclusions Our study demonstrates comparable performance of ABUS to HHUS in the diagnostic clinic. Integrating ABUS as a diagnostic modality provides a platform to increase access and availability of diagnostic breast ultrasound, particularly in settings without the presence of expert physician or sonographer.*Clinical Relevance/Application Many studies have demonstrated performance of ABUS in the screening setting. Our study provides robust evidence and support of comparable performance of ABUS to HHUS in the diagnostic setting.

RESULTS

A total of 900 exams in 894 women (61.6% symptomatic, e.g. lump, pain, nipple discharge; 38.4% asymptomatic, e.g. recall from screening, short-term follow-up) included 227 ABUS exams in 227 women (mean age 46.1±15.2 years) and 673 HHUS exams in 667 women (mean age 48.6±15.7 years, p=0.05). There was no evidence of differences in exam indication, breast density, and BIRADS assessments between ABUS and HHUS (all p>0.05). There was no evidence that performance metrics were different between ABUS and HHUS: AIR (31.3% [71/227] vs. 33.1% [223/673], p=0.61), PPV1 (18.3% [13/71] vs. 16.6 [37/223], p=0.74), PPV2 (50.0% [13/26] vs. 43.0% [37/86], p=0.53), PPV3 (50.0% [13/26] vs. 43.5% [37/85], p=0.56), and CDR (5.7% [13/227] vs. 5.5% [37/673], p=0.90). These results persisted after estimation of multivariable models (p>0.05).

CLINICAL RELEVANCE/APPLICATION

Many studies have demonstrated performance of ABUS in the screening setting. Our study provides robust evidence and support of comparable performance of ABUS to HHUS in the diagnostic setting.

SDP-BR-47 **Associations Between Immunohistochemistry And 18F-fmiso-pet/mri Parameters Of Hypoxia And Vascular Function In Er-positive Breast Cancer**

Participants

Julia Carmona-Bozo, MD, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

To examine relationships between tumor hypoxia and perfusion metrics from 18F-fluoromisonidazole (18F-FMISO) PET/MRI and endogenous immunohistochemical (IHC) markers in estrogen receptor (ER)-positive breast cancer*Methods and Materials Women aged >18 years with treatment-naïve, ER-positive breast cancer underwent a 60-min PET/MR scan of the breasts 2 hours post-injection of 300 MBq 18F-FMISO. Tumor vascular parameters were derived from DCE-MRI using the extended Tofts' model, while hypoxia was assessed using the 18F-FMISO influx rate constant Ki determined by Patlak-plot analysis. The apparent diffusion coefficient in the darkest part of the tumor (dp-ADC) was obtained from DWI-MRI. Following surgical excision, tumor sections were stained with CD31, hypoxia-inducible factor (HIF)-1a and carbonic anhydrase IX (CAIX). The number of tumor micro-vessels, micro-vessel diameter, and micro-vessel density (MVD) were obtained from CD31 microarrays via computer-assisted analysis. HIF-1a and CAIX expression were scored according to the percentage of positive cells stained. The percentage of stromal tumor-infiltrating lymphocytes (sTIL) was derived from available hematoxylin and eosin (H&E) slides. Regression analysis was used to study associations between imaging and IHC variables.*Results Of the 23 lesions examined, 14/23 (61%) were ductal tumors, grade 2 or 3 (20/23; 88%), while 18/23 (78%) were HER2-negative. 18F-FMISO Ki was negatively associated with micro-vessel diameter (R^2=0.23, p<0.03), MVD (R^2=0.26, p<0.02) and CAIX expression (R^2=0.52, p=0.03). A positive association was observed between dp-ADC and CAIX expression (R^2=0.44, p=0.03), while no significant relationships were found between DCE-MRI metrics and IHC parameters (all p>0.05). HIF-1a and sTIL expression did not significantly associate with PET/MR metrics (all p>0.05)*Conclusions Tumor hypoxia measured by 18F-FMISO PET is significantly associated with increased CAIX expression, low MVD, and smaller vessel diameters in ER-positive breast cancer*Clinical Relevance/Application CAIX expression seems to be a reliable marker of hypoxia in ER-positive breast cancer whereas HIF-1a seems to be an unreliable hypoxia marker because it has other modulators apart from hypoxia

RESULTS

Of the 23 lesions examined, 14/23 (61%) were ductal tumors, grade 2 or 3 (20/23; 88%), while 18/23 (78%) were HER2-negative. 18F-FMISO Ki was negatively associated with micro-vessel diameter (R^2=0.23, p<0.03), MVD (R^2=0.26, p<0.02) and CAIX expression (R^2=0.52, p=0.03). A positive association was observed between dp-ADC and CAIX expression (R^2=0.44, p=0.03), while no significant relationships were found between DCE-MRI metrics and IHC parameters (all p>0.05). HIF-1a and sTIL expression did not significantly associate with PET/MR metrics (all p>0.05)

CLINICAL RELEVANCE/APPLICATION

CAIX expression seems to be a reliable marker of hypoxia in ER-positive breast cancer whereas HIF-1a seems to be an unreliable hypoxia marker because it has other modulators apart from hypoxia

SDP-BR-48   A Preoperative Model To Predict The Probability Of Low- Nuclear-grade Ductal Carcinoma In Situ

Participants
Hee Jung Moon, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop a preoperative model to predict low-nuclear-grade ductal carcinoma in situ (DCIS) and evaluate upshift rate of low-nuclear-grade DCIS on biopsy to intermediate-to-high grade on surgery.*Methods and Materials Between January 2010 and December 2015, a total of 477 primary pure DCIS lesions on surgical pathology in 470 patients were included. We divided total patients into training (n=330) and validation set (n=147) to develop preoperative model to predict low-grade DCIS using multivariate regression. The 477 DCIS lesions were classified into one of two groups based on the final nuclear grade; the lesions with low grade both on biopsy- and surgical-pathology reports were 'Low-grade' group, and 'Intermediate-to-high grade' group included the lesions with intermediate- or high-grade DCIS on either biopsy- or surgical-pathology reports. 'Upshift' was defined when the low grade DCIS on biopsy was changed to intermediate-to-high grade on surgery. We evaluated which clinical, radiological, pathological factors associated with upshift of low-grade DCIS using multivariate regression.*Results A preoperative model consisting of lesions presenting as mass only on ultrasound and no comedonecrosis on biopsy predicted low-grade DCIS with high AUC (Area Under the Receiver Operating Characteristics curve) as 0.970 in validation set. Upshift rate of low-grade DCIS on biopsy was 38.8% (50 of 129). Lesions presenting both on ultrasound and mammography and Ki-67 positivity were substantially associated with upshift of low-grade DCIS, (P=0.056 and 0.065).*Conclusions The upshift rate of low grade DCIS on biopsy to intermediate-to-high grade on surgery was 38.8%, which was non-negligibly high. However, DCIS presenting as a mass only on ultrasound and no comedonecrosis on biopsy pathology can predict low-grade DCIS on final pathology.*Clinical Relevance/Application DCIS presenting as a mass only on ultrasound and no comedonecrosis on biopsy pathology can preoperatively predict low-grade DCIS on final pathology.

RESULTS

A preoperative model consisting of lesions presenting as mass only on ultrasound and no comedonecrosis on biopsy predicted low-grade DCIS with high AUC (Area Under the Receiver Operating Characteristics curve) as 0.970 in validation set. Upshift rate of low-grade DCIS on biopsy was 38.8% (50 of 129). Lesions presenting both on ultrasound and mammography and Ki-67 positivity were substantially associated with upshift of low-grade DCIS, (P=0.056 and 0.065).

CLINICAL RELEVANCE/APPLICATION

DCIS presenting as a mass only on ultrasound and no comedonecrosis on biopsy pathology can preoperatively predict low-grade DCIS on final pathology.

SDP-BR-49   Biopsy-proven Stromal Fibrosis: What Is The Appropriated Management Approach?

Participants
Prasaanthan Gopee-Ramanan, MD, Brampton, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

To determine the upgrade rate to malignancy of biopsy-proven stromal fibrosis and assess features associated with the upgrade on surgical excision.*Methods and Materials REB-approved retrospective imaging studies and patient's chart review of imaging-guided biopsy-proven stromal fibrosis carried out between April 2014 and December 2019. The upgrade rate of malignancy and the imaging features of the upgraded cases on surgical excision were recorded. The results were correlated with surgical histopathology as the ground truth or an uneventful clinical and radiological follow-up of at least 6 months. Predictors for malignancy were examined and appropriate statistical tests were applied.*Results Out of 9814 consecutive imaging-guided breast biopsies performed on women between April 2014 and December 2019, 470 patients (4.8%; median age 52 years) had biopsy-proven stromal fibrosis without atypia and fulfilled the inclusion criteria, representing the study cohort. Out of the 470 patients, 28 patients (5.9%) underwent excisional surgery due to the discordance between the imaging appearance and the pathology outcome or at the discretion of the patient/attending surgeon and 442 cases (94.1%) underwent clinical and imaging follow up of at least 6 months. Out of 470 cases with an initial diagnosis of stromal fibrosis, 6 cases (1.3%) were upgraded to malignancy consisting of 4/6 cases of invasive malignancy with in-situ component (67%) and 2/6 cases of invasive malignancy without in-situ disease (33%). The imaging features associated with upgrade to malignancy were suspicious mass or non-mass enhancement on MRI, coarse heterogeneous calcifications on mammography, and irregular mass on ultrasound.*Conclusions The lower rate of upgrade to malignancy when stromal fibrosis is diagnosed supports short-term imaging follow-up in this setting as a safe management recommendation, especially in the absence of certain atypical imaging features.*Clinical Relevance/Application The study results can impact the management of biopsy-proven stromal fibrosis, suggesting when additional excisional surgery is needed or when imaging follow-up is sufficient.

RESULTS

Out of 9814 consecutive imaging-guided breast biopsies performed on women between April 2014 and December 2019, 470 patients (4.8%; median age 52 years) had biopsy-proven stromal fibrosis without atypia and fulfilled the inclusion criteria, representing the study cohort. Out of the 470 patients, 28 patients (5.9%) underwent excisional surgery due to the discordance between the imaging appearance and the pathology outcome or at the discretion of the patient/attending surgeon and 442 cases (94.1%) underwent clinical and imaging follow up of at least 6 months. Out of 470 cases with an initial diagnosis of stromal fibrosis, 6 cases (1.3%) were upgraded to malignancy consisting of 4/6 cases of invasive malignancy with in-situ component (67%) and 2/6 cases of invasive malignancy without in-situ disease (33%). The imaging features associated with upgrade to malignancy were suspicious mass or non-mass enhancement on MRI, coarse heterogeneous calcifications on mammography, and irregular mass on ultrasound.

CLINICAL RELEVANCE/APPLICATION

The study results can impact the management of biopsy-proven stromal fibrosis, suggesting when additional excisional surgery is needed or when imaging follow-up is sufficient.

SDP-BR-5   A Simplified Scoring System For Preoperative Prediction Of Axillary Response To Neoadjuvant Chemotherapy In Node-positive Breast Cancer

Participants
Xiaomei Huang, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop a simplified scoring system based on MRI features and clinicopathologic variables to preoperatively predict axillary pathologic complete response (pCR) to neoadjuvant chemotherapy (NAC) in clinically node-positive breast cancer.*Methods and Materials In this retrospective study, 259 patients with clinically node-positive breast cancer who received NAC followed by surgery from June 2012 to February 2020 were included. The patients were split into a development cohort (n=183) and an independent validation cohort (n=76) according to sequencing the date of surgery. Pre- and post-NAC MRI features were analyzed. Univariate and multivariable logistic regression analysis were applied to identify independent predictors of axillary pCR in the development cohort. A simplified scoring system was constructed based on the regression coefficients of predictors in the multivariable logistic model. The predictive performance of the scoring system was assessed with the receiver operating characteristic (ROC) curve and calibration curve.*Results The axillary pCR rate was 51.9% (95 of 183) and 57.9% (44 of 76) in the development and validation cohort, respectively. The independent predictors of axillary pCR were progesterone receptor negativity, human epidermal growth factor receptor 2 positivity, higher values of apparent diffusion coefficient before NAC, clinical T0/T1 stage after NAC, absence of perinodal infiltration in pre- and post-NAC MRI, and absence of enhancement in the tumor bed in post-NAC MRI. The simplified scoring system incorporating these predictors achieved an AUC of 0.835 (95% confidence interval [CI]: 0.777-0.894) and 0.828 (95% CI: 0.736-0.920) in the development and validation cohort, respectively. The calibration curve also showed good calibration in both cohorts. The simplified score ranged from 0 to 13. When the patients had a simplified score of more than 10, the pCR rates was higher than 91% (21 of 23) in validation cohort.*Conclusions A simplified scoring system incorporating MRI features and clinicopathologic variables shows good predictive performance for axillary pCR, which has the potential to guide axillary management after NAC in patients with initially node-positive breast cancer.*Clinical Relevance/Application A simplified scoring system for prediction of axillary response to NAC may guide axillary management after NAC and reduce surgical complications in patients with initially node-positive breast cancer.

RESULTS

The axillary pCR rate was 51.9% (95 of 183) and 57.9% (44 of 76) in the development and validation cohort, respectively. The independent predictors of axillary pCR were progesterone receptor negativity, human epidermal growth factor receptor 2 positivity, higher values of apparent diffusion coefficient before NAC, clinical T0/T1 stage after NAC, absence of perinodal infiltration in pre- and post-NAC MRI, and absence of enhancement in the tumor bed in post-NAC MRI. The simplified scoring system incorporating these predictors achieved an AUC of 0.835 (95% confidence interval [CI]: 0.777-0.894) and 0.828 (95% CI: 0.736-0.920) in the development and validation cohort, respectively. The calibration curve also showed good calibration in both cohorts. The simplified score ranged from 0 to 13. When the patients had a simplified score of more than 10, the pCR rates was higher than 91% (21 of 23) in validation cohort.

CLINICAL RELEVANCE/APPLICATION

A simplified scoring system for prediction of axillary response to NAC may guide axillary management after NAC and reduce surgical complications in patients with initially node-positive breast cancer.

SDP-BR-50   Architectural Distortion On Digital Breast Tomosynthesis: Pathological Upgrade Rates Of Radial Scars And Other Benign Pathologies

Participants
Manisha Bahl, MD,MPH, Boston, Massachusetts (*Presenter*) Consultant, Lunit Inc;Advisory Board, Accolade Inc

PURPOSE

The integration of digital breast tomosynthesis (DBT) into clinical practice has led to increased detection and subsequent biopsy of architectural distortion, which may yield malignancy, radial scar, or other benign pathologies. However, the management of radial scars and other benign pathologies in this setting remains controversial. The purpose of this study is to determine pathological upgrade rates of radial scars and other benign pathologies diagnosed by image-guided core needle biopsy to malignancy at surgery, in order to guide management recommendations.*Methods and Materials In this HIPAA-compliant and IRB-approved retrospective study, consecutive cases of suspicious architectural distortion on mammography (coded as BI-RADS 4 or 5) from July 2017 to June 2019 were reviewed. Included cases underwent image-guided core needle biopsy and surgical excision or underwent core needle biopsy and had at least two-year imaging follow-up. Medical records were reviewed for core biopsy results, surgical outcomes, and imaging follow-up.*Results Suspicious architectural distortion was identified in 313 mammographic exams in 305 women (mean age 58 years, range 23-90 years). Of the 313 cases, 260 (83%) underwent both image-guided core needle biopsy and surgery (n=228) or underwent image-guided core needle biopsy only and had at least two-year imaging follow-up (n=32). These 260 mammographic exams in 255 women (mean age 58 years, range 23-90 years) comprise the study cohort. Of the 260 cases, 81% (n=210) were detected at screening mammography, and 56% (n=145) were biopsied under mammographic guidance. At biopsy, 57% (148/260) were malignant, 25% (65/260) were radial scars, and 18% (47/260) were other benign or high-risk pathologies. Of the 48 radial scars without associated atypia, only one case (2%) upgraded to malignancy at surgery (grade 2 ductal carcinoma in situ). Of the 34 benign cases without associated atypia (e.g., stromal fibrosis), only one case (3%), which was considered discordant, upgraded to malignancy at surgery (benign predominantly fatty breast tissue at biopsy and grade 1 invasive ductal carcinoma at surgery).*Conclusions In the DBT era, 25% of architectural distortion cases yield radial scar at biopsy and nearly 20% are other benign or high-risk pathologies. Of radial scars without atypia, only one case (2%) upgraded to ductal carcinoma in situ at surgery, and none upgraded to invasive malignancy at surgery. Of benign cases without atypia, only one discordant case (3%) upgraded to malignancy at surgery.*Clinical Relevance/Application Imaging follow-up rather than surgery can be considered for architectural distortion yielding (1) radial scar without atypia at biopsy and (2) other benign pathologies without atypia at biopsy.

RESULTS

Suspicious architectural distortion was identified in 313 mammographic exams in 305 women (mean age 58 years, range 23-90 years). Of the 313 cases, 260 (83%) underwent both image-guided core needle biopsy and surgery (n=228) or underwent image-guided core needle biopsy only and had at least two-year imaging follow-up (n=32). These 260 mammographic exams in 255 women (mean age 58 years, range 23-90 years) comprise the study cohort. Of the 260 cases, 81% (n=210) were detected at screening mammography, and 56% (n=145) were biopsied under mammographic guidance. At biopsy, 57% (148/260) were malignant, 25% (65/260) were radial scars, and 18% (47/260) were other benign or high-risk pathologies. Of the 48 radial scars without associated atypia, only one case (2%) upgraded to malignancy at surgery (grade 2 ductal carcinoma in situ). Of the 34 benign cases without associated atypia (e.g., stromal fibrosis), only one case (3%), which was considered discordant, upgraded to malignancy at surgery (benign predominantly fatty breast tissue at biopsy and grade 1 invasive ductal carcinoma at surgery).

CLINICAL RELEVANCE/APPLICATION

Imaging follow-up rather than surgery can be considered for architectural distortion yielding (1) radial scar without atypia at biopsy

Imaging follow-up rather than surgery can be considered for architectural distortion yielding (1) radial scar without atypia at biopsy and (2) other benign pathologies without atypia at biopsy.

SDP-BR-51 Performance Of Full Field Synthetic Mammography In The Detection Of Microcalcifications And How To Dismiss Pseudocalcifications.

Participants
Jose M. Net, MD, Miami Beach, Florida (*Presenter*) Nothing to Disclose

PURPOSE

To compare visibility of calcifications on FFDM, FFSM and DBT and how to dismiss those suspected to represent pseudocalcifications.*Methods and Materials This retrospective study included patients where magnification views were performed 10/1/2013-9/30/2016. Patients with Full Field Digital Mammogram (FFDM), Full Field Synthetic Mammogram (FFSM), Digital Breast Tomosynthesis (DBT) and magnification views were included. Images were reviewed by 2 board certified fellowship trained breast imagers with 5 and 10 years of experience who were blinded to results of the work up. Cases were scored for visualization of calcifications on FFDM, FFSM, DBT and magnification views. Biopsy results were recorded as benign, atypical or malignant. Years of follow up and cancer diagnoses were recorded.*Results 528 patients had magnifications views performed and all requisite imaging. Patient's age ranged 32-86 years, average 55.6 and median 55. Calcifications were visualized on FFDM, FFSM, DBT and magnification views in 470 patients. Of these, 229 were referred for biopsy of which 43 yielded DCIS, 11 IDC and 5 LIN but benign at excision, 1 ADH also benign at excision, 6 were lost to follow up and 164 were benign. Calcifications were visible only on FFSM, DBT and magnification views in 36 patients, of which 28 only had FFSM and DBT performed as our center moved to only acquiring FFSM/DBT in August 2015. Of these, 14 were referred for biopsy of which 1 yielded IDC, 4 DCIS, 1 ADH but benign at excision and 8 were benign. 14 patients had calcifications visible only on FFDM and magnification views. Of these, 6 were biopsied and all were benign. 8 were seen only on FFSM and no other technique; no cancers were detected in follow up. Patients were followed for an average of 2.28 years, median 3 years of follow up, range 0-5 years. After initial work up,19 patients were subsequently diagnosed with breast cancer of which 15 were in the contralateral breast, 4 were ipsilateral to calcifications in question, but in different quadrants.*Conclusions FFDM and FFSM demonstrated equivalent performance in demonstrating calcifications; all malignant lesions were seen on both techniques. None of the suspected calcifications seen only on FFSM were visible on magnification views and none of these patients developed breast cancer at follows up, thus representing pseudocalcifications. FFDM resulted in 6 benign biopsies which could have been avoided if FFDM was eliminated.*Clinical Relevance/Application FFSM identified all malignant calcifications; our results suggest those calcifications seen only on FFSM can safely be described as pseudocalcifications. Calcifications seen only on FFDM resulted in additional work up and biopsy which could have been avoided if only FFSM and DBT were performed.

RESULTS

528 patients had magnifications views performed and all requisite imaging. Patient's age ranged 32-86 years, average 55.6 and median 55. Calcifications were visualized on FFDM, FFSM, DBT and magnification views in 470 patients. Of these, 229 were referred for biopsy of which 43 yielded DCIS, 11 IDC and 5 LIN but benign at excision, 1 ADH also benign at excision, 6 were lost to follow up and 164 were benign. Calcifications were visible only on FFSM, DBT and magnification views in 36 patients, of which 28 only had FFSM and DBT performed as our center moved to only acquiring FFSM/DBT in August 2015. Of these, 14 were referred for biopsy of which 1 yielded IDC, 4 DCIS, 1 ADH but benign at excision and 8 were benign. 14 patients had calcifications visible only on FFDM and magnification views. Of these, 6 were biopsied and all were benign. 8 were seen only on FFSM and no other technique; no cancers were detected in follow up. Patients were followed for an average of 2.28 years, median 3 years of follow up, range 0-5 years. After initial work up,19 patients were subsequently diagnosed with breast cancer of which 15 were in the contralateral breast, 4 were ipsilateral to calcifications in question, but in different quadrants.

CLINICAL RELEVANCE/APPLICATION

FFSM identified all malignant calcifications; our results suggest those calcifications seen only on FFSM can safely be described as pseudocalcifications. Calcifications seen only on FFDM resulted in additional work up and biopsy which could have been avoided if only FFSM and DBT were performed.

SDP-BR-52 Prediction Models Of The Axillary Lymph Node Burden Combining Cone-beam Computerized Tomography And Ultrasound In T1-2 Breast Cancer Patients

Participants
Shen Chen, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To derive and validate predictive models for preoperatively evaluating lymph node burden to assist T1-2 breast cancer's surgical decision-making.*Methods and Materials Data on 1394 consecutive patients Academic Cancer Center for cone-beam computerized tomography (CBCT) examination was retrospectively collected. A total of 387 patients were included and randomly divided into training and validation cohorts. Clinical-pathological information of all patients was recorded and images were reinterpreted in this study. A bidirectional stepwise method followed by multivariable analysis incorporated preoperative features and built optimal model sets with the training cohort for prediction of model one (N0 versus N+) and model two (N<3 versus N=3). Receiver operating characteristic curves (ROC) of two models were generated with the training and validation cohorts and their calibration abilities were estimated with bootstrap resamples. Calibration analysis, the concordance index (C-index), decision curves and the clinical impact curves were plotted to verify the accuracy for further clinical application.*Results The areas under the ROC curves were 0.884 and 0.891 in the training cohort, 0.878 and 0.880 in the validation cohort for models one and two respectively. Calibration curves, decision curves and the clinical impact curves demonstrated that prediction of lymph node burden in both models show preferable discrimination performance. Delong's test demonstrated comparable performance in both training and validation cohorts.*Conclusions Our models were developed as reliable and noninvasive way of preoperative nodal prediction, and we hope that they can serve as useful tools for the early planning of treatment strategies for breast cancer patients.*Clinical Relevance/Application Coordination of CBCT with ultrasound parameters can achieve predictive value of axillary lymph node status and assisting noninvasive approaches for axillary surgical planning in early stage breast cancer.

RESULTS

The areas under the ROC curves were 0.884 and 0.891 in the training cohort, 0.878 and 0.880 in the validation cohort for models one and two respectively. Calibration curves, decision curves and the clinical impact curves demonstrated that prediction of lymph node burden in both models show preferable discrimination performance. Delong's test demonstrated comparable performance in both training and validation cohorts.

SDP-BR-53   Variability Of Post-lumpectomy Imaging Surveillance In Women With Personal Histories Of Breast Cancer

Participants
Derek Nguyen, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

This study assesses current imaging surveillance protocols used for breast cancer survivors after lumpectomy and aims to understand the influencing factors.*Methods and Materials An anonymous survey was distributed through email to national breast imaging radiologists by the Society of Breast Imaging on 12/17/20. Response collection concluded on 1/17/21. The survey queried breast imaging practice settings, post-lumpectomy surveillance protocols, and reasons behind their specific protocols. Differences in duration of surveillance imaging protocols between practices were compared using the Chi-squared test. Associations between practice characteristics and protocol reasoning were evaluated using univariate logistic regression.*Results A total of 381 responses were received with an overall response rate of 16.1% (381/2361). The majority of practices (72.2%) recommend diagnostic mammography (DM) for post-lumpectomy imaging surveillance ranging from 6 months to 5 years before returning to annual screening mammography (SM), with 2-3 years being the most common (31%). In contrast, smaller proportions of practices recommend returning immediately to annual SM (7.9%) or recommend DM surveillance indefinitely (4.7%). The most common influencing factors for a practice's protocol utilization were the preferences of referring clinicians (63.8%) and radiologists (50.9%). Within the United States, practices in the West were more likely to recommend immediate return to annual SM than practices in the South (OR 1.09, 95% CI 1.01-1.17). No differences were seen based on practice setting or within international practices. Referring clinician preference, financial benefit for the patient, and published literature/guidelines were the reasons more commonly cited for recommending immediate return to annual SM following lumpectomy.*Conclusions There is variability among national breast imaging practices regarding the type of mammographic imaging surveillance protocols recommended post-lumpectomy for breast cancer survivors. These variations most commonly result from referring clinician and radiologist preferences.*Clinical Relevance/Application Communication and collaboration between referring clinicians and breast radiologists can help to standardize the care and surveillance for post-lumpectomy breast cancer patients.

RESULTS

A total of 381 responses were received with an overall response rate of 16.1% (381/2361). The majority of practices (72.2%) recommend diagnostic mammography (DM) for post-lumpectomy imaging surveillance ranging from 6 months to 5 years before returning to annual screening mammography (SM), with 2-3 years being the most common (31%). In contrast, smaller proportions of practices recommend returning immediately to annual SM (7.9%) or recommend DM surveillance indefinitely (4.7%). The most common influencing factors for a practice's protocol utilization were the preferences of referring clinicians (63.8%) and radiologists (50.9%). Within the United States, practices in the West were more likely to recommend immediate return to annual SM than practices in the South (OR 1.09, 95% CI 1.01-1.17). No differences were seen based on practice setting or within international practices. Referring clinician preference, financial benefit for the patient, and published literature/guidelines were the reasons more commonly cited for recommending immediate return to annual SM following lumpectomy.

CLINICAL RELEVANCE/APPLICATION

Communication and collaboration between referring clinicians and breast radiologists can help to standardize the care and surveillance for post-lumpectomy breast cancer patients.

SDP-BR-54   Utilization Of Screening Mammography In Women Before 50: Cross-sectional Survey Results From The National Health Interview Survey

Participants
Corey A. Brown, MENG,BS, Scarborough, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

While the Society of Breast Imaging and other national societies recommend annual screening mammography in average risk women starting at age 40, the US Preventive Services Task Force (USPSTF) recommends that routine screening mammography should be an individual decision before the age of 50, reflecting patient considerations about benefits and potential harms. Using a nationally representative cross-sectional survey, the purpose of this study is to evaluate patient reported reasons and predictors for foregoing screening mammography prior to age 50.*Methods and Materials HIPAA compliant data from survey respondents aged 40-49 in the 2018 National Health Interview Survey (NHIS) without history of breast cancer were included (survey response rate 64%). Participants reported sociodemographic variables and reasons they did not undergo a mammogram within the last two years. Multiple variable logistic regression analyses were performed to evaluate the association between sociodemographic characteristics and patient-reported screening mammography practices. Analyses were conducted to account for complex survey sampling design and to obtain statistically valid estimates for the civilian, noninstitutionalized US population. *Results 1,489 women between the ages of 40-49 were included. 79.8% reported getting a screening mammogram within the last two years, and 60.6% reported getting a screening mammogram within the last year. Most common reasons for not undergoing screening mammography in the last two years included: No reason (36.2%), Didn't need it (23.5%), Doctor didn't order it (13.3%), Other (6.8%), Put it off (5.6%), I'm too young (5.6%), Haven't had any problems (3.7%), Too expensive (1.6%), Don't have doctor (1.5%). Multiple variable analyses revealed that participants without health insurance (OR 0.35, 95% CI 0.22, 0.55, p <0.001) were less likely to report undergoing screening mammography in the last two years. Asian participants (OR 0.47, 95% CI 0.24, 0.89, p = 0.004) and participants without health insurance (OR 0.30, 95% CI 0.20, 0.45, p < 0.001) were less likely to report undergoing screening mammography in the last year.*Conclusions The decision to not engage in screening mammography prior to age 50 was most strongly associated with lack of access to health insurance.*Clinical Relevance/Application USPSTF recommendations relying on complex decision making processes requiring access to health care providers may exacerbate breast cancer disparities and limit access to screening mammography for women in their 40s, particularly those without health insurance.

RESULTS

1,489 women between the ages of 40-49 were included. 79.8% reported getting a screening mammogram within the last two years, and 60.6% reported getting a screening mammogram within the last year. Most common reasons for not undergoing screening

mammography in the last two years included: No reason (36.2%), Didn't need it (23.5%), Doctor didn't order it (13.3%), Other (6.8%), Put it off (5.6%), I'm too young (5.6%), Haven't had any problems (3.7%), Too expensive (1.6%), Don't have doctor (1.5%). Multiple variable analyses revealed that participants without health insurance (OR 0.35, 95% CI 0.22, 0.55, p <0.001) were less likely to report undergoing screening mammography in the last two years. Asian participants (OR 0.47, 95% CI 0.24, 0.89, p = 0.004) and participants without health insurance (OR 0.30, 95% CI 0.20, 0.45, p < 0.001) were less likely to report undergoing screening mammography in the last year.

CLINICAL RELEVANCE/APPLICATION

USPSTF recommendations relying on complex decision making processes requiring access to health care providers may exacerbate breast cancer disparities and limit access to screening mammography for women in their 40s, particularly those without health insurance.

SDP-BR-55 Factors Associated With Screening Mammography Participation In Canadian Women

Participants
Nayaar Islam, BSC, Ottawa, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether sociodemographic factors are associated with screening mammography participation among women in Canada.*Methods and Materials This study used Canadian Community Health Survey data from all available survey cycles (2001, 2003, 2005, 2007-2008, 2009-2010, 2012, 2013-2014, 2015-2016, and 2017-2018). Survey weights assigned to survey responses by Statistics Canada were accounted for in all statistical analyses. Odds ratios (OR) and 95% confidence intervals (CI) were computed using multivariable regression models to determine the impact of age, province or territory of residence, ethnicity, immigrant status, level of education, household income, having a regular healthcare provider, perceived health status, and marital status on participation in a screening mammogram in the last two years.*Results A total of 138,284 respondents representing 27,663,094 individuals across nine survey cycles were included. From 2001 to 2018, an average of 63% (range: 60-67) of women aged 40-74 participated in screening mammography. In the two most recent survey cycles (2015-2016 and 2017-2018): odds of participation were lower among non-white women (OR=0.78 [95%CI: 0.77-0.79] and 0.52 [0.50-0.54], respectively; p<0.001 for both); odds of participation were higher among women aged 50-74 vs 40-49 (OR=6.10 [6.06-6.14] and 2.85 [2.80-2.90], respectively), who had higher levels of education, higher levels of household income, had a regular health care provider (OR=2.35 [2.33-2.38] and 2.84 [2.77-2.91], respectively), and were married vs single (OR=1.22 [1.21-1.24] and 1.60 [1.56-1.65], respectively] or in a common-law relationship vs single (OR=1.19 [1.17-1.20] and 1.60 [1.56-1.65], respectively; p<0.001 for all). In 2015-2016, odds of participation were lower among women who were immigrants (OR=0.963 [0.953-0.973]) and women with poorer levels of perceived health (p<0.001 for all).*Conclusions Non-white race, younger age, lower education, lower income, not having a regular healthcare provider, being single, worse perceived health, and being an immigrant were associated with lower participation in breast cancer screening mammography in Canada.*Clinical Relevance/Application Healthcare practitioners should consider patients' sociodemographic characteristics and provide additional guidance on accessing routine screening mammography to women who are less likely to participate in screening programs.

RESULTS

A total of 138,284 respondents representing 27,663,094 individuals across nine survey cycles were included. From 2001 to 2018, an average of 63% (range: 60-67) of women aged 40-74 participated in screening mammography. In the two most recent survey cycles (2015-2016 and 2017-2018): odds of participation were lower among non-white women (OR=0.78 [95%CI: 0.77-0.79] and 0.52 [0.50-0.54], respectively; p<0.001 for both); odds of participation were higher among women aged 50-74 vs 40-49 (OR=6.10 [6.06-6.14] and 2.85 [2.80-2.90], respectively), who had higher levels of education, higher levels of household income, had a regular health care provider (OR=2.35 [2.33-2.38] and 2.84 [2.77-2.91], respectively), and were married vs single (OR=1.22 [1.21-1.24] and 1.60 [1.56-1.65], respectively] or in a common-law relationship vs single (OR=1.19 [1.17-1.20] and 1.60 [1.56-1.65], respectively; p<0.001 for all). In 2015-2016, odds of participation were lower among women who were immigrants (OR=0.963 [0.953-0.973]) and women with poorer levels of perceived health (p<0.001 for all).

CLINICAL RELEVANCE/APPLICATION

Healthcare practitioners should consider patients' sociodemographic characteristics and provide additional guidance on accessing routine screening mammography to women who are less likely to participate in screening programs.

SDP-BR-56 Factors Affecting Axillary LN Metastasis In Patients With Clinically T1-2 N0 Breast Cancers Who Has Negative Preoperative Axillary Ultrasound

Participants
Sung Eun Song, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Randomized controlled trials are currently under way to investigate whether sentinel lymph node (LN) biopsy could be safely omitted in patients with clinically T1-2 N0 breast cancers who has negative preoperative axillary ultrasound. The purpose of our study was to reveal factors affecting pathologic axillary LN metastasis using clinical-pathologic and imaging features.*Methods and Materials From October 2013 to October 2020, consecutive women with clinically T1-2 N0 breast cancers whose sonographic findings for axillary LN were negative and who were treated with breast conservation therapy were retrospectively included. Clinical-pathologic data such as age, symptom, menopause, family history of breast cancer, histologic type and grade, pathologic tumor stage, Ki-67 index, hormone receptor status were collected. Imaging features such as mammograms (presence of calcifications, parenchymal density, and tumor location), ultrasound (BI-RADS category), and MRI (tumor morphology, enhancement kinetics, and apparent diffusion coefficient at diffusion-weighted imaging) were analyzed. Logistic regression analyses were performed to identify independent factors associated with pathologic LN metastasis.*Results A total of 402 women were included (mean age ± standard deviation, 57.61 ± 11.58). The axillary LN metastasis rate on pathology was 20.4% (82 of 402). Among 82 cases with metastasis, 21 (25.6%) were suspected to be metastatic by MRI. False positive rate by MRI was 4.4% (14 of 320). At univariate analysis, tumor stage T2 and progesterone receptor (PR) positivity, and outer tumor location on mammography, BI-RADS category 5 assessment on ultrasound, and suspicious LN metastasis on MRI were significantly associated with pathologic axillary LN metastasis (all P < .05). At mutivariate analysis, independent predictors for axillary LN metastasis were suspicious LN metastasis on MRI (odds ratio [OR], 8.19 ; 95% CI: 3.69, 18.13; P < .001), PR positivity (OR, 2.77 ; 95% CI: 1.18, 6.48; P = .018), and BI-RADS category 5 on ultrasound (OR, 2.32 ; 95% CI: 1.37, 3.92; P = .002).*Conclusions Clinical-pathologic feature of PR positivity, and imaging feature of BI-RADS category 5 assessment on ultrasound and suspicious LN metastasis on MRI might be helpful for predicting

pathologic axillary LN metastasis in patients with T1-2 N0 breast cancers who has negative axillary ultrasound.*Clinical Relevance/Application In patients with clinically T1-2 N0 breast cancers who has negative preoperative axillary ultrasound, a predictive model that incorporates clinical-pathologic features and imaging features was able to identify those patients who will have pathologic axillary LN metastasis and can be suitable candidates for sentinel LN biopsy.

RESULTS

A total of 402 women were included (mean age ± standard deviation, 57.61 ± 11.58). The axillary LN metastasis rate on pathology was 20.4% (82 of 402). Among 82 cases with metastasis, 21 (25.6%) were suspected to be metastatic by MRI. False positive rate by MRI was 4.4% (14 of 320). At univariate analysis, tumor stage T2 and progesterone receptor (PR) positivity, and outer tumor location on mammography, BI-RADS category 5 assessment on ultrasound, and suspicious LN metastasis on MRI were significantly associated with pathologic axillary LN metastasis (all P < .05). At mutivariate analysis, independent predictors for axillary LN metastasis were suspicious LN metastasis on MRI (odds ratio [OR], 8.19 ; 95% CI: 3.69, 18.13; P < .001), PR positivity (OR, 2.77 ; 95% CI: 1.18, 6.48; P = .018), and BI-RADS category 5 on ultrasound (OR, 2.32 ; 95% CI: 1.37, 3.92; P = .002).

CLINICAL RELEVANCE/APPLICATION

In patients with clinically T1-2 N0 breast cancers who has negative preoperative axillary ultrasound, a predictive model that incorporates clinical-pathologic features and imaging features was able to identify those patients who will have pathologic axillary LN metastasis and can be suitable candidates for sentinel LN biopsy.

SDP-BR-57 Post-neoadjuvant Chemotherapy Axillary Lymph Node Staging Ultrasound; A Pathological Analysis Of Missed Cases

Participants
Sepideh Sefidbakht, MD, Powel, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

To review pathological characteristics of lymph node metastases missed on post-neoadjuvant chemotherapy ultrasound; to compare residual malignancy size and original tumor receptors of LN metastases missed on post-neoadjuvant chemotherapy ultrasound with correctly diagnosed lymph nodes*Methods and Materials Institutional ethics committee approved this retrospective study. 165 patients with both pre and post NAC ultrasound available over the study period entered the study. Pathology reports and slides for patients with at least one lymph node with pathologically proven malignancy on post-NAC SLNB or ALND were reviewed. Size of the lymph node metastases and original tumor receptor status was compared between those with false negative post-neoadjuvant chemotherapy tumor residue and those with correctly diagnosed residual lymph node metastases.*Results Out of 113 patients with surgically proven LN metastases, 56 patients were correctly diagnosed and 57 patients were missed on post-neoadjuvant chemotherapy axillary staging. 15 of the missed lymph nodes were micrometastses less than 2 mm in diameter, 26 had metastases 2-5 mm in diameter and 16 had larger residual metastases. 22 patients had more than one positive lymph node. Residual malignancy could be seen pathologically in 12 patients in the same level presumably the same lymph node as seen in pre-NAC ultrasound. 11/57 cases with missed cancer and only 5/56 cases with correctly diagnosed cancer were either HER2+ or triple negative.*Conclusions There is an inherent limitation to ultrasound in axillary lymph node staging after neoadjuvant chemotherapy. Ultrasound can miss a significant number of residual malignancy in lymph nodes. Using color doppler ultrasound, marking the positive lymph nodes accurately and considering re-biopsy of previously positive lymph nodes should be considered to reduce the number of axillary lymph node dissections.*Clinical Relevance/Application Axillary Lymph node dissection can cause significant morbidity and disability in women who have been treated for breast cancer. Sentinel Lymph Node biopsy is among the newer surgical techniques used to limit this disability. Newer protocols allow avoiding Axillary Lymph Node Dissection if less than three lymph nodes are involved. Both over-diagnosis and under-diagnosis can significantly affect the treatment protocols, disease course and well-being of patients. Accurate diagnosis has thus gained increasing significance as treatment protocols evolve.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Axillary Lymph node dissection can cause significant morbidity and disability in women who have been treated for breast cancer. Sentinel Lymph Node biopsy is among the newer surgical techniques used to limit this disability. Newer protocols allow avoiding Axillary Lymph Node Dissection if less than three lymph nodes are involved. Both over-diagnosis and under-diagnosis can significantly affect the treatment protocols, disease course and well-being of patients. Accurate diagnosis has thus gained increasing significance as treatment protocols evolve.

SDP-BR-58 The Diagnostic Performance Of Lymphatic Contrast Enhanced Ultrasound Guided Fine Needle Biopsy In Preoperative Evaluation Of Sentinel Lymph Node In Breast Cancer Patients

Participants
Lifang Jin, MD, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the feasibility and accuracy of lymphatic contrast enhanced ultrasound (LCEUS) guided fine needle biopsy (FNA) in preoperative evaluation of sentinel lymph node in breast cancer patients.*Methods and Materials Seventy-two breast cancer patients were enrolled. One sentinel lymph node (SLN) was locked with LCEUS for each ipsilateral axilla and then punctured and aspirated with FNA. The lymph cells and breast cancer cells were identified by cytological analysis. The identification of lymph cells referred as accurate punctuation, and the identification of breast cancer cells referred as metastasis. The diagnostic accuracy of LCEUS guided FNA was validated by histopathology after the SLN was localized by wire and excised in operation.*Results LCEUS succeeded in 72 patients. Lymph cells were identified in 59/72 patients, and the success rate for lymph node punctuation was 81.9%. For SLN metastasis diagnosis, the sensitivity of LCEUS guided FNA was 81.3%, the specificity was 100%, and the accuracy was 94.9%.*Conclusions LCEUS guided FNA can be an accurate method to evaluate the SLNs in breast cancer patients preoperatively.*Clinical Relevance/Application LCEUS guided FNA can evaluate if the SLNs are metastatic in breast cancer patients

in a way at lowest trauma and relative high accuracy.

RESULTS

LCEUS succeeded in 72 patients. Lymph cells were identified in 59/72 patients, and the success rate for lymph node punctuation was 81.9%. For SLN metastasis diagnosis, the sensitivity of LCEUS guided FNA was 81.3%, the specificity was 100%, and the accuracy was 94.9%.

CLINICAL RELEVANCE/APPLICATION

LCEUS guided FNA can evaluate if the SLNs are metastatic in breast cancer patients in a way at lowest trauma and relative high accuracy.

SDP-BR-59 Screening Mammography During A Pandemic: Clinical Implementation Of Artificial Intelligence Model To Support Risk-based Return To Screening

Participants
Constance Lehman, MD,PhD, Boston, Massachusetts (*Presenter*) Institutional Grant, General Electric Company;Institutional Grant, Hologic, Inc;Co-founder, Clairity, Inc.

PURPOSE

Use of risk models was recommended to invite patients to return to mammography screening during the pandemic, without clear evidence this is an effective strategy for predicting patients with breast cancer in populations due for screening. We compared the accuracy of an artificial intelligence (AI) risk score, derived solely from a patient's prior mammogram, to traditional risk scores to predict patients with cancer in a large cohort due for screening.*Methods and Materials This was a prospective, multisite trial of consecutive patients undergoing screening mammography during early recovery post COVID closures. Breast cancer risk was estimated from a 5-year AI risk score from the prior mammogram and from traditional 5-year breast cancer risk models?[NCI Breast Cancer Risk Assessment Tool (NCI) and Tyrer-Cuzick?version 8/IBIS (TC8)], prior to?return to screening.?Cancer outcomes were linked through a regional tumor registry. Proportions invited to screen and cancers detected using NCI and TC8 risk model strategies, with and without screening women with a personal history of breast cancer, were compared to AI risk model using Pearson's Chi-squared test. Areas under the receiver-operating-characteristic curve (AUCs) were estimated for each risk score and compared with the DeLong test.*Results The study included?4,210 women who returned for screening mammography May 26-July 26, 2020. To identify >90% of cancers, the AI risk model required screening of?59.6% (95% CI: 58.1-61.1) patients,?compared to 74.9% (95% CI: 73.6-76.2) with?NCI and 84.1% (95% CI: 83.0-85.2) with TC8 models (P<0.001). Including patients with a personal history of breast cancer improved both traditional approaches. The 5-year AI model had increased performance (AUC=0.67) compared to both traditional 5-year models (NCI AUC=0.57, TC8 AUC=0.46).*Conclusions In this prospective trial of consecutive women undergoing screening mammography, an AI risk model based on the prior mammogram alone supported screening <60% of the population to identify >90% of breast cancers, compared to traditional models which required screening significantly more women to achieve equivalent cancer detection.*Clinical Relevance/Application An AI-based breast cancer risk model can identify women most likely to harbor breast cancer, supporting more effective screening and mitigating the risk of delayed diagnoses in peri-pandemic times.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

An AI-based breast cancer risk model can identify women most likely to harbor breast cancer, supporting more effective screening and mitigating the risk of delayed diagnoses in peri-pandemic times.

SDP-BR-60 Role Of Shear Wave Elastography Of Axillary Nodes As An Adjunct To Ultrasonography In Predicting Nodal Metastasis In Breast Cancer Patients

Participants
Vishnu Prasad Pulappadi, MD,MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic performance of quantitative shear wave elastography (SWE) of axillary nodes with B-mode ultrasonography (USG) and combination of both in diagnosing nodal metastasis in breast cancer patients with suspicious axillary nodes.*Methods and Materials Between June 2018 and August 2020, after obtaining Ethics Committee approval, a prospective observational study was performed on patients with biopsy proven breast carcinoma and having axillary nodes with cortical thickness greater than 3 mm on USG. SWE followed by core biopsy was performed on the node with maximum cortical thickness. B-mode USG features, including cortical thickness, effacement of fatty hilum and non-hilar blood flow, and SWE parameters of the cortex were compared with biopsy results to ascertain their diagnostic performances.*Results Of the 54 patients evaluated, stable elasticity maps were obtained in 49 nodes of 49 patients (mean age, 46.3 years [95% CI, 42.8-49.8 years]; females, 48/49 [98%]). Biopsy revealed metastasis in 38 nodes and reactive hyperplasia in 11 nodes. Median values of all SWE parameters were significantly higher in metastatic nodes than in reactive nodes- Emax (25.9 kPa vs 12.6 kPa, p=0.001), Emin (21.15 kPa vs 10.5 kPa, p=0.002), Emean (24.75 kPa vs 11.6 kPa, p=0.001) and ESD (1.6 kPa vs 0.9 kPa, p=0.032). Emax had the best diagnostic performance with area under the curve (AUC) of 0.831, sensitivity of 73.7% and specificity of 81.8% at a cut-off of 14.9 kPa. Amongst the B-mode USG features, cortical thickness had the best diagnostic performance at a cut-off of 6.7 mm with AUC of 0.878, sensitivity of 89.5% and specificity of 72.7%. On combining cortical thickness with Emax, specificity improved from 72.7% to 90.9%, although it was not statistically significant (p=0.157). Combination of all B-mode USG features had specificity of 90.9%, which increased to 100% on combining with Emax, although it was not statistically significant (p=0.317).*Conclusions SWE is useful in detecting nodal metastasis in breast cancer patients. Emax has the best diagnostic performance among SWE parameters and early experience suggests that it can improve the specificity of B-mode USG.*Clinical Relevance/Application B-mode USG features of metastatic nodes can overlap with that of reactive nodes and addition of SWE can help in increasing the specificity for diagnosing nodal metastasis in breast cancer patients.

RESULTS

Of the 54 patients evaluated, stable elasticity maps were obtained in 49 nodes of 49 patients (mean age, 46.3 years [95% CI, 42.8-49.8 years]; females, 48/49 [98%]). Biopsy revealed metastasis in 38 nodes and reactive hyperplasia in 11 nodes. Median values of all SWE parameters were significantly higher in metastatic nodes than in reactive nodes- Emax (25.9 kPa vs 12.6 kPa, p=0.001), Emin (21.15 kPa vs 10.5 kPa, p=0.002), Emean (24.75 kPa vs 11.6 kPa, p=0.001) and ESD (1.6 kPa vs 0.9 kPa, p=0.032). Emax had the best diagnostic performance with area under the curve (AUC) of 0.831, sensitivity of 73.7% and specificity of 81.8% at a cut-off of 14.9 kPa. Amongst the B-mode USG features, cortical thickness had the best diagnostic performance at a cut-off of 6.7 mm with AUC of 0.878, sensitivity of 89.5% and specificity of 72.7%. On combining cortical thickness with Emax, specificity improved from 72.7% to 90.9%, although it was not statistically significant (p=0.157). Combination of all B-mode USG features had specificity of 90.9%, which increased to 100% on combining with Emax, although it was not statistically significant (p=0.317).

CLINICAL RELEVANCE/APPLICATION

B-mode USG features of metastatic nodes can overlap with that of reactive nodes and addition of SWE can help in increasing the specificity for diagnosing nodal metastasis in breast cancer patients.

SDP-BR-61 Factors Influencing Trainees' Interest In Breast Imaging

Participants
Wyanne Law, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

To gauge the level of interest in breast imaging and to determine factors potentially impacting trainees' decision to pursue this subspecialty.*Methods and Materials An IRB approved survey study was conducted from November 2020 to February 2021 on Canadian radiology residents and medical students regarding their interests in breast imaging. Training, actual vs. preferred timing of breast rotations, fellowship choices, perceived positive and negative attributes of breast imaging and opinion of how Artificial Intelligence (AI) will impact breast imaging were collected. Chi-square and Fisher's exact tests, and univariate logistic regression were performed to determine the association between trainees' perceptions with interest in pursuing breast or women's imaging fellowships, and with level of training.*Results A total of 157 responses (77 medical students and 80 radiology residents) were collected. The top 3 fellowship subspecialties desired by residents were breast or women's imaging (36%), abdominal imaging (35%), and interventional radiology (25%). A quarter of the medical students (25%) were unsure due to lack of exposure. The most common reason residents found breast imaging appealing was procedures (59%), which was associated with increased odds of being interested in breast/women's fellowships (OR, 3.2, 95% CI,1.2-8.6, p=.021). However, significantly fewer medical students considered procedures as a reason to pursue breast imaging (16%, p<.001). The most common reason that both residents and medical students found breast imaging unappealing was repetitiveness (20%), which was associated with decreased odds of being interested in pursuing a breast/women's fellowships (OR, 0.25, 95% CI, 0.1-0.6, p=.021). Almost half (48%) of the radiology residents had their first breast imaging rotation in their third year. Forty percent of the residents reported that starting breast rotations in first or second year would affect their fellowship choice. AI was deemed by 51% of the respondents to improve breast imaging. Those who were interested in breast/women's imaging were enthusiastic in connecting with a mentor in this field (p<.001).*Conclusions Trainees have variable perceptions and exposures to breast imaging that may influence their interest in breast /women's fellowships.*Clinical Relevance/Application There is a shortage of breast imagers. Our study demonstrated that earlier exposure to breast imaging/procedures, increasing visibility of breast radiologists, and mentorship opportunities are key factors in the choice of breast imaging careers.

RESULTS

A total of 157 responses (77 medical students and 80 radiology residents) were collected. The top 3 fellowship subspecialties desired by residents were breast or women's imaging (36%), abdominal imaging (35%), and interventional radiology (25%). A quarter of the medical students (25%) were unsure due to lack of exposure. The most common reason residents found breast imaging appealing was procedures (59%), which was associated with increased odds of being interested in breast/women's fellowships (OR, 3.2, 95% CI,1.2-8.6, p=.021). However, significantly fewer medical students considered procedures as a reason to pursue breast imaging (16%, p<.001). The most common reason that both residents and medical students found breast imaging unappealing was repetitiveness (20%), which was associated with decreased odds of being interested in pursuing a breast/women's fellowships (OR, 0.25, 95% CI, 0.1-0.6, p=.021). Almost half (48%) of the radiology residents had their first breast imaging rotation in their third year. Forty percent of the residents reported that starting breast rotations in first or second year would affect their fellowship choice. AI was deemed by 51% of the respondents to improve breast imaging. Those who were interested in breast/women's imaging were enthusiastic in connecting with a mentor in this field (p<.001).

CLINICAL RELEVANCE/APPLICATION

There is a shortage of breast imagers. Our study demonstrated that earlier exposure to breast imaging/procedures, increasing visibility of breast radiologists, and mentorship opportunities are key factors in the choice of breast imaging careers.

SDP-BR-62 Axillary Lymphadenopathies Demonstrated By Ultrasound After Sars-cov-2 Vaccination

Participants
Myriam F. Montes, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To assess the incidence of axillary lymphadenopathies after SARS-CoV-2 vaccination by axillary ultrasound.*Methods and Materials Observational prospective cohort study to estimate the incidence of axillar lymphadenopathies after SARS-CoV-2 vaccination in adult volunteers. Ultrasound scan was performed in day 3-7 after immunization. Information about presence, laterality, size, andsonographic characteristics of lymph nodes was collected.*Results Lymphadenopathies were detected in 93/109 (82.6%; 95% confidence interval 77.5% - 90.8%) cases. We did not find significant differences in age, gender, previous history of Covid-19 infection or the presence of axillar pain/palpable node after vaccination. Up to 34.5% of thenodes showed suspicious morphology consisting in focal cortical enlargement and absent hilum.*Conclusions Axillary ultrasound shows enlargement and changes in morphology of the axillary nodes after receiving the mRNA SARS-CoV-2 vaccine in most of the recipients.*Clinical Relevance/Application Radiologists must know the high incidence of lymphadenopathies after SARS-CoV-2 vaccination by imaging to avoid misleading in oncological imaging check-ups and breast cancer screening that led to unnecessary biopsies.

RESULTS

Lymphadenopathies were detected in 93/109 (82.6%; 95% confidence interval 77.5% - 90.8%) cases. We did not find significant

Lymphadenopathies were detected in 93/109 (82.6%; 95% confidence interval 77.5% - 90.8%) cases. We did not find significant differences in age, gender, previous history of Covid-19 infection or the presence of axillar pain/palpable node after vaccination. Up to 34.5% of thenodes showed suspicious morphology consisting in focal cortical enlargement and absent hilum.

CLINICAL RELEVANCE/APPLICATION

Radiologists must know the high incidence of lymphadenopathies after SARS-CoV-2 vaccination by imaging to avoid misleading in oncological imaging check-ups and breast cancer screening that led to unnecessary biopsies.

SDP-BR-63 Deep Learning For Detecting Early-stage Invasive Breast Cancer At Magnetic Resonance Imaging : A Preliminary Study

Participants
Jihe Lim, MD, Hwaseong-si, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop a deep learning model for detecting early-stage invasive breast cancer from multicenter breast MRI data.*Methods and Materials A total of 1860 women (mean age: 53.7 years) with T1 breast cancer were obtained from five medial centers, which included dynamic contrast-enhanced breast MRI prior to surgery between 2012 and 2020. All patients had a newly diagnosed single-site invasive breast cancer measuring 2 cm or less in size on pathology. Enhancing masses on early phase postcontrast T1-weighted images (with 15057 labeled cancer images and 1635 labeled benign images) served as the ground truth. The whole dataset was divided into three sets: training (1346 [72%] women from three centers), internal test (90 [5%] women from three centers), and external test (424 [23%] women from two centers). To develop a deep learning-based automatic detection algorithm for identifying malignant masses, the single phase was performed using a regional-based You Only Look Once (YOLOv2) model. Statistical analysis included the detection sensitivity and average false-positive rate.*Results On the external dataset, the deep learning model achieved a sensitivity of 85.1% (95% confidence intervals [CIs]: 81.4%, 88.4%) and average false-positive rate of 30.0% (95% CI: 25.7%, 34.6%). On the internal dataset, the model achieved a sensitivity of 93.2% (95% CI: 85.6%, 97.6%) and average false-positive rate of 41.1% (95% CI: 30.6%, 52.2%).*Conclusions This MRI-based deep learning model has a potential in the early detection of invasive breast cancer.*Clinical Relevance/Application Deep learning algorithms can be used for the detection of malignant enhancing masses on single early postcontrast T1-weighted imaging. Further study is warranted to compare the performance of deep learning and breast radiologists in the detection of early breast cancer with MRI.

RESULTS

On the external dataset, the deep learning model achieved a sensitivity of 85.1% (95% confidence intervals [CIs]: 81.4%, 88.4%) and average false-positive rate of 30.0% (95% CI: 25.7%, 34.6%). On the internal dataset, the model achieved a sensitivity of 93.2% (95% CI: 85.6%, 97.6%) and average false-positive rate of 41.1% (95% CI: 30.6%, 52.2%).

CLINICAL RELEVANCE/APPLICATION

Deep learning algorithms can be used for the detection of malignant enhancing masses on single early postcontrast T1-weighted imaging. Further study is warranted to compare the performance of deep learning and breast radiologists in the detection of early breast cancer with MRI.

SDP-BR-64 Deep Learning-based Heterogeneous Model Improve Diagnostic Performance Of Ultrasound For Axillary Metastasis Of Early Breast Cancer

Participants
Jingwen Zhou, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Pre-treatment evaluation of axillary lymph node (ALN) metastasis is critical for treatment planification of early-stage breast cancer. To improve the diagnostic performance of traditional ultrasound, we develop a deep learning-based heterogeneous model (DLHM) to reveal the medical characteristics from ultrasonic images and assist pre-treatment evaluation of ALN.*Methods and Materials A total of 214 eligible patients were prospectively recruited. 220 breast lesions were identified and the ipsilateral axillae underwent ultrasound elastography (UE) evaluation. Image data of the UE including B-mode ultrasonography and shear wave elastography (SWE) and related clinic-pathological characteristics of the 220 target ALNs, that defined as the most suspicious node according the radiologist criteria from the corresponding ipsilateral axilla, were collected and divided randomly at a ratio of 7:4 for training and testing cohort. UE based on radiological criteria that combined B-mode morphological characteristics and elastic values, and DLHM that combined radiomics features, B-mode deep features, and SWE deep features were established to predict metastatic and non-metastatic axilla. Performance was compared between UE and DLHM in terms of areas under the receiver operating characteristics curve (AUC), sensitivity, specificity, accuracy, negative predictive value, and positive predictive value for predicting ALN metastasis in both training and testing cohorts.*Results The DLHM achieved excellent performance for both the training cohort and testing cohort in predicting ALN metastasis. In the testing cohort, the DLHM demonstrated significantly improved performance in identifying metastatic ALNs compared to UE (AUC: 0.911 [95% confidence interval (CI): 0.826, 0.963] vs. 0.707 [95% CI: 0.595, 0.804]; P<0.001).*Conclusions The DLHM demonstrated promising ability as an effective, accurate, and non-invasive pre-treatment method for assisting the diagnosis of ALN metastasis in patients with early breast cancer.*Clinical Relevance/Application The DLHM presented a non-invasive method to identify the involved axilla and could serve as a pre-treatment routine practice for patients with early stage breast cancer. Moreover, different from UE based on the subjective diagnoses of radiologists, DLHM automatically extracts relevant features from B-mode and SWE images for diagnosis and avoid the inter-, or intro-observers inconsistencies. With a trend of reduced axillary surgery in the modern management of breast cancer, it is increasingly important to accurately identify metastatic burden. DLHM provided the basis for accurate axillary ultrasound staging with artificial intelligence for patients with early breast cancer.

RESULTS

The DLHM achieved excellent performance for both the training cohort and testing cohort in predicting ALN metastasis. In the testing cohort, the DLHM demonstrated significantly improved performance in identifying metastatic ALNs compared to UE (AUC: 0.911 [95% confidence interval (CI): 0.826, 0.963] vs. 0.707 [95% CI: 0.595, 0.804]; P<0.001).

CLINICAL RELEVANCE/APPLICATION

The DLHM presented a non-invasive method to identify the involved axilla and could serve as a pre-treatment routine practice for

patients with early stage breast cancer. Moreover, different from UE based on the subjective diagnoses of radiologists, DLHM automatically extracts relevant features from B-mode and SWE images for diagnosis and avoid the inter-, or intro-observers inconsistencies. With a trend of reduced axillary surgery in the modern management of breast cancer, it is increasingly important to accurately identify metastatic burden. DLHM provided the basis for accurate axillary ultrasound staging with artificial intelligence for patients with early breast cancer.

SDP-BR-65 Comparison Of Two Contrast-enhanced Spectral Mammography (cesm) Systems Regarding Background Enhancement And Its Possible Impact On Diagnostic Accuracy

Participants
Daniel Wessling, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the impact of the digital mammography imaging system on the overall background enhancement on recombined contrast-enhanced spectral mammography (CESM) images, the overall background enhancement of two different mammography systems was compared.*Methods and Materials We evaluated CESM images of female patients who underwent CESM in the between 2016 and 2019 with regard to the background enhancement. For this purpose, we compared the images of the mammography system Senographe EssentialTM, GE Healthcare, Chicago, IL, USA (machine A) and those of the Selenia ® Dimensions ® system, Hologic, Marlborough, MA, USA (machine B). Background enhancement was assessed qualitatively by using a Likert-scale from 1 (minimal overall background enhancement) to 4 (marked overall enhancement) and quantitatively by placing a region of interest (ROI) and measuring the pixel density. The background parenchymal enhancement as well as the overall image background enhancement were considered in the evaluation, excluding known artefacts and suspicious findings.*Results The quantitative image analysis revealed differences in background enhancement measurements, both for the first (1.72 vs 2.29) and the second reader (1.74 vs 2.35), which proved to be statistically significant (p<0.001). No relevant differences between the first and the second reader could be observed (p=0.8852). In concordance with the quantitative analysis, the qualitative evaluation also shows statistically significant differences in background enhancement (p<0.001) with an average difference of 75.69 pixels (99%-CI [74.37, 77.02]).*Conclusions Mammography machines seem to have a significant impact on the overall background enhancement qualitatively and quantitatively, thus having a possible impact on the diagnostic accuracy.*Clinical Relevance/Application Similar to MRI, in CESM there is a certain background enhancement of the benign breast parenchyma, even if the date of examination is timed to the menstrual cycle. In both imaging modalities, CESM and breast MRI, a high level of background enhancement can influence the radiological qualitative analysis and interpretation and thereby the diagnostic accuracy. Therefore, it is essential to identify possible influencing factors on the background enhancement.

RESULTS

The quantitative image analysis revealed differences in background enhancement measurements, both for the first (1.72 vs 2.29) and the second reader (1.74 vs 2.35), which proved to be statistically significant (p<0.001). No relevant differences between the first and the second reader could be observed (p=0.8852). In concordance with the quantitative analysis, the qualitative evaluation also shows statistically significant differences in background enhancement (p<0.001) with an average difference of 75.69 pixels (99%-CI [74.37, 77.02]).

CLINICAL RELEVANCE/APPLICATION

Similar to MRI, in CESM there is a certain background enhancement of the benign breast parenchyma, even if the date of examination is timed to the menstrual cycle. In both imaging modalities, CESM and breast MRI, a high level of background enhancement can influence the radiological qualitative analysis and interpretation and thereby the diagnostic accuracy. Therefore, it is essential to identify possible influencing factors on the background enhancement.

SDP-BR-66 Quantitative T2 Mapping Combined With The ADC Metric From Diffusion Weighted Imaging Improves Lesion Characterization In Breast MRI

Participants
Isabella Bolengo, MD, Rozzano, Italy (*Presenter*) Nothing to Disclose

PURPOSE

We explored the hypothesis that quantitative analysis of T2 relaxation time could be a useful addition to diffusion weighted imaging (DWI) with the calculation of an apparent diffusion coefficient (ADC) in characterizing enhancing lesions in breast MRI*Methods and Materials This IRB-approved retrospective single-centre study included all patients presenting with contrast-enhancing lesions on consecutive breast MRI examinations performed due to BIRADS 0, 4 or 5 findings at our Institution between February 2018 and December 2019. Histological verification was defined as the reference standard and patients undergoing neoadjuvant chemotherapy were excluded. Examinations were performed at 3T in line with international recommendations and included a DWI and a T2 mapping sequence with five different echo times. For malignant lesions, ki67 count was recorded. MRI evaluation of T2 relaxation time and ADC values for each breast lesion was performed by a fellow in breast imaging. Two other readers (an experienced breast radiologist and a second breast imaging fellow) independently repeated the measurements. Statistical analysis included the calculation of Spearman correlation coefficients and ROC-analysis. Multivariable combination of T2 and ADC values was done using 10-fold cross-validated classification and regression trees (CRT).*Results The study included 85 female patients, mean age 53.3 ±15.3, range 18-88 years, presenting with 88 enhancing breast lesions (35 benign and 53 malignant). T2 measurements showed a significant correlation between readers (0.55 and 0.74, P<0.001 respectively); ADC values also correlated significantly (0.43-0.71, P<0.001, respectively). A significant positive correlation was found between ki67 and T2 (P< 0.03) but not between ki67 and ADC values (P>0.05). CRT revealed significant contributions of both T2 and ADC to the model (P<=0.002). The area under the ROC curve was 0.770 for T2, 0.861 for ADC and 0.900 for the combined CRT model. The latter provided operating points both ruling-out and ruling-in malignancy.*Conclusions Combining quantitative T2 measurements with ADC provides additional value in the characterization of breast lesions as a part of a mp (multiparametric) MRI study. Besides improved diagnosis of malignant lesions, there is a significant correlation between T2 relaxation time and ki67 as a surrogate marker of cancer aggressiveness.*Clinical Relevance/Application The addition of the quantitative analysis of T2 relaxation time to ADC can improve characterization of enhancing lesions as a part of a mpMRI study. T2 relaxation time has also shown to correlate significantly with Ki67, providing important information about breast cancer aggressiveness.

RESULTS

The study included 85 female patients, mean age 53.3 ±15.3, range 18-88 years, presenting with 88 enhancing breast lesions (35 benign and 53 malignant). T2 measurements showed a significant correlation between readers (0.55 and 0.74, P<0.001

respectively); ADC values also correlated significantly (0.43-0.71, P<0.001, respectively). A significant positive correlation was found between ki67 and T2 (P< 0.03) but not between ki67 and ADC values (P>0.05). CRT revealed significant contributions of both T2 and ADC to the model (P<=0.002). The area under the ROC curve was 0.770 for T2, 0.861 for ADC and 0.900 for the combined CRT model. The latter provided operating points both ruling-out and ruling-in malignancy.

CLINICAL RELEVANCE/APPLICATION

The addition of the quantitative analysis of T2 relaxation time to ADC can improve characterization of enhancing lesions as a part of a mpMRI study. T2 relaxation time has also shown to correlate significantly with Ki67, providing important information about breast cancer aggressiveness.

SDP-BR-67 Discharging Nipple: Does It Really Matter ?

Participants
Hannah L. Chung, MD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To assess the role of imaging in patients presenting with nipple discharge.*Methods and Materials This was a retrospective, single-institution, IRB approved study of patients who underwent breast imaging evaluation for symptom of nipple discharge between November 2015 to October 2018. A total of 356 patients were identified from the EHR. After excluding 89 patients with < 1 year imaging or clinical follow up, 267 patients with biopsy results and/or follow up constituted the study cohort.*Results Of the 267 cases, discharge was unilateral in 220 and bilateral in 47. Color was bloody in 103, clear in 95, all other in 61, and not specified in 8. The following incidences were observed: cancers (38/267,14.2%), atypical histologies (14/267, 5.3%), papilloma without atypia (58/267,21.7%), nonspecific benign (42/267, 15.7%) and benign on imaging or clinical follow up (115 (43.1%). Among the 38 cancers (13 DCIS and 25 invasive), the median age was 52 with range 26-80. Discharge was unilateral in 35 (92.1%), spontaneous in 32 (84.2%), bloody in 27 (71.0%), clear in 8 (21.1%), associated with a palpable lump in 12 (31.6%). Cancer diagnosis was obtained by image guided needle biopsy in 35; skin punch biopsy in 1; surgical excisional biopsy in 2. Eight cancers (21.1%) were upstaged at surgery from an atypical high risk lesion at needle biopsy.*Conclusions Imaging evaluation of all nipple discharge yielded a malignant diagnosis in 14.2% and atypias in 5.3%. The upgrade rate of atypias in the setting of nipple discharge was 21.1%, so surgical excision should be performed.*Clinical Relevance/Application Nipple discharge is a common breast complaint. One in 5 nipple discharge cases are pathologic (due to malignancy or atypia) and do not always present with unilateral, spontaneous, bloody or clear discharge or with an associated palpable lump.

RESULTS

Of the 267 cases, discharge was unilateral in 220 and bilateral in 47. Color was bloody in 103, clear in 95, all other in 61, and not specified in 8. The following incidences were observed: cancers (38/267,14.2%), atypical histologies (14/267, 5.3%), papilloma without atypia (58/267,21.7%), nonspecific benign (42/267, 15.7%) and benign on imaging or clinical follow up (115 (43.1%). Among the 38 cancers (13 DCIS and 25 invasive), the median age was 52 with range 26-80. Discharge was unilateral in 35 (92.1%), spontaneous in 32 (84.2%), bloody in 27 (71.0%), clear in 8 (21.1%), associated with a palpable lump in 12 (31.6%). Cancer diagnosis was obtained by image guided needle biopsy in 35; skin punch biopsy in 1; surgical excisional biopsy in 2. Eight cancers (21.1%) were upstaged at surgery from an atypical high risk lesion at needle biopsy.

CLINICAL RELEVANCE/APPLICATION

Nipple discharge is a common breast complaint. One in 5 nipple discharge cases are pathologic (due to malignancy or atypia) and do not always present with unilateral, spontaneous, bloody or clear discharge or with an associated palpable lump.

SDP-BR-68 Prospectively Evaluating The Cost Of Modalities For Breast Cancer Screening And Diagnosis Using Time-driven Activity-based Costing Method

Participants
Aamir Ali, MBBS, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To calculate and compare the cost of performing breast imaging or procedures with different modalities using the time-driven activity-based costing (TDABC) method.*Methods and Materials This IRB-approved, prospective study was performed in 80 female patients who presented for breast imaging or breast procedures at a single institution from July 2020 to April 2021. Data were collected for 5 patients for each screening and diagnostic modality and procedure which included 2D and 3D mammography, breast ultrasound (US), breast MRI and contrast-enhanced mammography (CEM), and stereotactic, US-guided, and MRI-guided biopsy. For diagnostic 3D mammography, data for an additional 15 patients were collected to subdivide this exam into unilateral vs bilateral 3D mammography and 3D mammography followed by US exam and without US exam. TDABC process maps recorded all steps involved in patient care from check-in to check-out time. Capacity cost rates (cost per minute) for all personnel staff and fixed equipment were calculated. Capacity cost rates were multiplied with time utilized by a resource in minutes to calculate the cost of a resource. TDABC cost of exam was the sum of the cost of personnel staff, fixed equipment and consumables. The cost of image interpretation was not included in this study.*Results The cost of screening breast MRI was $249, whereas the cost of screening CEM, breast US, 3D and 2D mammography were 48% ($120), 33% ($83), 11% ($28) and 12% ($30) of the cost of the MRI exam. Personnel staff cost was the major contributor (60-88%) of the total cost of exam for all screening modalities except MRI exam in which 62% of the total cost was attributed to the fixed equipment cost. Only 3-14%, of the total exam cost was attributed to consumables in all screening modalities. For diagnostic breast exams, the cost of MRI was $241. The cost of diagnostic CEM, US and 2D mammography were 51% ($123), 29% ($71) and 18% ($43) of the cost of the MRI exam. The total cost of unilateral and bilateral 3D mammography exams followed by additional US exam were $99 and $125, respectively. For biopsy procedures, the cost of US guided biopsy was $356 which was 43% ($827) of stereotactic biopsy and 22% ($1,611) of MRI guided biopsy. Consumables contributed 40-50% and personnel staff contributed 31-56% to the total cost of biopsy procedures.*Conclusions TDABC provides a granular assessment of the true cost of performing breast imaging procedures. Personnel costs accounted for the majority of the total cost of screening, diagnostic, and biopsy procedures.*Clinical Relevance/Application Prospectively assessed TDABC provides a granular and accurate assessment of breast imaging costs, which can be used to improve efficiency in value-based alternative payment models.

RESULTS

The cost of screening breast MRI was $249, whereas the cost of screening CEM, breast US, 3D and 2D mammography were 48% ($120), 33% ($83), 11% ($28) and 12% ($30) of the cost of the MRI exam. Personnel staff cost was the major contributor (60-

88%) of the total cost of exam for all screening modalities except MRI exam in which 62% of the total cost was attributed to the fixed equipment cost. Only 3-14%, of the total exam cost was attributed to consumables in all screening modalities. For diagnostic breast exams, the cost of MRI was $241. The cost of diagnostic CEM, US and 2D mammography were 51% ($123), 29% ($71) and 18% ($43) of the cost of the MRI exam. The total cost of unilateral and bilateral 3D mammography exams followed by additional US exam were $99 and $125, respectively. For biopsy procedures, the cost of US guided biopsy was $356 which was 43% ($827) of stereotactic biopsy and 22% ($1,611) of MRI guided biopsy. Consumables contributed 40-50% and personnel staff contributed 31-56% to the total cost of biopsy procedures.

CLINICAL RELEVANCE/APPLICATION

Prospectively assessed TDABC provides a granular and accurate assessment of breast imaging costs, which can be used to improve efficiency in value-based alternative payment models.

SDP-BR-69   Performance In Consecutive Mammography Screenings Following Digital Breast Tomosynthesis Screening: Results From A Large, Prospective Trial

Participants
Sophia Zackrisson, Malmo, Sweden (*Presenter*) Speaker, Siemens AG;Consultant, Collective Minds Radiology AB

PURPOSE

To evaluate if the new screening modality, digital breast tomosynthesis (DBT), contributes to early detection of breast cancer by assessing recall rates (RR), cancer detection rates (CDR), and fraction of invasive cancers in consecutive routine digital mammography (DM).*Methods and Materials A paired, prospective trial, *****, including 14848 women between 2010 and 2015 where both DBT and DM were performed at one screening occasion showed increased CDR compared to routine DM. In this study, we followed the women included in the trial through their first (DM1, n=12876) and second (DM2, n=10880) consecutive DM screenings. In line with the national screening program DM1 took place 18-24 and DM2 36-48 months after the trial screening. Cancer diagnoses were identified through record linkages. Screening RRs and CDRs were calculated with 95% confidence intervals (CI).*Results The RRs in the trial were 2.5/100 women (CI(95%) 2.2-2.8) for DM and 3.6/100 (CI(95%) 3.3-3.9) for DBT. In both DM1 and DM2 the RR was 2.1 (CI(95%) 1.8-2.3). Compared to CDRs in the trial, 6.5/1000 (CI(95%)5.2-7.9) for DM and 8.7/1000 women (CI(95%)7.3-10.3) for DBT,CDR was lower in DM1 (4.6/1000 women, CI(95%)3.6-5.9), and in DM2 (5.5/1000, CI(95%)4.2-7.1). In the trial 139 tumors were detected, 85% of which were invasive, corresponding numbers for DM1 were 59 and 66%, and for DM2 60 and 83%.*Conclusions Following the trial, numbers of CDR and fraction of invasive cancers were lower at DM1 and then increasing at DM2, indicating that relevant invasive cancers were detected with DBT in the trial. Recall rates remained quite stable over time for DM. More rigorous statistical analyses will be performed and data on tumor characteristics will be provided.*Clinical Relevance/Application Analysis of how DBT screening affects consecutive screening performance is important in order to evaluate future value of DBT.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Analysis of how DBT screening affects consecutive screening performance is important in order to evaluate future value of DBT.

SDP-BR-7   Development And Validation Of Nomogram For Prediction Of Pathologic Response After Neoadjuvant Chemotherapy In Triple-negative Breast Cancer Using Pretreatment Dynamic Contrast-enhanced MRI

Participants
Yanbo Li, Tianjin, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop a nomogram based on pretreatment dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) to predict pathologic complete response (pCR) to neoadjuvant chemotherapy (NAC) in patients with triple-negative breast cancer (TNBC).*Methods and Materials A total of 108 female patients with TNBC who underwent completed neoadjuvant chemotherapy followed by surgery between January 2017 and October 2020 were enrolled. The patients were divided into the primary cohort (n=87) and the validation cohort (n=21). The pretreatment DCE-MRI and clinicopathological features were reviewed and recorded. Univariate analysis and multivariate logistic regression analyses were used to determine the independent predictors of pCR in primary cohort. A nomogram was developed based on the predictors, and its predictive performance was evaluated by the area under the curve (AUC) of receiver operating characteristics (ROC). The validation cohort was used to test the predictive model.*Results Tumor volume measured on DCE-MRI, time to peak (TTP), and androgen receptor (AR) status was identified as an independent predictor of pCR. The AUC of the nomogram was 0.84 (95% CI: 0.75-0.93) and 0.79 (95% CI: 0.59-0.99) in the primary cohort and validation cohort, respectively.*Conclusions Pretreatment DCE-MRI could predict pCR to NAC in TNBC. The nomogram can be used to predict the probability of pCR and might apply for individualized treatment approach-making.*Clinical Relevance/Application To apply for individualized treatment approach-making in patients with triple-negative breast cancer.

RESULTS

Tumor volume measured on DCE-MRI, time to peak (TTP), and androgen receptor (AR) status was identified as an independent predictor of pCR. The AUC of the nomogram was 0.84 (95% CI: 0.75-0.93) and 0.79 (95% CI: 0.59-0.99) in the primary cohort and validation cohort, respectively.

CLINICAL RELEVANCE/APPLICATION

To apply for individualized treatment approach-making in patients with triple-negative breast cancer.

SDP-BR-8   Outcomes Of Using Artificial Intelligence-based Computer-assisted Detection For Mammography: A Retrospective Simulation Study With A Screening Cohort

Participants
Jung Hyun Yoon, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Little has been reported on applying artificial intelligence-based computer-assisted detection/diagnosis (AI-CAD) in real-world screening mammograms. In this study we retrospectively evaluated the outcomes and analyze the abnormality features detected by AI-CAD when applied to real-world screening mammograms.*Methods and Materials From January 2016 to December 2017, 5479 screening mammograms of 4362 women were collected from a single screening facility. Mammograms were interpreted individually by three radiologists, according to the American College of Radiology Breast Imaging Reporting And Data System lexicon (ACR BI-RADS). A commercially-available AI-CAD for mammography was used for mammography analysis. Mammography features at the AI-CAD marks were reviewed. Ground truth in terms of cancer, benign diagnosis or absence of abnormality was confirmed according to histopathologic diagnosis via biopsy/surgery or at least 1 year of follow-up.*Results Of the 5479 mammograms, 34 (0.6%) were cancers, 175 (3.2%) benign lesions, and 5270 (96.2%) were negative. Among the 34 cancers, 23 (67.6%) were detected as abnormal findings by the interpreting radiologists. Six (17.6%, 6 of 34) of the 11 cancers initially overlooked by the radiologists had abnormality scores =10% with abnormal findings at the AI-CAD marks on retrospective review. Asymmetry (255 of 570, 44.7%) was the most common finding on the AI-CAD marks. Approximately 75.4% (430 of 570) of false-positive AI-CAD findings were interpreted as benign on retrospective review.*Conclusions AI-CAD detected 17.6% additional cancers that were initially overlooked by the radiologists in a screening population. Asymmetry was the most common false-positive AI-CAD finding, of which 75.4% were confidently interpreted as benign at the retrospective review.*Clinical Relevance/Application AI-CAD detected 17.6% additional cancers that were initially overlooked by the radiologists in a screening population. Asymmetry was the most common false-positive AI-CAD finding, of which 75.4% were confidently interpreted as benign at the retrospective review.

RESULTS

Of the 5479 mammograms, 34 (0.6%) were cancers, 175 (3.2%) benign lesions, and 5270 (96.2%) were negative. Among the 34 cancers, 23 (67.6%) were detected as abnormal findings by the interpreting radiologists. Six (17.6%, 6 of 34) of the 11 cancers initially overlooked by the radiologists had abnormality scores =10% with abnormal findings at the AI-CAD marks on retrospective review. Asymmetry (255 of 570, 44.7%) was the most common finding on the AI-CAD marks. Approximately 75.4% (430 of 570) of false-positive AI-CAD findings were interpreted as benign on retrospective review.

CLINICAL RELEVANCE/APPLICATION

AI-CAD detected 17.6% additional cancers that were initially overlooked by the radiologists in a screening population. Asymmetry was the most common false-positive AI-CAD finding, of which 75.4% were confidently interpreted as benign at the retrospective review.

SDP-BR-9   Can Artificial Intelligence Replace Ultrasound As A Complementary Tool To Mammogram For The Detection And The Diagnosis Of The Breast Cancer?

Participants
Sahar Mansour, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

PURPOSE

to study the impact of artificial intelligence (AI) on the performance of mammogram with regards the discrimination not just the detection of breast cancer in correlation mammograms aided with ultrasound.*Methods and Materials Ethics committee approval was obtained in this prospective analysis. The study included 2000 mammograms. The mammograms were interpreted by the radiologists, breast ultrasound was performed for all cases and the Breast Imaging Reporting and Data System (BI-RADS) score was applied accordingly. Each breast side was individually assessed with the aid of AI scanning in the form of targeted heat-map and a probability of malignancy (abnormality scoring percentage) was obtained. Operative data were the gold standard.*Results Normal assigned cases (BI-RADS 1) with no lesions were excluded from the statistical evaluation. The study included 538 benign and 642 malignant category breasts (n=1180, 59%). ACR BI-RADS categories for the breast lesions as regards the combined evaluation of the digital mammogram and ultrasound were assigned BI-RADS 2 (Benign) in 385 lesions with AI median value of the abnormality scoring percentage of 10, (n=385/1180, 32.6%), and BI-RADS 5 (malignant) in 471, that had showed median percentage AI value of 88 (n=471/1180, 39.9%). AI abnormality scoring of 59% yielded a sensitivity of 96.8% and specificity of 90.1% in the discrimination of the breast lesions detected on the included mammograms.*Conclusions Artificial intelligence (AI) could be considered as an optional reliable complementary tool to the digital mammogram for the evaluation of the breast lesions. The color hue and the abnormality scoring percentage presented a credible method for the detection and discrimination of breast cancer comparable to the breast ultrasound. So consequently, AI- mammogram combination could be used as a one setting method to discriminate between cases that require further imaging or biopsy from those that need only time interval follow up.*Clinical Relevance/Application Recently, the indulgence of AI in the work up for the detection of breast cancer and the probability that it could help the diagnosis, the choice of the treatment, the patient's outcome, and the workflow areas in the field of radiology became seriously considered. In the current work, the performance of the artificial intelligence was studied with regard the diagnosis not just the detection of breast cancer in lesions detected on mammography.

RESULTS

Normal assigned cases (BI-RADS 1) with no lesions were excluded from the statistical evaluation. The study included 538 benign and 642 malignant category breasts (n=1180, 59%). ACR BI-RADS categories for the breast lesions as regards the combined evaluation of the digital mammogram and ultrasound were assigned BI-RADS 2 (Benign) in 385 lesions with AI median value of the abnormality scoring percentage of 10, (n=385/1180, 32.6%), and BI-RADS 5 (malignant) in 471, that had showed median percentage AI value of 88 (n=471/1180, 39.9%). AI abnormality scoring of 59% yielded a sensitivity of 96.8% and specificity of 90.1% in the discrimination of the breast lesions detected on the included mammograms.

CLINICAL RELEVANCE/APPLICATION

Recently, the indulgence of AI in the work up for the detection of breast cancer and the probability that it could help the diagnosis, the choice of the treatment, the patient's outcome, and the workflow areas in the field of radiology became seriously considered. In the current work, the performance of the artificial intelligence was studied with regard the diagnosis not just the detection of breast cancer in lesions detected on mammography.

CH01-A

Chest Sunday Poster Discussions

Sub-Events

CH01-A5   **Leveraging Serial CT Scans In Deep-feature Reinforcement Learning Model For Improvement Of Early Diagnosis Of Lung Cancer**

Participants
Yifan Wang, ANN ARBOR, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

To develop a deep reinforcement learning (D-RL) model with serial CT scans to improve early diagnosis of lung cancer at the baseline CT scan.*Methods and Materials We formulated the classification of malignant and benign lung nodules as a Markov decision process, and used the RL method to learn stochastic policies that make a sequence of decisions according to serial screening exams by mapping the state (the features characterized nodule patterns) to the nodule's risk of malignancy (decision). Our customary mapping was designed based on a value function that represents the expected cumulative reward associated with the lung cancer risk. The functional values were increased when the nodules were diagnosed as malignant and vice versa, or no change when follow-ups were required in the next annual exam. With access permission from the National Lung Screening Trial (NLST) project, a data set of 653 cases was randomly selected as the training set. Of the 653 cases, 260 were diagnosed with lung cancer and 393 were negative. The subjects had 1 to 3 years of CT exams from baseline to diagnosis or stayed negative in the 3-year study period, resulting in a total of 1345 CT scans. We trained a VGG deep learning network as an encoder to extract 64 features to characterize the patterns for each nodule in each CT scan. As lung cancer biologically progresses over time, the RL method served as the decoder to map the evolving patterns for malignant or benign nodules in the serial scans. We finally trained the new D-RL model using 1,345 CT scans from all available years, and another D-RL model using only 653 scans from the baseline year for comparison. The models were deployed to 300 first-year baseline CT scans in an independent test set containing 150 malignant and 150 benign cases. The area under the receiver operating characteristic (ROC) curve (AUC) was used for performance evaluation.*Results Our D-RL model trained with serial scans achieved a test AUC of 0.856 ± 0.025 while the D-RL model trained with only baseline scan achieved a test AUC of 0.825 ± 0.021.*Conclusions The D-RL model trained with 3-year serial CT screening scans could achieve higher accuracy in diagnosing lung cancer 1 or 2 years earlier in baseline CT exams.*Clinical Relevance/Application Accurate early diagnosis is crucial for lung cancer screening program. The serial-exam-trained reinforcement learning model has the potential to improve early diagnosis, allowing better treatment options.

RESULTS

Our D-RL model trained with serial scans achieved a test AUC of 0.856 ± 0.025 while the D-RL model trained with only baseline scan achieved a test AUC of 0.825 ± 0.021.

CLINICAL RELEVANCE/APPLICATION

Accurate early diagnosis is crucial for lung cancer screening program. The serial-exam-trained reinforcement learning model has the potential to improve early diagnosis, allowing better treatment options.

CH01-A6   **Automated Segmentation Of Pleural Effusion Subtypes In Computed Tomography Using Deep Learning**

Participants
Raphael Sexauer, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

Pleural effusion is a common finding in cross-sectional imaging, but is currently reported in a qualitative, non-standardized way. Quantification is feasible but usually not performed in clinical routine, since manual segmentation is time-consuming. Therefore, the aims of this study were to develop an algorithm on CT scans to 1) detect 2) segment and 3) quantify pleural effusions.*Methods and Materials All written radiological reports from 01/2016 to 01/2021 with pleural effusions were queried for the following terms: "blood", "loculation", "pleural enhancement or pleural thickening", "pleural plaques, calcification or nodularity", "gas bubbles or pneumothorax", "chest tube" and "subdiaphragmatic fluid". Studies including none of these terms were rated as "no finding", studies with one term as "one finding", two or more terms as "findings". Assuming a normal distribution (n = 2659), we randomly selected 6% of the data for the semi-manual segmentation of the pleural space (n = 160; no finding = 106; one finding = 27; findings = 27). We also added 160 patients without pleural effusion as a negative cohort. Deep convolutional neural network algorithms were trained and cross-validated using semi-automatically (lung) and manually (effusion) generated segmentations (n = 224; 70%) and tested on a separate test subset (n = 96; 30%). To measure performance we used sensitivity, specificity and ROC curves for detection and Dice coefficient, Jaccard and volume analysis for the segmentation task.*Results The sensitivity and specificity to detect effusion was 99% and 98% (n=96, AUC: 99,6, test data). The algorithm showed a robust segmentation (Dice coefficient median: 88.9, mean: 83.8, CI 80.1-87.5), irrespective of volume, pleural complexity or contrast phase.*Conclusions Using a heterogeneous data set, a robust model was developed that detects pleural effusions, quantifies effusion volume and classifies subtypes. This implementation will improve clinical workflows by adding automated quantification.*Clinical Relevance/Application The model can be used in the clinical routine for the detection and quantification of pleural effusions (ml).

RESULTS

The sensitivity and specificity to detect effusion was 99% and 98% (n=96, AUC: 99,6, test data). The algorithm showed a robust segmentation (Dice coefficient median: 88.9, mean: 83.8, CI 80.1-87.5), irrespective of volume, pleural complexity or contrast phase.

CLINICAL RELEVANCE/APPLICATION

The model can be used in the clinical routine for the detection and quantification of pleural effusions (ml).

CH01-A7   Idiopathic Pulmonary Fibrosis: A Radiology Resident's Guide

Participants
Nidhi Reddy, MD, Wauwatosa, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

Identify high-resolution CT (HRCT) findings commonly seen in Interstitial Lung Disease (ILD), with specific attention to Usual Interstitial Pneumonia (UIP) and Idiopathic Pulmonary Fibrosis (IPF) using an image-rich approach from our institution's database Review the American Thoracic Society clinical practice guidelines for the Diagnosis of IPF published in 2018, with emphasis on the radiologist's role in diagnostic evaluation of patients with suspected ILD/IPF Troubleshoot probable or indeterminate UIP cases and guide clinicians in next steps of work-up Narrowing the differential when an alternative diagnosis is suggested based on HRCT findings and their distribution

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Introduction and epidemiology Clinical presentation and diagnostic criteria for IPF • Physical exam findings • Pulmonary function tests • Serology Diagnosis of IPF: ATS Guidelines 2018 • HRCT parameters/protocol • Findings and distribution in definite, probable, indeterminate, and alternative UIP patterns • Case review Histopathologic Diagnosis • Surgical biopsy • Endobronchial tissue sampling/bronchoalveolar lavage Clinical management • Acute IPF exacerbation • Antifibrotics Mimics of UIP/IPF • Non-specific interstitial pneumonia • Chronic hypersensitivity pneumonitis • Connective-tissue related interstitial lung disease

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Abstract Archives of the RSNA, 2021

Sub-Events

NPM03-C1   Racial Inequities In The Use Of Diagnostic Imaging: A Systematic Review

Participants
Rebecca Colwell, La Crosse, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

Diagnostic imaging plays a fundamental role in modern medical practice. Disparities in access to imaging based on patient race and ethnicity have been documented in multiple studies across a wide range of clinical practice settings and may play a role in other racial inequities in the health care system. The aim of this study was to summarize the existing literature on race-based inequities in diagnostic imaging and highlight priority areas for further research.*Methods and Materials Using key words focused on diagnostic imaging, race/ethnicity, and health disparities, we performed a systematic review of the literature in Medline, Cochrane, Web of Science, and Scopus for the years 2000 to the present. Citations were reviewed for relevance by title and abstract and then full text review. Papers were included if they compared rates of diagnostic imaging use by patient race and ethnicity. The included articles underwent data extraction including title, country of origin, publication year, number of participants, participant demographics, data source, clinical care setting, article conclusion, and whether health outcomes or strategies to promote health equity were evaluated.*Results The search strategy returned 2908 non-duplicate papers of which 2510 were removed by title/abstract review and 224 by full text review leaving 174 meeting inclusion criteria. 86% of studies (n=149) were conducted in the United States and over half (52%, n=91) used nationally representative data from government administered surveys or insurance claims. The majority (57%, n=99) were focused on breast cancer screening followed by general diagnostic imaging (10%, n=17), neurologic imaging (7%, n=12), cancer care (6%, n=10), and a variety of other less represented topics. 70% (n=121) of studies found disparities in imaging use in some or all of the minority groups evaluated. 10% (n=17) of studies reported health outcomes and 8% (n=14) evaluated strategies to mitigate race-based imaging disparities.*Conclusions Disparities based on patient race and ethnicity exist in multiple care settings within diagnostic radiology. Many of the existing studies are clustered on a narrow range of topics, and only a small minority of studies evaluated patient health outcomes or tested strategies to mitigate disparities suggesting that these may be avenues for future research.*Clinical Relevance/Application Although there is substantial existing literature on racial disparities in diagnostic radiology, much remains unknown. Radiologists are well-equipped to better evaluate disparities across a variety of care settings, connect inequities in imaging to patient health outcomes, and identify and evaluate strategies to promote equity in radiologic care.

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CLINICAL RELEVANCE/APPLICATION

Although there is substantial existing literature on racial disparities in diagnostic radiology, much remains unknown. Radiologists are well-equipped to better evaluate disparities across a variety of care settings, connect inequities in imaging to patient health outcomes, and identify and evaluate strategies to promote equity in radiologic care.

NPM03-C2   Understanding How Patients Define Value With Respect To Imaging Center Attributes And Radiologist Interaction

Participants
Kayla Berigan, MD, Burlington, Vermont (*Presenter*) Nothing to Disclose

PURPOSE

In the value-based care era, providers are accountable for patient experience, and radiology societies encourage radiologists to be more patient-facing. Gaps remain, however, in understanding the attributes of imaging services that matter to patients and the type of interaction they desire with radiologists. This study assessed patient prioritization of some of these attributes using a discrete choice experiment (DCE).*Methods and Materials A representative sample of US adults was asked to consider a hypothetical urgent x-ray encounter. Participants indicated their preferences for a set of hypothetical imaging locations with different combinations of attributes. Attributes included image-interpreting doctor specialty, PCP recommendation, wait time to results, out of pocket cost, travel time, wait time to appointment, staff sensitivity, Medicare star rating, and online scheduling availability. Data were analyzed using a mixed logit model. Participant understanding of a radiologist's role and preferences for interaction with radiologists and ordering providers were also assessed.*Results Presented herein are preliminary data from 121 of the 400 total participants in the study. Image-interpreting doctor specialty, PCP recommendation, staff sensitivity, reputation, and online scheduling increased preference for a location, whereas higher out of pocket cost decreased preference. Models estimated a

willingness to pay of $99 for interpretation by a sub-specialty radiologist, $78 for PCP recommendation, $19 for staff sensitivity, and $29 for an additional CMS star. Only 32.47% of participants correctly identified the role of a radiologist from a list of options. Preferences for interaction with radiologists and ordering providers varied somewhat across respondents. Overall, there was a strong preference for going over results and discussing next steps with ordering providers, with relatively low priority placed on meeting the radiologist in person.*Conclusions Patients place high value on subspecialty reads and recommendations of imaging centers by PCPs, factors not captured by existing quality metrics for Radiology. Staff sensitivity, a focus of current patient experience metrics, may be of less importance to patients. Finally, patient education about the radiologist role is needed before preferences for radiologist interaction can reliably be assessed.*Clinical Relevance/Application Insight into what patients value when it comes to their imaging experiences and their interactions with radiologists will inform the ongoing transition to patient-centered care in Radiology.

RESULTS

Presented herein are preliminary data from 121 of the 400 total participants in the study. Image-interpreting doctor specialty, PCP recommendation, staff sensitivity, reputation, and online scheduling increased preference for a location, whereas higher out of pocket cost decreased preference. Models estimated a willingness to pay of $99 for interpretation by a sub-specialty radiologist, $78 for PCP recommendation, $19 for staff sensitivity, and $29 for an additional CMS star. Only 32.47% of participants correctly identified the role of a radiologist from a list of options. Preferences for interaction with radiologists and ordering providers varied somewhat across respondents. Overall, there was a strong preference for going over results and discussing next steps with ordering providers, with relatively low priority placed on meeting the radiologist in person.

CLINICAL RELEVANCE/APPLICATION

Insight into what patients value when it comes to their imaging experiences and their interactions with radiologists will inform the ongoing transition to patient-centered care in Radiology.

NPM03-C3 Women Utilizing Computers For Healthcare Tasks Are More Likely To Undergo Breast Cancer Screening: Digital Divide Widening Healthcare Disparities

Participants
Patricia Balthazar, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to 1) identify patient characteristics associated with utilization of computers to schedule an appointment with a health care provider; and 2) determine if patients utilizing computers for healthcare-related tasks are more likely to utilize breast cancer screening.*Methods and Materials A retrospective analysis was conducted of female respondents aged 40-74 years without history of breast cancer to the 2018 National Health Interview Survey, a large publicly available cross-sectional survey database representative of the non-institutionalized, civilian, United States population. We compared sociodemographic characteristics of survey respondents who reported using a computer to schedule an appointment with a health care provider with respondents who did not report using a computer to schedule an appointment with a health care provider. Multivariable logistic regression was used to evaluate the potential association between computer utilization (including the following healthcare-related tasks: look up health information on the Internet, fill a prescription, schedule an appointment with a health care provider, communicate with a health care provider by email) in the last 12 months and reported utilization of screening mammography within the last year.*Results Among 6,511 women meeting inclusion criteria, 1,100 (18.6%) reported using a computer to schedule an appointment with a health care provider. These women were more frequently younger (53.4 vs. 56.3 years; p<0.001), White (73% vs. 65%; p<0.001), from a higher mean household income ($112,627 vs. $80,162; p<0.001), more educated (85% college level or above vs. 61%; p<0.001), married (76% vs. 73%; p= 0.031), insured (96% vs. 90%; p<0.001), and employed (73% vs. 59%; p<0.001). Utilization of screening mammography was positively associated with computer utilization for all the evaluated healthcare-related tasks: look up health information on the Internet (OR 1.3 [95% CI 1.1-1.5]), fill a prescription (1.6 [1.3-1.9], schedule an appointment with a health care provider (1.3 [1.1-1.6]), communicate with a health care provider by email (1.5 [1.3-1.8]).*Conclusions Female participants who used computers for health care related tasks were more likely to be white, higher income, employed, insured, and have higher levels of education. Female participants who used computers for health care related tasks were more likely to report breast cancer screening.*Clinical Relevance/Application Reliance on digital portals and online scheduling may exacerbate health disparities.

RESULTS

Among 6,511 women meeting inclusion criteria, 1,100 (18.6%) reported using a computer to schedule an appointment with a health care provider. These women were more frequently younger (53.4 vs. 56.3 years; p<0.001), White (73% vs. 65%; p<0.001), from a higher mean household income ($112,627 vs. $80,162; p<0.001), more educated (85% college level or above vs. 61%; p<0.001), married (76% vs. 73%; p= 0.031), insured (96% vs. 90%; p<0.001), and employed (73% vs. 59%; p<0.001). Utilization of screening mammography was positively associated with computer utilization for all the evaluated healthcare-related tasks: look up health information on the Internet (OR 1.3 [95% CI 1.1-1.5]), fill a prescription (1.6 [1.3-1.9], schedule an appointment with a health care provider (1.3 [1.1-1.6]), communicate with a health care provider by email (1.5 [1.3-1.8]).

CLINICAL RELEVANCE/APPLICATION

Reliance on digital portals and online scheduling may exacerbate health disparities.

Printed on: 06/28/22

MS04-A

Multisystem Wednesday Poster Discussions

Sub-Events

MS04-A1   **CT Imaging In Pregnant Trauma: Findings Of Uterine And Placental Injury**

Participants
Kacie Steinbrecher, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to assess the diagnostic performance of computed tomography (CT) in the diagnosis of placental abruption and determine which imaging findings correlate with clinical diagnosis.*Methods and Materials Sixty-five pregnant patients (mean gestational age, 23.8 weeks [range 4-39 weeks]; mean age, 26.3 years [range 18-44 years]) underwent CT for the evaluation of trauma between 2010 and 2019. Two radiologists independently and retrospectively reviewed each case. Various imaging characteristics were correlated with clinical outcome. The reference standard for clinical abruption was non-reassuring fetal status requiring early delivery. The standard for pathologic placental abruption was the presence of fibrin and clots within the placenta.*Results Incidence of clinical abruption in the present study was 18% (13 patients). In these patients, the mean percentage of placental enhancement was 46% in the clinically-abrupted group versus 87% for the non-clinically abrupted group (p < 0.05) Nine of 13 patients (79%) with clinical abruption demonstrated full thickness enhancement defects whereas 14 of 52 patients (27%) without clinical abruption also demonstrated full thickness enhancement defects of the placenta.*Conclusions Contrary to popular teaching, full thickness placental enhancement defects were found to be both insensitive and non-specific for both the clinical and pathologic diagnosis of placental abruption. In contrast, the percentage of placental enhancement may be a more useful diagnostic tool as there was a statistically significant difference between the means.*Clinical Relevance/Application As CT is often avoided in pregnancy to prevent unnecessary radiation exposure, lack of familiarity with both the normal and abnormal placental appearance can add to diagnostic confusion. In this study, we determined that percentage of placental enhancement was the imaging finding best correlate to the diagnosis of placental abruption in trauma. In assessing for this finding, diagnostic radiologists can suggest the possibility of placental abruption and expedite triage and care of pregnant trauma patients.

RESULTS

Incidence of clinical abruption in the present study was 18% (13 patients). In these patients, the mean percentage of placental enhancement was 46% in the clinically-abrupted group versus 87% for the non-clinically abrupted group (p < 0.05) Nine of 13 patients (79%) with clinical abruption demonstrated full thickness enhancement defects whereas 14 of 52 patients (27%) without clinical abruption also demonstrated full thickness enhancement defects of the placenta.

CLINICAL RELEVANCE/APPLICATION

As CT is often avoided in pregnancy to prevent unnecessary radiation exposure, lack of familiarity with both the normal and abnormal placental appearance can add to diagnostic confusion. In this study, we determined that percentage of placental enhancement was the imaging finding best correlate to the diagnosis of placental abruption in trauma. In assessing for this finding, diagnostic radiologists can suggest the possibility of placental abruption and expedite triage and care of pregnant trauma patients.

Abstract Archives of the RSNA, 2021

Sub-Events

SDP-NPM-1 **Sociodemographic And Geographic Disparities In Obstetrical Ultrasound Imaging Utilization: A Population-based Study**

Participants
Scott Adams, MD, Saskatoon, Saskatchewan (*Presenter*) Nothing to Disclose

PURPOSE

Obstetrical ultrasound imaging is an important part of prenatal care, though not all patients have readily available access to ultrasound services. This study aimed to assess the relationship between sociodemographic and geographic factors and (1) having a second trimester complete obstetrical ultrasound and (2) overall obstetrical ultrasound utilization.*Methods and Materials All pregnancies and obstetrical ultrasound exams billed from 2014-2018 in Saskatchewan, Canada were identified from province-wide databases. Generalized estimating equation models with binomial and Poisson distributions were used to identify factors associated with having a second trimester ultrasound and overall obstetrical ultrasound utilization, respectively.*Results 80,536 pregnancies from 57,881 individuals were included. Of 57,186 pregnancies carried to =23 weeks, a second trimester ultrasound was performed in 50,180 (87.7%). Patients living in higher income neighbourhoods (adjusted odds ratio [aOR], 1.86 for highest vs. lowest quintile; 95% confidence interval [CI], 1.63-2.12; p<0.0001) were more likely to have a second trimester ultrasound. Patients living in rural areas (aOR, 0.70; 95% CI, 0.64-0.77; p<0.0001), remote areas (aOR, 0.49 for greatest vs. least remoteness level; 95% CI, 0.42-0.59; p<0.0001), and status First Nations individuals (aOR, 0.49; 95% CI, 0.46-0.53; p<0.0001) were less likely to have a second trimester ultrasound. Poisson regression analysis demonstrated these same factors, except rural residence, were associated with overall obstetrical ultrasound utilization.*Conclusions Substantial disparities in obstetrical ultrasound utilization exist among patients in remote geographic areas, Indigenous peoples, and patients in low income neighbourhoods. Addressing barriers which these demographic groups face in accessing ultrasound imaging is critical to ensure health equity.*Clinical Relevance/Application Significant variation in obstetrical ultrasound utilization across the health system suggests there is a need for radiology leaders to develop targeted approaches to ensure equitable access to obstetrical ultrasound for specific demographic groups, including patients in remote communities, Indigenous peoples, and low-income patients. Potential solutions to reduce disparities in obstetrical ultrasound utilization may include culturally-safe outreach, a culturally-safe clinic environment, sonographer recruitment and retention in rural and remote communities, telerobotic ultrasound technology, and increased collaboration with referring clinicians.

RESULTS

80,536 pregnancies from 57,881 individuals were included. Of 57,186 pregnancies carried to =23 weeks, a second trimester ultrasound was performed in 50,180 (87.7%). Patients living in higher income neighbourhoods (adjusted odds ratio [aOR], 1.86 for highest vs. lowest quintile; 95% confidence interval [CI], 1.63-2.12; p<0.0001) were more likely to have a second trimester ultrasound. Patients living in rural areas (aOR, 0.70; 95% CI, 0.64-0.77; p<0.0001), remote areas (aOR, 0.49 for greatest vs. least remoteness level; 95% CI, 0.42-0.59; p<0.0001), and status First Nations individuals (aOR, 0.49; 95% CI, 0.46-0.53; p<0.0001) were less likely to have a second trimester ultrasound. Poisson regression analysis demonstrated these same factors, except rural residence, were associated with overall obstetrical ultrasound utilization.

CLINICAL RELEVANCE/APPLICATION

Significant variation in obstetrical ultrasound utilization across the health system suggests there is a need for radiology leaders to develop targeted approaches to ensure equitable access to obstetrical ultrasound for specific demographic groups, including patients in remote communities, Indigenous peoples, and low-income patients. Potential solutions to reduce disparities in obstetrical ultrasound utilization may include culturally-safe outreach, a culturally-safe clinic environment, sonographer recruitment and retention in rural and remote communities, telerobotic ultrasound technology, and increased collaboration with referring clinicians.

SDP-NPM-10 **Leadership Titles In Radiology: Usage Of Non-inclusive Terminology Among Academic Radiology Departments And Societies**

Participants
Alan Shan, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

Non-inclusive terminology, including gender-specific titles like "chairman" and potentially culturally-insensitive terms like "chief," have traditionally been used to describe leaders of academic radiology departments and/or divisions. These terms are problematic, as they may reinforce historical gender hierarchies and racial biases. However, the prevalence of these terms has not yet been systematically evaluated.The purpose of this study was to characterize the use of gender-specific (chairman) and non-inclusive terminology (chief) to describe departmental and divisional/sectional leadership within academic radiology department and radiological society websites.*Methods and Materials From a total of 157 unique institutions identified, we gathered a list of 123 departments with functioning websites. We screened for use of the terms "chairman" and "chief" on departmental home pages, welcome messages, faculty listings, and residency program pages, noting location on websites and alternative terms, if present. We also assessed for use of "chairman" through a list of 14 radiological society websites. The overall usage of these terms was determined and the relationships between geographic region, faculty gender, and use of terminology were assessed.*Results

"Chairman" is common among radiology department websites, with 42.1% (51/121) of websites using the term at least once. Usage of "chairman" was higher in departments whose chairs were men (OR 4.32, 95% CI: 1.36-13.69) and lower in those located in the Midwest (versus Northeast, OR 0.34, 95% CI: 0.12-0.96). Use of "chief" is extremely common among departments listing divisional leadership, at 82.7% (67/81). Alternative terms used included "chair," "head," "chairperson," and "director." Among departments, the proportion of women in leadership roles is low, representing 19.7% (22/122) of chairs and 31.1% (272/874) of other leadership. Radiological societies were unlikely to use "chairman," with only one website using the term.*Conclusions Use of "chairman" and "chief" is frequent among academic radiology departments. Radiological societies, in contrast, seldom used "chairman," suggesting a more progressive approach to leadership titles in these professional groups. Further efforts should be made to assess the usage of non-inclusive terminology and its potential impact within academic radiology departments with consideration of alternative terms, such as "head" or "chair" (Table 1).*Clinical Relevance/Application We highlight the high prevalence of non-inclusive terminology in leadership titles in radiology departments. The use of these terms, such as "chairman" and "chief" should be reconsidered, as they may perpetuate gender and racial biases.

RESULTS

"Chairman" is common among radiology department websites, with 42.1% (51/121) of websites using the term at least once. Usage of "chairman" was higher in departments whose chairs were men (OR 4.32, 95% CI: 1.36-13.69) and lower in those located in the Midwest (versus Northeast, OR 0.34, 95% CI: 0.12-0.96). Use of "chief" is extremely common among departments listing divisional leadership, at 82.7% (67/81). Alternative terms used included "chair," "head," "chairperson," and "director." Among departments, the proportion of women in leadership roles is low, representing 19.7% (22/122) of chairs and 31.1% (272/874) of other leadership. Radiological societies were unlikely to use "chairman," with only one website using the term.

CLINICAL RELEVANCE/APPLICATION

We highlight the high prevalence of non-inclusive terminology in leadership titles in radiology departments. The use of these terms, such as "chairman" and "chief" should be reconsidered, as they may perpetuate gender and racial biases.

SDP-NPM-11 Health Disparities In Systemic Staging Of Rectal Cancer

Participants
Jessica Colin Escobar, Irvine, California (*Presenter*) Nothing to Disclose

PURPOSE

To assess health disparity in initial systemic staging of rectal cancer in race, ethnicity, insurance coverage, socioeconomic status.*Methods and Materials We reviewed consecutive rectal adenocarcinoma cases at a high volume colorectal academic institution from 2013-2019. Patients with indeterminant workup history, or initial work up performed outside of United States were excluded. We recorded the date of diagnosis, date of systemic staging imaging exam, type of systemic staging, CT vs PET/CT, if CT, whether chest abdomen and pelvis were performed or only CT abdomen and pelvis were performed, age, gender, insurance type, residence zip-code. Chi square and t-tests, as well as linear and logistic regression models were utilized for analysis.*Results 266 subjects were included. Racial/ethnic categories were non-Hispanic white were 49.8%, Hispanic 22.5%, Asian 19.5%, and African-American 2.6%. Insurance coverage was private in 49.8% and public in 48.2%. 40.4% were from zip code income median family income greater than 100,000$ per year. 96.6% had some type of systemic imaging evaluation at initial staging. 63.4% had CT chest, abdomen and pelvis, as recommended by NCCN guidelines. 33. 9% had PET/CT. 12.4% had only CT abdomen and pelvis, with no CT chest. Hispanics had higher rate of incomplete systemic evaluation compared to non Hispanic whites, odd ratio (OR) = 3.7 (95 % confidence interval [CI] 1.6 to 8.6, P = 0.003). Lower socioeconomic status also had a lower rate of completing systemic staging, odd ratio (OR) = 3.8 (95% confidence interval [CI] 1.6 to 8.8, P = 0.002). No significant difference was noted between public vs. private insurance coverage, odd ratio (OR) = 1.18 (95% confidence interval [CI] 0.58 to 2.4, P = 0.64).Among private insurance and Medicare-covered 8.3% and 9.0% had both CT chest, abdomen and pelvis and PET/CT. None of the 48 Medicaid patients had both modality. Non-Hispanic white had shorter time interval between the date of diagnosis compared to Hispanic, average days, 21.2 ± SD 28.1 days compared to 32.6 ± SD 50.7 days(P=0.07). Private insurance coverage had shorter time interval between diagnosis and exam, average 19.0 ± SD 32.9 days days compared to Medicaid 25.9 ± SD 36.3 days (P=0.27).*Conclusions Significant disparity was present in systemic initial staging evaluation for rectal cancer, between race/ethnicity and socioeconomic status.*Clinical Relevance/Application Health disparity in initial systemic staging rectal cancer, associated with minority race/ethnicity, lower socioeconomic status and inadequate insurance coverage, is a gap that needs to be addressed in order to achieve to health equity and improved population outcome.

RESULTS

266 subjects were included. Racial/ethnic categories were non-Hispanic white were 49.8%, Hispanic 22.5%, Asian 19.5%, and African-American 2.6%. Insurance coverage was private in 49.8% and public in 48.2%. 40.4% were from zip code income median family income greater than 100,000$ per year. 96.6% had some type of systemic imaging evaluation at initial staging. 63.4% had CT chest, abdomen and pelvis, as recommended by NCCN guidelines. 33. 9% had PET/CT. 12.4% had only CT abdomen and pelvis, with no CT chest. Hispanics had higher rate of incomplete systemic evaluation compared to non Hispanic whites, odd ratio (OR) = 3.7 (95 % confidence interval [CI] 1.6 to 8.6, P = 0.003). Lower socioeconomic status also had a lower rate of completing systemic staging, odd ratio (OR) = 3.8 (95% confidence interval [CI] 1.6 to 8.8, P = 0.002). No significant difference was noted between public vs. private insurance coverage, odd ratio (OR) = 1.18 (95% confidence interval [CI] 0.58 to 2.4, P = 0.64).Among private insurance and Medicare-covered 8.3% and 9.0% had both CT chest, abdomen and pelvis and PET/CT. None of the 48 Medicaid patients had both modality. Non-Hispanic white had shorter time interval between the date of diagnosis compared to Hispanic, average days, 21.2 ± SD 28.1 days compared to 32.6 ± SD 50.7 days(P=0.07). Private insurance coverage had shorter time interval between diagnosis and exam, average 19.0 ± SD 32.9 days days compared to Medicaid 25.9 ± SD 36.3 days (P=0.27).

CLINICAL RELEVANCE/APPLICATION

Health disparity in initial systemic staging rectal cancer, associated with minority race/ethnicity, lower socioeconomic status and inadequate insurance coverage, is a gap that needs to be addressed in order to achieve to health equity and improved population outcome.

SDP-NPM-12 Trends In Medicare Part B Payments And Utilization For Imaging Services Between 2009 And 2019

Participants
Monica Kassavin, Cleveland, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

In 2019, the total National Healthcare Expenditure (NHE) reached $3.8 trillion, or nearly 20% of the total Gross Domestic Product (GDP). This represents a 4-fold increase in its GDP share since 1960. Given the magnitude and growth of such expenditures, healthcare cost containment is central to the country's financial sustainability. Moreover, as Medicare represents nearly 20% of the total NHE, it is a primary target for piloting, implementing and scaling initiatives that reduce expenditures.The purpose of this study is to assess trends in Medicare Physician Fee Schedule for Service (Part B) payments and utilization for Imaging relative to other services from 2009 through 2019.*Methods and Materials We conducted a retrospective observational study of annual expenditures and utilization of imaging services using data from Centers for Medicare and Medicaid Services (CMS) Medicare Part B. Data was grouped according to the Berenson-Eggers Type of Service Classification. The values were adjusted for inflation and we calculated the annual changes and the compound annual growth rates and the price elasticity of supply.*Results For the 10-year period, Imaging represented on average 8% of the total Medicare Part B expenditures, an equivalent of 1.4% of total Medicare expenditures or 0.05% of the NHE. While NHE, overall Medicare and overall Part B had positive growth rates of total expenditures, Imaging did not. Moreover, Imaging had the most negative CAGR compared to all other categories, including Drugs, Procedures, Evaluation and Management and Durable Medical Equipment.*Conclusions Imaging did not contribute to the increase in Medicare Part B expenditures, and it might have been disproportionately affected by cost containment policies.*Clinical Relevance/Application While annual adjustments in physician fees are aiming for budget neutrality as a final goal, the impact on categories (e.g., Imaging) and specialties (e.g., Radiology) may not be effectively assessed with the current CMS strategy.

RESULTS

For the 10-year period, Imaging represented on average 8% of the total Medicare Part B expenditures, an equivalent of 1.4% of total Medicare expenditures or 0.05% of the NHE. While NHE, overall Medicare and overall Part B had positive growth rates of total expenditures, Imaging did not. Moreover, Imaging had the most negative CAGR compared to all other categories, including Drugs, Procedures, Evaluation and Management and Durable Medical Equipment.

CLINICAL RELEVANCE/APPLICATION

While annual adjustments in physician fees are aiming for budget neutrality as a final goal, the impact on categories (e.g., Imaging) and specialties (e.g., Radiology) may not be effectively assessed with the current CMS strategy.

SDP-NPM-2   A Telerobotic Ultrasound Clinic Model Of Ultrasound Service Delivery To Improve Access To Imaging In Rural And Remote Communities

Participants
Scott Adams, MD, Saskatoon, Saskatchewan (*Presenter*) Nothing to Disclose

PURPOSE

Patients living in many rural and remote areas do not have readily available access to ultrasound services due to a lack of sonographers and radiologists in these communities. As a potential solution to improve access to ultrasound imaging, telerobotic ultrasound is a technology which allows a sonographer or radiologist to remotely manipulate an ultrasound probe and control ultrasound machine settings, allowing sonographers and radiologists to remotely perform an ultrasound exam. The purpose of this study was to determine the feasibility of using telerobotic ultrasound to establish a service delivery model to remotely provide diagnostic ultrasound services in rural and remote communities.*Methods and Materials Telerobotic ultrasound clinics were developed in three remote communities more than 500 km away from our academic medical centre. Sonographers remotely performed all ultrasound exams using telerobotic ultrasound systems and exams were subsequently interpreted by radiologists at an academic medical centre. A mixed-methods approach was used to evaluate telerobotic ultrasound as a potential service delivery model to remotely provide ultrasound services, with consideration given to diagnostic assessment, patient experience, and health system and radiology practice integration. Diagnostic performance was assessed by each interpreting radiologist using a standardized reporting form. Patient experience was assessed through quantitative and qualitative analysis of survey responses and operational challenges and solutions were identified.*Results Eighty-seven telerobotic ultrasound exams were remotely performed and included in this study, with the most frequent exam types being abdominal (n=35), first trimester obstetrical (n=26), and second trimester complete obstetrical (n=12). Across all exam types, 70% of telerobotic ultrasound exams were sufficient for diagnosis, minimizing travel or reducing wait times for these patients. Ninety-five percent of patients would be willing to have another telerobotic ultrasound exam in the future. Operational challenges were related to technical infrastructure, human resources, and coordination between clinic sites.*Conclusions Telerobotic ultrasound can provide access to diagnostic ultrasound services for patients in underserved rural and remote communities without regular ultrasound services, thereby reducing disparities in access to care and improving health equity.*Clinical Relevance/Application Radiology practices may wish to consider implementing telerobotic ultrasound technology in underserved rural and remote communities in their region to improve patient access to ultrasound imaging.

RESULTS

Eighty-seven telerobotic ultrasound exams were remotely performed and included in this study, with the most frequent exam types being abdominal (n=35), first trimester obstetrical (n=26), and second trimester complete obstetrical (n=12). Across all exam types, 70% of telerobotic ultrasound exams were sufficient for diagnosis, minimizing travel or reducing wait times for these patients. Ninety-five percent of patients would be willing to have another telerobotic ultrasound exam in the future. Operational challenges were related to technical infrastructure, human resources, and coordination between clinic sites.

CLINICAL RELEVANCE/APPLICATION

Radiology practices may wish to consider implementing telerobotic ultrasound technology in underserved rural and remote communities in their region to improve patient access to ultrasound imaging.

SDP-NPM-3   Demographic, Socioeconomic Status (SES) And Nodule Risk Can Accurately Predict Adherence To Follow Up Of Incidental Pulmonary Nodules

Participants
Eduardo J. Mortani Barbosa JR, MD, Philadelphia, Pennsylvania (*Presenter*) Research Consultant, FLUIDDA nv;Research Grant, Siemens AG

PURPOSE

Incidental pulmonary nodules (IPNs) are commonly found in chest imaging, however are often not followed up appropriately. We assessed a large cohort of patients to identify which demographic and socioeconomic status (SES), clinical context (CC) and

nodule characteristics (NC) variables are most predictive of adequate follow up.*Methods and Materials We reviewed electronic medical record and U.S. Census data for 1,843 patients diagnosed with IPNs identified on chest CT in a tertiary healthcare system in 2016, and examined their follow-up adherence until 2019. We collected variables including: demographics/SES (age, sex, race, employment, mean income , educational attainment, the latter 2 via geocoding based on U.S. Census block data from 2019), CC (smoking history, encounter context) and NC via risk assessment by the interpreting radiologist using a coding scheme based on Fleischner society guidelines. Our outcome was whether patients did not receive a specific recommendation for follow up (#1), received a recommendation but never obtained follow up (#2), obtained follow up delayed by more than 2 months (#3), or obtained follow up timely (#4). We performed chi-square univariate (CSU), multivariate logistic regression (MLR) and bootstrap forest (BF) analyses to predict the outcome.*Results 6 variables were statistically significant predictors of non-adherence via CSU (p<0.005, CSU likelihood ratio 99.2 - 408.3): black race, not employed status, current smoker, non-outpatient setting, medicaid or no insurance, and lower risk nodules. MLR ordered nodule risk, patient context, smoking status and race as the four best predictors, with whole model ROC AUC of 0.729 - 0.881. BF obtained ROC AUC of 0.674-0.944.*Conclusions Our models not only can accurately identify patients at greatest risk of not obtaining adequate follow up of IPNs, but more importantly can delineate which variables are most predictive and the magnitude of their influence. Demographic/SES variables dominate model prediction, though nodule risk assessment is also a key predictor.*Clinical Relevance/Application Our research has major implications for clinical practice, by characterizing the most vulnerable patients at risk for non-adherence to follow up of IPNs, which can inform policy interventions to improve patient outcomes.

RESULTS

6 variables were statistically significant predictors of non-adherence via CSU (p<0.005, CSU likelihood ratio 99.2 - 408.3): black race, not employed status, current smoker, non-outpatient setting, medicaid or no insurance, and lower risk nodules. MLR ordered nodule risk, patient context, smoking status and race as the four best predictors, with whole model ROC AUC of 0.729 - 0.881. BF obtained ROC AUC of 0.674-0.944.

CLINICAL RELEVANCE/APPLICATION

Our research has major implications for clinical practice, by characterizing the most vulnerable patients at risk for non-adherence to follow up of IPNs, which can inform policy interventions to improve patient outcomes.

SDP-NPM-4 Increasing Diversity And Inclusion In Diagnostic Radiology Residency: A Survey Of Program Directors

Participants
Arif Musa, MS, Detroit, Michigan (*Presenter*) Research Grant, Stryker Corporation;Contract, WebMD Health Corp (WebMD, Inc)

PURPOSE

Diagnostic radiology residency training programs historically lack trainees from under-represented backgrounds. The goal of this study was to determine which methods were endorsed by radiology residency program directors to increase under-represented minorities and female applicants.*Methods and Materials A cross-sectional study of diagnostic radiology residency training program directors was performed via an electronic survey that listed strategies to increase minority and female representation. Level of agreement or disagreement was converted to a weighted average (WA) for each strategy (1 = disagree, 2 = somewhat disagree, 3 = neutral, 4 = somewhat agree, 5 = agree). Responses were collected from January to April 2021. A lottery incentive was included.*Results A total of 30 responses were obtained from 181 program directors (16.6%). The most supported strategies to increase diversity were promoting mentorship by female and minority faculty (WA = 4.6), recruiting female and minority medical students (WA = 4.6), increasing the number of female and minority faculty (WA = 4.5), implementing unconscious bias training (WA = 4.5), increasing female and minority interviewers (WA = 4.4), analyzing successful diversity initiatives (WA = 4.3), conducting holistic application reviews (WA = 4.3), cultural bias training (WA = 4.3), and establishing Women in Radiology or similar groups (WA = 4.3). Other highly supported methods included increasing funding for diversity initiatives (WA = 4.2), including diversity in the program mission statement (WA = 4.2), establishing an office of diversity (WA = 4.2), and having a webpage dedicated to diversity and inclusion (WA = 4.1). Establishing a safe space (WA = 3.9), conducting diversity research (WA = 3.8), establishing a pipeline program for female and minority applicants (WA = 3.8), and advertising at medical schools with historically diverse students (WA = 3.8) were also endorsed. Other strategies included establishing a diversity subcommittee (WA = 3.3), accepting more international medical graduates (WA = 2.8), accepting a minimum number of female or minority applicants (WA = 2.8), deemphasizing USMLE scores (WA = 2.7), and removing applicant photos, gender, and ethnicity from applications (WA = 2.7).*Conclusions Diagnostic radiology residency training program directors endorsed a wide variety of methods to increase diversity and inclusion. These strategies affected resident recruitment, interviewing, training, and program structure.*Clinical Relevance/Application Diagnostic radiology residency training program directors should be aware of what strategies are most supported by their peers to increase the number of female and minority residents.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Diagnostic radiology residency training program directors should be aware of what strategies are most supported by their peers to increase the number of female and minority residents.

SDP-NPM-5 Readability Of Patient Education Materials Related To Radiation Safety And The Implications For Patient-centred Radiology Care

Participants

Francis Delaney, MD, Dublin, Ireland (*Presenter*) Nothing to Disclose

PURPOSE

Patients increasingly rely on Web-based resources for healthcare information on which they base decisions about their medical care. Radiation safety is an issue that can be misunderstood by patients and clinicians and lead to patient anxiety. Online patient education materials are frequently written at a higher than recommended reading level. We aimed to assess the readability of currently available online patient educational materials (PEMs) related to radiation safety.*Methods and Materials The readability of 84 articles pertaining to radiation safety from 14 well-known online resources were assessed using 8 readability formulae. The mean reading grade level (RGL) of each article was compared to the recommended reading level for PEMs (6th grade) and the average adult reading level (8th grade). The mean RGL of each website's articles were also compared. In addition, a comparison was made between academic and non-profit resources.*Results The cumulative mean RGL for all 84 articles was 13.3 (range = 8.6-17.4). No article (0%) was written at or below either the 6th or 8th grade reading level. The cumulative mean RGL exceeded the 6th grade reading level by an average of 7.3 levels (95% CI, 6.8-7.8; P<0.001) and the 8th grade level by an average of 5.3 grade levels (95% CI, 4.8-5.8; P<0.001). The mean Flesch Reading Ease Score was 39/100 which is classified as 'difficult'. There was no statistically significant difference between academic and non-profit resources. On comparison of our results to prior studies, there has been no substantial improvement in the readability of PEMs on radiation safety in recent years.*Conclusions Currently available online PEMs related to radiation safety are still written at higher than recommended reading levels. Radiation safety is a topic in which the specialist knowledge of radiologists is crucial in providing guidance to clinicians and education to patients. Addressing the readability of online PEMs may help to improve health literacy and enhance radiology-patient communication as part of the shift to a more patient-centred model of practice.*Clinical Relevance/Application The readability of online patient education materials is a significant factor in health literacy in modern medical practice. Improving the readability of materials pertaining to radiation safety is important for radiologists to help guide clinical practice and enable informed decision-making between clinicians and patients in the era of patient-centred care.

RESULTS

The cumulative mean RGL for all 84 articles was 13.3 (range = 8.6-17.4). No article (0%) was written at or below either the 6th or 8th grade reading level. The cumulative mean RGL exceeded the 6th grade reading level by an average of 7.3 levels (95% CI, 6.8-7.8; P<0.001) and the 8th grade level by an average of 5.3 grade levels (95% CI, 4.8-5.8; P<0.001). The mean Flesch Reading Ease Score was 39/100 which is classified as 'difficult'. There was no statistically significant difference between academic and non-profit resources. On comparison of our results to prior studies, there has been no substantial improvement in the readability of PEMs on radiation safety in recent years.

CLINICAL RELEVANCE/APPLICATION

The readability of online patient education materials is a significant factor in health literacy in modern medical practice. Improving the readability of materials pertaining to radiation safety is important for radiologists to help guide clinical practice and enable informed decision-making between clinicians and patients in the era of patient-centred care.

SDP-NPM-6 Practical Preventive Strategies For Extravasation Of Contrast Media During CT: What The Radiology Team Can Do

Participants
Shinsuke Shigematsu, Kumamoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to assess the practical preventive strategies (i.e. venous vulnerability assessment and prevention scan protocol rules) for extravasation of contrast media (ECM) during CT.*Methods and Materials 73,931 patients who underwent contrast-enhanced CT scans between January 2013 and December 2019 were retrospectively included. Venous vulnerability assessment by the radiology team (radiology nurses, radiology technicians, and radiologists) began in 2015, and prevention scan protocol rules for the prevention of ECM were added in 2017. We defined each period as follows: 2013-2014, no prevention period (Period A); 2015-2016, prevention period (Period B, venous vulnerability assessment only); 2017-2019: prevention period (Period C, venous vulnerability assessment with prevention scan protocol rules). The incident reports, radiology reports, and medical records of patients in whom ECM occurred were reviewed. We compared the frequency of ECM during each period.*Results ECM occurred in 0.39% (292/73,931) of patients. The frequencies of ECM for Period A, Period B, and Period C were 0.62% (121/19,505), 0.43% (89/20,847), and 0.24% (82/33,579), respectively. There was a significant difference in the frequency of ECM during each period (Chi-squared test, p<0.01).*Conclusions Venous vulnerability assessment and prevention scan protocol rules by the radiology team can be practical and simple solutions for ECM during CT.*Clinical Relevance/Application Venous vulnerability assessment and prevention scan protocol rules by the radiology team can play an important role in the prevention of ECM during CT.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Venous vulnerability assessment and prevention scan protocol rules by the radiology team can play an important role in the prevention of ECM during CT.

SDP-NPM-7 The 2020 Radiology Residency Match: Preferences And Success Rates Of Applicants

Participants
Faranak Rafiee, MD, Shiraz, Iran, Islamic Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The preferences and success rates of different applicant pools in the different specialties of the NRMP residency match may determine future applications to those specialties. The competition for spots can influence the constitution of the applicant pool.*Methods and Materials The NRMP web site was accessed to review the candidate pools and success rates of specialties by reviewing the online "Results and Data of the 2020 Main Residency Match" and "Charting Outcomes in the Match: International Medical Graduates" reports site (www.nrmp.org/about-match-data). Success rates were determined by calculating the number of

applicants applying to a specialty to the number that matched. Raw data were used to determine specialty preferences.*Results Among US medical school (USMD) seniors, Diagnostic Radiology (DR) was the 8th most popular specialty after internal medicine, pediatrics, emergency medicine, family medicine, general surgery, obstetrics and gynecology, and anesthesiology. The success rate for USMD seniors applicants in DR (75.9%) was less than that for Pediatrics (89.1%), EM (88.5%), IM (84.6%), FM (84.6%) and OB-GYN (84.3%) but was higher than Anesthesiology (68.2%) and general surgery (74.9%). By comparison, among Doctor of Osteopathy (DO) seniors, DR was the 10th most popular specialty (Psychiatry and physical medicine rehab surpassed radiology). However the success rate for DOs in applying to DR fell to 66.1% with only PMR (29.1%), general surgery (59.4%), anesthesiology (60.5%) and OB-GYN (65.4%) more competitive. USMD and DO seniors (total 795) and graduates (total 45) filled 840 (84.8%) of 990 DR spots offered. 127 International medical graduates matched to DR (the 8th most popular specialty among IMGs). However 210 USMD and 69 DO senior applicants did not match in DR.*Conclusions The competition for DR spots in the NRMP residency match is more difficult for DO seniors than USMD seniors with success rates for applicants of 66.1% and 75.9% respectively. Despite this, diagnostic radiology is in the top 10 of specialties applied to, being surpassed largely by the clinical primary care specialties.*Clinical Relevance/Application Diagnostic Radiology is a popular specialty in the NRMP match. USMD seniors are 75.9% successful in securing spots, surpassing DOs (66.1%) and IMGs, but many fail to match in DR. The competitiveness for positions suggests a high quality resident pool.

RESULTS

Among US medical school (USMD) seniors, Diagnostic Radiology (DR) was the 8th most popular specialty after internal medicine, pediatrics, emergency medicine, family medicine, general surgery, obstetrics and gynecology, and anesthesiology. The success rate for USMD seniors applicants in DR (75.9%) was less than that for Pediatrics (89.1%), EM (88.5%), IM (84.6%), FM (84.6%) and OB-GYN (84.3%) but was higher than Anesthesiology (68.2%) and general surgery (74.9%). By comparison, among Doctor of Osteopathy (DO) seniors, DR was the 10th most popular specialty (Psychiatry and physical medicine rehab surpassed radiology). However the success rate for DOs in applying to DR fell to 66.1% with only PMR (29.1%), general surgery (59.4%), anesthesiology (60.5%) and OB-GYN (65.4%) more competitive. USMD and DO seniors (total 795) and graduates (total 45) filled 840 (84.8%) of 990 DR spots offered. 127 International medical graduates matched to DR (the 8th most popular specialty among IMGs). However 210 USMD and 69 DO senior applicants did not match in DR.

CLINICAL RELEVANCE/APPLICATION

Diagnostic Radiology is a popular specialty in the NRMP match. USMD seniors are 75.9% successful in securing spots, surpassing DOs (66.1%) and IMGs, but many fail to match in DR. The competitiveness for positions suggests a high quality resident pool.

SDP-NPM-8 Radiology Residency Match Criteria: Program Directors' 2020 Survey

Participants
Parisa Khoshpouri, MD, Coquitlam, British Columbia (*Presenter*) Nothing to Disclose

PURPOSE

The national residency match program (NRMP) provides the results of program director (PD) survey to assess and identify the factors that PDs use to rank residency applicants for all specialties each year. Our study aims to describe the important factors provided by PDs for the Radiology residency match of 2020.*Methods and Materials We reviewed the official published data of 2020 NRMP Program Director (PD) Survey in its website (https://mk0nrmp3oyqui6wqfm.kinstacdn.com/wp-content/uploads/2020/08/2020-PD-Survey.pdf). This survey evaluates (1) the number of applicants that were received, reviewed and eventually ranked, (2) the frequency of interviewing and ranking by programs, (3) test scores, and (4) factors used for applicant selection pre-interview and post-interview.*Results Of all 195 Radiology PDs, 36 (18.5%) responded to the survey. The results included 38 factors important in selecting applicants (pre-interview) and 44 factors in ranking applicants (post-interview). The most important criteria by which candidates were assessed for being selected for interviews were: USMLE Step 1 score (100%), Medical Student Performance Evaluation (MSPE/Dean's Letter) (93%), personal statement (89%), Class ranking/quartile (89%), letters of recommendation in the specialty (81%), failed USMLE (81%), and USMLE Step 2 CK scores (78%). The factors important in ranking applicants after interviews were: Interpersonal skills (93%), Interactions with faculty during the interview (93%), Interactions with housestaff during the interview(93%), Medical Student Performance Evaluation (MSPE/Dean's Letter) (85%), Feedback from current residents (81%) and USMLE Step 1 score (81%). 70% of PDs require obtaining a target score for Step 1 and 41% of PDs will not consider applicants who fail Step 1.*Conclusions Multiple factors are weighed by radiology program directors in selecting residents for an interview, but if an applicant passes the initial criteria successfully, the PDs prioritize interpersonal skills and personal traits at the interview. However USMLE Step 1 scores play a large role in both processes.*Clinical Relevance/Application USMLE Step 1 plays an important role in considering an applicant for matching into radiology, which currently seems like the best accessible filter.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

USMLE Step 1 plays an important role in considering an applicant for matching into radiology, which currently seems like the best accessible filter.

SDP-NPM-9 Estimating Population Reach Of Global Health Radiology Outreach Using Geographic Information Systems Analysis

Participants
David Gage, BSC,MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

According to the World Health Organization, widespread scarcity of radiology and medical imaging resources is generally estimated at one-half to two-thirds of the world, but difficult to specifically quantify at the facility and regional level. Geographic Information Systems (GIS) research has accelerated real-time monitoring of health data for identifying populations and measuring the impact of interventions. The purpose of this study was to design, develop and test GIS methods for nonprofit global health radiology outreach planning and quantifying potential impact of interventions on medically underserved populations.*Methods and Materials The study developed and tested GIS methodology using publicly available databases used by the global health radiology nonprofit organization, RAD-AID International. The data collection targeted the regions and populations served by seventy-eight (78) low-resource medical facilities partnered with RAD-AID in 30 low and middle-income countries (LMICs). Three constraints were used to measure proximity for approximating patient's level of geographic access to healthcare: 1) one-hour driving time, 2) one-hour walking time, and 3) ten-mile circular radius. To calculate the population within each constraint, a GIS analysis used geospatial input data sources including a global digital elevation model, population and land cover data, and roads at country level from OpenStreetMap. Demographic and health data from the World Health Organization were also incorporated to provide insight into further characteristics of the covered population.*Results Total population served by all RAD-AID sites as measured by driving time, walking time, and ten-mile radius was 189,241,193 (47.8% female), 26,190,117 (48.7% female), and 110,884,095(48.1% female), respectively. For individual locations, the median population within one-hour driving time was found to be 1,795,977 (range: 8,742—30,630,800; interquartile range [IQR]: 537,808—4,192,237), with an average life expectancy of 68.4 (range: 54.0—78.3; standard deviation: ±5.8) years. Median child mortality before age five was 3.8% (range: 0.9—8.3%; IQR: 2.0—5.7%), and median HIV prevalence was 3.1% (range: 0.7—10.9%; IQR: 2.0—4.8%).*Conclusions This study demonstrates the role of geographic information systems analysis for estimating total global health outreach, which can be used for resource allocation and planning.*Clinical Relevance/Application Given heightened needs for measuring reach of global health strategies, this GIS-based method and variables for approximating geographic access to health institutions may be useful for analysis, outreach planning, and resource allocation among medical outreach organizations.

RESULTS

Total population served by all RAD-AID sites as measured by driving time, walking time, and ten-mile radius was 189,241,193 (47.8% female), 26,190,117 (48.7% female), and 110,884,095(48.1% female), respectively. For individual locations, the median population within one-hour driving time was found to be 1,795,977 (range: 8,742— 30,630,800; interquartile range [IQR]: 537,808—4,192,237), with an average life expectancy of 68.4 (range: 54.0—78.3; standard deviation: ±5.8) years. Median child mortality before age five was 3.8% (range: 0.9—8.3%; IQR: 2.0—5.7%), and median HIV prevalence was 3.1% (range: 0.7—10.9%; IQR: 2.0—4.8%).

CLINICAL RELEVANCE/APPLICATION

Given heightened needs for measuring reach of global health strategies, this GIS-based method and variables for approximating geographic access to health institutions may be useful for analysis, outreach planning, and resource allocation among medical outreach organizations.

Abstract Archives of the RSNA, 2021

MS05-A

Multisystem Thursday Poster Discussions

IR05-A
Interventional Radiology Thursday Poster Discussions

Sub-Events

IR05-A1   Minimally Invasive Treatment For Unicameral Bone Cysts With Chemical Sclerosis And Bone Graft Substitute: A Preliminary Report.

Participants
Shankar Rajeswaran, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Unicameral bone cysts (UBCs) are benign lesions that primarily occur in childhood and can present with pain, pathologic fracture and growth disturbances. Existing treatment approaches for the management of UBCs are highly variable and recurrence is not uncommon. This study seeks to evaluate an image-guided, minimally invasive combination of chemical sclerotherapy and synthetic grafting as a novel outpatient management treatment option for UBCs.*Methods and Materials Retrospective evaluation from August 2018 through July 2020 of fourteen pediatric patients, ages 5-14 years, undergoing treatment for a UBC, at a single institution. All UBCs were treated in a single, minimally invasive, image guided procedure using percutaneous needle access into the UBC followed by chemical sclerotherapy and injection of regenerative synthetic graft. Patients were followed clinically and with serial radiographs to evaluate for healing and complications, with an average follow-up of 13.7 months and descriptive statistics were performed.*Results 12 of 14 (85.7%) patients showed Neer classification class 1 or 2 healed cysts at their most recent follow-up and there was one case of recurrence noted at 3 months. Patients were pain-free and returned to normal physical activity on average within 2.0 months, and all patients remained asymptomatic at the most recent follow-up. There were no complications related to the procedures.*Conclusions Image guided chemical sclerosis and bone grafting is a minimally invasive treatment option for unicameral bone cysts and compares favorably to other existing treatment options.*Clinical Relevance/Application Given the high efficacy and low morbidity of this treatment approach, the preliminary findings of this technique are promising as an alternative management option for UBCs.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Given the high efficacy and low morbidity of this treatment approach, the preliminary findings of this technique are promising as an alternative management option for UBCs.

IR05-A2   Sex Disparities In Survival After Transjugular Intrahepatic Portosystemic Shunt Placement

Participants
Ryan Lokken, MD, San Francisco, California (*Presenter*) Consultant, Neptune Medical Inc

PURPOSE

To compare transplant-free survival (TFS) between women and men after transjugular intrahepatic portosystemic shunt (TIPS) creation in patients with similar Model for End Stage Liver Disease (MELD) scores.*Methods and Materials This multi-center retrospective cohort study was approved by the Institutional Review Board. A total of 717 patients underwent primary TIPS placement between November 1998 and June 2020. After excluding patients on dialysis and with emergent indications, 520 patients (221 women, 42.5%; 299 men, 57.5%; mean age 56 years) met study criteria. 53.6% were White, 25.4% Hispanic, 12.5% categorized as Other, 6.5% Black and 1.9% Asian. 65% of cases were for refractory ascites or hydrothorax, 29% for non-emergent bleeding and 6% for other indications. MELD scores and TFS were tabulated. Kaplan-Meier survival curves were obtained and Harrington-Fleming tests performed to compare overall, 30-day, 90-day and 365-day survival based on indication and sex. Comparisons were also made in three MELD subcategories: 10 or less, 11 - 18 and 19 - 25.*Results Overall median survival was 5.5 years for females and 4.1 years for males. At a MELD score of 10 or less, median survival was 3.4 years for females and 11.5 years for males. In the overall cohort, no difference was observed in overall TFS ($p = 0.4$), survival at 1 year ($p = 0.8$), survival at 90 days ($p = 0.7$) and survival at 30 days ($p = 0.9$) between the sexes. At a MELD score of 10 or less, overall TFS was slightly better for men compared to women after TIPS ($p = 0.05$). At MELD scores between 11 - 18 ($p = 0.3$) and 18 - 25 ($p = 0.2$), no difference was observed in overall TFS between sexes. There was no difference in TFS based on indication between the sexes ($p = 0.3$).*Conclusions For patients with a MELD score of 10 or less, women had poorer TFS after TIPS compared to men. The findings suggest that MELD underestimates disease severity in women relative to men.*Clinical Relevance/Application Developed to estimate mortality after TIPS placement, the MELD score is now factored into liver transplant allocation algorithms. Liver transplant waitlist outcomes (allocation and death) are worse for females compared to males. A proposed reason for this disparity is that MELD systematically underestimates disease severity in women because of the incorporation of serum creatinine. On average, women with the same creatinine level as men have worse renal function because of lower mean muscle mass. While the relationship between MELD and aspects of liver transplant has been explored, sex-related differences based on MELD in regard to TIPS outcomes remain understudied. This study provides further evidence that MELD is a less adequate prognostic index for women

compared to men. MELD adjustment based on sex is worthy of further investigation.

RESULTS

Overall median survival was 5.5 years for females and 4.1 years for males. At a MELD score of 10 or less, median survival was 3.4 years for females and 11.5 years for males. In the overall cohort, no difference was observed in overall TFS (p = 0.4), survival at 1 year (p = 0.8), survival at 90 days (p = 0.7) and survival at 30 days (p = 0.9) between the sexes. At a MELD score of 10 or less, overall TFS was slightly better for men compared to women after TIPS (p = 0.05). At MELD scores between 11 - 18 (p = 0.3) and 18 - 25 (p = 0.2), no difference was observed in overall TFS between sexes. There was no difference in TFS based on indication between the sexes (p = 0.3).

CLINICAL RELEVANCE/APPLICATION

Developed to estimate mortality after TIPS placement, the MELD score is now factored into liver transplant allocation algorithms. Liver transplant waitlist outcomes (allocation and death) are worse for females compared to males. A proposed reason for this disparity is that MELD systematically underestimates disease severity in women because of the incorporation of serum creatinine. On average, women with the same creatinine level as men have worse renal function because of lower mean muscle mass. While the relationship between MELD and aspects of liver transplant has been explored, sex-related differences based on MELD in regard to TIPS outcomes remain understudied. This study provides further evidence that MELD is a less adequate prognostic index for women compared to men. MELD adjustment based on sex is worthy of further investigation.

IR05-A3   Gastric Arterial Patency After Bariatric Embolization In A Swine Model.

Participants
Frank Yuan, MD, Morgantown, West Virginia (*Presenter*) Nothing to Disclose

PURPOSE

This study evaluates the vascular patency and the degree of left gastric artery revascularization after bariatric embolization with embolic microspheres of varying sizes in a swine model.*Methods and Materials Bariatric embolization was performed in 16 juvenile pigs with 31 left gastric arteries embolized. The selection of fundal arteries for bariatric embolization was based on celiac DSA Cone Beam CT (CBCT). On average, 1 to 3 arteries were embolized using one of three types of particle embolics: 50μm barium-alginate beads, 100-300μm or 300-500μm Embospheres. Repeat angiography was performed before sacrifice (50μm treated animals at 4-weeks; the rest at 16-weeks) to assess the rate and degree of arterial revascularization. Angiograms were scored for the degree of recanalization (complete or partial) or collateralization. Fisher exact test was performed to compare the groups.*Results Of the 11 arteries embolized in the 50μm group, 7 (63%) had complete recanalization, 3 (27%) had partial recanalization, and 1 (10%) had collateralization (no recanalization). In the 100-300μm group (n=10 arteries), 7 (70%) had complete recanalization and 3 (30%) had partial recanalization. In the 300-500μm group (n=10 arteries), 7 (70%) had complete recanalization, 1 (10 %) had partial recanalization and 2 (20%) had collateralization. No statistical difference in the degree of recanalization was present between the groups (Table 1; Figure 1).Table 1. Degree of revascularization per group pan style="font-family: "Times New Roman", serif; font-size: 12pt;">No difference in the degree of revascularization between the three groups (P=0.637).*Conclusions Overall, 90% (28/31) of the embolized arteries exhibited partial or complete arterial recanalization. New arterial collateral formation was observed in 9.7% (3/31) of previously embolized arteries. The embolic microsphere size did not appear to affect the degree of arterial revascularization. *Clinical Relevance/Application The findings from this study challenge the concern that bariatric embolization may preclude future bariatric surgery due to an increased risk for ischemia-related anastomotic dehiscence.

RESULTS

Of the 11 arteries embolized in the 50μm group, 7 (63%) had complete recanalization, 3 (27%) had partial recanalization, and 1 (10%) had collateralization (no recanalization). In the 100-300μm group (n=10 arteries), 7 (70%) had complete recanalization and 3 (30%) had partial recanalization. In the 300-500μm group (n=10 arteries), 7 (70%) had complete recanalization, 1 (10 %) had partial recanalization and 2 (20%) had collateralization. No statistical difference in the degree of recanalization was present between the groups (Table 1; Figure 1).Table 1. Degree of revascularization per group pan style="font-family: "Times New Roman", serif; font-size: 12pt;">No difference in the degree of revascularization between the three groups (P=0.637).

CLINICAL RELEVANCE/APPLICATION

The findings from this study challenge the concern that bariatric embolization may preclude future bariatric surgery due to an increased risk for ischemia-related anastomotic dehiscence.

IR05-A4   Using Intraoperative Neuromonitoring To Prevent Iatrogenic Peripheral Nerve Injury During Embolization Of High-flow Arteriovenous Malformations

Participants
Adham Khalil, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To assess the efficacy of intraoperative neuromonitoring (IONM) as a method to minimize iatrogenic peripheral nerve injury during embolization of high-flow vascular malformations (HFVM).*Methods and Materials The authors retrospectively derived a study cohort of 21 symptomatic patients (mean age 25.4±17 years, range 2-65 years; 66.7% males) with peripherally located Arteriovenous Malformations (AVM) who underwent 80 image-guided embolization sessions (endovascular = 53; percutaneous = 29) using different sclerosants (e.g. Ethanol, Onyx, Glue, Sotradecol, and others) performed between 2012-2021. Provocative testing (PT) using Lidocaine 2% (20-40 mg per vessel; max. total dose 1 g/kg) was performed prior to each individual embolization. Areas with unremarkable PT were embolized. In these cases, IONM was also performed after embolic injection.*Results A total of 80 embolization sessions were performed (44 in lower extremities, 17 abdominopelvic, 15 in upper extremities, 7 in shoulders, and 7 gluteal). Ethanol was used in 45.3% (34/75) of sessions. The mean clinical and image follow-up durations were 34.1±28.6 months and 36.2±28.9 months (range: <1-91.4 months) from first embolization. Neuromonitoring modalities included somatosensory evoked potential (SSEP; N=72 sessions), transcranial motor evoked potentials (TcMEP; N=35 sessions) and/or motor nerve conduction studies (MNCS; N=33 sessions). Intraoperatively, 20% (16/80) of sessions showed signal changes after PT and the decision was made not to proceed with embolization at the corresponding site to avoid nerve damage. Overall, neuromonitoring signal changes were observed in 46.4% (32/69) of SSEP tests, 17.1% (6/35) of TcMEP test, and 34.4% (11/32) of MNCS tests. Of the IONM sessions with signal changes, signal recovery was noted in 11.4% (3/26) SSEP, 40% (2/5) TcMEP, and 28.6% (2/7) MNCS sessions. The overall neurologic complication rate was 6.3% (5/79). All of them were transient. No patient developed a permanent neurologic complication. Previous studies in the literature have reported complication rates ranging from 0% to 12.9% for transient neurologic

complications and rates ranging from 0% to 3.4% for permanent neurologic complications.*Conclusions IONM may improve the safety of embolization of HFVM by preventing permanent neurologic injury.*Clinical Relevance/Application IONM is a valuable tool for intra-procedural use during embolization of HFVMs to protect against iatrogenic peripheral nerve injury.

RESULTS

A total of 80 embolization sessions were performed (44 in lower extremities, 17 abdominopelvic, 15 in upper extremities, 7 in shoulders, and 7 gluteal). Ethanol was used in 45.3% (34/75) of sessions. The mean clinical and image follow-up durations were 34.1±28.6 months and 36.2±28.9 months (range: <1-91.4 months) from first embolization. Neuromonitoring modalities included somatosensory evoked potential (SSEP; N=72 sessions), transcranial motor evoked potentials (TcMEP; N=35 sessions) and/or motor nerve conduction studies (MNCS; N=33 sessions). Intraoperatively, 20% (16/80) of sessions showed signal changes after PT and the decision was made not to proceed with embolization at the corresponding site to avoid nerve damage. Overall, neuromonitoring signal changes were observed in 46.4% (32/69) of SSEP tests, 17.1% (6/35) of TcMEP test, and 34.4% (11/32) of MNCS tests. Of the IONM sessions with signal changes, signal recovery was noted in 11.4% (3/26) SSEP, 40% (2/5) TcMEP, and 28.6% (2/7) MNCS sessions. The overall neurologic complication rate was 6.3% (5/79). All of them were transient. No patient developed a permanent neurologic complication. Previous studies in the literature have reported complication rates ranging from 0% to 12.9% for transient neurologic complications and rates ranging from 0% to 3.4% for permanent neurologic complications.

CLINICAL RELEVANCE/APPLICATION

IONM is a valuable tool for intra-procedural use during embolization of HFVMs to protect against iatrogenic peripheral nerve injury.

IR05-A5   Prediction Of Complication Risk In CT-guided Thoracic Biopsy: A Prescription For Improving Procedure Safety

Participants
Hwan Lee, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

CT-guided trans-thoracic biopsy (CTTB) is a minimally invasive procedure with high diagnostic yield in the evaluation of a variety of thoracic diseases. In this study, we comprehensively assessed a large CTTB cohort to predict procedural and patient factors associated with risk of complication.*Methods and Materials e medical record and CT images of 1,430 patients who underwent CTTB were reviewed individually to obtain clinical information and technical factors of the procedure. Statistical analyses included descriptive and summary statistics, univariate analysis with Fisher's test, multivariate logistic regression, and machine learning methods.*Results The most common type of complication was pneumothorax (17.4% of the patients), followed by bleeding (5.9%). Only 26 patients (1.8%) developed a major complication (defined by SIR guidelines). On univariate analysis, significantly higher rate of complication was seen for lung lesions (OR 14.5 [6.4-32.9] for lung vs. non-lung). In addition, non-dependent position of the lesion (OR 4.2 [2.3-7.5]), vertical needle approach (OR 2.5 [1.8-3.6]), and involvement of a trainee (OR 1.3 [1.0-1.7]) increased risk of complication, whereas use of co-axial technique (OR 0.6 [0.4-0.7]) was a protective factor (shown as OR [95% CI]). Similar odd ratios were obtained when the patients with lung lesions (n=1,196) were analyzed separately. Presence of emphysema (P=0.32), patient position (P=0.32), and sex (P=0.40) were not linked to rate of complication. For non-lung lesions, trespassing the pleural space was highly predictive of complications (OR 82.7 [9.0-760.5]). On multivariate analysis, a support vector machine model achieved an AUC of 0.898 for prediction of complications on lung lesions (on validation cohort). A logistic regression model achieved AUC of 0.884, 0.723 and 0.745 for prediction of major, minor and no complications, respectively.*Conclusions Technical procedural factors that can be decided by the operator are highly predictive of the risk of complications on CTTB.*Clinical Relevance/Application Physicians may optimize their techniques to improve procedure safety and outcomes of CT-guided trans-thoracic biopsy.

RESULTS

The most common type of complication was pneumothorax (17.4% of the patients), followed by bleeding (5.9%). Only 26 patients (1.8%) developed a major complication (defined by SIR guidelines). On univariate analysis, significantly higher rate of complication was seen for lung lesions (OR 14.5 [6.4-32.9] for lung vs. non-lung). In addition, non-dependent position of the lesion (OR 4.2 [2.3-7.5]), vertical needle approach (OR 2.5 [1.8-3.6]), and involvement of a trainee (OR 1.3 [1.0-1.7]) increased risk of complication, whereas use of co-axial technique (OR 0.6 [0.4-0.7]) was a protective factor (shown as OR [95% CI]). Similar odd ratios were obtained when the patients with lung lesions (n=1,196) were analyzed separately. Presence of emphysema (P=0.32), patient position (P=0.32), and sex (P=0.40) were not linked to rate of complication. For non-lung lesions, trespassing the pleural space was highly predictive of complications (OR 82.7 [9.0-760.5]). On multivariate analysis, a support vector machine model achieved an AUC of 0.898 for prediction of complications on lung lesions (on validation cohort). A logistic regression model achieved AUC of 0.884, 0.723 and 0.745 for prediction of major, minor and no complications, respectively.

CLINICAL RELEVANCE/APPLICATION

Physicians may optimize their techniques to improve procedure safety and outcomes of CT-guided trans-thoracic biopsy.

Abstract Archives of the RSNA, 2021

Sub-Events

IN05-B2   **Dynamic Priority Queues Improve Study Turnaround Times In A Radiology Worklist**

Participants
Thilakshan Kanesalingam, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

The overuse of urgency on imaging studies (e.g., STAT) can place an undue burden on radiology departments where every study is now a top priority. In response, many hospitals have developed fine-grain priority levels and processes to better communicate studies that require immediate action. Unfortunately, this separation of priority levels into many separate queues can easily lead to the 'starvation' of imaging studies in lower priority groups. In this study we adapted a dynamic priority queue algorithm commonly used in network routing to improve the turnaround time for radiological interpretation across all modalities without adding new resources.*Methods and Materials We adopted a simulation approach to test the hypothetical performance gains of a dynamic priority queue over more common workflow management strategies such as a priority grouping coupled with first-in first-out. Our case study includes over 25,000 imaging studies derived from the operations of a large teleradiology firm. Our dynamic priority queue combined an 'earliest due date' and 'shortest processing time first' scheduling strategy to optimally allocate the next most important study to a given radiologist.*Results A dynamic priority queue improved three core measures in our simulated radiology department relative to a priority group first-in first-out strategy. First, it reduced the average turnaround time of imaging studies by 27% (252 to 184 minutes). Second, it increased the percentage of imaging studies returned by their deadline by 6.6% (77.6% to 84.2%). Third, it reduced the number of studies that required off-hours interpretations by 12.4% (22.7% to 10.3%).*Conclusions We saw resource starvation of lower priority studies anecdotally in our observation of a large teleradiology organization, but we also reproduced these results in a simulation of their operations. In our simulation around half of the caseload were routine studies, but only 63% of them were interpreted within 24 hours. This starvation was driven by a quarter of the caseload from the emergency department that required attention in that hour. Dynamic priority queueing jointly considers the study's deadline as well as its priority level. This more evenly distributed studies to radiologists to improve workflow efficiency and the reliability of turnaround time agreements.*Clinical Relevance/Application Improving workflow efficiency in radiology departments will have positive downstream impacts in emergency departments by reducing delays in critical treatments and report turnaround times.

RESULTS

A dynamic priority queue improved three core measures in our simulated radiology department relative to a priority group first-in first-out strategy. First, it reduced the average turnaround time of imaging studies by 27% (252 to 184 minutes). Second, it increased the percentage of imaging studies returned by their deadline by 6.6% (77.6% to 84.2%). Third, it reduced the number of studies that required off-hours interpretations by 12.4% (22.7% to 10.3%).

CLINICAL RELEVANCE/APPLICATION

Improving workflow efficiency in radiology departments will have positive downstream impacts in emergency departments by reducing delays in critical treatments and report turnaround times.

Printed on: 06/28/22

IN04-C

Informatics Wednesday Poster Discussions

Sub-Events

IN04-C2   Deep Learning For Detection Of Metal Dense Implants In X-ray Imaging

Participants
Hien Tran, MD, Freiburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Development of a robust algorithm for detection of metal dense implants such as osteosynthesis, prosthesis, screws or endobuttons in musculoskeletal x-ray imaging.*Methods and Materials MSK-Radiographs from our department from 2018-2019 were classified for presence or absence of implants. Reading was performed first by a medical student, followed by a junior and a senior radiologist. 13600 images were annotated and exported for the deep learning study; about 17% were showing implants. Data leakage was excluded by separating the data groups on a patient level, resulting in 8607 images for training, 3662 for validation and 1331 for result calculation. To develop the deep learning model, established convolutional neural networks, InceptionV3, ResNet50, and Densenet121 (results in that order) were modified with Keras to produce binary output, using a custom network-top on a fully trainable base model pretrained on Imagenet. Images were rescaled to 256*256 pixels and grayscale was augmented using the image, an inverted image, and an edge-optimized image to form a 3-level image. The data was randomized, balanced, and mildly augmented on the fly as batches were created. Deep learning was performed by using Tensorflow 2.4 with a standard graphics unit (Nvidia Tesla K80). Following parameters were used: 200 training epochs. AdaDelta as a solver type and the learning rate reducing from 0.1 to 0.005. The calculation and visualization of the results of the networks used sklearn and tf-explain.*Results The training of the CNNs took each around 3h. Image processing of all 1331 test-images took 144,116,107 seconds. The overall accuracy of the separate test sample is 99.0, 99.3, 99.3%. The sensitivity was 0.94, 0.96, 0.97 and specificity was for all 1.00.*Conclusions The algorithms created all show good detection and exclusion rates for metal-dense material in MSK radiographs. The best performance was achieved with a DenseNet121, although the results of the other two tested networks were almost comparable.*Clinical Relevance/Application For clinical acceptance, a major challenge in AI is to avoid misapplications that lead to incorrect results. With sorting algorithms as a precursor, optimized automated use of AI-based algorithms within clinical workflows becomes feasible.

RESULTS

The training of the CNNs took each around 3h. Image processing of all 1331 test-images took 144,116,107 seconds. The overall accuracy of the separate test sample is 99.0, 99.3, 99.3%. The sensitivity was 0.94, 0.96, 0.97 and specificity was for all 1.00.

CLINICAL RELEVANCE/APPLICATION

For clinical acceptance, a major challenge in AI is to avoid misapplications that lead to incorrect results. With sorting algorithms as a precursor, optimized automated use of AI-based algorithms within clinical workflows becomes feasible.

Abstract Archives of the RSNA, 2021

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NPM01-B

Noninterpretive Sunday Poster Discussions

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Sub-Events

NPM01-B2   Is Radiology Lagging Behind Other Specialties In Education Scholarship Publications?

Participants

Elana Smith, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To compare the numbers of educational scholarship publications per medical specialty. The authors hypothesized: 1. Percentage of educational scholarship publications is lower in highest impact factor (IF) radiology journals than in other specialties. 2. In radiology journals, the proportion of educational scholarship publications is negatively associated with journal IF.*Methods and Materials The Journal Citation Reports (JCR) database was used to select the 5 titles with the highest IFs in 19 medical specialties. For time period Jan 1, 2016-Jan 1, 2021, this PubMed search strategy was performed in top IF and all JCR-listed Radiology journals: (Education, Medical[MAJR] OR Education, Medical, Graduate[MAJR] OR Education, Medical, Undergraduate[MAJR] OR "medical education"[tiab] OR "graduate medical education"[tiab] OR "undergraduate medical education"[tiab]) AND "journal name"[TA] AND "2016/1/1"[dcom] : "2021/1/1"[dcom], followed by "journal name"[TA] AND "2016/1/1"[dcom] : "2021/1/1"[dcom]. To test hypothesis 1, an indicator variable for radiology journals vs. non-radiology journals was created. Fixed effects logistic regressions were implemented. To address hypothesis 2, mixed effects logistic regressions were implemented.*Results Neurosurgery and Radiation Oncology journals index with Surgery and Radiology journals respectively; 17 specialties were assessed. Radiology educational scholarship publications ranked 12/17 across specialties. The proportion of educational articles is significantly higher for non-radiology journals, 12.16 per 1000 articles [SE=0.31, 95% CI: [11.56, 12.78], compared to radiology journals, 4.94 per 1000 articles (SE=0.79, 95% CI: [3.61, 6.75]. IF was not associated with the proportion of educational scholarship publications in radiology journals (p=0.86). Educational scholarship: 0.41% of publications in top IF Radiology journals. 16/132 Radiology journals published >1% educational scholarship articles. Academic Radiology published 12.37%.41 radiology journals IF > 3. Of these, 85.4% (35/41) devoted <1% of their publications to educational scholarship.*Conclusions 1. Radiology lags behind most medical specialties in educational scholarship publications in top IF journals. 2. Many radiology journals with high IF do not emphasize educational scholarship.*Clinical Relevance/Application Educational publications are important to academic portfolios and career advancement for clinician educators. Fewer opportunities to publish educational scholarship negatively impacts Radiology faculty. Passive learning yields medical student disinterest and negatively affects radiology recruitment; innovative teaching engages students and assists in recruitment/retention.

RESULTS

Neurosurgery and Radiation Oncology journals index with Surgery and Radiology journals respectively; 17 specialties were assessed. Radiology educational scholarship publications ranked 12/17 across specialties. The proportion of educational articles is significantly higher for non-radiology journals, 12.16 per 1000 articles [SE=0.31, 95% CI: [11.56, 12.78], compared to radiology journals, 4.94 per 1000 articles (SE=0.79, 95% CI: [3.61, 6.75]. IF was not associated with the proportion of educational scholarship publications in radiology journals (p=0.86). Educational scholarship: 0.41% of publications in top IF Radiology journals. 16/132 Radiology journals published >1% educational scholarship articles. Academic Radiology published 12.37%.41 radiology journals IF > 3. Of these, 85.4% (35/41) devoted <1% of their publications to educational scholarship.

CLINICAL RELEVANCE/APPLICATION

Educational publications are important to academic portfolios and career advancement for clinician educators. Fewer opportunities to publish educational scholarship negatively impacts Radiology faculty. Passive learning yields medical student disinterest and negatively affects radiology recruitment; innovative teaching engages students and assists in recruitment/retention.

NPM01-B4   Conversion Factor: Converting An In-Person Didactic Rectal Cancer MRI Lecture Into An Interactive Online Experience

Participants

Jonathan Levine, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

The COVID-19 pandemic has pushed medical student and trainee education to the virtual world. New challenges for Radiology educators presenting digitally include limited participation, technology hiccups, absence of live feedback, and image quality limitations. However, online tools also provide new opportunities to go beyond simply converting an in-person lecture to a virtual one. In the time of COVID-19 and beyond, leveraging technology and learning theory can allow the educator to engage learners in a more meaningful interactive experience.

TABLE OF CONTENTS/OUTLINE

1. Goals and objectives 2. The traditional model for Radiology education and its shortcomings 3. A proposed new model incorporating virtual tools and lessons from learning theory 4. Specific ways to make a traditional Powerpoint presentation more interactive and meaningful in the virtual world: Scrollable cases instead of still images or GIFs, Polling software (RSNA Diagnosis

Live, Poll Everywhere) instead of "hot seat" questioning, Self-directed online modules instead of or to augment scheduled lectures 5. Lessons from learning theory and how the above techniques can improve knowledge retention over didactic lectures: Retrieval practice, Spaced learning, Reflection, Gamification, Interleaving 6. The authors' experience of converting a didactic lecture on Rectal Cancer MRI into an online learning experience, including results and lessons learned along the way 7. Continuing challenges for the Radiology educator in the virtual world

Abstract Archives of the RSNA, 2021

Sub-Events

PH01-B10   Ultra-high Resolution And Area-detector CTs For Lung Density Evaluation: Capability For Radiation Dose Reduction With Two-types Of Iterative Reconstruction And Deep Learning Reconstruction At QIBA Phantom Study

Participants
Chika Shigemura, Toyoake, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To compare radiation dose reduction capability of ultra-high-resolution CT (UHR-CT) and area-detector CT (ADCT) for lung density assessment among hybrid-type and mode-based iterative reconstruction (IR) and developed deep learning reconstruction (DLR) at Quantitative Imaging Biomarkers Alliance (QIBA) recommended phantom study.*Methods and Materials QIBA recommended phantom (COPDGene II, Phantom Laboratory) was scanned by UHR-CT with normal resolution (NR: 0.5mm×80 rows/896 channels), high resolution (HR: 0.5mm×80 rows/1792 channels) and super-high resolution (SHR: 0.25mm×160 rows/1792 channels) and ADCT (0.5mm×80 rows/896 channels) at 400mA, 230mA, 100mA, 50mA, 20mA and 6mA in five times. Then, all CT data were reconstructed as 0.5mm and 1mm section thicknesses by each reconstruction. Then, CT values of all density forms and mean differences between measured CT value within lung density form and standard reference (?CT) were determined by ROI measurements in five times. Then, Pierson's correlation was analyzed between measured CT density and standard reference of each form on all CT protocols. To compare the capability for radiation dose reduction on each CT data with ADCT obtained by 400mA and reconstructed with hybrid-type IR (i.e. standard protocol), ?CT of each protocol was compared with that of standard protocol by paired t-test. In addition, the limits of agreements by Bland-Altman analyses were compared with QIBA profile for lung densitometry.*Results There was significant and excellent correlation with standard reference on each protocol (0.99<r<1, p<0.0001). When reconstructed as 0.5mm and 1mm section thicknesses, UHR-CT with SHR modes at 6mA and reconstructed by each method or UHR-CT with HR mode at 6mA and reconstructed with DLR had significant differences of ?CT with standard protocol (p<0.05). The limits of agreement on all CT protocols were ranged from -5.1HU to 5.4HU and small enough as compared with QIBA profile.*Conclusions For lung density assessment, hybrid-type and model-based IR as well as DLR on UHR-CT and ADCT can reduce 95% radiation dose with keeping accuracy as compared with standard CT protocol and QIBA profile.*Clinical Relevance/Application For lung density assessment, hybrid-type and model-based IR and DLR on UHR-CT and ADCT can reduce radiation dose at 5% level with keeping accuracy as compared with standard protocol and QIBA profile.

RESULTS

There was significant and excellent correlation with standard reference on each protocol (0.99<r<1, p<0.0001). When reconstructed as 0.5mm and 1mm section thicknesses, UHR-CT with SHR modes at 6mA and reconstructed by each method or UHR-CT with HR mode at 6mA and reconstructed with DLR had significant differences of ?CT with standard protocol (p<0.05). The limits of agreement on all CT protocols were ranged from -5.1HU to 5.4HU and small enough as compared with QIBA profile.

CLINICAL RELEVANCE/APPLICATION

For lung density assessment, hybrid-type and model-based IR and DLR on UHR-CT and ADCT can reduce radiation dose at 5% level with keeping accuracy as compared with standard protocol and QIBA profile.

PH01-B3   A Comparative Study Of CT Image Standardization Models In Non-small Cell Lung Cancer

Participants
Mauro Hanaoka, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose

PURPOSE

Due to the sensitivity of CT images to acquisition parameters, multicentric images studies across intra/inter manufacturers with different noise level, sharpness, edge enhancement and reconstruction algorithms often suffer from a lack of homogeneity in terms of statistical characteristics. There is a critical need for image-based standardization, making CT imaging more sensitive, specific and predictive, and improving clinical outcomes associated with image-based features. This study evaluates several CT image standardization techniques that translate heterogeneous images to match the statistical properties of a standard domain.*Methods and Materials Seven CT image standardization models, namely cGAN, CNN, GANai, STAN-CT, RadiomicGAN, CycleGAN, and CVS-CT were evaluated and compared using NSCLC patient data. The models required paired training data except CycleGAN and CVS-CT. CT images for training and testing were acquired in a Siemens Sensation Force using two different kernels (Br40, Bl64) and 1 mm slice thickness. The training data included a total of 33,406 CT image slices. The test data contains images from 13 NSCLC patients which includes a total 9,116 CT image slices. Approximately 1715 radiomics sub-features extracted from the lung nodule of each individual patient using IBEX were used to evaluate the performance of CT image normalization models. Concordance Correlation Coefficient (CCC) was employed to measure the level of reproducibility of radiomic features between the standardized images and target images.*Results The baseline images (before standardized) have an averaged CCC score 0.71&3;0.18 on NSCLC, and the RadiomicGAN has the best averaged CCC of 0.95&3;0.07 on NLCS. Overall, cGAN, CNN, GANai, STAN-CT, RadiomicGAN, CycleGAN, and CVS-CT improves the feature stability by 22.8%, 23.5%, 23.3%, 23.3%, 23.7%, 9.3% and 7.3%, respectively. Models that do not require paired training image data have significantly lower performance than the others probably due to high model

complexity.*Conclusions Image standardization reduces cross-domain variation and improves the stability of radiomic features. RadiomicGAN shows the best performance.*Clinical Relevance/Application Understanding CT standardization models can help advance the radiomic studies in NSCLC and improve clinical outcomes associated with image-based features.

RESULTS

The baseline images (before standardized) have an averaged CCC score 0.71&3;0.18 on NSCLC, and the RadiomicGAN has the best averaged CCC of 0.95&3;0.07 on NLCS. Overall, cGAN, CNN, GANai, STAN-CT, RadiomicGAN, CycleGAN, and CVS-CT improves the feature stability by 22.8%, 23.5%, 23.3%, 23.3%, 23.7%, 9.3% and 7.3%, respectively. Models that do not require paired training image data have significantly lower performance than the others probably due to high model complexity.

CLINICAL RELEVANCE/APPLICATION

Understanding CT standardization models can help advance the radiomic studies in NSCLC and improve clinical outcomes associated with image-based features.

PH01-B4   Use Of 7 Tesla MRI For Frameless Presurgical Planning With Skin-Adhesive Fiducials: Overcoming Image Geometric Distortion

Participants
Krystal Kirby, Baton Rouge, Louisiana (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate and correct image geometric distortion at the position of skin-adhesive fiducial markers in 7 Tesla (7T) MR images used for frameless stereotactic neurosurgical navigation.*Methods and Materials Three volunteers were imaged at 3T and 7T (Magnetom Prisma and Terra respectively, Siemens, Germany). 10 skin-adhesive fiducials were placed on the exposed skin surface of the volunteers, according to standard placement procedures, to facilitate patient-to-image registration in a commercial surgical planning system (StealthStation S8, Medtronic, USA). Imaging sequences included a magnetization-prepared rapid gradient echo (MPRAGE) with three receiver bandwidths (400, 690, and 1020 Hz/pixel) and a B0 field map. The vendor-provided distortion correction (DC) algorithm for gradient nonlinearity was used. A custom grid phantom was 3D printed to evaluate gradient scaling correction (GSC) factors. The phantom scans included a very high-bandwidth MPRAGE (1450 Hz/pixel) and high-resolution CT (Somatom Force, Siemens, Germany). GSC factors were determined by comparing three-axis measurements on the grid phantom through isocenter in MR and CT images. After rigid registration of in vivo images, a geometric distortion comparison was performed by measuring corresponding locations of the 10 fiducials in each volume with only the DC, after gradient scaling, and after correction via the B0 field map.*Results Scaling correction factors were X=101.1%, Y=102.2%, and Z=101.0%. With only the DC, differences between 3T and 7T MPRAGE with high/medium/low bandwidth were 2.2mm, 2.6mm, and 2.3mm. After the GSC, differences lowered (p<0.001) to 1.6mm, 1.3mm, and 1.0mm. Data from 4 fiducials was excluded due to patient positioning differences on 3T vs. 7T. Corrections with B0 field maps did not change these values significantly. 3T phantom data compared to CT had errors < 1.0mm.*Conclusions Geometric distortions in frameless 7T presurgical imaging can be reduced to a clinically relevant level (errors <~1mm) with no significant susceptibility-related distortions, by using high receiver bandwidth, ensuring gradients are properly calibrated, and placing skin fiducials in areas where distortions from patient positioning are minimal.*Clinical Relevance/Application Skin fiducial locations in 7T images yielded about 1mm distortion, without additional B0 correction. This facilitates the clinical implementation of 7T for frameless surgical guidance procedures.

RESULTS

Scaling correction factors were X=101.1%, Y=102.2%, and Z=101.0%. With only the DC, differences between 3T and 7T MPRAGE with high/medium/low bandwidth were 2.2mm, 2.6mm, and 2.3mm. After the GSC, differences lowered (p<0.001) to 1.6mm, 1.3mm, and 1.0mm. Data from 4 fiducials was excluded due to patient positioning differences on 3T vs. 7T. Corrections with B0 field maps did not change these values significantly. 3T phantom data compared to CT had errors < 1.0mm.

CLINICAL RELEVANCE/APPLICATION

Skin fiducial locations in 7T images yielded about 1mm distortion, without additional B0 correction. This facilitates the clinical implementation of 7T for frameless surgical guidance procedures.

PH01-B5   Miniaturized Head Tomography Imaging Using CNT X-ray Tubes - First Experimental Results

Participants
Brian Gonzales, PhD, SeaTac, Washington (*Presenter*) Scientist, Micro-X Ltd

PURPOSE

Stroke patients require rapid treatment due to the time-sensitive nature of the disease; Ischemic strokes can be directly treated with TPA if identified early. The use of TPA requires medical imaging to ensure there is no hemorrhage in the brain. Mobile Stroke Units using small head CT imaging units have shown significant improvement in patient outcomes by bringing CT imaging directly to patients, but these units are large, complex, expensive and difficult to deploy. We are investigating the use of CNT x-ray tubes to create an ultra-lightweight cost-effective stroke imaging tomography device that could be deployed in any ambulance to enable early imaging of patients suffering a stroke.*Methods and Materials We tested an early version of the concept using a digital x-ray device and a set of technical phantoms. We improved the early version through a series of simple geometric simulations and constructed a prototype fixed gantry cone beam wide angle Tomosynthesis scanner. Together with the Royal Melbourne Hospital, we imaged two cadavers and compared these images with scans taken using a conventional CT. We further tested the concept with a more detailed initial simulation study.*Results Early testing of the of the wide angle tomosynthesis showed accurate high resolution in the coronal plane, tangential to the array of CNT x-ray sources, but significant artifacts in the other planes. The second version significantly improved the resolution in the axial and sagittal planes, but the contrast within the brain was still low due to the number of sources and artifacts due to the skull. A unique dual-energy bone suppression approach was applied to suppress the skull artifacts in the projection slices and reconstructions showed improved soft-tissue contrast. Simulations showed further optimization of the array of x-ray tubes along with the dual-energy approach could enable the visualization of small hemorrhages down to a few mm in size.*Conclusions First testing demonstrated the potential effectiveness of a simple fixed gantry tomosynthesis imaging system using an array of CNT x-ray tubes to image patients suffering strokes, to rule out hemorrhages and enable early treatment with TPA. The unique fixed gantry approach allows for the use of simple dual energy bone suppression that significantly improves soft-tissue contrast. Further work is in progress via simulations and algorithm refinement to achieve a targeted 1mm bleed.*Clinical Relevance/Application Stroke is the second most common cause of death in individuals over sixty and the second most common cause of long-term disability globally. If early stroke imaging can be achieved in a low-cost system that is

easily deployed into any ambulance, millions of people every year could be helped, and thousands of lives saved.

RESULTS

Early testing of the of the wide angle tomosynthesis showed accurate high resolution in the coronal plane, tangential to the array of CNT x-ray sources, but significant artifacts in the other planes. The second version significantly improved the resolution in the axial and sagittal planes, but the contrast within the brain was still low due to the number of sources and artifacts due to the skull. A unique dual-energy bone suppression approach was applied to suppress the skull artifacts in the projection slices and reconstructions showed improved soft-tissue contrast. Simulations showed further optimization of the array of x-ray tubes along with the dual-energy approach could enable the visualization of small hemorrhages down to a few mm in size.

CLINICAL RELEVANCE/APPLICATION

Stroke is the second most common cause of death in individuals over sixty and the second most common cause of long-term disability globally. If early stroke imaging can be achieved in a low-cost system that is easily deployed into any ambulance, millions of people every year could be helped, and thousands of lives saved.

PH01-B6   Ultra Low Dose Whole-body Computed Tomography Protocol Optimization For Patients With Plasma Cell Disorders: Diagnostic Accuracy And Effective Dose Analysis From An Italian Reference Center

Participants
Giulio Strazzarino, MD, Torino, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the performances of a whole-body low dose CT protocol, evaluating diagnostic accuracy and patient effective dose reduction achievable with a latest generation CT scanner.*Methods and Materials The study was performed using a 256 slices CT scanner (Revolution CT, GE, USA). First WBLDCT examinations were performed in 2018 starting from a reference protocol with acquisition parameters set (120 kV, collimation 80 mm, rotation time, pitch, slice thickness 1,25 mm, noise index (NI) 25, iterative ASIR-V 50%). In February 2019, a phantom study was performed to investigate the minimum dose that allow to maintain an optimal diagnostic accuracy in lesion detection. This low dose protocol was implemented in clinical practice from April 2019 on 189 consecutive patients.Images were evaluated by three readers for image quality using a 5 point scale (1:non diagnostic; 5:excellent quality) and to detect lesions.*Results There was an overall very good agreement on image quality scores between the three readers for both groups as demonstrated by repeated measures ANOVA test with p values always superior to 0,05.An excellent inter-rater agreement for lesion detection was achieved evaluating both groups singularly and also considering the whole patient population,obtaining high values of Fleiss' kappa for all districts, ranging from 0,851 for humeral head to 1 for thoracic spine with values of p always <0,001.DLP median value for the original protocol was about 345 mGy cm (mean value 342,5 ± 102 mGy cm), with an interquartile range (IQR) of 302-408 mGy cm. With the optimized protocol, a 56% reduction of the median DLP was observed resulting in a value of 151 mGy cm (IQR 128-188 mGy cm, mean 160,5 ± 55 mGy cm). A dose reduction of about 60% was observed also for CTDIvol, from an initial median value of 2.2 mGy (IQR 1.9 - 2.7 mGy, mean 2,2 ± 0,6 mGy cm) down to a median CTDIvol of 0.9 mGy (IQR 0.8 - 1.2 mGy, mean 1 ± 0,4 mGy cm). Dose reduction was statistically significant for both DLP and CTDI vol (p < 0,001 in both cases).*Conclusions The lowest achievable dose for WBLDCT can be assessed with phantom studies and proper image quality metrics (including noise power spectrum, task transfer function and subjective image quality) thus demonstrating that routine ultra-low dose WBLDCT is feasible on latest generation CT scanners with a proper balance between tube current modulation parameters and iterative reconstruction strength resulting in excellent image quality and diagnostic accuracy with significant dose reduction for patients respecting the ALARA/ALARP principles (as low as reasonably achievable/as low as reasonably practicable).*Clinical Relevance/Application Optimization of Low Dose protocols in clinical practice starting from a phantom study.

RESULTS

There was an overall very good agreement on image quality scores between the three readers for both groups as demonstrated by repeated measures ANOVA test with p values always superior to 0,05.An excellent inter-rater agreement for lesion detection was achieved evaluating both groups singularly and also considering the whole patient population,obtaining high values of Fleiss' kappa for all districts, ranging from 0,851 for humeral head to 1 for thoracic spine with values of p always <0,001.DLP median value for the original protocol was about 345 mGy cm (mean value 342,5 ± 102 mGy cm), with an interquartile range (IQR) of 302-408 mGy cm. With the optimized protocol, a 56% reduction of the median DLP was observed resulting in a value of 151 mGy cm (IQR 128-188 mGy cm, mean 160,5 ± 55 mGy cm). A dose reduction of about 60% was observed also for CTDIvol, from an initial median value of 2.2 mGy (IQR 1.9 - 2.7 mGy, mean 2,2 ± 0,6 mGy cm) down to a median CTDIvol of 0.9 mGy (IQR 0.8 - 1.2 mGy, mean 1 ± 0,4 mGy cm). Dose reduction was statistically significant for both DLP and CTDI vol (p < 0,001 in both cases).

CLINICAL RELEVANCE/APPLICATION

Optimization of Low Dose protocols in clinical practice starting from a phantom study.

PH01-B7   Estimating Water-equivalent Diameter From CT Localizer

Participants
Christiane Burton, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Estimating water-equivalent diameter (WED) from CT localizer radiographs would allow it to be included into data-driven clinical workflows such as size adaptive protocol selection like diagnostic reference ranges (DRRs) which provide a minimum estimated patient dose. A calibration method to estimate WED from CT localizers was proposed. In this study we apply this method to patient data on 3 scanners and compare it to AAPM 220 results.*Methods and Materials CT axial and CT localizer images of the CTDIvol phantom with 1.0 (PMMA rod), 16, and 32 cm diameters and the ACR phantom were acquired on 3 scanners. Calibration curves were obtained for each scanner. Using patient data, the CT localizer-based WED was plotted as a function of the CT axial-based WED.*Results The calibration curves are linear on all scanners with R2<0.97, however the slope and y-intercepts vary. With the exception of outliers cause by truncation in the CT axial images, the CT localizer-based WED as a function of CT axial-based WED falls within the 95% confidence interval.*Conclusions The water-equivalent diameter can be estimated from the CT localizer radiograph.*Clinical Relevance/Application The water-equivalent diameter (WED) takes into account the attenuation of the patient when estimating dose prior to CT axial scanning.

RESULTS

The calibration curves are linear on all scanners with R2<0.97, however the slope and y-intercepts vary. With the exception of outliers cause by truncation in the CT axial images, the CT localizer-based WED as a function of CT axial-based WED falls within the 95% confidence interval.

CLINICAL RELEVANCE/APPLICATION

The water-equivalent diameter (WED) takes into account the attenuation of the patient when estimating dose prior to CT axial scanning.

PH01-B9   Comparison Of Two Deep Learning Image Reconstruction Algorithms on Chest CT Images: A Task-based Image Quality Assessment on Phantom Data

Participants
Joel Greffier, PhD, Nimes, France (*Presenter*) Nothing to Disclose

PURPOSE

To compare the effect of two Deep Learning Image Reconstruction (DLR) algorithms (AiCE and TrueFidelity) on task-based image quality.*Methods and Materials Acquisitions on an image quality phantom were acquired using six dose levels (CTDIvol: 10/7.5/5/2.5/1/0.5mGy) on two CT scanners. Raw data were reconstructed using the filtered back-projection (FBP) and the lowest/intermediate/highest DLR levels (L-DLR/M-DLR/H-DLR) of each algorithm. The noise power spectrum and task-based transfer function (TTF) were computed. The detectability index (d') was computed to model the detection of a low-contrast chest nodule, a ground-glass opacity, and a high contrast pulmonary lesion.*Results For the L-DLR and M-DLR levels, the noise magnitude was lower with TrueFidelity than with AiCE from 2.5 to 10mGy but the opposite for 1 and 0.5mGy. For all dose levels and H-DLR, noise magnitude was lower with AiCE than with TrueFidelity. For L-DLR and M-DLR, the average NPS spatial frequency (fav) values were higher for AiCE than for TrueFidelity for all dose levels except for 0.5mGy. For H-DLR levels, fav values were higher for TrueFidelity than for AiCE. Compared to TrueFidelity, TTF values at fifty percent were higher with AiCE for the air insert, and lower for the polyethylene insert. From 10 to 2.5mGy, d' values were higher for AiCE than for TrueFidelity for H-DLR for all simulated lesions, but were in the same range for L-DLR and M-DLR.*Conclusions DLR algorithms reduced the image noise and improved lesion detectability. The operation and properties of these algorithms impacted in different ways the noise texture and the spatial resolution.*Clinical Relevance/Application This study compared for the first time the two new DLR algorithms most used in clinical practice. We confirmed that these two algorithms reduced noise and improved the detectability of simulated chest lesions. We also showed that the operation and properties of these algorithms impacted in different ways the noise texture and spatial resolution. TrueFidelity had less impact on the spatial resolution and did not modify the image texture compared to AiCE. It should be noted that the choice of the DLR level has an impact on the metric results obtained.

RESULTS

For the L-DLR and M-DLR levels, the noise magnitude was lower with TrueFidelity than with AiCE from 2.5 to 10mGy but the opposite for 1 and 0.5mGy. For all dose levels and H-DLR, noise magnitude was lower with AiCE than with TrueFidelity. For L-DLR and M-DLR, the average NPS spatial frequency (fav) values were higher for AiCE than for TrueFidelity for all dose levels except for 0.5mGy. For H-DLR levels, fav values were higher for TrueFidelity than for AiCE. Compared to TrueFidelity, TTF values at fifty percent were higher with AiCE for the air insert, and lower for the polyethylene insert. From 10 to 2.5mGy, d' values were higher for AiCE than for TrueFidelity for H-DLR for all simulated lesions, but were in the same range for L-DLR and M-DLR.

CLINICAL RELEVANCE/APPLICATION

This study compared for the first time the two new DLR algorithms most used in clinical practice. We confirmed that these two algorithms reduced noise and improved the detectability of simulated chest lesions. We also showed that the operation and properties of these algorithms impacted in different ways the noise texture and spatial resolution. TrueFidelity had less impact on the spatial resolution and did not modify the image texture compared to AiCE. It should be noted that the choice of the DLR level has an impact on the metric results obtained.

CA04-C

Cardiac Wednesday Poster Discussions

Sub-Events

CA04-C3   Assessment Of Dose Reduction Potential For Virtual Monoenergetic Coronary Artery Calcium Quantification With Dual-source Photon-counting CT: A Dynamic Phantom Study

Participants
Niels Van der Werf, MSc, Rotterdam, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

To assess the potential of coronary artery calcium (CAC) quantification on virtual monoenergetic images (VMI) at reduced radiation dose on a clinical dual source photon-counting detector (PCD) computed tomography (CT) system.*Methods and Materials A dynamic phantom with a cylindrical CAC (length:1.0 cm, diameter: 0.5 cm, density: 800 mg hydroxyapatite cm-3) was scanned with a clinical protocol for CAC scoring on a clinical dual-source PCD CT (NAEOTOM Alpha, Siemens Healthineers). The artery was moved in one direction at 60-75 beats per minute within a water compartment at the center of an anthropomorphic thorax phantom (QRM thorax, QRM). All acquisitions were repeated five times at 100% and 50% clinical radiation dose by adapting the tube current. VMI were reconstructed with filtered back projection at 40, 50, ?, 190 keV. For CAC quantification as Agatston scores, previously defined VMI energy level specific thresholds were used. Agatston scores were automatically calculated with a previously validated, in-house developed Python script. Agatston score deviations of >10% with the reference (ME 70 keV - 130 HU) were deemed to be clinically relevant. Contrast-to-noise ratios (CNR) were determined for each VMI level to assess CAC visualization.*Results Compared to the reference at 70 keV, deviations in median Agatston scores for clinical radiation dose were at most -6.4%, irrespective of VMI level. At reduced radiation dose, VMI at 40, 50 and 60 keV again showed comparable (maximum deviation -7.1%) median Agatston scores in comparison with the reference. Increased VMI levels showed clinically relevant in Agatston score up to 22%. Reference median (total range) CNR was at 18.6 (17.6;19.6) and 15.3 (14.8;15.5) for 100% and 50% radiation dose, respectively. CNR increased with decreasing VMI level, and decreased with increasing VMI level. At 40 keV, CNR was at 26.8 (26.0;27.9) and 21.9 (20.1;22.7) for 100% and 50% radiation dose, respectively. CNR at 190 keV was reduced to 7.4 (7.2;8.5) and 6.6 (5.8;7.2), respectively.*Conclusions With VMI level specific CAC thresholds, reduced VMI levels resulted in comparable Agatston scores with superior CNR at reduced radiation dose.*Clinical Relevance/Application For the first time, one can profit from both VMI and high temporal resolution with dual-source PCCT. A dose reduction for the CAC scoring protocol is feasible with VMI level specific CAC thresholds.

RESULTS

Compared to the reference at 70 keV, deviations in median Agatston scores for clinical radiation dose were at most -6.4%, irrespective of VMI level. At reduced radiation dose, VMI at 40, 50 and 60 keV again showed comparable (maximum deviation -7.1%) median Agatston scores in comparison with the reference. Increased VMI levels showed clinically relevant in Agatston score up to 22%. Reference median (total range) CNR was at 18.6 (17.6;19.6) and 15.3 (14.8;15.5) for 100% and 50% radiation dose, respectively. CNR increased with decreasing VMI level, and decreased with increasing VMI level. At 40 keV, CNR was at 26.8 (26.0;27.9) and 21.9 (20.1;22.7) for 100% and 50% radiation dose, respectively. CNR at 190 keV was reduced to 7.4 (7.2;8.5) and 6.6 (5.8;7.2), respectively.

CLINICAL RELEVANCE/APPLICATION

For the first time, one can profit from both VMI and high temporal resolution with dual-source PCCT. A dose reduction for the CAC scoring protocol is feasible with VMI level specific CAC thresholds.

IN01-B

Informatics Sunday Poster Discussions

Sub-Events

IN01-B1   **Assessing Machine Learning Models: Pipeline For Validation And Comparison Of Multiple Models**

Participants
Bernardo Bizzo, MD,PhD, Newton, Massachusetts (*Presenter*) Consultant, Diagnosticos da America (Dasa)

PURPOSE

To design, build and test an objective evaluation pipeline to normalize performance measurement of three independently developed machine learning (ML) models for detection of lung nodules on chest CTs, using a common test imaging dataset.*Methods and Materials With IRB approval, we identified an enriched dataset of 100 chest CTs (n= 100 patients; age 19-92 years; male: female 46:54) from a pool of 2459 consecutive chest CTs and reports in our local clinical PACS archive. The majority opinion of three radiologists served as the ground-truth for the presence of nodules. All chest CTs were processed with three ML models for detecting lung nodules using our data-preprocessing and assessment pipeline chain. The pipeline included tools for image cohort creation and de-identification; report and image annotation for ground-truth labeling; server partitioning to receive vendor "black box" models and to enable model testing of selected 100 chest CTs within our security firewall; model validation and results visualization; and calculation of precision recall statistics for performance assessment of each model.*Results The evaluation was done without imaging data leaving our institutional firewall, and without our need to understand the black box of the third-party models that were being evaluated. The ground-truth radiologists annotated 243 nodules (127 solid; 76 ground glass; 40 part-solid) with a mean diameter of 7 (range 4-23) mm. There were significant variations (p<0.001) in true positives, false positives, false negatives, recall, and precision for detecting lung nodules among the tested ML models (Vendor-1: 194, 23, 49, 0.80, 0.89; Vendor-2: 182, 270, 61, 0.75, 0.40; Vendor-3: 75, 120, 168, 0.32, 0.39).*Conclusions Model performance varied greatly, overall underperforming compared with vendor advertisement and therefore justifying our premise that a standardized objective ML model evaluation process is needed. Our ML model validation pipeline tested the specific use case of detecting lung nodules in chest CTs, but is generalizable to other models and use cases.*Clinical Relevance/Application There is increasing availability of ML models for similar use cases. Prior to clinical use, ML models must be evaluated on local institutional data using standardized objective methods so that their performance can be normalized and compared.

RESULTS

The evaluation was done without imaging data leaving our institutional firewall, and without our need to understand the black box of the third-party models that were being evaluated. The ground-truth radiologists annotated 243 nodules (127 solid; 76 ground glass; 40 part-solid) with a mean diameter of 7 (range 4-23) mm. There were significant variations (p<0.001) in true positives, false positives, false negatives, recall, and precision for detecting lung nodules among the tested ML models (Vendor-1: 194, 23, 49, 0.80, 0.89; Vendor-2: 182, 270, 61, 0.75, 0.40; Vendor-3: 75, 120, 168, 0.32, 0.39).

CLINICAL RELEVANCE/APPLICATION

There is increasing availability of ML models for similar use cases. Prior to clinical use, ML models must be evaluated on local institutional data using standardized objective methods so that their performance can be normalized and compared.

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Sub-Events

MS03-A1   Blunt Cerebrovascular Injury (bcvi) In Ankylosed Cervical Spine: A Manual Review Of 5867 CT Angiographies At A Single Level 1 Traumacenter

Participants
Riku Vierunen, MD, Helsinki, Finland (*Presenter*) Nothing to Disclose

PURPOSE

To examine the incidence, location, and grade of blunt cerebrovascular injury (BCVI), and the concomitant strokes in patients with ankylosed cervical spine.*Methods and Materials Retrospective manual review of 5867 computed tomographic angiographies (CTA) of the craniocervical arteries obtained during nine years and six months revealed 153 patients with ankylosis of at least three consecutive cervical vertebrae. BCVI was the primary and concomitant brain infarction the secondary outcome. Predictive variables were facial, skull, and cervical spine fractures. Etiology and levels of ankylosis were recorded and compared to original reports from radiologists and clinicians. For correlation between cervical spine fracture and BCVI we used Chi-squared test, and for correlation between levels of ankylosis and concomitant fractured vertebrae and transversally disrupted intervertebral discs Spearman's ?. Interrater reliability for blinded review of BCVI between two musculoskeletal radiologists and one fellow in training had calculation by Krippendorf's alpha and percentage agreement, and for etiology of ankylosis by Cohen's ? between musculoskeletal radiologist and the trainee.*Results Of the 153 patients (M/F=111/42; median age 75 years) with ankylosed cervical spines, 28 (18.3%) had 34 BCVIs, of which 30 (88%) were located in the vertebral arteries. The most common level for BCVI was at C2. Biffl grade II (15) was most common, followed by grade IV (14), grade III (4) and grade V (1). In 28 patients, three BCVIs in vertebral arteries caused cerebellar, and two in carotid arteries caused cerebral infarctions. Most common mechanism of injury was a fall on ground level (81%). Cervical spine fractures correlated with BCVIs (P=.001), and the number of fractured vertebrae and intervertebral discs correlated with the number of ankylosed intervertebral discs (0.214, P<.01). Interrater reliability for BCVI was considered fair (37.56%, percentage agreement: 92.8-94.1) and for etiology of ankylosis substantial (0.728, P<.001). The original radiological reports revealed documentation of ankylosis in 82 patients (53%), of which clinicians noted 43 (28%), and in 59 (39%) ankylosis remained undocumented.*Conclusions In conclusion, ankylosis of the cervical spine is poorly recognized and falling on ground level predisposes patients to BCVI. Compared to nonspecified blunt trauma populations the relative risk for overall BCVI is increased tenfold and in vertebral arteries 33-fold.*Clinical Relevance/Application Detection of ankylosis in cervical spine of at least three consecutive vertebrae improves diagnostics of BCVI. Patients with ankylosed cervical spine require CTA after a fall on ground level for timely commencing of anticoagulation therapy.

RESULTS

Of the 153 patients (M/F=111/42; median age 75 years) with ankylosed cervical spines, 28 (18.3%) had 34 BCVIs, of which 30 (88%) were located in the vertebral arteries. The most common level for BCVI was at C2. Biffl grade II (15) was most common, followed by grade IV (14), grade III (4) and grade V (1). In 28 patients, three BCVIs in vertebral arteries caused cerebellar, and two in carotid arteries caused cerebral infarctions. Most common mechanism of injury was a fall on ground level (81%). Cervical spine fractures correlated with BCVIs (P=.001), and the number of fractured vertebrae and intervertebral discs correlated with the number of ankylosed intervertebral discs (0.214, P<.01). Interrater reliability for BCVI was considered fair (37.56%, percentage agreement: 92.8-94.1) and for etiology of ankylosis substantial (0.728, P<.001). The original radiological reports revealed documentation of ankylosis in 82 patients (53%), of which clinicians noted 43 (28%), and in 59 (39%) ankylosis remained undocumented.

CLINICAL RELEVANCE/APPLICATION

Detection of ankylosis in cervical spine of at least three consecutive vertebrae improves diagnostics of BCVI. Patients with ankylosed cervical spine require CTA after a fall on ground level for timely commencing of anticoagulation therapy.

MS03-A2   Multimodality Imaging Of Hamartomas: An Interactive Case Based Approach

Awards
Identified for RadioGraphics

Participants
Meghan G. Lubner, MD, Madison, Wisconsin (*Presenter*) Grant, Koninklijke Philips NV;Grant, Johnson & Johnson

TEACHING POINTS

1. Hamartomas are non-neoplastic masses that represent abnormal growth of normal tissue.2. Hamartomas may be seen in isolation or may be syndromic, with relevant syndromes including Cowden Syndrome, Tuberous Sclerosis, and Peutz-Jehgers syndrome.3. Hamartomas often have a characteristic imaging appearance depending on the specific organ system involved.4. Many of these masses are discovered incidentally and may be mistaken for neoplasm. Awareness of common location and multimodality imaging features can aid in appropriate diagnosis.

TABLE OF CONTENTS/OUTLINE

-Epidemiology and clinical features of hamartomas-Pathophysiology and pathologic features of hamartomas-Spectrum of imaging findings of hamartomas involving multiple organ systems-Interactive case examples-Emphasis on cross sectional imaging findings - Associated syndromes-Goals of Imaging-Mimics/Differential for hamartoma-Summary

Abstract Archives of the RSNA, 2021

Sub-Events

NMMI03-B1 **Multiparametric Integrated 18F-FDG PET/MRI Based Radiomics For Prediction Of Therapy Response To Neoadjuvant Chemotherapy In Breast Cancer**

Participants
Julian Kirchner, Dusseldorf, Germany (*Presenter*) Nothing to Disclose

PURPOSE

This study investigated the performance of simultaneous 18F-FDG PET/MRI of the breast as a platform for comprehensive radiomics analysis to predict therapy response to neoadjuvant chemotherapy.*Methods and Materials 89 patients underwent simultaneous 18F-FDG PET/MRI. Breast tumors were segmented and radiomic features were extracted utilizing CERR software following the IBSI guidelines. LASSO regression was employed to select the most important radiomics features prior to model development. Five-fold cross validation was then utilzied alongside support vector machines, resulting in predictive models for various combinations of imaging data series.*Results Highest AUC and accuracy for differentiation between responders (partial or complete response) and non-responders (stable disease or progressive disease was achieved by all MR aand PET data (AUC 0.9; accuracy 84.3%), closely followed by exclusively PET data (AUC 0.89; accuracy 83.3%). Lowest results were achieved by exclusive T2 imaging, yielding an AUC of 0.74 and accuracy of 75%.*Conclusions 18F-FDG PET/MRI enables comprehensive high-quality radiomics analysis for prediction of therapy response to neoadjuvant chemotherapy in patients with breast cancer, with strong radiomic signatures being provided by all dynamic MRI and PET data.*Clinical Relevance/Application Multiparametric 18F-FDG PET/MRI enables high-quality radiomics analysis for prediction of therapy response to neoadjuvant chemotherapy in patients with breast cancer.

RESULTS

Highest AUC and accuracy for differentiation between responders (partial or complete response) and non-responders (stable disease or progressive disease was achieved by all MR aand PET data (AUC 0.9; accuracy 84.3%), closely followed by exclusively PET data (AUC 0.89; accuracy 83.3%). Lowest results were achieved by exclusive T2 imaging, yielding an AUC of 0.74 and accuracy of 75%.

CLINICAL RELEVANCE/APPLICATION

Multiparametric 18F-FDG PET/MRI enables high-quality radiomics analysis for prediction of therapy response to neoadjuvant chemotherapy in patients with breast cancer.

NMMI03-B2 **Radiomic Analysis For Forfollicular Lymphoma And Diffuse Large B-cell Lymphoma Classification**

Participants
Yunchao Yin, MSc, Groningen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Follicular lymphoma (FL) is a B-cell non-Hodgkin lymphoma associated with a generally favorable prognosis. However, one of the challenges in the management of these patients is the identification of individuals at high risk of histological transformation, most commonly into diffuse large B-cell lymphoma (DLBCL). Yet, no single reliable predictor has been identified. [18F]FDG PET/CT is increasingly used at diagnosis in FL patients but visual interpretation cannot reliably distinguish between FL and DLBCL. Therefore, we evaluated whether radiomic analysis of clinical baseline [18F]FDG PET/CT may be used to discriminate between patients with FL and DLBCL, potentially identify patients with transformation of FL during the course of disease.*Methods and Materials A retrospective cohort of patients consecutively included at a tertiary care center between the years 2010 and 2020. Patients were selected based on confirmed histopathological diagnosis of primary FL or DLBCL as well as available [18F]FDG PET/CT with EARL reconstruction parameters within 6 months of diagnosis. Radiomic features were extracted from the region of interest on well-registered CT and PET images. A subset of features selected by univariate analysis were used for radiomic analysis based on multiple logistic regression and ensemble classifiers. The trained models were tested on 20% of patients. The performance of radiomic analysis was compared with SUVmax as a sole predictor.*Results The study cohort included 76 patients with DLBCL and 44 patients with FL.214 features were extracted from CT and PET images and 135 were remained after feature selection. The best performing radiomic analysis for FL and DLBCL classification reached an AUC of 0.86 and accuracy of 0.8. Th analysis with SUVmax as sole predictor achieved an AUC 0.79, accuracy of 0.7. Based on gradient boosting classifier, the AUC and accuracy of radiomic features was found to be significantly larger than that of SUVmax (P<0.01).*Conclusions Radiomic analysis was superior to SUVmax in differentiating FL from DLBCL. Our current approach represents a small but significant improvement compared to current semiquantitative methods using SUVmax and should be further investigated.*Clinical Relevance/Application Radiomic analysis is superior to lesion semiquantification with SUVmax at differentiating FL from DLBCL.

RESULTS

The study cohort included 76 patients with DLBCL and 44 patients with FL.214 features were extracted from CT and PET images and 135 were remained after feature selection. The best performing radiomic analysis for FL and DLBCL classification reached an AUC of 0.86 and accuracy of 0.8. Th analysis with SUVmax as sole predictor achieved an AUC 0.79, accuracy of 0.7. Based on

gradient boosting classifier, the AUC and accuracy of radiomic features was found to be significantly larger than that of SUVmax (P<0.01).

CLINICAL RELEVANCE/APPLICATION

Radiomic analysis is superior to lesion semiquantification with SUVmax at differentiating FL from DLBCL.

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Abstract Archives of the RSNA, 2021

RI01-A

Reproductive Imaging Sunday Poster Discussions

Sub-Events

RI01-A2 **Reproductive Outcome Of Infertile Patients With Proximal Tubal Obstruction Treated With Selective Salpingography With Tubal Catheterization.**

Participants
Marcin Czeczelewski, Lublin, Poland (*Presenter*) Nothing to Disclose

PURPOSE

Evaluation of pregnancy rate of infertile patients with proximal tubal obstruction 12 months after selective salpingography (SSG) and tubal catheterization (TC).*Methods and Materials The prospective, single-center study between January 2012 and January 2019 included 248 women (age 34.4 ± 4.7 years) without any patent tube diagnosed. SSG was performed with the 5 F Kumpe catheter (Cook, Bloomington, IN) directed to the proximal tubal opening by tactile sensation. Its position was controlled under fluoroscopy and if correct, a contrast medium was injected to assess the patency and attempt to unblock the tube. In case of persistent obstruction, the radiologically guided tubal catheterization and guidewire recanalization was performed. Reproductive outcomes at minimum of 12 months following the treatment were collected by a telephone survey in patients with at least one patent tube.*Results Of a total of 399 tubes with confirmed proximal tubal occlusion, 383 successfully restored their patency resulting in a 96% technical success rate. Thirty-five percent of occluded oviducts were treated with SSG and 65% required additional TC. Out of 200 patients included in follow-up, 80 patients conceived which resulted in a 40% overall pregnancy rate. In this group 68 women conceived spontaneously (85 %) and 12 after controlled ovarian hyperstimulation (15 %).*Conclusions The SSG with TC is an effective method of restoring tubal patency with promising clinical outcomes. However, careful assessment of fallopian tubes and comprehensive evaluation of partners' reproductive situation before therapy required.*Clinical Relevance/Application Selective salpingography and tubal canalization offer minimally invasive and cost-effective alternatives to tubal microsurgery and IVF-ET in women with tubal occlusion.

RESULTS

Of a total of 399 tubes with confirmed proximal tubal occlusion, 383 successfully restored their patency resulting in a 96% technical success rate. Thirty-five percent of occluded oviducts were treated with SSG and 65% required additional TC. Out of 200 patients included in follow-up, 80 patients conceived which resulted in a 40% overall pregnancy rate. In this group 68 women conceived spontaneously (85 %) and 12 after controlled ovarian hyperstimulation (15 %).

CLINICAL RELEVANCE/APPLICATION

Selective salpingography and tubal canalization offer minimally invasive and cost-effective alternatives to tubal microsurgery and IVF-ET in women with tubal occlusion.

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Sub-Events

CA05-A2   **A Lasso-derived Risk Model For Subclinical Cac Progression In Asian Population With An Initial Score Of Zero**

Participants
Fu-Zong Wu, MD, Kaohsiung, Taiwan (*Presenter*) Nothing to Disclose

PURPOSE

This study is aimed at developing a prediction nomogram for subclinical coronary atherosclerosis in an Asian population with baseline zero score, and to compare its discriminatory ability with Framingham risk score (FRS) and atherosclerotic cardiovascular disease (ASCVD) models.*Methods and Materials Clinical characteristics, physical examination, and laboratory profiles of 830 subjects were retrospectively reviewed. Subclinical coronary atherosclerosis in term of Coronary artery calcification (CAC) progression was the primary endpoint. A nomogram was established based on a least absolute shrinkage and selection operator (LASSO)-derived logistic model. The discrimination and calibration ability of this nomogram was evaluated by Hosmer-Lemeshow test and calibration curves in the training and validation cohort.*Results Of the 830 subjects with baseline zero score with the average follow-up period of 4.55 ± 2.42 year in the study, these subjects were randomly placed into the training set or validation set at a ratio of 2.8:1. These study results showed in the 612 subjects with baseline zero score, 145 (23.69%) subjects developed CAC progression in the training cohort (N = 612), while in the validation cohort (N = 218), 51 (23.39%) subjects developed CAC progression. This LASSO-derived nomogram included the following 10 predictors: "sex," age," "hypertension," "smoking habit," "Gamma-Glutamyl Transferase (GGT)," "C-reactive protein (CRP)," "high-density lipoprotein cholesterol (HDL-C)," "cholesterol," "waist circumference," and "follow-up period." Compared with the FRS and ASCVD models, this LASSO-derived nomogram had higher diagnostic performance and lower Akaike information criterion (AIC) and Bayesian information criterion (BIC) value. The discriminative ability, as determined by the area under receiver operating characteristic curve was 0.780 (95% confidence interval: 0.731-0.829) in the training cohort and 0.836 (95% confidence interval: 0.761-0.911) in the validation cohort.*Conclusions This validated nomogram provided a useful predictive value for subclinical coronary atherosclerosis in subjects with baseline zero score, and could provide clinicians and patients with the primary preventive strategies timely in individual-based preventive cardiology.*Clinical Relevance/Application This nomogram could help clinicians to identify subclinical coronary atherosclerosis in subjects at low to intermediate risk for guidance for the primary preventive strategies in individual-based preventive cardiology.

RESULTS

Of the 830 subjects with baseline zero score with the average follow-up period of 4.55 ± 2.42 year in the study, these subjects were randomly placed into the training set or validation set at a ratio of 2.8:1. These study results showed in the 612 subjects with baseline zero score, 145 (23.69%) subjects developed CAC progression in the training cohort (N = 612), while in the validation cohort (N = 218), 51 (23.39%) subjects developed CAC progression. This LASSO-derived nomogram included the following 10 predictors: "sex," age," "hypertension," "smoking habit," "Gamma-Glutamyl Transferase (GGT)," "C-reactive protein (CRP)," "high-density lipoprotein cholesterol (HDL-C)," "cholesterol," "waist circumference," and "follow-up period." Compared with the FRS and ASCVD models, this LASSO-derived nomogram had higher diagnostic performance and lower Akaike information criterion (AIC) and Bayesian information criterion (BIC) value. The discriminative ability, as determined by the area under receiver operating characteristic curve was 0.780 (95% confidence interval: 0.731-0.829) in the training cohort and 0.836 (95% confidence interval: 0.761-0.911) in the validation cohort.

CLINICAL RELEVANCE/APPLICATION

This nomogram could help clinicians to identify subclinical coronary atherosclerosis in subjects at low to intermediate risk for guidance for the primary preventive strategies in individual-based preventive cardiology.

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Abstract Archives of the RSNA, 2021

Sub-Events

IR01-B3   **Evaluating Uterine Fibroids Pre And Post Uterine Artery Embolization Using Advanced Ultrasound Techniques**

Participants
Priscilla Machado, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To assess fibroid microvascularity before and after uterine artery embolization (UAE) using contrast-enhanced ultrasound (CEUS) and superb microvascular imaging (SMI; Canon Medical Systems, Tustin, CA, USA); a new high-sensitive Doppler mode.*Methods and Materials To date 38 women scheduled for UAE to treat their uterine fibroids were enrolled in this ongoing IRB-approved study. Subjects underwent 3 examinations (day 0, 15 and 90 after UAE) using an Aplio i800 scanner (Canon Medical Systems) with a curvilinear array. Color Doppler (CDI), power Doppler (PDI), color and monochrome SMI (cSMI and mSMI) images of the uterine fibroids were acquired followed by CEUS. For the CEUS examination 2.0 mL of Lumason (Bracco, Milan, Italy) was administered IV. Digital clips were assessed by two radiologists classifying the fibroids as having internal, peripheral or no vascularity for CDI, PDI, cSMI and mSMI; the classification for CEUS was a binary yes/no for the presence of vascularity within the fibroid. The images were analyzed using ImageJ (NIH, Bethesda, MD, USA) to quantify the fractional vascularity of the fibroids (FV) and flow intensity. Results were analyzed using one-way ANOVA, t-test and kappa-values.*Results All 38 subjects underwent the pre-UAE ultrasound examination, 35 subjects underwent the 15 days post-UAE ultrasound examination and 28 subjects underwent the 90 days post-UAE ultrasound examination completing their enrollment in the study. There was an overall agreement between the 2 readers for all imaging modalities (CDI, PDI, cSMI, mSMI and CEUS) and examination times (p=0.25) with kappa=0.7. Fraction vascularity (FV) analysis across imaging modes (CDI, PDI, cSMI, mSMI and CEUS) and examination times showed statistically significant differences (p<0.0001). Flow intensity values across imaging modes (CDI, PDI, cSMI and mSMI) and examination times pre UAE and 15 days post UAE showed statistically significant differences (p<0.02), the flow intensity analysis for the 90 days post UAE showed no statistically significant difference (p>0.4).*Conclusions Results indicate that CEUS and SMI pre and post UAE can accurately evaluate fibroid microvascularity, and therefore, can be a noninvasive and accurate method for monitoring treatment results.*Clinical Relevance/Application UAE is a nonsurgical therapy to block blood flow to fibroids. CEUS and SMI can accurately evaluate fibroid microvascularity, and therefore can become noninvasive methods for monitoring UAE treatment results.

RESULTS

All 38 subjects underwent the pre-UAE ultrasound examination, 35 subjects underwent the 15 days post-UAE ultrasound examination and 28 subjects underwent the 90 days post-UAE ultrasound examination completing their enrollment in the study. There was an overall agreement between the 2 readers for all imaging modalities (CDI, PDI, cSMI, mSMI and CEUS) and examination times (p=0.25) with kappa=0.7. Fraction vascularity (FV) analysis across imaging modes (CDI, PDI, cSMI, mSMI and CEUS) and examination times showed statistically significant differences (p<0.0001). Flow intensity values across imaging modes (CDI, PDI, cSMI and mSMI) and examination times pre UAE and 15 days post UAE showed statistically significant differences (p<0.02), the flow intensity analysis for the 90 days post UAE showed no statistically significant difference (p>0.4).

CLINICAL RELEVANCE/APPLICATION

UAE is a nonsurgical therapy to block blood flow to fibroids. CEUS and SMI can accurately evaluate fibroid microvascularity, and therefore can become noninvasive methods for monitoring UAE treatment results.

IR01-B4   **Blood Derived Embolic Materials For Embolization**

Participants
Izzet Altun, Scottsdale, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

Endovascular embolization has become the cornerstone of clinical interventions in the treatment of life-threatening vascular hemorrhages, aneurysms and vascular malformation. Here, we present novel blood-derived embolic material (BEM) with regenerative properties that can be prepared at point-of-care for urgent embolization and can be delivered using endovascular catheters to achieve instant and durable intra-arterial hemostasis regardless of coagulopathy.*Methods and Materials Adult Yorkshire pigs were anticoagulated with IV heparin (ACT 250-500). Following intra-arterial access into the carotid artery, a clinical catheter was advanced to the renal arteries or pelvic arteries and digital subtraction angiography (DSA) was performed. Arteries embolized with approximately 2 ml of BEM. BEM was produced by isolating the platelet rich fibrin from 10 ml of blood and mixed with nanosilicates to create the shear thinning hydrogel. Subset of the animals was allowed to survive 1 hour (n=4), 14 days (n=4) and another subset (n=4) received traumatic vascular injury to simulate point-of-care rapid synthesis and embolization. CT angiography (CTA) was conducted just prior to necropsy. Extensive cell culture and in vitro testing of BEM were also performed.*Results In a large animal model of vascular embolization, we show that BEM can be prepared at point-of-care within 26 minutes using fresh blood, it can be easily delivered using clinical catheters to embolize renal and iliac arteries, and we show that BEM is safe and biocompatible. We further demonstrated that in an anticoagulated state, delivery of 1-2 ml of point of care BEM into the coil mass was able to achieve complete occlusion of iliac and renal arteries and eventually rescuing failed coil embolization. Additionally, BEM could be successfully

retrieved in the event of temporary embolization or non-target delivery of BEM. Histology and micro-CT of embolized arteries demonstrated complete occlusion of the artery and gradual biodegradation of BEM over time with its replacement with fibroinflammatory tissue. Fluoroscopy images of all the animals and CTA studies of day 14 pigs consistently showed successful embolization with BEM without any recanalization, artifact, fragmentation, displacement, or migration.*Conclusions In the swine arteries, BEM achieved durable hemostasis without any complication, imaging artifact, recanalization, displacement and fragmentation. BEM has many advantages over currently used embolic materials, making it a promising new tool for embolization.*Clinical Relevance/Application BEM has significant advantages over the current embolic agents with the potential for rapid adoption in clinical practice.

RESULTS

In a large animal model of vascular embolization, we show that BEM can be prepared at point-of-care within 26 minutes using fresh blood, it can be easily delivered using clinical catheters to embolize renal and iliac arteries, and we show that BEM is safe and biocompatible. We further demonstrated that in an anticoagulated state, delivery of 1-2 ml of point of care BEM into the coil mass was able to achieve complete occlusion of iliac and renal arteries and eventually rescuing failed coil embolization. Additionally, BEM could be successfully retrieved in the event of temporary embolization or non-target delivery of BEM. Histology and micro-CT of embolized arteries demonstrated complete occlusion of the artery and gradual biodegradation of BEM over time with its replacement with fibroinflammatory tissue. Fluoroscopy images of all the animals and CTA studies of day 14 pigs consistently showed successful embolization with BEM without any recanalization, artifact, fragmentation, displacement, or migration.

CLINICAL RELEVANCE/APPLICATION

BEM has significant advantages over the current embolic agents with the potential for rapid adoption in clinical practice.

IR01-B5   **Deep Convolutional-Neural-Network-Based Metal Artifact Reduction For CT-Guided Interventional Oncology Procedures (MARIO)**

Participants
Liqiang Ren, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To train and evaluate a deep convolutional neural network (CNN) model to identify and remove metallic-probe-induced artifact on CT images acquired during interventional oncology procedures.*Methods and Materials A previously validated metal insertion framework was applied to create CNN training images from the planning scans of ten CT-guided kidney cryoablation procedures (SOMATOM Edge, Siemens Healthcare). For each case, up to 4 intersecting cryoablation probes (IceForce, Boston Scientific) were artificially inserted in multiple positions/orientations into projection (images with artifacts, input) and in image (artifact-free images, target) CT data, respectively, creating a total of ~200 CT volumes. Training images were reconstructed with clinical reconstruction parameters (kernel: Br40(3), thickness: 3 mm, field of view: 400 mm) using manufacturer reconstruction software. Approximately 23,000 training patches with at least 5% of the total pixels affected by probe-induced artifact were cropped from training images with and without artifacts for network inputs and targets, respectively; 3 adjacent slices comprised the input channel dimension. A CNN model (MARIO) was trained to identify and remove artifacts from input images, and then applied to 50 independent, previously unseen CT datasets from treatment monitoring scans during kidney cryoablations. One hundred CT datasets (50 original, 50 MARIO processed) were reviewed independently by three senior interventional radiologists in a randomized, blinded study. Each dataset was scored on an ordinal scale (1 unacceptable, 4 excellent) on aspects that included overall image quality, severity of metal artifact, visualization of needle tips, ice-ball conspicuity, and overall treatment confidence. Signed-rank tests were performed to compare the scores between original and MARIO images.*Results Average reader scores were significantly higher for MARIO images compared to the original images across all metrics (all p<0.0001), demonstrating the effectiveness of MARIO to reduce probe-induced artifacts. Notably, the number of image quality metrics with suboptimal (i.e. average score <2) scores decreased from 10/300 in the original images to 1/300 in the MARIO data.*Conclusions Reduction of metal artifacts by the CNN-based MARIO model significantly improved overall image quality, provided better visualization of the needle tips and ice-ball, and increased radiologists' overall treatment confidence.*Clinical Relevance/Application MARIO increased radiologists' confidence in the placement accuracy of the cryoablation probes and in the resulting treatment zone, which may improve safety and oncologic outcomes for patients undergoing CT-guided interventional oncology procedures.

RESULTS

Average reader scores were significantly higher for MARIO images compared to the original images across all metrics (all p<0.0001), demonstrating the effectiveness of MARIO to reduce probe-induced artifacts. Notably, the number of image quality metrics with suboptimal (i.e. average score <2) scores decreased from 10/300 in the original images to 1/300 in the MARIO data.

CLINICAL RELEVANCE/APPLICATION

MARIO increased radiologists' confidence in the placement accuracy of the cryoablation probes and in the resulting treatment zone, which may improve safety and oncologic outcomes for patients undergoing CT-guided interventional oncology procedures.

IR01-B6   **Hepatocellular Carcinoma Circulating Tumors Cells Using Interventional Treatment: Conventional Transarterial Chemoembolization Versus Microwave Ablation**

Participants
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the short-term dynamics of circulating tumor cells (CTCs) in patients with hepatocellular carcinoma (HCC) under conventional transarterial chemoembolization (cTACE) or microwave ablation (MWA). The short-term dynamics were compared with the clinical course of the patients using a novel method for the isolation and detection of CTCs.*Methods and Materials Blood samples from 18 patients with HCC who underwent cTACE (n=8) or MWA (n=10) were analyzed. Intravenous blood was taken before and immediately after the radiological interventions to isolate CTCs and quantify them by flow cytometry. CTCs were considered to be those cells that were negative for the marker CD45 and positive for the markers ASGPR, CD146, and CD274 (PDL1). Follow-up studies of up to 2 years after the radiological intervention were evaluated.*Results The number of CTCs after radiological intervention (post=0.9 CTCs/ml of blood) was on average lower than that before therapy (pre=1.2 CTCs/ml of blood). The number of CTCs decreased more in patients treated with MWA (0.4 CTCs/ml of blood) than in those who received cTACE (0.2 CTCs/ml of blood). The 2-year survival rate in the group receiving cTACE (37.5% died) was lower than that in MWA patients (0% died).*Conclusions The therapeutic benefit of cTACE and MWA in patients with HCC is emphasized by decreasing CTCs and the

clinical course of the patients.*Clinical Relevance/Application Interventional treatment using cTACE or MWA results in improved survival rates in patients with HCC

RESULTS

The number of CTCs after radiological intervention (post=0.9 CTCs/ml of blood) was on average lower than that before therapy (pre=1.2 CTCs/ml of blood). The number of CTCs decreased more in patients treated with MWA (0.4 CTCs/ml of blood) than in those who received cTACE (0.2 CTCs/ml of blood). The 2-year survival rate in the group receiving cTACE (37.5% died) was lower than that in MWA patients (0% died).

CLINICAL RELEVANCE/APPLICATION

Interventional treatment using cTACE or MWA results in improved survival rates in patients with HCC

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SDP-CH

Chest Pre-recorded Scientific Posters

Sub-Events

SDP-CH-1   A Hybrid Loss-based Network Architecture For End-to-end Lung Nodule Segmentation

Participants
Jiangdian Song, PhD, Shenyang, China (*Presenter*) Nothing to Disclose

PURPOSE

Machine learning-based lung nodule segmentation methods are limited by the requirement for additional human interaction and the challenge of accurately segmenting adhesive nodules, whereas current deep learning models may be strict towards image pre-processing and pre-selected nodule patches. We aim to propose a hybrid loss-based network by integrating the Faster R-CNN with generalized intersection over union (GIoU) and the Wasserstein generative adversarial network with a gradient penalty (WGAN-GP) for end-to-end lung nodules segmentation on CT images.*Methods and Materials The proposed model consisted of a Faster-RCNN module for bounding box detection of nodule candidates, and subsequently a refined WGAN-GP module for lung nodule segmentation. GIoU loss was used to improve nodule detection of Faster-RCNN, and mean square error loss and VGG loss were used in WGAN-GP to improve nodule generation, respectively. In addition, short connection was introduced to accumulate the output of each 2D Conv with the corresponding 2D DeConv results in the generator of WGAN-GP to stimulate the network for nodule segmentation. The LIDC-IDRI dataset were used in this study, and U-net was used for comparison. Dice coefficient was used to evaluate the segmentation accuracy, and the measurements of precision and recall were used to evaluate nodule detection performance.*Results A total of 2,635 lung nodules collected from the LIDC-IDRI dataset were used in this study, and was randomly divided into training, validation, and test dataset (8:1:1). For the proposed network, DC of 85.33%, 77.43%, and 76.09% was acquired on the three datasets for segmentation, with precision of 85.00% and recall of 91.73% on the test dataset for detection, respectively. For the U-net, DC of 94.58%, 81.09%, and 80.55% was acquired on the three datasets, with precision of 60.11% and recall of 88.71% on the test dataset, respectively. Compared with U-net, overfitting and false positive nodule production could be significantly mitigated using the proposed model (P < 0.001).*Conclusions Our study provided a new solution for mitigating the inevitable human interaction and pre-processing procedures which are necessary for the existing lung nodule segmentation methods. Compared with the current mainstream segmentation network, the proposed approach alleviated false positive production and overfitting challenges and achieved competitive segmentation result.*Clinical Relevance/Application Our findings offer a new paradigm to effectively utilize state-of-the-art networks for accurate detection and end-to-end segmentation of lung nodules on CT images. The mitigation on manual interaction and network overfitting will promote lung nodule segmentation algorithms to clinical practice.

RESULTS

A total of 2,635 lung nodules collected from the LIDC-IDRI dataset were used in this study, and was randomly divided into training, validation, and test dataset (8:1:1). For the proposed network, DC of 85.33%, 77.43%, and 76.09% was acquired on the three datasets for segmentation, with precision of 85.00% and recall of 91.73% on the test dataset for detection, respectively. For the U-net, DC of 94.58%, 81.09%, and 80.55% was acquired on the three datasets, with precision of 60.11% and recall of 88.71% on the test dataset, respectively. Compared with U-net, overfitting and false positive nodule production could be significantly mitigated using the proposed model (P < 0.001).

CLINICAL RELEVANCE/APPLICATION

Our findings offer a new paradigm to effectively utilize state-of-the-art networks for accurate detection and end-to-end segmentation of lung nodules on CT images. The mitigation on manual interaction and network overfitting will promote lung nodule segmentation algorithms to clinical practice.

SDP-CH-11   Progression Of Architectural Distortion In Usual Interstitial Pneumonia: Evaluation Based On Deformable Registration Of Sequential Computed Tomography Images

Participants
NAOFUMI YASUDA, Yokohama, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Idiopathic pulmonary fibrosis (IPF) presents a usual interstitial pneumonia (UIP) pattern on computed tomography (CT). Subpleural fibrosis with architectural distortion is a characteristic histological finding of UIP. We assessed the architectural distortion accompanying disease progression by measuring deformities in the peripheral lung structures on sequential CT.*Methods and Materials This single-institution retrospective study was approved by our institutional review board. Written informed patient consent was waived. We included IPF patients who initially visited our hospital in 2015 and underwent three annual CT scans and pulmonary function tests. The total CT lung volume (CTLVtotal) and lesion volume were measured using Quantification software (QZIP, Ziosoft, Inc.). The lesion extent was defined as the lesion volume divided by CTLVtotal. The initial and follow-up CT images were deformably registered and the three-dimensional average displacement (3D-AD) of the pulmonary vessels and peripheral bronchi were calculated using Ziostation2 software (Ziosoft, Inc.). We defined the subpleural lung region as within 1 cm below the pleura, and compared various parameters in the whole, subpleural region, and inner region of lungs using Wilcoxon's signed-rank test.*Results Forty-one IPF patients (median age, 69 y; 36 men, 5 women; median %forced vital capacity, 84.8%) were included.

The median normal lung volume decreased from 3362 cc on the initial CT to 3331, and 3098 cc on the 2nd, and 3rd CT, respectively. The median lesion volume increased from 531 cc to 600, and 714 cc, respectively. On initial CT, the median lesion extent was larger in the outer than in the inner lungs (22.0% vs. 5.7%, p<0.001). The peripheral bronchi and vessels approached the pleura. The 3D-AD color map revealed peripheral structure deviation. The median 3D-AD was larger in the subpleural region than in the inner region of lungs: 4.1 vs. 3.4 mm (p<0.001) between the initial and 1st follow-up CT, 5.3 vs. 4.9 mm (p<0.001) between the initial and 2nd follow-up CT.*Conclusions The 3D-AD-based architectural distortion was larger in the outer lungs in IPF patients.*Clinical Relevance/Application The 3D-AD color map by deformable registration of sequential CT images can help visualize the progression of pulmonary architectural distortion in patients with idiopathic pulmonary fibrosis.

RESULTS

Forty-one IPF patients (median age, 69 y; 36 men, 5 women; median %forced vital capacity, 84.8%) were included. The median normal lung volume decreased from 3362 cc on the initial CT to 3331, and 3098 cc on the 2nd, and 3rd CT, respectively. The median lesion volume increased from 531 cc to 600, and 714 cc, respectively. On initial CT, the median lesion extent was larger in the outer than in the inner lungs (22.0% vs. 5.7%, p<0.001). The peripheral bronchi and vessels approached the pleura. The 3D-AD color map revealed peripheral structure deviation. The median 3D-AD was larger in the subpleural region than in the inner region of lungs: 4.1 vs. 3.4 mm (p<0.001) between the initial and 1st follow-up CT, 5.3 vs. 4.9 mm (p<0.001) between the initial and 2nd follow-up CT.

CLINICAL RELEVANCE/APPLICATION

The 3D-AD color map by deformable registration of sequential CT images can help visualize the progression of pulmonary architectural distortion in patients with idiopathic pulmonary fibrosis.

SDP-CH-12 Association Of Total Lung Field Volume Change In Peri-peak Inspiration Period Measured On Dynamic-ventilation Computed Tomography With Percent Forced Vital Capacity: Comparison Between Idiopathic Pulmonary Fibrosis And Connective-tissue Disease Interstitial Lung Disease

Participants
Yukihiro Nagatani, MD, Otsu, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To compare the association of global lung volume change in peri-peak inspiration period with percent forced vital capacity (%FVC) and relative time duration of inspiration to expiration on dynamic-ventilation computed tomography (DVCT) between idiopathic pulmonary fibrosis/usual interstitial pneumonia (IPF/UIP) and connective-tissue disease interstitial lung disease (CTD-IP)*Methods and Materials Thirty-four patients including 12 IPF/UIP and 16 CTD-IP patients underwent DVCT by using 320-row scanner (Aquilion ONE, Canon Medical Systems, Otawara, Tochigi, Japan) with 16cm-coverage during 5.5m-sec single respiration for upper and lower lung fields in a single examination (4.8 mSv). Bilateral lung field volumes (LFVs) were automatically measured by dedicated software in each phase during a single respiration. Average volume decrease ratio (aVDR) in peri-peak inspiration period for 3 and 5 time frames: 1.05 and 1.75 sec (PPIP-3 and PPIP-5) and maximal volume decrease ratio in respiration (mVDR) were calculated for total LFVs by using measured values at peak-inspiration as standard of reference. Correlation between %FVC and quantified values such as aVDR in PPIP-3 and PPIP-5, mVDR, LFVs for total, right and left LF at peak-inspiration (PI) were assessed by using Spearman's rank coefficient, in total as well as IPF/UIP and CTD-ILD. Ratio in time duration of inspiration to expiration (IER-TD) and ratio in maximal volume change velocity of inspiration to expiration (IER-MVCV) were compared between IPF/UIP and CTD-ILD by using Mann-Whitney U test.*Results In IPF/UIP as well as total study population, %FVC correlated positively with aVDR in PPIP-3 and PPIP-5 and LFVs for total, right and left LFs at PI (r= 0.717, 0.749, 0.809, 0.837 and 0.830, p<0.05), and did not correlate with mVDR (r=0.500, p=0.10). Whereas in CTD-ILD, %FVC correlated positively only with aVDR in PPIP-5, LFs for total and left LFs at PI (r=0.537, 0.507 and 0.690, p<0.05). IER in IPF/UIP (0.83 ± 0.35) was smaller than that in CTD-ILD (0.98 ± 0.23) (p=0.02), although IER-MVCV in IPF/UIP (1.36 ± 0.60) was comparable to that in CTD-ILD (1.16 ± 0.37) (p=0.54).*Conclusions Global lung volume analysis on DVCT demonstrated relative shorter inspiratory duration with positive relation between change in peri-peak inspiration period and %FVC, reflecting subpleural fibrosis and its advance parallel to %FVC reduction in IPF/UIP.*Clinical Relevance/Application Pathological change such as subpleural fibrosis could be reflected in respiratory change in global lung volume on dynamic-ventilation CT.

RESULTS

In IPF/UIP as well as total study population, %FVC correlated positively with aVDR in PPIP-3 and PPIP-5 and LFVs for total, right and left LFs at PI (r= 0.717, 0.749, 0.809, 0.837 and 0.830, p<0.05), and did not correlate with mVDR (r=0.500, p=0.10). Whereas in CTD-ILD, %FVC correlated positively only with aVDR in PPIP-5, LFs for total and left LFs at PI (r=0.537, 0.507 and 0.690, p<0.05). IER in IPF/UIP (0.83 ± 0.35) was smaller than that in CTD-ILD (0.98 ± 0.23) (p=0.02), although IER-MVCV in IPF/UIP (1.36 ± 0.60) was comparable to that in CTD-ILD (1.16 ± 0.37) (p=0.54).

CLINICAL RELEVANCE/APPLICATION

Pathological change such as subpleural fibrosis could be reflected in respiratory change in global lung volume on dynamic-ventilation CT.

SDP-CH-13 To Explore The Correlation Of Ge Revolution Wide-body Detector Energy Spectrum CT Multi-mode Iterative Reconstruction Algorithm To Chest Vascular Image Quality In Energy Spectrum CT Scanning

Participants
Xin Fang, Shizuishan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the influence of adaptive statistical iterative restructure-VEO (ASIR-V) algorithm on the image quality of chest CT enhanced with energy spectrum at low radiation dose, and to provide reference for optimizing the use of iterative reconstruction on chest CT enhanced with energy spectrum.*Methods and Materials 30 patients were scanned using fast kVp switch (80/140 kVp) spectral CT, automatic mA (200mA-485mA), pitch 0.992:1, noise index 11 for the enhanced CT chest enhancement examination. All patients received total 0.8*weight bolus of iodixanol 320 at an infusion rate of 4ml/s. Theparenchymal phase image was acquired after 50 seconds after trigger threshold (130HU). The CT scan was reconstructed using 4 levels of iterative reconstruction 20%, 40%, 60% and 80%at 70kev monochromatic energy level. The CT value, standard deviation, image noise (SD) and other energy

spectrum information of thoracic aorta in each 70keV single-energy reconstructed image were recorded in FILE format, and the SNR and CNR of thoracic aorta were calculated, and then the data were analyzed by statistical analysis. Subjective image evaluation was performed by 2 physicians.*Results There was no significant difference in CT values of thoracic aorta under different posterior weights. There were statistically significant differences in the SD, SNR and CNR of thoracic aorta in different image reconstruction groups in the four groups (P < 0.05). The SD of thoracic aorta in each group were 20% (29.35±3.65) HU, 40% (23.29±2.57) HU, 60% (17.53±1.61) HU, and 80% (12.44±1.10) HU, respectively.he subjective score of 60% and 80% ASiR-V were 4.48±0.74 and 4.03±0.59, respectively. The subjective scores of all other iterative recontruction level were all below 4.0.*Conclusions Energy spectrum CT scanning using full model real-time iterative reconstruction technique can provide image quality of thoracic aorta at low radiation dose.*Clinical Relevance/Application For thoracic aortic vascular diseases, energy spectrum CT single energy scan combined with 60% iterative reconstruction weight can be used to significantly improve the image quality of vascular lumen and provide more effective information for clinical use.

RESULTS

There was no significant difference in CT values of thoracic aorta under different posterior weights. There were statistically significant differences in the SD, SNR and CNR of thoracic aorta in different image reconstruction groups in the four groups (P < 0.05). The SD of thoracic aorta in each group were 20% (29.35±3.65) HU, 40% (23.29±2.57) HU, 60% (17.53±1.61) HU, and 80% (12.44±1.10) HU, respectively.he subjective score of 60% and 80% ASiR-V were 4.48±0.74 and 4.03±0.59, respectively. The subjective scores of all other iterative recontruction level were all below 4.0.

CLINICAL RELEVANCE/APPLICATION

For thoracic aortic vascular diseases, energy spectrum CT single energy scan combined with 60% iterative reconstruction weight can be used to significantly improve the image quality of vascular lumen and provide more effective information for clinical use.

SDP-CH-14 Computed Tomography Quantitative Analysis Of Diaphragmatic Crus In Patients With Chronic Obstructive Pulmonary Disease

Participants
Shinji Wada, MD, Kawasaki, Japan (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to investigate the relationship between the results of the pulmonary function tests (PFTs) of patients with chronic obstructive pulmonary disease (COPD) and the size of their diaphragmatic crus as evaluated with inspiratory and expiratory computed tomography (CT).*Methods and Materials Inspiratory and expiratory CT was performed between July and December 2019 in 33 patients who underwent PFTs within one week. The short axis, long axis, and cross-sectional area (CSA) at the superior mesenteric artery orifice level of the right and left crus were measured, and the rate of change in the size of the diaphragmatic crus due to respiration (ROCC) was determined. The correlation between the results of the PFTs (forced expiratory volume in one second [FEV1], FEV1/forced vital capacity [FVC], percent predicted FEV1 [%FEV1]) and the size and the ROCC were statistically analyzed.*Results In the right crus, the short axis was extended by 32%; the long axis was contracted by 6%; and the CSA was 21% larger in inspiration than in expiration. In the left crus, the short axis was hardly extended, the long axis was contracted by 5%, and the CSA was 20% larger in inspiration than in expiration. The short axis of the diaphragmatic crus contracted more as age increased. There was a positive correlation between the short axis of the right and left diaphragmatic crus at expiration and PFTs (FEV1, r = -0.35, -0.48; FEV1/FVC, r = -0.52, -0.65; %FEV1, r = -0.56, -0.60), between the CSA of the right crus at expiration and PFTs (FEV1/FVC, r = -0.42; %FEV1, r = -0.41), and between the ROCC of the short axis of the left crus and the CSA of the right and left crus and PFTs (FEV1, r = 0.64, 0.39, 0.56; FEV1/FVC, r = 0.48, 0.46, 0.44; %FEV1, r = 0.52, 0.44, 0.51), each of which was statistically significant. The smaller the short axis of the crus and the CSA and the larger the ROCC, the better the PFT results.*Conclusions There was a positive correlation between the following: (1) the short axis of the bilateral diaphragmatic crus at expiration and the PFT results and (2) the ROCC of the CSA at expiration and the PFT results. These results suggested that measurements of the diaphragmatic crus by means of CT may be used as biomarkers for COPD.*Clinical Relevance/Application When checking for bronchial and lung lesions in COPD patients with chest CT, measurements of the diaphragmatic crus should also be conducted to estimate respiratory function since these may be used as biomarkers for COPD.

RESULTS

In the right crus, the short axis was extended by 32%; the long axis was contracted by 6%; and the CSA was 21% larger in inspiration than in expiration. In the left crus, the short axis was hardly extended, the long axis was contracted by 5%, and the CSA was 20% larger in inspiration than in expiration. The short axis of the diaphragmatic crus contracted more as age increased. There was a positive correlation between the short axis of the right and left diaphragmatic crus at expiration and PFTs (FEV1, r = -0.35, -0.48; FEV1/FVC, r = -0.52, -0.65; %FEV1, r = -0.56, -0.60), between the CSA of the right crus at expiration and PFTs (FEV1/FVC, r = -0.42; %FEV1, r = -0.41), and between the ROCC of the short axis of the left crus and the CSA of the right and left crus and PFTs (FEV1, r = 0.64, 0.39, 0.56; FEV1/FVC, r = 0.48, 0.46, 0.44; %FEV1, r = 0.52, 0.44, 0.51), each of which was statistically significant. The smaller the short axis of the crus and the CSA and the larger the ROCC, the better the PFT results.

CLINICAL RELEVANCE/APPLICATION

When checking for bronchial and lung lesions in COPD patients with chest CT, measurements of the diaphragmatic crus should also be conducted to estimate respiratory function since these may be used as biomarkers for COPD.

SDP-CH-15 The Incidence Rate Of Which Radiologists Miss Breast Lesions On Contrast Chest CT

Participants
Jiyeon Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the incidence rate of which radiologists miss breast lesions on contrast chest CT*Methods and Materials In this study, medical records of 344 patients who registered with the diagnosis code 'breast cancer' in between February 2016 to September 2020 and had undergone contrast chest CT exams 3 to 18 months before the code registration were reviewed. 250 patients with known breast lesions or histories of breast cancers were excluded. Chest CT exams of the remaining 94 patients were reviewed retrospectively. The incidence rates of which the radiologists had missed or incidentally detected breast lesions were calculated. A breast lesion was classified as either 'missed' or 'detected' if its location and shape matched those at the time of cancer diagnosis. The characteristics of the lesions, including sizes, shapes, margins, and enhancements, were evaluated and compared.*Results 81 patients had breast lesions on chest CT, while 13 patients had no breast lesion on CT. Only on CT of 9

patients (11.0%; 9/81), the radiologists had detected the lesions and further exams for cancer evaluation were carried out. On CT of other 73 patients (90.0%; 73/81), radiologists had missed the breast lesions. In the group of the missed breast lesions, the mean time interval between the CT examination and the initiation of the breast lesion work up was 8.3 ± 5.9 months. Mean size of the missed breast lesions (8.6 ± 4.0mm) was smaller than the mean size of the detected breast lesions (12.8 ± 3.8mm) (p = 0.002). There was no significant difference in the enhancement ratio between the two groups (p = 0.46). There was no predominance in the breast lesion location and breast density in either group. Missed breast lesions showed no significant tendency in their shapes, margins and enhancement patterns. All detected breast lesions showed homogeneous enhancement patterns and had regular shapes, and most of them had well circumscribed margins (7/8).*Conclusions In this study, 90% of the incidental breast lesions, especially the lesions with sub-centimeter sizes, irregular shapes and margins, or heterogeneous enhancement patterns, were missed on contrast chest CT and later confirmed as breast cancers through other examinations. More careful imaging review of a chest CT will enable early detection and treatment of breast cancer.*Clinical Relevance/Application As more patients undergo chest CT for various clinical purposes, careful imaging review for small enhancing breast lesions on contrast chest CT will increase the number of incidental detection of breast cancers.

RESULTS

81 patients had breast lesions on chest CT, while 13 patients had no breast lesion on CT. Only on CT of 9 patients (11.0%; 9/81), the radiologists had detected the lesions and further exams for cancer evaluation were carried out. On CT of other 73 patients (90.0%; 73/81), radiologists had missed the breast lesions. In the group of the missed breast lesions, the mean time interval between the CT examination and the initiation of the breast lesion work up was 8.3 ± 5.9 months. Mean size of the missed breast lesions (8.6 ± 4.0mm) was smaller than the mean size of the detected breast lesions (12.8 ± 3.8mm) (p = 0.002). There was no significant difference in the enhancement ratio between the two groups (p = 0.46). There was no predominance in the breast lesion location and breast density in either group. Missed breast lesions showed no significant tendency in their shapes, margins and enhancement patterns. All detected breast lesions showed homogeneous enhancement patterns and had regular shapes, and most of them had well circumscribed margins (7/8).

CLINICAL RELEVANCE/APPLICATION

As more patients undergo chest CT for various clinical purposes, careful imaging review for small enhancing breast lesions on contrast chest CT will increase the number of incidental detection of breast cancers.

SDP-CH-16 Motion Tracking Analysis Of Cine MRI For Diagnosing Thymic Epithelial Tumors: A Feasibility Study

Participants
Koji Takumi, MD,PhD, Kagoshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Cine MRI is widely used for evaluating cardiovascular diseases or chest wall invasion of a thoracic mass, and also has the potential to provide the information of the morphological deformation of the mass due to pulsation of adjacent vascular structure. Thymic epithelial tumors (TETs) are pathologically diagnosed based on the morphologic manifestations of the epithelial cells and the ratio of lymphocytes to epithelial cells, which could result in differences in tumor stiffness among the TET subtypes. We hypothesize that the evaluation of morphological deformation using cine MRI motion tracking analysis can help diagnose histopathological subtypes of TETs.*Methods and Materials Our study population consisted of 42 consecutive patients with pathologically proven TETs including 9 low-grade thymomas (WHO classification type A, AB, B1), 23 high-grade thymomas (B2, B3), and 10 thymic carcinomas. Cine MR images were acquired using balanced steady state free precession (bSSFP) sequence with short periods of breath-holding in axial planes on the slice with the largest lesion cross sectional area. The tumor margin was manually delineated on diastolic phase and automatically tracked for all the other cardiac phases. The change rates of long-to-short diameter ratio (?LSratio) and tumor area (?Area) associated with pulsation were compared among the three groups using Kruskal-Wallis H test and the Mann-Whitney U test. Receiver-operating characteristic (ROC) curve analysis was performed to assess the ability of each parameter to differentiate thymic carcinomas from thymomas.*Results The ?LSratio and ?Area were significantly different among the three groups (p=0.027 and 0.011, respectively). The ?LSratio and ?Area of thymic carcinomas were significantly smaller than those of thymomas (p=0.014 and 0.024, respectively). Area under the ROC curves for ?LSratio and ?Area to diagnose thymic carcinomas were 0.756 and 0.738, respectively.*Conclusions The evaluation of morphological deformation using cine MR motion tracking analysis can help diagnose histopathological subtypes of TETs and identify thymic carcinomas preoperatively.*Clinical Relevance/Application The evaluation of morphological deformation using cine MR motion tracking analysis may be useful in diagnosing histological subtype of TETs.

RESULTS

The ?LSratio and ?Area were significantly different among the three groups (p=0.027 and 0.011, respectively). The ?LSratio and ?Area of thymic carcinomas were significantly smaller than those of thymomas (p=0.014 and 0.024, respectively). Area under the ROC curves for ?LSratio and ?Area to diagnose thymic carcinomas were 0.756 and 0.738, respectively.

CLINICAL RELEVANCE/APPLICATION

The evaluation of morphological deformation using cine MR motion tracking analysis may be useful in diagnosing histological subtype of TETs.

SDP-CH-17 3D Airway Reconstruction Enabled By A Novel Bronchiole-sensitive Deep-learning Model For Planning Of Navigation Bronchoscopy

Participants
Andong Wang, BEng, Hong Kong, Hong Kong (*Presenter*) Nothing to Disclose

PURPOSE

Navigation bronchoscopy is a promising approach to safer sampling of pulmonary nodules than transthoracic needle biopsy. A 3D tracheobronchial airway roadmap reconstructed from CT images is the prerequisite for the bronchoscopy procedure. We hereby hypothesize that Deep Learning (DL) can better delineate complex tree-like structures of airways than existing automated algorithms during reconstruction.*Methods and Materials Our proposed DL model is based on 3D U-Net with 1) a new loss function together with an enhanced training strategy which can recognize more bronchioles of higher generations by penalizing the airway segments with low confidence and focusing on bronchiole training and 2) dilated convolutions with self-attention mechanism which extract morphological features in a larger area to distinguish between real airways and other shapes, like the esophagus. 80 cases annotated with ITK-SNAP and clinicians' correction (regarded as benchmark (BM) annotation because ideal ground truth annotation can only be obtained by bronchoscopy) from two open-source chest CT datasets — EXACT09 and LIDC-IDRI — were used for

model training and testing with a split of 70/10. Cross-validation was conducted. Lung CT images from 9 anonymized patients scanned at the Queen Mary Hospital in Hong Kong were annotated with LungPoint and clinicians' correction for external testing of our bronchiole-sensitive DL model performance on unseen data.*Results The model outputs a probability map (p) of airways. As BM annotations may miss some bronchioles, p=0.7 denotes airway segments with high confidence, while 0.5=p=0.7 indicates inferred airway segments by the learned features from BM. For internal testing, precision/sensitivity were 96.1±1.4%/92±1.5% (threshold of p = 0.7) and 85.6±1.9%/98.0±0.9% (threshold of p = 0.5), respectively. When threshold of p = 0.5, the tree detection rate (ratio of model-outputted airway length to BM airway length) was 114.0±14.7%. This suggested that the model detected almost all the BM airways and many unlabeled bronchioles, which were visually validated by an expert. For external testing, precision, sensitivity, and tree detection rate were 81.4±4.7%, 89.3±5.4%, and 82%±13.7%, respectively (threshold of p = 0.5), showing that the model performed well on unseen data.*Conclusions Results validated our hypothesis that our DL model could detect finer bronchioles (up to 12th generation with mean and median generations being 7.9 and 7.5, respectively) while maintaining high overall accuracy for 3D airway reconstruction.*Clinical Relevance/Application Our DL model reconstructs a 3D airway roadmap with finer bronchioles detected, showing clearer paths with possibility values for pulmonary nodule sampling in navigation bronchoscopy.

RESULTS

The model outputs a probability map (p) of airways. As BM annotations may miss some bronchioles, p=0.7 denotes airway segments with high confidence, while 0.5=p=0.7 indicates inferred airway segments by the learned features from BM. For internal testing, precision/sensitivity were 96.1±1.4%/92±1.5% (threshold of p = 0.7) and 85.6±1.9%/98.0±0.9% (threshold of p = 0.5), respectively. When threshold of p = 0.5, the tree detection rate (ratio of model-outputted airway length to BM airway length) was 114.0±14.7%. This suggested that the model detected almost all the BM airways and many unlabeled bronchioles, which were visually validated by an expert. For external testing, precision, sensitivity, and tree detection rate were 81.4±4.7%, 89.3±5.4%, and 82%±13.7%, respectively (threshold of p = 0.5), showing that the model performed well on unseen data.

CLINICAL RELEVANCE/APPLICATION

Our DL model reconstructs a 3D airway roadmap with finer bronchioles detected, showing clearer paths with possibility values for pulmonary nodule sampling in navigation bronchoscopy.

SDP-CH-19 AI For High-performance "Data Capture" Automated CXR Annotation Of Three Large Public Datasets Based On "Similarity" To A Validated Model

Participants
Doyun Kim, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

CheXpert, MIMIC, and NIH are large open access CXR datasets for widespread AI development. Unfortunately, the accuracy of their provided labels is unknown and may vary between datasets. We built and tested an explainable model for automated CXR annotation which leverages atlas creation/prediction-basis retrieval modules for high-quality labeling at a user selected performance level.*Methods and Materials We developed our model from 241,723 frontal CXR images (2015-2020) trained on 20 features, with 3-6 expert readers as ground truth. The model outputs a probability estimate of input-image similarity for each of 5 pooled-feature categories: cardiomegaly, atelectasis, edema, pneumonia, and pleural effusion. The system, which consists of an explainable AI model (Fig A) and an auto-annotation algorithm (Fig B), mimics human thinking, in that it associates degree of similarity between novel input-images and its "memory" of stored images (i.e., atlas of typical, representative features from the training sets). We tested model performance for a random subset of images from the public datasets at two different probability thresholds, "TH=0" (nominal similarity but maximal image capture count) and "TH=best" (maximal similarity but lower image capture count), applied to posteroanterior (PA) images in CheXpert (n=224,316), MIMIC (n=377,110), and NIH (n=108,948); majority vote of 7 expert readers was ground truth.*Results The positive/negative image count captured by our model per category per dataset at the TH=0 and TH=best thresholds is in Fig C (UL=unlabeled public data), with examples in Fig E; overall percent images captured at the TH=best threshold were 86% for cardiomegaly, 62% atelectasis, 59% edema, 37% pneumonia, and 82% for pleural effusion. For the image subsets with 7-reader ground truth, model labeling performance equaled or exceeded that of the public label accuracy for all categories (Fig D). Labels are available at: https://github.com/MGH-LMIC/AutoLabels-PublicData-CXR-PA.git.*Conclusions Our model for automated labeling of public CXR datasets, based on similarity to a validated model, is highly accurate and efficient. This approach may be generalizable and has the potential to help inform future automated re-training strategies.*Clinical Relevance/Application Commonly shared, defined labels among different datasets can allow for generalized AI model development.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Commonly shared, defined labels among different datasets can allow for generalized AI model development.

SDP-CH-2 Machine Learning Model For Chest X-rays In Emergency Radiology: Using Local Data To Enhance Performance

Participants
Sarah Mohn, BEng, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

PURPOSE

Our purpose was to develop and assess the diagnostic performance of a machine learning (ML) model which screens chest radiographs for multiple pathologies simultaneously. The model was developed for integration into the emergency radiology workflow at our local institution to prioritize the order in which chest x-rays are reported. Many ML algorithms in radiology have been developed, but they are not always generalizable for use at various institutions. We hypothesize that a model trained on an open-source dataset will have improved performance at our local institution after being fine-tuned on local data.*Methods and Materials An ensemble of neural networks was trained on the Stanford ML CheXpert open-source dataset consisting of 224,316 x-rays for 14 pathologies. The model was then tested on chest radiographs from our local institution and subsequently fine-tuned using 4510 local studies. Radiologists' reports were used as the gold standard when evaluating model performance. Finally, the model's

accuracy was tested on a new set of 802 local radiographs.*Results The model was trained to identify 14 chest x-ray pathologies. Of these, it identified 12 pathologies with areas under the receiver operating curve (AUC) greater than 0.75. For example, the fine-tuned model detected pleural effusions with AUC of 0.86 (95% CI(0.836, 0.887)), pneumothorax with AUC of 0.87 (95% CI (0.834, 0.904)), and negative x-rays with AUC of 0.90 (95% CI (0.843, 0.951)). After fine-tuning with local data, the model performed significantly better in detecting six pathologies (p<0.05). For example, the AUC for detecting pneumothorax improved from 0.82 to 0.87. Overall, the AUC increased from 0.79 to 0.82 (p=0.002) after fine-tuning with local data*Conclusions A ML model with the ability to accurately detect 14 different chest pathologies was successfully developed using open-source data and its performance was improved after fine-tuning on local data. This multi-pathology detection model can be easily integrated into the radiology workflow and used to prioritize the order in which chest radiographs are interpreted by radiologists, knowing that it has been adapted to the local reporting practices.*Clinical Relevance/Application We have shown that fine-tuning a model with a local dataset can improve its performance locally. Our model can now be integrated into the local emergency radiology workflow and used to prioritize the most critical cases, which may lead to improved patient outcomes.

RESULTS

The model was trained to identify 14 chest x-ray pathologies. Of these, it identified 12 pathologies with areas under the receiver operating curve (AUC) greater than 0.75. For example, the fine-tuned model detected pleural effusions with AUC of 0.86 (95% CI(0.836, 0.887)), pneumothorax with AUC of 0.87 (95% CI (0.834, 0.904)), and negative x-rays with AUC of 0.90 (95% CI (0.843, 0.951)). After fine-tuning with local data, the model performed significantly better in detecting six pathologies (p<0.05). For example, the AUC for detecting pneumothorax improved from 0.82 to 0.87. Overall, the AUC increased from 0.79 to 0.82 (p=0.002) after fine-tuning with local data

CLINICAL RELEVANCE/APPLICATION

We have shown that fine-tuning a model with a local dataset can improve its performance locally. Our model can now be integrated into the local emergency radiology workflow and used to prioritize the most critical cases, which may lead to improved patient outcomes.

SDP-CH-20 Iodine And Water Concentrations In COVID-19 Pneumonia Assessed By Contrast Enhanced Dual-energy Computed Tomography

Participants
Lien van Liedekerke, MD, Ghent, Belgium (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate iodine and water concentrations in normal lung tissue, ground-glass opacities and consolidations in COVID-19 patients without pulmonary embolisms, obtained by contrast enhanced DECT.*Methods and Materials In this IRB approved study, pulmonary DECT angiography scans were analyzed of patients with clinical signs of COVID-19 pneumonia who presented themselves at the emergency department of our tertiary center, between September 1st 2020 and December 31th 2020. We selected all patients that tested positive for COVID-19 by RT-PCR. Patients with pulmonary embolisms and lung pathologies other than COVID-19 pneumonia were excluded. Iodine and water concentrations were measured in normal lung tissue, ground-glass opacity and consolidation by manually drawing 1 cm3 regions of interest (ROI). Normalized iodine concentrations were calculated by dividing the iodine concentration value of the tissue by the concentration inside the pulmonary artery trunk. A CT-severity score was determined for each scan. Obtained values were compared by paired samples T-test. Spearman's Rho correlation tests were performed to investigate correlations between relative iodine concentrations, water concentrations and CT- severity scores. Descriptive statistics and the Shapiro-Wilk test were performed on all data to check the normality.*Results A total of 65 patients (49 male and 19 female with mean age 63, range 19 - 92 yr) were included in this study. All data was normally distributed (p-values ranging from 0,002 to 0,046). The mean CT-severity score was 11,8/25 ± 5,2. Compared to normal lung tissue (0,076 +/- 0,036 mgI/mL), normalized iodine concentration was significantly higher in ground-glass opacity (0,125 +/- 0,043 mgI/mL, p = 0,001) and consolidation (0,167 +/- 0,055 mgI/mL, p = 0,001). Water concentration was significantly higher in ground-glass opacity (284,7 mgH2O/mL, p = 0,001) and consolidation (832,6 +/- 146 mgH2O/mL, p = 0,001) compared to normal tissue (147,1 +/- 33,8 mgH2O/mL). A significant positive correlation was found between the normalized iodine concentrations and CT-severity scores in ground-glass opacity (p < 0,002) and consolidation (p < 0,001).*Conclusions Different iodine and water concentrations are seen in normal lung tissue, ground-glass opacities and consolidations in COVID-19 pneumonia. Iodine concentrations in ground-glass opacities and consolidations are positively correlated with the CT-severity scores.*Clinical Relevance/Application In contrast to low-dose pulmonary CT scans, contrast enhanced dual-energy CT scans give additional information about iodine and water content in COVID-19 lesions. In the literature, iodine and water concentrations have been described as parameters for inflammation and lung perfusion.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

In contrast to low-dose pulmonary CT scans, contrast enhanced dual-energy CT scans give additional information about iodine and water content in COVID-19 lesions. In the literature, iodine and water concentrations have been described as parameters for inflammation and lung perfusion.

SDP-CH-21 Anterior Mediastinal Cystic Lesions Assessed With Chest MRI: Follow-up Outcome And Clinical Implications

Participants
Jooae Choe, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The use of chest MR has been increased for the evaluation of anterior mediastinal cystic lesion as suggested by International

Thymic Malignancy Interest Group (ITMIG) but the outcome in those patients is not well known. This study aimed to evaluate the follow-up outcome in patients with chest MR findings of probable cysts in the anterior mediastinum and assess whether MR findings can rule out malignancy.*Methods and Materials In this multicenter retrospective study, patients who underwent contrast enhanced chest MR from two tertiary center for the evaluation of anterior mediastinal lesion and suspected for cystic lesions were evaluated. Chest MR was evaluated by thoracic radiologist, and patients were classified into two categories: probable cystic lesion or indeterminate lesion based on MR findings. Baseline and follow-up imaging was evaluated in terms of the largest dimension and imaging characteristics. Events of surgery and incidence of confirmed tumor were recorded.*Results A total of 205 patients (mean age 59±11 years; M:F = 111:94) were studied. 186 (90.7%) were classified as probable cystic lesion on MR and 19 (9.3%) were classified indeterminate on MR. The median follow-up duration in patients with probable cystic lesions was 2.9 years (range, 0-15) and follow-up interval was variable among physicians after MR (median 12 months; range 3-50 months). Patients with probable cystic lesion with more than 6 months follow-up showed variable change in size (28.0% increase, 60.6% stable, and 11.3% decrease), but no new enhancing nodular portion was observed during follow-up. Among such patients with an increase in probable cystic lesions, six patients underwent surgery, and all confirmed thymic cyst. In patients with an indeterminate lesion on MR, 21.1% were confirmed tumors (3 thymomas and 1 teratoma).*Conclusions Diagnosing anterior mediastinal cystic lesions is accurate, which can rule out malignancy. Those cystic lesions can show a variable change in size on follow-up, but none of the probable cystic lesions on MR turned out to be malignant.*Clinical Relevance/Application Diagnosing anterior mediastinal cystic lesions using MR is accurate, which can rule out malignancy. Understanding long-term follow-up changes of anterior mediastinal cystic lesion and recognizing indeterminate features on chest MR can reduce the number of unnecessary follow-up and surgery.

RESULTS

A total of 205 patients (mean age 59±11 years; M:F = 111:94) were studied. 186 (90.7%) were classified as probable cystic lesion on MR and 19 (9.3%) were classified indeterminate on MR. The median follow-up duration in patients with probable cystic lesions was 2.9 years (range, 0-15) and follow-up interval was variable among physicians after MR (median 12 months; range 3-50 months). Patients with probable cystic lesion with more than 6 months follow-up showed variable change in size (28.0% increase, 60.6% stable, and 11.3% decrease), but no new enhancing nodular portion was observed during follow-up. Among such patients with an increase in probable cystic lesions, six patients underwent surgery, and all confirmed thymic cyst. In patients with an indeterminate lesion on MR, 21.1% were confirmed tumors (3 thymomas and 1 teratoma).

CLINICAL RELEVANCE/APPLICATION

Diagnosing anterior mediastinal cystic lesions using MR is accurate, which can rule out malignancy. Understanding long-term follow-up changes of anterior mediastinal cystic lesion and recognizing indeterminate features on chest MR can reduce the number of unnecessary follow-up and surgery.

SDP-CH-22   Diagnosis Of Pneumothorax After Percutaneous Transthoracic Needle Biopsy On Chest Radiographs: Impact Of Clinical Implementation Of A Deep Learning System

Participants
Wonju Hong, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate whether a deep learning based computer-aided detection (CAD) system can improve pneumothorax diagnosis on chest radiographs (CXRs) after percutaneous transthoracic needle biopsies (PTNBs) in actual clinical practice.*Methods and Materials Our institution implemented a deep learning based CXR CAD system for pneumothorax detection after PTNBs on February, 2020. In this retrospective cohort study, CXRs interpreted with CAD assistance (CAD-applied group, obtained from February 4, 2020 to November 2020) after the implementation and those interpreted before the implementation (conventional group, obtained from January 2018 to February 3, 2020) were consecutively included. The diagnostic accuracy of CXR interpretation for pneumothorax were compared between the two groups using generalized estimating equations. Matching was made according to whether the reader of CXRs and the operator of PTNB were the same by using Greedy method.*Results A total of 676 CXRs from 655 patients (M:F=390:286, mean age 66.6 years) in the CAD-applied group and 676 CXRs from 664 patients (M:F=400:276, mean age 65.5 years) in the conventional group were included in this study. One hundred twenty-three CXRs (18.2%) in the CAD-applied group and 152 CXRs (22.5%) in the conventional group (P=0.052) had pneumothorax. The sensitivity, specificity, PPV, NPV, and accuracy in the conventional group were 67.1%, 99.6%, 98.1%, 91.3%, and 92.3%, respectively. Those in the CAD-applied group were 85.4%, 99.3%, 96.3%, 96.8%, and 96.8%, respectively. The CAD-applied group showed significantly higher sensitivity (P<0.001), NPV (P<0.001), and accuracy (P<0.001) for pneumothorax diagnosis than the conventional group. Among patients with pneumothorax, 50 cases (3.7%) required subsequent drainage catheter insertion (34 cases [5.0%] from the conventional group and 16 cases [2.4%] from the CAD-applied group) (P=0.009). The time interval from follow-up CXRs to drainage catheter insertion (25.2±19.5 hours vs. 26.5±27.4 hours; P=0.869) and the catheter dwell time (75.9±32.5 hours vs. 91.7±85.6 hours, P=0.479) were shortened in the CAD-applied group, however the difference did not reach statistical significance.*Conclusions A deep learning based computer-aided detection system improved the sensitivity, negative predictive value, and accuracy of pneumothorax diagnosis on CXRs after PTNBs.*Clinical Relevance/Application A deep learning based CAD system can improve the accuracy of radiologists' CXR interpretation and might be expected to shorten management time in patients with pneumothorax.

RESULTS

A total of 676 CXRs from 655 patients (M:F=390:286, mean age 66.6 years) in the CAD-applied group and 676 CXRs from 664 patients (M:F=400:276, mean age 65.5 years) in the conventional group were included in this study. One hundred twenty-three CXRs (18.2%) in the CAD-applied group and 152 CXRs (22.5%) in the conventional group (P=0.052) had pneumothorax. The sensitivity, specificity, PPV, NPV, and accuracy in the conventional group were 67.1%, 99.6%, 98.1%, 91.3%, and 92.3%, respectively. Those in the CAD-applied group were 85.4%, 99.3%, 96.3%, 96.8%, and 96.8%, respectively. The CAD-applied group showed significantly higher sensitivity (P<0.001), NPV (P<0.001), and accuracy (P<0.001) for pneumothorax diagnosis than the conventional group. Among patients with pneumothorax, 50 cases (3.7%) required subsequent drainage catheter insertion (34 cases [5.0%] from the conventional group and 16 cases [2.4%] from the CAD-applied group) (P=0.009). The time interval from follow-up CXRs to drainage catheter insertion (25.2±19.5 hours vs. 26.5±27.4 hours; P=0.869) and the catheter dwell time (75.9±32.5 hours vs. 91.7±85.6 hours, P=0.479) were shortened in the CAD-applied group, however the difference did not reach statistical significance.

CLINICAL RELEVANCE/APPLICATION

A deep learning based CAD system can improve the accuracy of radiologists' CXR interpretation and might be expected to shorten management time in patients with pneumothorax.

SDP-CH-23 **Attention-guided Analysis To Predict Presence Of Pulmonary Embolism And Related Features On CTPA Using A Multi-stage Deep Learning Framework**

Participants
Gagandeep Singh, MD, Newark, New Jersey (*Presenter*) Nothing to Disclose

PURPOSE

Pulmonary embolism (PE) is the most common preventable cause of hospital death. Detection of PE on Computed Tomography Pulmonary Angiography (CTPA) is the diagnostic gold standard. Timely diagnosis is crucial to halt subsequent decompensation into heart failure. Current machine learning algorithms for detecting PE focus on blood clot regions. Analysis of other abnormal regions suggestive of clots remains unexplored. We propose a two-stage attention-based network comprising a Convolutional Neural Network (CNN) and a Sequence model (LSTM+Dense) to predict PE and its associated attributes like laterality, chronicity, and Right Ventricular to Left Ventricular ratio on CTPA. The learnt features capture spatial and global relationships between successive slices to mimic the human cognitive process while examining cross-sectional images.*Methods and Materials We used the RSNA PE CT dataset. 5824 studies were randomly assigned to the training dataset D1, and 1455 to the validation cohort D2. For the test set, D3, 106 CTPA studies were collected from InstituteX. We trained the network in two stages. Stage 1 includes using CNN Efficient-Net to extract features from each slice, followed by average pooling. In Stage 2, we use a sequence model to capture long-range image dependencies. The sequence model consists of bidirectional long short-term memory (BiLSTM) and a dense layer. It has two heads; one is used to detect PE (?image), another is used to predict different characteristics of PE (?study). Features generated from the Sequence Model are passed through the attention module to facilitate the identification of informative slices in the study and assign them higher value for final study level prediction. This yielded bag-level features are passed through ?study for global prediction. We provided features from LTSM directly to ?image to detect the presence of PE on each slice. A custom loss function was used to train the network and the model with lowest loss on D2 was used to evaluate performance on D3.*Results We compared our model with a CNN classifier (Baseline 1) and a CNN-LTSM network without attention module (Baseline 2). Test set area under receiver operating curve (AUC) of Baseline 1, Baseline 2, and our method were 0.5, 0.94, and 0.95, respectively. The accuracies were 0.74, 0.65, and 0.88, respectively.*Conclusions Our attention based two stage CNN-LSTM network was able to learn and predict the presence of PE and associated attributes with a high AUC. This can potentially increase the speed of PE detection without a decrease in accuracy.*Clinical Relevance/Application Incorporating deep learning models into clinical workflows can decrease diagnostic delays and errors, thereby lowering morbidity and mortality associated with PE.

RESULTS

We compared our model with a CNN classifier (Baseline 1) and a CNN-LTSM network without attention module (Baseline 2). Test set area under receiver operating curve (AUC) of Baseline 1, Baseline 2, and our method were 0.5, 0.94, and 0.95, respectively. The accuracies were 0.74, 0.65, and 0.88, respectively.

CLINICAL RELEVANCE/APPLICATION

Incorporating deep learning models into clinical workflows can decrease diagnostic delays and errors, thereby lowering morbidity and mortality associated with PE.

SDP-CH-25 **Deep Learning-based Computer-aided Detection System For Pulmonary Metastasis On Chest Ct: Performance In Consecutive Patients Undergoing Pulmonary Metastasectomy**

Participants
Eui Jin Hwang, MD, Seoul, Korea, Republic Of (*Presenter*) Research Grant, Lunit Inc;Research Grant, Coreline Soft, Co Ltd;Research Grant, Monitor Corporation Inc

PURPOSE

To develop a deep learning-based computer-aided detection (CAD) system for pulmonary metastasis in chest CTs of patients with cancers and to evaluate its performance in patients undergoing pulmonary metastasectomy.*Methods and Materials A deep learning-based CAD system for identifying pulmonary metastasis was developed with 5000 chest CTs (19064 annotated potential metastasis) from patients with cancers. For evaluation of the CAD, patients who underwent therapeutic pulmonary metastasectomy were consecutively included from a single institution. Thoracic radiologists marked any pulmonary nodules suspicious of metastasis on chest CTs before surgery as a part of clinical practice (original reading). The CAD system was retrospectively applied to preoperative CTs to identify pulmonary metastasis. After CAD analysis, a thoracic radiologist reviewed CAD results to check additional nodules overlooked in the radiologists' annotation (Second reading with CAD). Whether individual nodules were metastatic or not was determined by pathologic results of resected nodule or presence of growth on follow-up CT examinations. Nodules that were stable for more than two years were regarded as benign nodules.*Results Among 71 patients (47 men, median age 56 years), 232 pulmonary metastases were identified (median 2 per patient). In the original reading, radiologists identified 590 nodules (median 6 per patient) and exhibited sensitivity and positive predictive value (PPV) of 92% and 38%, respectively. The CAD detected 767 lesions (median 10 per patient), and its sensitivity (82% vs. 92%; P<.001) and PPV (25% vs. 38%; P<.001) for detecting pulmonary metastasis were significantly lower than radiologists. Interestingly, in the second reading with CAD assistance, radiologists detected 64 additional nodules, and 7 (11%) of them were true metastasis. With CAD assistance, the sensitivity of detecting metastasis (95%) was significantly improved (P=.01), while PPV was declined (38% to 35%; P<.001).*Conclusions In consecutive patients undergoing pulmonary metastasectomy, a deep learning-based CAD could detect pulmonary metastases that radiologists overlooked in daily practice.*Clinical Relevance/Application Deep learning-based CAD for pulmonary metastasis may help manage patients undergoing pulmonary metastasis since complete resection of every metastasis is essential in pulmonary metastasectomy.

RESULTS

Among 71 patients (47 men, median age 56 years), 232 pulmonary metastases were identified (median 2 per patient). In the original reading, radiologists identified 590 nodules (median 6 per patient) and exhibited sensitivity and positive predictive value (PPV) of 92% and 38%, respectively. The CAD detected 767 lesions (median 10 per patient), and its sensitivity (82% vs. 92%; P<.001) and PPV (25% vs. 38%; P<.001) for detecting pulmonary metastasis were significantly lower than radiologists. Interestingly, in the second reading with CAD assistance, radiologists detected 64 additional nodules, and 7 (11%) of them were true metastasis. With CAD assistance, the sensitivity of detecting metastasis (95%) was significantly improved (P=.01), while PPV was declined (38% to 35%; P<.001).

CLINICAL RELEVANCE/APPLICATION

Deep learning-based CAD for pulmonary metastasis may help manage patients undergoing pulmonary metastasis since complete

resection of every metastasis is essential in pulmonary metastasectomy.

SDP-CH-26 Performance Assessment Of Artificial Intelligence (ai) Assisted Incomplete Rib Fracture Diagnostic For Residents In Radiology Department For Emergency Trauma

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the effect of artificial intelligence (AI)-assisted diagnostic system on detection of incomplete rib fracture for residents.*Methods and Materials Seventy-six patients with emergency chest trauma underwent chest CT examination were enrolled. The image reconstruction slice thickness was set to 1-1.25mm and reconstructed under lung algorithms. Reading time and detection sensitivity was used to compare the observer's performance in detecting incomplete rib fracture with and without use of AI-assisted system (InferRead CT Bone Research,Infervision, Beijing), with the interval of more than 4 weeks. Gold standard of incomplete rib fracture was established by two board-certified radiologists with more than 15 years of experience on the review of the results by AI-assisted system. Chi-square test was used to compare the sensitivity and false positive rate of incomplete rib fracture detection between two reading modes while reading time was compared using independent-sample t test.*Results 1822 ribs (two of which were hypoplastic) including 108 incomplete rib fractures were found in 76 patients. For resident without using AI, a total of 113 rib fractures including 82 true positive and 31 false positive were identified, with a sensitivity of 75.93% and a false positive rate of 1.81%. For radiologist resident with using AI, a total of 136 rib fractures including 94 true positive and 42 false positive were detected, with a sensitivity of 87.04% and the false positive rate of 2.45%. There was significant difference in the sensitivity of incomplete rib fracture detection with or without AI (p=0.036), while no significant difference was found in the false positive rate of rib fracture detection (p=0.193). The reading time using AI (105.26±57.20 s) was found to be significantly reduced as compared with that without using AI (240.79±63.20 s) (p<0.001).*Conclusions AI-assisted fracture system improved the accuracy of incomplete rib fracture detection and significantly shortened the diagnosis time for residents.*Clinical Relevance/Application Although incomplete rib fracture is easily missed by residents which might be life-threatening, the use of AI-assisted fracture detection system could improve incomplete rib fracture detection sensitivity.

RESULTS

1822 ribs (two of which were hypoplastic) including 108 incomplete rib fractures were found in 76 patients. For resident without using AI, a total of 113 rib fractures including 82 true positive and 31 false positive were identified, with a sensitivity of 75.93% and a false positive rate of 1.81%. For radiologist resident with using AI, a total of 136 rib fractures including 94 true positive and 42 false positive were detected, with a sensitivity of 87.04% and the false positive rate of 2.45%. There was significant difference in the sensitivity of incomplete rib fracture detection with or without AI (p=0.036), while no significant difference was found in the false positive rate of rib fracture detection (p=0.193). The reading time using AI (105.26±57.20 s) was found to be significantly reduced as compared with that without using AI (240.79±63.20 s) (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Although incomplete rib fracture is easily missed by residents which might be life-threatening, the use of AI-assisted fracture detection system could improve incomplete rib fracture detection sensitivity.

SDP-CH-27 Identification Of Active Pulmonary Tuberculosis Among Patients With Latent Tuberculosis Infection: Application Of Deep Learning-based Computer-aided Detection System

Participants
Jongsoo Park, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Identification of active tuberculosis (TB) patients before treatment of latent tuberculosis infection (LTBI) is one of the vital roles of chest X-ray (CXR) in managing patients with TB. We aimed to evaluate the diagnostic performance of a deep learning-based computer-aided detection (CAD) system in identifying patients with active TB among consecutive patients with LTBI.*Methods and Materials We consecutively collected CXRs of patients with LTBI confirmed by immunoglobulin release assay. Reference standard for active pulmonary TB was defined by culture or nucleic acid amplification test of respiratory specimens. A previously developed deep learning-based CAD (TB-CAD, hereafter), trained with 54221 normal CXRs and 6768 CXRs with active TB, was applied to all CXRs to provide probability scores for active pulmonary TB. The performance of CAD was compared to a commercialized deep learning-based CAD, trained for various abnormalities in addition to findings of TB (Commercial CAD, hereafter). For comparison of radiologists' performance, a reader test was conducted with 5 radiologists, using subgroup CXRs with enriched prevalence. At first, each reader interpreted CXRs to identify active pulmonary TB at their discretion. Afterward, each reader re-interpreted CXRs after reviewing TB-CAD results (CAD-assisted reading).*Results Among 1780 patients (53.8% male; median age 56 years) with LTBI, 44 (2.5%) were confirmed as active pulmonary TB. The TB-CAD exhibited higher performance than commercial CAD (area under curves, 0.85 vs. 0.70; P<.001). At pre-defined thresholds, the TB-CAD exhibited 89% sensitivity at 61% specificity and 61% sensitivity at 90% specificity. In the reader test (219 CXRs, 44 active TB), the TB-CAD exhibited higher sensitivity than radiologists (73% vs. 60%; P=.01), at the same specificity (88%). In the CAD-assisted reading, radiologists' sensitivity was improved (60% to 72%; P<.001) with a modest decline of specificity (88% to 83%; P<.001).*Conclusions Deep learning-based CAD for active TB could accurately identify CXRs with active pulmonary TB among patients with LTBI. The CAD showed higher sensitivity than radiologists and enhanced radiologists' sensitivity.*Clinical Relevance/Application The deep learning-based CAD system can help to screen active pulmonary TB on CXR before treatment of LTBI, with higher sensitivity than radiologists' interpretation.

RESULTS

Among 1780 patients (53.8% male; median age 56 years) with LTBI, 44 (2.5%) were confirmed as active pulmonary TB. The TB-CAD exhibited higher performance than commercial CAD (area under curves, 0.85 vs. 0.70; P<.001). At pre-defined thresholds, the TB-CAD exhibited 89% sensitivity at 61% specificity and 61% sensitivity at 90% specificity. In the reader test (219 CXRs, 44 active TB), the TB-CAD exhibited higher sensitivity than radiologists (73% vs. 60%; P=.01), at the same specificity (88%). In the CAD-assisted reading, radiologists' sensitivity was improved (60% to 72%; P<.001) with a modest decline of specificity (88% to 83%; P<.001).

CLINICAL RELEVANCE/APPLICATION

The deep learning-based CAD system can help to screen active pulmonary TB on CXR before treatment of LTBI, with higher sensitivity than radiologists' interpretation.

SDP-CH-28 Clinical Dual Source Photon Counting CT For Non-contrast Enhanced Chest CT: Initial Results

Participants
Ronald Booij, PhD, Rotterdam, Netherlands (*Presenter*) Research Collaboration, Siemens AG

PURPOSE

To assess improvements in image quality (IQ) and lung structure visualization of a clinical dual source photon counting detector (PCD) CT in comparison with energy integrating detector (EID) CT.*Methods and Materials Twenty adult patients (12 males [age range 39 - 71 years and 8 females [age range 33 - 78 years]) referred for a follow-up non-contrast enhanced chest CT were scanned on a dual source PCD CT (Siemens NAEOTOM Alpha). Virtual monoenergetic plus images at 70 keV were reconstructed with a Bl64 kernel and an automatically selected matrix size (either 768 or 1024 elements). Images were compared with the most recent prior non-contrast enhanced chest CT of the same patient obtained with an EID CT scanner (Siemens SOMATOM Force) with a median time difference of nine months. EID CT data was reconstructed with routine lung reconstruction kernels (Bl57/I70f) and a 512 matrix. Both scans were reconstructed with a slice thickness / increment of 1.0 / 0.8 mm. Two experienced radiologists qualitatively compared PCD CT and EID CT images using 5-point Likert scales. We compared the mean score of the answers regarding IQ for 8 items regarding specific anatomical parts of the lung (1=very poor, poor, fair, good or 5=excellent) between EID CT and PCD CT. Specific attention was given to bronchial division visibility. Additionally, for ten items the observers' preference for either the PCD CT or the EID CT was determined using a 5-point Likert scale (1=EID better, EID slightly better, EID and PCD equal, PCD slightly better, 5=PCD better).*Results In comparison with EID CT, both observers rated the mean overall IQ for the specific anatomical parts of the lung 0.3 points higher for PCD CT at 4.8. IQ per lung lobe was scored similarly, but the agreement between observers was higher for PCD CT (range 70% - 90%) compared to EID CT (range 30% - 55%). The smallest bronchial division visibility was scored 'slightly better' or 'better' on PCD CT by both observers for all scans. Overall, the observers had a preference for the PCD CT over EID CT (mean score 4.0 and 4.2 for observer A and B, respectively). In 17/20 patients, PCD CT was scored as better than the EID CT.*Conclusions PCD CT provides superior overall IQ and was scored as the preference for clinical non-contrast enhanced chest CT exams compared to EID CT.*Clinical Relevance/Application The image quality of chest CT scans obtained with PCD CT is scored as superior including more detailed evaluation of the lung parenchyma which may lead to more consistent evaluation of especially small airway disease.

RESULTS

In comparison with EID CT, both observers rated the mean overall IQ for the specific anatomical parts of the lung 0.3 points higher for PCD CT at 4.8. IQ per lung lobe was scored similarly, but the agreement between observers was higher for PCD CT (range 70% - 90%) compared to EID CT (range 30% - 55%). The smallest bronchial division visibility was scored 'slightly better' or 'better' on PCD CT by both observers for all scans. Overall, the observers had a preference for the PCD CT over EID CT (mean score 4.0 and 4.2 for observer A and B, respectively). In 17/20 patients, PCD CT was scored as better than the EID CT.

CLINICAL RELEVANCE/APPLICATION

The image quality of chest CT scans obtained with PCD CT is scored as superior including more detailed evaluation of the lung parenchyma which may lead to more consistent evaluation of especially small airway disease.

SDP-CH-29 Deep Learning-based Lung Nodule Detection And Classification System In Lung Cancer Screening Population: Improved Radiologists' Nodule Detection Sensitivity And Inter-reader Agreement

Participants
Jongsoo Park, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the performance of a deep learning-based lung nodule detection and classification system for interpretation of low dose chest CTs (LDCTs) in comparison with radiologists' interpretations.*Methods and Materials Screening LDCTs of 50 high-risk participants were retrospectively collected from a nationwide lung cancer screening program, with enriched lung cancer prevalence (30%). A commercialized, regulatory-approved deep learning-based software analyzed LDCTs to detect and classify lung nodules based on the Lung-RADS (ver. 1.1). For comparison, 3 thoracic radiologists and 3 radiology residents independently interpreted LDCTs using the Lung-RADS (reader-alone interpretation). After the interpretation, each reader reviewed software results and modified their initial interpretation as needed (software-assisted interpretation). The majority of three thoracic radiologists decided reference standards for the presence and classification of lung nodules based on the Lung-RADS. Diagnostic accuracy was calculated for lung cancer and Lung-RADS positive nodules.*Results Among 50 participants (male 100%; median age 63 years; median smoking burden of 40 pack-year), 15 participants were diagnosed as lung cancer. For the identification of participants with lung cancer, the software exhibited similar sensitivity (87%) with readers (81%; P=.57) with lower specificity (60% vs. 75%; P=.04). The software and readers exhibited similar sensitivities for detection of any lung nodules (67% vs. 60%; P=.08), and Lung-RADS positive (category =3) nodules (73% vs. 71%; P=.72). In the software-assisted interpretation, sensitivities of readers in the detection of any lung nodules (60% to 73%; P<.001) and Lung-RADS positive nodules (71% to 76%; P=.02) were improved compared to the reader-alone interpretation. Inter-reader agreement of Lung-RADS categorization was improved in the software-assisted interpretation (Fleiss' kappa, 0.51 to 0.57).*Conclusions To interpret screening LDCTs, a deep learning-based lung nodule detection and classification system exhibited radiologist-level sensitivity and improved radiologists' lung nodule detection performance and inter-reader agreement of interpretation.*Clinical Relevance/Application To interpret screening LDCTs, a deep learning-based lung nodule detection and classification system can help radiologists detect lung nodules and reduce inter-reader variability.

RESULTS

Among 50 participants (male 100%; median age 63 years; median smoking burden of 40 pack-year), 15 participants were diagnosed as lung cancer. For the identification of participants with lung cancer, the software exhibited similar sensitivity (87%) with readers (81%; P=.57) with lower specificity (60% vs. 75%; P=.04). The software and readers exhibited similar sensitivities for detection of any lung nodules (67% vs. 60%; P=.08), and Lung-RADS positive (category =3) nodules (73% vs. 71%; P=.72). In the software-assisted interpretation, sensitivities of readers in the detection of any lung nodules (60% to 73%; P<.001) and Lung-RADS positive nodules (71% to 76%; P=.02) were improved compared to the reader-alone interpretation. Inter-reader agreement of Lung-RADS categorization was improved in the software-assisted interpretation (Fleiss' kappa, 0.51 to 0.57).

CLINICAL RELEVANCE/APPLICATION

To interpret screening LDCTs, a deep learning-based lung nodule detection and classification system can help radiologists detect

lung nodules and reduce inter-reader variability.

SDP-CH-30 A Comparative Study To Evaluate CtBased Semantic And Radiomic Features In Preoperative Diagnosis Of Invasive Pulmonary Adenocarcinomas Manifesting As Subsolid Nodules

Participants
Fu-Zong Wu, MD, Kaohsiung, Taiwan (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to predict the histological invasiveness of pulmonary adenocarcinoma spectrum manifesting with subsolid nodules ?3 cm using the preoperative CT-based radiomic approach.*Methods and Materials A total of 186 patients with 203 SSNs confrmed with surgically pathologic proof were retrospectively reviewed from February 2016 to March 2020 for training cohort modeling. The validation cohort included 50 subjects with 57 SSNs confrmed with surgically pathologic proof from April 2020 to August 2020. CT-based radiomic features were extracted using an open-source software with 3D nodular volume segmentation manually. The association between CT-based conventional features/ selected radiomic features and histological invasiveness of pulmonary adenocarcinoma status were analyzed. Diagnostic models were built using conventional CT features, selected radiomic CT features and experienced radiologists.*Results In the training cohort of 203 SSNs, there were 106 invasive lesions and 97 pre-invasive lesions. Logistic analysis identifed that a selected radiomic feature named GLCM_Entropy_log10 was the predictor for histological invasiveness of pulmonary adenocarcinoma spectrum (OR: 38.081, 95% CI 2.735-530.309, p = 0.007). The sensitivity and specifcity for predicting histological invasiveness of pulmonary adenocarcinoma spectrum using the cutof value of CT-based radiomic parameter (GLCM_Entropy_log10) were 84.8% and 79.2% respectively (area under curve, 0.878). The diagnostic model of CT-based radiomic feature was compared to those of conventional CT feature (morphologic and quantitative) and three experienced radiologists. The diagnostic performance of radiomic feature was similar to those of the quantitative CT feature (nodular size and solid component, both lung and mediastinal window) in prediction invasive pulmonary adenocarcinoma (IPA). The AUC value of CT radiomic feature was higher than those of conventional CT morphologic feature and three experienced radiologists. The c-statistic of the training cohort model was 0.878 (95% CI 0.831-0.925) and 0.923 (0.854-0.991) in the validation cohort. Calibration was good in both cohorts.*Conclusions The diagnostic performance of CT-based radiomic feature is not inferior to solid component (lung and mediastinal window) and nodular size for predicting invasiveness. CT-based radiomic feature and nomogram could help to diferentiate*Clinical Relevance/Application Radiomic feature may provide superior diagnostic performance compared with those of morphologic CT features and radiologists. Te nomogram may help clinicians with decision making in the management of subsolid nodules.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Radiomic feature may provide superior diagnostic performance compared with those of morphologic CT features and radiologists. Te nomogram may help clinicians with decision making in the management of subsolid nodules.

SDP-CH-31 Comparison Of Capability For Lymph Node Metastasis Prediction Among Lung MRIs With Ultra-Short TE (UTE-MRIs) By Single And Dual Echo Techniques, Thin-section CT, DWI, FDG-PET/CT And Combined MR Predictors In Non-small Cell Lung Cancer

Participants
Yoshiharu Ohno, MD,PhD, Toyoake, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation;Research Grant, DAIICHI SANKYO Group

PURPOSE

Evaluation of solid component within tumor as ratio between consolidation and total tumor (C/T ratio) on thin-section CT had been suggested as useful for prediction of patients' survival in non-small cell lung cancer (NSCLC). Recently, lung MRI with ultra-short TE (UTE) has been suggested as useful for tumor morphological evaluation since 2016. Moreover, lung MRI with multiple UTEs is tested for adding morphological information with T2* relaxation time in various diseases. The purpose of this study was to compare capability for lymph node metastasis prediction in NSCLC among UTE-MRIs with single- and dual-echo techniques (UTE-MRISingle and UTE-MRIDual), CT, DWI, FDG-PET/CT and combined MR predictors.*Methods and Materials 56 NSCLC patients underwent CT, UTE-MRIs with both techniques, DWI, FDG-PET/CT, surgical resection and pathological and follow-up examinations. Then, C/T ratios from CT and both UTE-MRIs, ADC and SUVmax at each primary lesion were assessed. All indexes were compared between N0 and equal to or more than N1 (N1=) cases by Student's t test. Multiple regression analysis was performed to determine predictors for differentiation of N1= from N0 cases among all MR indexes. Moreover, ROC analysis was also performed among all indexes and combined MR predictors. Finally, sensitivity (SE), specificity (SP) and accuracy (AC) were compared among all indexes.*Results There was significant difference of each index between N0 and N1= cases (p<0.05). C/T ratio from UTE-MRIDual (p=0.04) and ADC (p=0.0002) were determined significant predictors in this setting. Area under the curves (AUCs) of ADC (AUC=0.84), SUVmax (AUC=0.82) or combined MR predictors (AUC=0.90) were significantly larger than that of each C/T ratio (0.69=AUC=0.73, p<0.05). SP or AC of combined MR predictors were significantly higher than those of others (p<0.05). Moreover, SP and AC of ADC and SUVmax were significantly higher than those of each C/T ratio (p<0.05).*Conclusions UTE-MRIDual is considered as having the capability to play as significant predictor for lymph node metastasis similar to DWI, and combined MR predictors shows significant higher capability than each C/T ratio, DWI and PET/CT in this setting.*Clinical Relevance/Application UTE-MRIDual is considered as having the capability to play as significant predictor for lymph node metastasis similar to DWI, and combined MR predictors shows significant higher capability than each C/T ratio, DWI and PET/CT in this setting.

RESULTS

There was significant difference of each index between N0 and N1= cases (p<0.05). C/T ratio from UTE-MRIDual (p=0.04) and ADC

There was significant difference of each index between N0 and N1= cases (p<0.05). C/T ratio from UTE-MRIDual (p=0.04) and ADC (p=0.0002) were determined significant predictors in this setting. Area under the curves (AUCs) of ADC (AUC=0.84), SUVmax (AUC=0.82) or combined MR predictors (AUC=0.90) were significantly larger than that of each C/T ratio (0.69=AUC=0.73, p<0.05). SP or AC of combined MR predictors were significantly higher than those of others (p<0.05). Moreover, SP and AC of ADC and SUVmax were significantly higher than those of each C/T ratio (p<0.05).

CLINICAL RELEVANCE/APPLICATION

UTE-MRIDual is considered as having the capability to play as significant predictor for lymph node metastasis similar to DWI, and combined MR predictors shows significant higher capability than each C/T ratio, DWI and PET/CT in this setting.

SDP-CH-32   Clinical Research On Patients With Surgically Resected Primary Lung Adenocarcinoma: Are Heterogeneous Ggns Different From Part Solid Nodules?

Participants
Hirofumi Koike, Nagasaki, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the natural course of patients with surgically resected lung adenocarcinoma (Ad) with heterogenous GGN, and to clarify the difference between heterogeneous GGNs and part solid nodules.*Methods and Materials Between 2006 and 2015, 507 patients with proven lung Ad were retrospectively reviewed. Preoperative lung Ad lesions were investigated, and were classified into solid nodule, part solid nodule, heterogeneous GGN, and pure GGN group on thin-section CT. After surgery, they were examined pathologically. Disease-free survival (DFS) and overall survival (OS) of the patients were also investigated.*Results All of the 61 heterogeneous GGNs were found only in patients with postoperative stage IA. The numbers of the other types including solid nodule, part solid nodule, and pure GGN in stage IA were 70, 181, and 9, respectively. In part solid nodule group, recurrence of lung Ad and death from the primary disease were observed in 12(6.6%) and 6(3.3%) of 181 patients, respectively. There were no recurrences or deaths from the primary disease of lung Ad in heterogeneous GGN group. Heterogeneous GGNs were significantly associated with longer DFS than part solid nodules (p=0.042). On the other hand, there was no significant difference between heterogeneous GGNs and part solid nodules (p=0.139) in OS. Pathological diagnoses based on IASLC/ATS/ERS new classification of lung Ad advocated in 2011 have been obtained in 176 patients. 100 part solid nodules were classified into 71 invasive adenocarcinomas (71%), 24 minimally invasive adenocarcinomas (MIAs) (24%), and 5 adenocarcinomas in situ (AIS) (5%), and 32 heterogeneous GGNs were classified into 9 invasive adenocarcinomas (28.1%), 15 MIAs (46.9%), and 8 AIS (25%).*Conclusions Heterogeneous GGNs were associated with longer DFS than part solid nodules. Pathologically, the heterogeneous GGN group had a lower proportion of invasive adenocarcinoma, a higher proportion of MIA and AIS than part solid nodule group.*Clinical Relevance/Application • Heterogeneous GGNs were found only in patients with postoperative stage IA. • There were no recurrences or deaths from the primary disease of lung Ad in heterogeneous GGN group after surgery. • There were differenced in proportions of pathological subclassification of lung Ad between part solid nodule and heterogeneous GGN.

RESULTS

All of the 61 heterogeneous GGNs were found only in patients with postoperative stage IA. The numbers of the other types including solid nodule, part solid nodule, and pure GGN in stage IA were 70, 181, and 9, respectively. In part solid nodule group, recurrence of lung Ad and death from the primary disease were observed in 12(6.6%) and 6(3.3%) of 181 patients, respectively. There were no recurrences or deaths from the primary disease of lung Ad in heterogeneous GGN group. Heterogeneous GGNs were significantly associated with longer DFS than part solid nodules (p=0.042). On the other hand, there was no significant difference between heterogeneous GGNs and part solid nodules (p=0.139) in OS. Pathological diagnoses based on IASLC/ATS/ERS new classification of lung Ad advocated in 2011 have been obtained in 176 patients. 100 part solid nodules were classified into 71 invasive adenocarcinomas (71%), 24 minimally invasive adenocarcinomas (MIAs) (24%), and 5 adenocarcinomas in situ (AIS) (5%), and 32 heterogeneous GGNs were classified into 9 invasive adenocarcinomas (28.1%), 15 MIAs (46.9%), and 8 AIS (25%).

CLINICAL RELEVANCE/APPLICATION

• Heterogeneous GGNs were found only in patients with postoperative stage IA. • There were no recurrences or deaths from the primary disease of lung Ad in heterogeneous GGN group after surgery. • There were differenced in proportions of pathological subclassification of lung Ad between part solid nodule and heterogeneous GGN.

SDP-CH-33   Improvement Diagnostic Performance On Fibrotic Hypersensitivity Pneumonitis Using Ultra-high Resolution Computed Tomography

Participants
Tae Iwasawa, MD,PhD, Yokohama, Japan (*Presenter*) Support, Canon Medical Systems CorporationSupport, Ziosoft Inc.Speaker, FUJIFILM Holdings CorporationSpeaker, Boehringer Ingelheim GmbH

PURPOSE

To evaluate whether ultra-high-resolution computed tomography (U-HRCT) can increase diagnostic performance of fibrotic hypersensitivity pneumonitis (fHP) compared to conventional CT.*Methods and Materials This single-institution retrospective study was approved by our institutional review board. Fifty-five patients (38 men, 17 women; median age: 63 years) who underwent surgical lung biopsy and were diagnosed with chronic fibrotic interstitial lung diseases by multi-disciplinary discussion as idiopathic pulmonary fibrosis (n=22), fHP (n=14), and others (n=19) were included in this study. All CT scans were performed by a 160-row U-HRCT scanner (Aquilion Precision, Canon Medical Systems, Otawara,Tochigi, Japan). CT scans were performed at 120 kVp, 0.25 × 160 collimation, and 0.828 beam pitch using automatic exposure control. Two kinds of images were constructed and compared: U-HRCT image (1024 × 1024 matrix size, 0.25-mm slice thickness, and deep learning reconstruction algorithm for the lung) and normal-resolution simulation (NR-sim) image (512 × 512 matrix size, 0.5-mm slice thickness, and iterative reconstruction method). Three board-certificated chest radiologists independently and randomly evaluated these images and judged the probability of usual interstitial pneumonia (UIP) or fHP patterns based on each guideline. We compared the probability of UIP or fHP patterns using the average area under the curve (AUC) of the receiver operating characteristics. The radiologists counted lung segments with bronchiectasis and bronchioloectasis and evaluated overall image qualities. These data were compared using the Wilcoxon's signed-rank test.*Results The overall U-HRCT image qualities were better than the NR-sim image qualities (p<0.001). The median number of lung segments with bronchiectasis was significantly more in U-HRCT (15) than in NR-sim images (12) (p<0.001). The AUC for UIP in U-HRCT and NR-sim images was 0.745 and 0.746, respectively. The AUC for fHP diagnosis significantly increased from 0.692 in NR-sim images to 0.794 in U-HRCT images.*Conclusions U-HRCT can increase diagnostic performance of fHP.*Clinical Relevance/Application U-HRCT can clearly visualize peripheral bronchiectasis and increase the diagnostic performance of fibrotic

hypersensitivity pneumonitis, which is difficult to diagnose with conventional CT.

RESULTS

The overall U-HRCT image qualities were better than the NR-sim image qualities (p<0.001). The median number of lung segments with bronchiectasis was significantly more in U-HRCT (15) than in NR-sim images (12) (p<0.001). The AUC for UIP in U-HRCT and NR-sim images was 0.745 and 0.746, respectively. The AUC for fHP diagnosis significantly increased from 0.692 in NR-sim images to 0.794 in U-HRCT images.

CLINICAL RELEVANCE/APPLICATION

U-HRCT can clearly visualize peripheral bronchiectasis and increase the diagnostic performance of fibrotic hypersensitivity pneumonitis, which is difficult to diagnose with conventional CT.

SDP-CH-34　Idiopathic Dendriform Pulmonary Ossification; Detailed CT Pathologic Correlation In 22 Patients

Participants
Midori Ueno, MD, Kitakyushu, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Idiopathic dendriform pulmonary ossification (DPO) is a rare condition which characterized the mature bone formation in the lung parenchyma. The aim of this study is to clarify the histological background of HRCT findings in DPO.*Methods and Materials 22 DPO patients (18 men and 4 women, mean age, 37.9 years; range, 22-56 years), histologically confirmed by surgical lung biopsy, were identified in a nationwide epidemiological survey. HRCT findings of the high-attenuated structures on bone window (WW 2500HU, WL 500HU), and other associated parenchymal findings including iso-attenuated nodule, band-like opacity, reticulation, ground-glass opacity (GGO) and cysts were compared to the corresponding histological ones side by side.*Results High-attenuated structures, showing either linear, branching, or round forms, on CT (n=22) were seen in centrilobular and perilobular area and histologically corresponded to dendriform ossification itself both in alveolar space and interstitium. Band like opacities (n=22) corresponded to fibrous scar or partial collapsing lung, iso-attenuated nodules (n=22) corresponded to small ossification with cicatricialorganizing pneumonia (OP) or ossification with bone marrow, GGOs (n=22) to hemorrhage, alveolar edema and/or accumulation of macrophages, cysts (n=7) to emphysematous change and reticulation (n=4) corresponded to small foci of ossification and fibrosis.*Conclusions In idiopathic DPO, HRCT findings histologically corresponded to dendriform ossification itself and associated cicatricial OP, fibrosis, or hemorrhage. Small ossifications and ossification with bone marrow can be seen as iso-attenuated nodules or reticulation on HRCT.*Clinical Relevance/Application The HRCT findings seen in DPO reflected not only ossification, but also accompanying cicatricial OP, fibrosis, and hemorrhage. This result may help to understand the pathogenesis of this disease.

RESULTS

High-attenuated structures, showing either linear, branching, or round forms, on CT (n=22) were seen in centrilobular and perilobular area and histologically corresponded to dendriform ossification itself both in alveolar space and interstitium. Band like opacities (n=22) corresponded to fibrous scar or partial collapsing lung, iso-attenuated nodules (n=22) corresponded to small ossification with cicatricialorganizing pneumonia (OP) or ossification with bone marrow, GGOs (n=22) to hemorrhage, alveolar edema and/or accumulation of macrophages, cysts (n=7) to emphysematous change and reticulation (n=4) corresponded to small foci of ossification and fibrosis.

CLINICAL RELEVANCE/APPLICATION

The HRCT findings seen in DPO reflected not only ossification, but also accompanying cicatricial OP, fibrosis, and hemorrhage. This result may help to understand the pathogenesis of this disease.

SDP-CH-35　Validation Of A Deep Learning-based Automatic Detection Algorithm For Reticular Opacity On Chest Radiograph

Participants
Wooil Kim, MD, Charlottesville, Virginia (*Presenter*) Nothing to Disclose

PURPOSE

To validate a deep learning-based algorithm (DLA) in diagnosing reticular opacity on chest radiograph in patients with surgically confirmed interstitial lung disease.*Methods and Materials Two test sets (abnormal : normal = 1:1) were separately included from two institutions (validation set A: 396; validation set B: 102). The performance of the DLA was assessed using the validation set A and B. Six reader without and with DLA interpreted chest radiographs in the validation set A. The area under the receiver operating characteristic curve (AUC) and diagnostic indices of the DLA and readers were measured and compared. Inter-reader agreement was measured with Fleiss' Kappa. Subgroup analysis according to CT-based severity classification of reticular opacity was also performed.*Results The AUCs of DLA in detecting reticular opacity in validation set A and B were 0.987 and 1, respectively. The AUCs of pooled readers without and with DLA were 0.879 and 0.966, respectively (P=0.15). The sensitivity, specificity, and accuracy of pooled readers without DLA were 77.3%, 92.3%, and 84.8%, respectively. With DLA assistance, the sensitivity, specificity, and accuracy of pooled readers increased to 93.8%, 97.3%, and 95.6%, respectively (all, P<0.0001). The sensitivity of pooled readers in diagnosing reticular opacity in mild and moderate category improved with assistance of DLA (mild, 66.7% and 86.8%; moderate, 84.2% and 98.8%; all, P<0.0001). The DLA also improved inter-reader agreement from moderate (kappa=0.517) to excellent (kappa=0.870) degree.*Conclusions The DLA presented excellent performance in diagnosing reticular opacity on chest radiograph. DLA assistance improved diagnostic performance, especially sensitivity and interobserver agreement.*Clinical Relevance/Application The DLA presented excellent performance in diagnosing reticular opacity on chest radiograph and with its assistance the interobserver agreement and sensitivity improved in diagnosing relatively subtle reticular opacity.

RESULTS

The AUCs of DLA in detecting reticular opacity in validation set A and B were 0.987 and 1, respectively. The AUCs of pooled readers without and with DLA were 0.879 and 0.966, respectively (P=0.15). The sensitivity, specificity, and accuracy of pooled readers without DLA were 77.3%, 92.3%, and 84.8%, respectively. With DLA assistance, the sensitivity, specificity, and accuracy of pooled readers increased to 93.8%, 97.3%, and 95.6%, respectively (all, P<0.0001). The sensitivity of pooled readers in diagnosing reticular opacity in mild and moderate category improved with assistance of DLA (mild, 66.7% and 86.8%; moderate, 84.2% and 98.8%; all, P<0.0001). The DLA also improved inter-reader agreement from moderate (kappa=0.517) to excellent (kappa=0.870)

degree.

CLINICAL RELEVANCE/APPLICATION

The DLA presented excellent performance in diagnosing reticular opacity on chest radiograph and with its assistance the interobserver agreement and sensitivity improved in diagnosing relatively subtle reticular opacity.

SDP-CH-36 Can Deep Learning Reconstruction Keep Balance Between Lower Dose And High Image Quality In Interstitial Lung Disease

Participants
Ruijie Zhao, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the feasibility of deep learning reconstruction in improving the image quality and reducing radiation dose in ILD, in comparison with HRCT.*Methods and Materials 50 cases of ILD patients (were prospectively enrolled in this study, including 14 male and 36 female, mean age (59.7±9.9) years old, BMI (24.68±3.00) kg/m2. 22 patents were CTD-related ILD, 1 sarcoidosis-related, 1 IgG4-related and the other 24 unclear. All patients underwent HRCT(120kVp, automatic tube current) followed by (LDCT (120kVp, 30mAs). HRCT images were reconstructed with Adaptive Iterative Dose Reduction 3-Dimensional, AIDR3D, standard setting, and LDCT images were reconstructed with Advanced Intelligence Clear-IQ Engine[AiCE], lung/bone, mild/standard/strong setting. Two radiologists independently evaluated the image noise, streak artifact, image quality, visualization of normal and abdominal features of ILD, and comparison between all reconstructed HRCT and LDCT images were conducted.*Results The mean radiation dose of LDCT was reduced to 1/3 of HRCT. The image noise of all reconstructed images in low dose scan was about 33.4% to 91.5% of HRCT, and signal-to-noise ratio (SNR) was improved to 1.1 to 3 times of the latter (p<0.0001). No significant difference was found in overall image quality, streak artifact, and visualization of normal features(fissures, proximal bronchi and vessels, peripheral bronchi and vessels, subpleural vessels) between all reconstructed LDCT images and HRCT images, and in some cases, LDCT scores were even higher(p < 0.05). LDCT (AiCE, lung) was superior to HRCT (AIDR3D) in visualizing ground-glass opacity (GGO) and architectural distortion (p < 0.05). LDCT(AiCE, lung-strong setting, bone-mild/strong setting) had better scores in honeycombing than HRCT (p < 0.05), while no significant difference was found in other abnormal features (reticulation, bronchiectasis and bronchiolectasis) between reconstructed LDCT and HRCT images(p > 0.05).*Conclusions Deep learning reconstruction could effectively reduce the radiation dose and keep the image quality compared with HRCT in ILD patients, and AiCE (lung, strong setting) was promising to become the preferred reconstruction scheme for LDCT scans for ILD patients in the future.*Clinical Relevance/Application Deep learning reconstruction could be applied to improve the image quality of low dose chest CT in ILD patients.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Deep learning reconstruction could be applied to improve the image quality of low dose chest CT in ILD patients.

SDP-CH-37 Utility Of Visual Coronary Artery Calcification In Prognosticating Patients With COVID-19

Participants
Anirudh Nair, MBBS, Doha, Qatar (*Presenter*) Nothing to Disclose

PURPOSE

To ascertain the role of semi-quantitative scoring in visual-coronary artery calcification score (V-CACS) for predicting the clinical severity and outcome in patients with COVID-19.*Methods and Materials The study included 67 COVID-19 confirmed adult patients who underwent non-cardiac gated CT chest in an inpatient setting. Two blinded radiologists (Radiologist-1 &2) assessed the V-CACS, CT Chest severity score (CT-SS). The inter-rater agreement was assessed using Cohens k. The clinical data including the requirement for oxygen, ventilation, ICU admission, and the outcome was assessed. The patients were clinically subdivided depending on severity into mild and severe. Multivariate logistic regression analyses were performed to identify independent predictors. ROC curves analysis is performed for the assessment of performance. Pearson correlation was performed to looks for the associations.*Results V-CACS cut-off value of 3 (82.67% sensitivity and 54.55% specificity; AUC 0.75) and CT-SS with a cut-off value of 21.5 and above (95.7% sensitivity and 63.6% specificity; AUC 0.87) are independent predictors of clinical disease severity and also the need for ICU admission or assisted ventilation. The pooling of both CT-SS and V-CACS (82.67% sensitivity and 86.4% specificity) is associated with a primary outcome. V-CACS and CT-SS are individual independent predictors of clinical severity in COVID-19 (Odds ratio, 1.72; 95% CI, 0.99-2.98; p = 0.05 and Odds ratio, 1.22; 95% CI, 1.08-1.39; p = 0.001 respectively). The area under the curve (AUC) for pooled V-CACS and CT-SS was 0.96 (95% CI 0.84-0.98).*Conclusions Logistic regression model using pooled Visual-Coronary artery calcification score and CT Chest severity score in non-cardiac gated CT can predict clinical severity and outcome in patients with COVID-19.*Clinical Relevance/Application This study evaluated the ability of V-CACS in predicting clinical severity and outcome in COVID-19, using semi-quantitative scoring of coronary artery calcifications. Our results indicate patients with a known COVID-19, in whom there is an inpatient CT scan the V-CACS and CT-SS above the threshold will help to identify potential clinically severe disease.

RESULTS

V-CACS cut-off value of 3 (82.67% sensitivity and 54.55% specificity; AUC 0.75) and CT-SS with a cut-off value of 21.5 and above (95.7% sensitivity and 63.6% specificity; AUC 0.87) are independent predictors of clinical disease severity and also the need for ICU admission or assisted ventilation. The pooling of both CT-SS and V-CACS (82.67% sensitivity and 86.4% specificity) is associated with a primary outcome. V-CACS and CT-SS are individual independent predictors of clinical severity in COVID-19 (Odds ratio, 1.72; 95% CI, 0.99-2.98; p = 0.05 and Odds ratio, 1.22; 95% CI, 1.08-1.39; p = 0.001 respectively). The area under the curve (AUC) for pooled V-CACS and CT-SS was 0.96 (95% CI 0.84-0.98).

This study evaluated the ability of V-CACS in predicting clinical severity and outcome in COVID-19, using semi-quantitative scoring of coronary artery calcifications. Our results indicate patients with a known COVID-19, in whom there is an inpatient CT scan the V-CACS and CT-SS above the threshold will help to identify potential clinically severe disease.

SDP-CH-38 Extracting And Quantifying Shape Pattern Of Ascending Aorta By Statistical Shape Analysis In Patients With Marfan Syndrome.

Participants
Yu-cheng Huang, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose

PURPOSE

Aortic dissection is one of the major causes of mortality in patients with Marfan syndrome. However, morphology and speed of progression is variable between patients. In this study, we aimed to develop a computational way to quantify the shape pattern changes in ascending aorta of patients with Marfan syndrome with statistical shape analysis.*Methods and Materials Patients with marfan syndrome who received cross sectional imaging during 2017 to 2020 for evaluation of aorta diameter were retrospectively reviewed and included in this study. Patients with no preoperative image, with bicuspid aortic valve or poor image quality were excluded. Aortic valves, sinus valsalva, sinotubular junction and ascending aorta were segmented and transformed into shape meshes. These meshes were then landmarked and subdivision fit to standardize comparison between different patients. Statistical shape analysis with Procrustes transformation and Principal component analysis was applied to register different standardized meshes, gain independant major shape change patterns and quantify shape changes in each subject.*Results A total of 43 patients were found to have cross sectional imaging. After excluding patients with no preoperative image, with bicuspid aortic valve and poor image quality, there are 32 eligible studies for analysis. All ascending aorta in remaining patients are segmented and subdivision-fit successfully. Principal component yielded independent 5 major shape change patterns (modes) that correspond to the shape pattern observed in clinical practice. Major change modes are observed in subgroups of patients.*Conclusions Statistical shape analysis is a feasible way of performing major shape pattern capture and quantification in pathological aorta with marfan syndrome. It might allow further grouping and analysis.*Clinical Relevance/Application Statistical shape analysis might be a feasible quantification tool that captures information in addition to conventional morphometry. Our method potentially adapts to different body sizes and habitus. It might allow further statistical analysis with correlation with genetic study, prognosis and automatic grouping in a wider range of age groups in congenital disease.

RESULTS

A total of 43 patients were found to have cross sectional imaging. After excluding patients with no preoperative image, with bicuspid aortic valve and poor image quality, there are 32 eligible studies for analysis. All ascending aorta in remaining patients are segmented and subdivision-fit successfully. Principal component yielded independent 5 major shape change patterns (modes) that correspond to the shape pattern observed in clinical practice. Major change modes are observed in subgroups of patients.

CLINICAL RELEVANCE/APPLICATION

Statistical shape analysis might be a feasible quantification tool that captures information in addition to conventional morphometry. Our method potentially adapts to different body sizes and habitus. It might allow further statistical analysis with correlation with genetic study, prognosis and automatic grouping in a wider range of age groups in congenital disease.

SDP-CH-39 Development Of Medication Prediction Model For COPD Patients With Using Chest CT Image And Pulmonary Function Test: Pilot Study

Participants
Zepa Yang, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Treatment of most COPD patients is usually done with prescription medications. However, due to the ambiguous relationship between COPD subtyping and prescription medications, prescriptions for the treatment of patients are based on changes in the patient's current symptoms, patient status based on previous prescription results, and experience of the respiratory physicians.This study purposes to develop deep learning based classification and prediction models using medical records and CT image of patients who have been prescribed drugs due to lung diseases such as COPD, that can classify which groups of COPD that patient is currently included and which drugs should be administered in current status.*Methods and Materials The list of prescriptible medication in our hospital were categorized as LAMA / LABA / ICS group with overlapped. From 2000 patient who is being treated at a medical center for COPD disease, prescript drug information, the pulmonary function test result and chest CT data of 2000 patient was acquired, and were pre-processed and converted to a time-series data. The data with the same medication prescribed for six consecutive months were assumed as gold standard, and used for training and the validation of the estimation model. Machine learning based prediction model was developed with using CNN-LSTM based estimation model.Among the various patient information, the specific features used in prediction process were PFT measurements which are commonly referred to by respiratory physicians in the diagnosis process, such as DLCO, FEV1, TV, TLC, etc., as well as image biomarkers acquired from chest CT, such as emphysema index (LAA%), airway thickness (AWT-Pi10), long airway vessel, volume, pectoralis muscle volume, etc. From the gold standard data, 200 CT data and PFT data were used for validation set, and the estimation results were compared with groups of drugs. Binary cross entropy was used to assess the estimation performance for gold standard and the result of the proposed model.*Results In training and validation process, average accuracy and loss value of the estimation model was 0.8523 and 0.1536, respectively.In manual evaluation, the accuracy of the estimated result was 83.5%. In detail, 112 cases were estimated exactly same drug as gold standard, and 52 cases were estimated the drugs in same group.*Conclusions The medication estimation model showed promising result, even with relatively sparse time series data. The performance of the estimation may show better result with larger, dense data is provided in further study.*Clinical Relevance/Application Based on the information on the current patient's condition and the process of the medication, deep learning model could determine what medication should be taken for current status.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Based on the information on the current patient's condition and the process of the medication, deep learning model could determine what medication should be taken for current status.

SDP-CH-4   The Evolution Of The Lung Damages After COVID-19 Infection In The Early And Late Term According To CT Data

Participants
Katsiaryna Rudas, Minsk, Belarus (*Presenter*) Nothing to Disclose

PURPOSE

Using LDCT to assess the consequences of Covid19-associated lung damage, depending on the volume of lung tissue damage in patients of different age groups.*Methods and Materials The study involved 130 patients aged 35 to 80 years with laboratory-confirmed Covid19, changes in the lungs and comorbidity. The primary and repeated studies were performed on a GE Revolution CT using a low-dose protocol for scanning in pulmonary mode with a step of 0.625mm and soft tissue reformats. DLP coefficient was 1mSv.*Results We assessed the characteristics of changes in the lungs during the primary study, the repeated studies performed from 14 days to 3, 6, 9 months.First group includes 95 patients 35-60 years old with non-severe comorbidity who had mild to moderate disease with the lesions in the lungs up to 50% of lung volume. During the second study 73 patients (77%) showed a complete restoration of the pulmonary pattern and pneumatization of the interstitium within 3 months. Within 6 months 9 patients (9%) of this group demonstrated total recovering of the lung tissue. Second group includes 28 patients 55-80 years old with comorbidity (diabetes 2nd type, IHD, thrombosis etc.) with lung damages up to 50-75% of lung volume. Within 3 months 25 patients (90%) showed lung lesions: disatelectasis in the peripheral parts of the lungs, local emphysema of the intact parenchyma, fibrosis-like changes in the lungs. These changes persisted longer in patients with high volume of consolidation of the lung tissue. 16 patients (64%) passed the examination within 6 and 9 months, the lung tissue was almost recovered at 12 patients (75%), with minimal residual changes at the 4 patients (25%) mostly with large volume of the consolidation during the acute phase of the disease. Third group includes 7 patients over 55 years old with comorbidity who underwent severe disease with a lesion up to 75-100% of lung volume. After 3 months intensity of damage to lung tissue decreased in 5 examined patients (71%), intact parenchyma became emphysematous. Within 6 months all of them showed a further reduction of lesions: emphysema of the intact parenchyma, a gradual decrease of the length and the volume of subsegmental disatelectasis in the peripheral parts of the lungs.*Conclusions Complete reparation of lung tissue is possible after suffering COVID19 in mild to moderate form within 3-6 months. Comorbidity plays a greater role than age in the timing of the resolution of residual changes in the lungs and more often accompanies moderate and severe forms of COVID19.*Clinical Relevance/Application Patients with large residual changes should be monitored by a pulmonologist and undergo rehabilitation. Patients with mild to moderate course of COVID19 do not show significant residual lung changes within 3 months.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Patients with large residual changes should be monitored by a pulmonologist and undergo rehabilitation. Patients with mild to moderate course of COVID19 do not show significant residual lung changes within 3 months.

SDP-CH-40   E-cigarette Use Among Self-described Former Smokers Undergoing Lung Cancer Screening

Participants
Karim Oueidat, MD,BEng, Providence, Rhode Island (*Presenter*) Nothing to Disclose

PURPOSE

Examine the extent to which lung cancer screening patients use e-cigarettes to achieve and maintain smoking cessation.*Methods and Materials An assessment of smoking behaviors and attitudes was conducted among (self-described) former smokers who attended an annual lung cancer screening from 12 imaging practices between 04/2019-05/2020. Patients eligible for lung cancer screens were at least 30 pack year smokers and 55-77 years old. Because data were anonymous, IRB determined no IRB approval was needed.*Results Of 1085 self-described former smokers, 13% (139) reported having vaped one or more times within the last 12 months. Of these, 84% (117/139) reported they had quit smoking 12 months ago or more. Of the 378 patients who provided an open-ended response to how they achieved smoking cessation, 27% (102/378) reported using an over-the-counter (OTC) nicotine replacement product; of these, 34.3% (34/102) vaped e-cigarettes, making it the second most common OTC product next to patches, 47.1% (47/102). Note, 31.4% (32/102) of participants reported using e-cigarettes exclusively with no other products. Likewise, of the 354 participants who provided an open-ended response to how they avoid smoking during a craving or urge, 36 (10.2%) indicated that they use OTC nicotine replacement products. Among these 36 patients, 12 (33.0%) vaped e-cigarettes, making it the second most common product; 52.8% (19/36) used gum.*Conclusions Many current e-cigarette users consider themselves former smokers, which suggests that some patients do not view vaping e-cigarettes as using tobacco. A sizeable number of former smokers indicated that they use e-cigarettes to maintain and achieve smoking cessation: e-cigarettes were listed only somewhat less often than gum. The prevalence of e-cigarette use for smoking cessation suggested by the current study is likely an under-estimation, as these data are only based off people who volunteered such information in response to generic, open-ended questions.*Clinical Relevance/Application This study suggests that e-cigarettes may be a common method of achieving and maintaining smoking abstinence among former smokers receiving a lung screen with a history of very heavy smoking. More research is needed concerning the efficacy and safety of e-cigarettes as a cessation tool given that many patients are naturalistically using them in this capacity.

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CLINICAL RELEVANCE/APPLICATION

This study suggests that e-cigarettes may be a common method of achieving and maintaining smoking abstinence among former smokers receiving a lung screen with a history of very heavy smoking. More research is needed concerning the efficacy and safety of e-cigarettes as a cessation tool given that many patients are naturalistically using them in this capacity.

SDP-CH-41 Automatic Labeling Of Airway Tree With Stream Order Robust To Anatomical Variations

Participants
Jihye Yun, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The labeling of airway trees from thoracic CT scans is crucial to accurately quantify airway morphology which could be used to measure progression and response to treatment. To develop an automated airway tree labeling system robust to anatomical variations using stream order and expertise for anatomical characteristics of the airway tree.*Methods and Materials Airway segmentation was employed as a first step to obtaining personalized tree structures, and then the skeletonization method extracted the centerlines of airways. Using centerlines of airways, the airway branches were labeled in stream order in terms of generations. We assigned a stream number to all nodes of the airway tree in bottom-up order; 1) If two branches of the same order merge, the resulting branch is given a stream number that is one higher.; 2) If two branches with different orders merge, the resulting branch is given the higher stream number. And then we revisited and relabeled them in top-down order. The robustness of our method was improved by fixing the branch levels for branches with little anatomical variations. We maximized the usability of our system by developing efficient manual correction modules.*Results Our method outperformed the conventional airway labeling method for all 50 thoracic CT scans which were collected retrospectively, overcoming mislabeling due to trifurcation and problems that segmental bronchus of the same level was labeled to different levels in the lower lobe.*Conclusions For accurate airway tree labeling, we labeled the airway trees in stream order combined the expertise for anatomical characteristics of airways, resulting in robust anatomical variations.*Clinical Relevance/Application To enable more accurate and automated measurement of each airway level below the subsegmental bronchus for assessment of small airway disease.

RESULTS

Our method outperformed the conventional airway labeling method for all 50 thoracic CT scans which were collected retrospectively, overcoming mislabeling due to trifurcation and problems that segmental bronchus of the same level was labeled to different levels in the lower lobe.

CLINICAL RELEVANCE/APPLICATION

To enable more accurate and automated measurement of each airway level below the subsegmental bronchus for assessment of small airway disease.

SDP-CH-42 Chest CT Findings And Pulmonary Function Tests In The Post recovery Phase Of Mild To Severe Cases Of COVID-19

Participants
Eduardo Kaiser Ururahy Nunes Fonseca, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

To correlate follow-up chest computed tomography (CT) and pulmonary function test (PFT) findings of mild to severe COVID-19 survivors.*Methods and Materials This retrospective study was performed in two medical centers in Sao Paulo, Brazil. Data were collected from consecutive patients who underwent PFT and chest CT (within a maximum interval of 14 days) after recovery from COVID-19 between May and October 2021. Clinical data, spirometric parameters, diffusing capacity for carbon monoxide (DLCO), lung CT abnormalities, distribution and CT extent score were recorded. Clinical and tomographic differences between the patients with normal or abnormal PFTs were assessed by Chi-Square, Mann-Whitney or Fisher tests.*Results 101 COVID-19 survivors were included (mild disease 48, moderade 40, severe 13), at a median 95 days from initial symptom onset. 33% (33/101) had persistent symptoms. Reduction of DLCO% predicted was the most common abnormality in lung function (19% of the patients). Persistence of symptoms was not associated with abnormal lung function. The presence of reticular opacities (p=0.003), bronchial dilatation (p=0.005) and architectural distortion (p<0.001) in chest CT and a CT extent score > 5 (p=0.006) were significantly more prevalent in patients with impairment of DLCO.The optimal CT score for identifyng patients with reduced DLCO% predicted was 5.5 (area under curve = 0.7), with 78.9% sensitivity and 56.1% specificity.*Conclusions The presence of reticular opacities, bronchial dilatation and architectural distortion in chest CT and the extent of lung abnormalities was associated with lung function impairment in the postrecovery phase of mild to severe cases of COVID-19.*Clinical Relevance/Application The anatomical and functional pulmonary sequelae of SARS-CoV-2 infection are not yet fully understood. The evaluation of late chest CT findings associated with lung function impairment can help to estabilish the role of imaging in the postrecovery phase of COVID-19 patients.

RESULTS

101 COVID-19 survivors were included (mild disease 48, moderade 40, severe 13), at a median 95 days from initial symptom onset. 33% (33/101) had persistent symptoms. Reduction of DLCO% predicted was the most common abnormality in lung function (19% of the patients). Persistence of symptoms was not associated with abnormal lung function. The presence of reticular opacities (p=0.003), bronchial dilatation (p=0.005) and architectural distortion (p<0.001) in chest CT and a CT extent score > 5 (p=0.006) were significantly more prevalent in patients with impairment of DLCO.The optimal CT score for identifyng patients with reduced DLCO% predicted was 5.5 (area under curve = 0.7), with 78.9% sensitivity and 56.1% specificity.

The anatomical and functional pulmonary sequelae of SARS-CoV-2 infection are not yet fully understood. The evaluation of late chest CT findings associated with lung function impairment can help to establish the role of imaging in the postrecovery phase of COVID-19 patients.

SDP-CH-43 Integrated Application Of Noise Reduction And Emphysema Quantification Based On Deep Learning Training In Low-dose Chest CT For Lung Cancer Screening: A Feasibility Study

Participants
Suho Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate integrated applicability of noise reduction and emphysema quantification based on deep learning training in low-dose chest CT for lung cancer screening.*Methods and Materials Using 281 lung cancer screening low-dose chest CT data, mean lung attenuation (MLA), total lung volume (TLV), RA950 (ml) and RA950 (%) were calculated by applying a newly developed, integrated denoising technique (ClariCT.AI, ClariPi) and emphysema quantification (ClariPulmo, ClariPi) trained with a deep learning model, which were compared with values obtained from a conventional emphysema quantification tool with anti-noise function, according to denoising settings (on or off) for AI-powered tool and anti-noise level (0 or 1) for conventional tool.*Results There was no statistically significant difference between MLA and TLV in both AI-powered and conventional tools regardless of denoising setting or anti-noise level. Between AI-powered, denoising off setting and conventional, anti-noise level 0, there was no statistically significant difference in RA950 (ml) and RA950(%). However, there was a statistically significant difference in RA950 (ml) and RA950(%) between AI-powered and conventional tools according to the denoising setting or anti-noise level. Between AI-powered, denoising on setting and conventional, anti-noise level 1, there was a statistically significant difference in RA950 (ml) and RA950(%).*Conclusions Even in the integrated application of the newly developed deep learning-based denoise and emphysema tools, MLA and TLV are considered reliable reference values. Although noise reduction is essential in the emphysema quantification of low-dose CT, there are still sensitive differences depending on the noise reduction method and level. In the future, it is expected that the integrated applicability of denosing and emphysema quantification will be better due to the algorithm improvement of deep learning models.*Clinical Relevance/Application Integrated application of deep learning-based noise reduction and emphysema quantification are expected to help early detection of chronic obstructive pulmonary disease by improving the accuracy of emphysema quantification through effective noise reduction of low-dose CT for lung cancer screening.

RESULTS

There was no statistically significant difference between MLA and TLV in both AI-powered and conventional tools regardless of denoising setting or anti-noise level. Between AI-powered, denoising off setting and conventional, anti-noise level 0, there was no statistically significant difference in RA950 (ml) and RA950(%). However, there was a statistically significant difference in RA950 (ml) and RA950(%) between AI-powered and conventional tools according to the denoising setting or anti-noise level. Between AI-powered, denoising on setting and conventional, anti-noise level 1, there was a statistically significant difference in RA950 (ml) and RA950(%).

CLINICAL RELEVANCE/APPLICATION

Integrated application of deep learning-based noise reduction and emphysema quantification are expected to help early detection of chronic obstructive pulmonary disease by improving the accuracy of emphysema quantification through effective noise reduction of low-dose CT for lung cancer screening.

SDP-CH-44 Clinical Potential For AI Enabled Dynamic Worklist Prioritization In Tele-radiology Settings

Participants
Xin Wang, PhD, Cambridge, Massachusetts (*Presenter*) Employee, Koninklijke Philips NV

PURPOSE

The aim is to use quantitative methodologies in the evaluation of clinical potential of using artificial intelligence to prioritize radiology exams with positive critical findings, so that radiology practices can appropriately apply AI technologies in their specific clinical settings.*Methods and Materials We used the discrete event simulation (DES) method to quantitatively evaluate how AI-enabled worklist prioritization can accelerate the Turnaround time (TAT) for pneumothorax (PTX) cases in chest radiograph (CXR), for both STAT and routine exams, and how much it affects the other CXR cases, in a realistic teleradiology setting. We simulated the CXR workflow of our collaborating teleradiology practice for 200 days, based on historic operational data, including discrete distributions of how often CXRs are received and how fast the reports are finalized, the prevalence of PTX cases, and order priority (STAT or routine). In total, about 60k STAT and 10k routine simulated events were generated. Detection of PTX was simulated based on the performance of our AI model, a DenseNet-based model trained on NIH ChestX-ray14 and MIMIC CXR with an AUC of 0.96. If a case was predicted to be PTX positive, it was moved to the top of the worklist.*Results We compared our simulation with AI prioritization to a simulation with the standard worklist processing "first-in, first-out" (FIFO). With the AI model, PTX was predicted and prioritized in about 5 STAT cases per day - the median TAT being reduced from 8.0 to 5.0 min (P < .0001), and in about 1 routine case per day - the median TAT being reduced from 51.0 to 5.0 min (P < .0001). For other STAT exams, the median TAT was still 8.0 min. Given findings of the study, the radiology practice can make informed decision on whether to apply AI on all CXR studies or only to routine CXR.*Conclusions Our study demonstrated a robust way to assess quality improvement of patient care with help of AI models, as well as associated operational impact. AI based worklist prioritization can significantly accelerate the TAT for pneumothorax cases in CXR, and its adverse impact on the TAT of other STAT exams should be evaluated before its adoption.*Clinical Relevance/Application AI-enabled techniques can look at hundreds of images in parallel, identify critical conditions, and prioritize these cases in the worklist to accelerate report turnaround time and patient care.

RESULTS

We compared our simulation with AI prioritization to a simulation with the standard worklist processing "first-in, first-out" (FIFO). With the AI model, PTX was predicted and prioritized in about 5 STAT cases per day - the median TAT being reduced from 8.0 to 5.0 min (P < .0001), and in about 1 routine case per day - the median TAT being reduced from 51.0 to 5.0 min (P < .0001). For other STAT exams, the median TAT was still 8.0 min. Given findings of the study, the radiology practice can make informed decision on whether to apply AI on all CXR studies or only to routine CXR.

CLINICAL RELEVANCE/APPLICATION

AI-enabled techniques can look at hundreds of images in parallel, identify critical conditions, and prioritize these cases in the worklist to accelerate report turnaround time and patient care.

SDP-CH-45 The CT Features Of Different Types Of The Pulmonary Lymphedema Caused By Congenital Lymphatic Refluxdisorders

Participants
Yan Zhang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to identify CT features of different types of the pulmonary lymphedema (PLE) caused by congenital lymphatic reflux disorders (CLRD).*Methods and Materials We collected 3440 patients with clinical and operative proven CLRD in the study, of which 580 cases presented with different types of pulmonary lymphedema on HRCT and MSCT lymphography. The imaging features of PLE were retrospectively reviewed by two chest radiologists who reached decisions by consensus.*Results PLE was seen in 580 (17%) of 3440 patients with CLRD, which consisted of various imaging manifestations of pulmonary interstitial thickening caused by pulmonary lymphatic disorders. According to the imaging patterns and distribution, it is divided into five types: (1) diffuse inhomogeneous ground-glass opacity (GGO) dominated by peripheral distribution (265/580, 46%); (2) diffuse patchy or butterfly's winged GGO or irregular consolidation dominated by intrapleural or central distribution (45/580, 8%); (3) diffuse reticular and linear patterns with extensive distribution (114/580, 20%); (4) diffuse frogspawn sign, which consisted of diffuse inhomogeneous GGO with superimposed multiple discontinuous small nodules (86/580, 15%); (5) diffuse crazy-paving appearance, which consisted of diffuse GGO with superimposed interlobular and intralobular interstitial thickening (71/580, 12%). The other accompanying findings includes stenosis or obstruction of thoracic duct (542/580, 94%) and right lymphatic duct (155/580, 27%),chylothorax (188/580, 32%), chylopericardium (45/580, 8%) and mediastinal thickening or lymphedema (322/580, 56%).*Conclusions Our data suggest that PLE is mostly a part of the systemic lymphedema, indecating the dilatation of the lymphatic vessels and lymphatic reflux in pulmonary interstitium. The different types of PLE are related to the degree and location of lymphedema and chylous fistula, also to the degree of lymphedema and the clinical stage.*Clinical Relevance/Application PLE is the main pathological change of pulmonary lymphatic dysplasia, which has various imaging morphological features that has not been reported in the literature by our knowledge.It is most important for clinical diagnosis and differential diagnosis and selection of reasonable treatment with understand with these imaging types and pathogenesis.

RESULTS

PLE was seen in 580 (17%) of 3440 patients with CLRD, which consisted of various imaging manifestations of pulmonary interstitial thickening caused by pulmonary lymphatic disorders. According to the imaging patterns and distribution, it is divided into five types: (1) diffuse inhomogeneous ground-glass opacity (GGO) dominated by peripheral distribution (265/580, 46%); (2) diffuse patchy or butterfly's winged GGO or irregular consolidation dominated by intrapleural or central distribution (45/580, 8%); (3) diffuse reticular and linear patterns with extensive distribution (114/580, 20%); (4) diffuse frogspawn sign, which consisted of diffuse inhomogeneous GGO with superimposed multiple discontinuous small nodules (86/580, 15%); (5) diffuse crazy-paving appearance, which consisted of diffuse GGO with superimposed interlobular and intralobular interstitial thickening (71/580, 12%). The other accompanying findings includes stenosis or obstruction of thoracic duct (542/580, 94%) and right lymphatic duct (155/580, 27%),chylothorax (188/580, 32%), chylopericardium (45/580, 8%) and mediastinal thickening or lymphedema (322/580, 56%).

CLINICAL RELEVANCE/APPLICATION

PLE is the main pathological change of pulmonary lymphatic dysplasia, which has various imaging morphological features that has not been reported in the literature by our knowledge.It is most important for clinical diagnosis and differential diagnosis and selection of reasonable treatment with understand with these imaging types and pathogenesis.

SDP-CH-46 Performance Of A Commercial Software Package For Lung Nodule Detection On Chest Radiographs Compared With 8 Expert Readers

Participants
Kicky van Leeuwen, MSc, Nijmegen, Netherlands (*Presenter*) Technical Expert, Scarlet NB

PURPOSE

Multi-center evaluation of the stand-alone performance of commercially available lung nodule detection software (Lunit INSIGHT CXR3).*Methods and Materials A set of 300 posteroanterior (PA) and lateral chest radiographs from four medical centers in the Netherlands was collected. Solitary lung nodules ranging from 5 to 35 mm in size were present in 111 of the cases. All nodules were confirmed by CT within three months of the radiograph acquisition. Control radiographs were determined based on a negative CT within six months. Five radiologists and three radiology residents scored the set to provide context to the algorithm performance. All PA radiographs were processed by Lunit INSIGHT CXR3, a commercial software product that detects ten common abnormalities in chest radiographs. Area under the receiver operating characteristics curve (AUC) and sensitivity at 90% specificity were used to measure performance. Multi-reader multi-case ROC analysis based on U-statistics (iMRMC-v4 software) was applied to compare CXR3 with the readers. Subanalysis was performed regarding nodule size (small<15mm, large>15mm) and conspicuity levels (well visible, moderately visible, subtle, very subtle).*Results Out of the 300 radiographs, 7 could not be processed by CXR3, resulting in a set of 104 nodule cases and 189 normal cases for evaluation. The CXR3 AUC was 0.93 and significantly higher than the mean reader AUC of 0.82 (p<0.001). CXR3 was also significantly better than the best reader with an AUC of 0.88 (p=0.028). At a specificity level of 90%, sensitivity was 83.2% for CXR3 and 63.3% (std±7.5%) for the reader average. Regarding conspicuity of the nodules, CXR3 AUCs were 0.99 for well visible, 0.94 for moderately visible, 0.94 for subtle, and 0.78 for very subtle nodules. No significant difference in CXR3 performance was observed between the detection of small (AUC 0.91) and large nodules (AUC 0.93).*Conclusions Lunit INSIGHT CXR3 significantly outperforms the comparison group of eight readers in nodule detection on chest radiographs.*Clinical Relevance/Application Generalizability of artificial intelligence algorithms is not trivial. Performance studies increase confidence in algorithms to the users, especially to those with similar patient populations.

RESULTS

Out of the 300 radiographs, 7 could not be processed by CXR3, resulting in a set of 104 nodule cases and 189 normal cases for evaluation. The CXR3 AUC was 0.93 and significantly higher than the mean reader AUC of 0.82 (p<0.001). CXR3 was also significantly better than the best reader with an AUC of 0.88 (p=0.028). At a specificity level of 90%, sensitivity was 83.2% for CXR3 and 63.3% (std±7.5%) for the reader average. Regarding conspicuity of the nodules, CXR3 AUCs were 0.99 for well visible, 0.94 for moderately visible, 0.94 for subtle, and 0.78 for very subtle nodules. No significant difference in CXR3 performance was observed between the detection of small (AUC 0.91) and large nodules (AUC 0.93).

SDP-CH-47   Utilizing A Generative Adversarial Network To Produce Realistic Novel Chest Radiographs

Participants
Christian Park, DO, Hershey, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the possibility of utilizing generative adversarial networks to synthesize chest radiographs that are functionally equivalent to real chest radiographs.*Methods and Materials The source dataset (CheXpert) included 224,316 chest x-rays of 65,240 patients. These included PA, AP and lateral projections as well as pathologies such as effusion, pneumonia and pneumothorax. 191,027 frontal (PA, AP) projection images were selected for the final dataset. The images were resized to 3x64x64 and input into an open source Generative Adversarial Network with a Pytorch machine learning framework. After training the discriminator and generator, the two competing neural networks, loss metrics for both networks, D(x) and D(G(z)) were recorded. Additionally, three radiology residents and one attending radiologist were provided a sample of both ground truth and synthesized images for scoring via five point Likert Scale (1=Completely Fake, 5 = Completely Real).*Results After five epochs, our GAN model achieved a Loss D: 0.4465, Loss G: 2.7268, D(x): 0.8291 (Discriminator was able to discern images were fake 83% of the time), and D(G(z)): 0.1878 / 0.0885. There was no significant difference in Likert scale scores between the real and generated images (t-test, p=0.35).*Conclusions These findings show that a GAN model is able to synthesize chest radiographs that are realistic enough to be found comparable to real radiographs. More investigation is required to improve generative performance (increasing resolution and reducing error) as well as developing tools for better detection of generated images.*Clinical Relevance/Application The potential applications include generation of an imaging database that can be used for educational purposes, particularly of rare pathologies such as hemangiopericytoma and pheochromocytoma in the abdomen.Utilization of "predictive" generation of stents and other procedures for pre-surgical/pre-procedural planningIt can also raise awareness about its potential for more nefarious use, such as removal or replacement of pathology within existing medical imaging datasets.Technologies such blockchain and non-fungible tokens could be utilized to ensure that study original and not altered. Additionally, non-fungible tokens may open up the possible for patients to have ownership of their health data, which is currently of great ethical debate.

RESULTS

After five epochs, our GAN model achieved a Loss D: 0.4465, Loss G: 2.7268, D(x): 0.8291 (Discriminator was able to discern images were fake 83% of the time), and D(G(z)): 0.1878 / 0.0885. There was no significant difference in Likert scale scores between the real and generated images (t-test, p=0.35).

CLINICAL RELEVANCE/APPLICATION

The potential applications include generation of an imaging database that can be used for educational purposes, particularly of rare pathologies such as hemangiopericytoma and pheochromocytoma in the abdomen.Utilization of "predictive" generation of stents and other procedures for pre-surgical/pre-procedural planningIt can also raise awareness about its potential for more nefarious use, such as removal or replacement of pathology within existing medical imaging datasets.Technologies such blockchain and non-fungible tokens could be utilized to ensure that study original and not altered. Additionally, non-fungible tokens may open up the possible for patients to have ownership of their health data, which is currently of great ethical debate.

SDP-CH-48   AI-based Severity Scoring Of Admission Chest CT Is Not Predictive For In-hospital Mortality In COVID-19 ICU Patients

Participants
Eva Gresser, BSC, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Severe COVID-19 disease is associated with a high in-hospital mortality due to respiratory failure and multi-organ dysfunction. We tested the diagnostic value of quantitative imaging features on admission chest CTs by using an artificial intelligence (AI)-based algorithm for mortality prediction and compared the performance to clinical scoring on ICU admission.*Methods and Materials 83 confirmed COVID-19 patients admitted to the participating ICUs were included for this single center retrospective study. Chest CT scans as well as the sequential organ failure assessment (SOFA) score on ICU admission were evaluated for the discriminative potential to predict in-hospital mortality. A CE-certified AI-based algorithm (CAD4COVID, Thirona) was used for chest CT assessment. Statistical analyses include multivariate regression analysis and receiver operating characteristic (ROC) curves.*Results In multivariate binary logistic regression, the CT severity score was not significantly associated with in-hospital mortality (odds ratio (OR) 1.02, 95%-CI 0.90-1.15, p=0.791), whereas the SOFA score showed a significant association (OR 1.48, 95%-CI 1.19-1.84). In ROC analysis SOFA score on admission resulted in an area under the curve (AUC) for in-hospital mortality of 0.79 (95%-CI 0.69-0.90), whereas CT severity score did not yield a sufficient AUC (0.55, 95%-CI 0.40-0.70). These results were consistent for the more critically ill subgroup of patients with moderate and severe ARDS (oxygenation index below 200, n=50) with an AUC for SOFA score of 0.78 (95%-CI 0.65-0.91) compared to an AUC for the CT severity score of 0.60 (95%-CI 0.43-0.78).*Conclusions Advanced COVID-19 disease is not restricted to lung damage but leads to a multi-organ involvement. Therefore, AI-based quantitative assessment of COVID-19 lung disease on chest CT on ICU admission is not sufficient in predicting in-hospital mortality, even for patients with moderate to severe ARDS.*Clinical Relevance/Application Risk stratification for severe COVID-19 ICU patients should not solely be based on lung involvement on chest CT but needs to include multi-organ failure assessment.

RESULTS

In multivariate binary logistic regression, the CT severity score was not significantly associated with in-hospital mortality (odds ratio (OR) 1.02, 95%-CI 0.90-1.15, p=0.791), whereas the SOFA score showed a significant association (OR 1.48, 95%-CI 1.19-1.84). In ROC analysis SOFA score on admission resulted in an area under the curve (AUC) for in-hospital mortality of 0.79 (95%-CI 0.69-0.90), whereas CT severity score did not yield a sufficient AUC (0.55, 95%-CI 0.40-0.70). These results were consistent for the more critically ill subgroup of patients with moderate and severe ARDS (oxygenation index below 200, n=50) with an AUC for SOFA score of 0.78 (95%-CI 0.65-0.91) compared to an AUC for the CT severity score of 0.60 (95%-CI 0.43-0.78).

CLINICAL RELEVANCE/APPLICATION

Risk stratification for severe COVID-19 ICU patients should not solely be based on lung involvement on chest CT but needs to

include multi-organ failure assessment.

SDP-CH-5   Quantitative CT Indexes At Discharge To Predict Pulmonary Diffusion Function 5 Months After COVID-19

Participants
Leqing Chen, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the predictive value of total lung and lobar quantitative CT indexes at discharge on the pulmonary diffusion function of coronavirus disease 2019 (COVID-19) patients at 5 months after symptoms onset.*Methods and Materials A total of 90 patients with moderate and severe COVID-19 were prospectively enrolled (35 male, 55 female, median age, 57 [49.75, 64.25] years), all of whom underwent CT scans at discharge, and quantitative analysis of the total lung and lobes were performed. Pulmonary function tests (PFTs) were performed at 5 months after symptoms onset (median duration, 146 [140, 164] days). The differences of quantitative CT and PFTs results between Group1 (abnormal diffusion function group) and Group2 (normal diffusion function group) were compared by Chi-square test, Fisher's exact test or Mann-Whitney U test. Univariate analysis, stepwise linear regression and logistic regression were used to determine the predictors of DLCO% of predicted and whether there was diffusion dysfunction, respectively.*Results A total of 58.9% (53/90) of moderate and severe patients presented pulmonary dysfunction at 5 months after symptoms onset, of whom 34 patients had diffusion dysfunction in Group1 (DLCO% of predicted, 74.55% [65.73%, 75.73%]), the remaining 56 patients in Group2 (DLCO% of predicted, 91.45% [85.28%, 98.95%]). The mean lung density (MLD) of the total lung in Group1 was higher than that in Group2 (P=0.023), and the percentage of well-aerated lung tissue volume (WAL%) of Group1 was lower than that of Group2 (P=0.019), but there were no differences in residual lesions (ground-glass opacity, consolidation) between the two groups evaluated from total lung level. Multiple stepwise linear regression only screened out WAL (Coefficient: 0.004; 95% CI: 0.001-0.007; P=0.002) from the total lung indexes and WAL% of left upper lobe (LUL) from the lobar indexes (Coefficient: 0.459; 95% CI: 0.152-0.766; P=0.004) that positively correlated with DLCO% of predicted. Multivariable analysis identified MLD (OR: 1.011; 95% CI: 1.001-1.02; P=0.035) and MLD of LUL (OR: 1.016; 95% CI: 1.004-1.027; P=0.008) as independent predictors for COVID-19 patients with diffusion dysfunction in the convalescence from the total lung and lobar CT indexes, respectively.*Conclusions At 5 months after symptoms onset, more than one-third of moderate and severe COVID-19 patients presented with diffusion dysfunction. The well-aerated lung and mean lung density quantified by CT at discharge could be predictors of diffusion function in convalesce.*Clinical Relevance/Application Providing suggestions for optimized management plans for COVID-19 patients in convalescent.

RESULTS

A total of 58.9% (53/90) of moderate and severe patients presented pulmonary dysfunction at 5 months after symptoms onset, of whom 34 patients had diffusion dysfunction in Group1 (DLCO% of predicted, 74.55% [65.73%, 75.73%]), the remaining 56 patients in Group2 (DLCO% of predicted, 91.45% [85.28%, 98.95%]). The mean lung density (MLD) of the total lung in Group1 was higher than that in Group2 (P=0.023), and the percentage of well-aerated lung tissue volume (WAL%) of Group1 was lower than that of Group2 (P=0.019), but there were no differences in residual lesions (ground-glass opacity, consolidation) between the two groups evaluated from total lung level. Multiple stepwise linear regression only screened out WAL (Coefficient: 0.004; 95% CI: 0.001-0.007; P=0.002) from the total lung indexes and WAL% of left upper lobe (LUL) from the lobar indexes (Coefficient: 0.459; 95% CI: 0.152-0.766; P=0.004) that positively correlated with DLCO% of predicted. Multivariable analysis identified MLD (OR: 1.011; 95% CI: 1.001-1.02; P=0.035) and MLD of LUL (OR: 1.016; 95% CI: 1.004-1.027; P=0.008) as independent predictors for COVID-19 patients with diffusion dysfunction in the convalescence from the total lung and lobar CT indexes, respectively.

CLINICAL RELEVANCE/APPLICATION

Providing suggestions for optimized management plans for COVID-19 patients in convalescent.

SDP-CH-6   Prospective Evaluation Of The Performance Of Deep Learning Image Reconstruction On Low-dose And Ultralow-dose Chest CT.

Participants
Seung-Jin Yoo, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To compare the image quality of low-dose and ultralow-dose chest CT scans reconstructed with deep learning image reconstruction (DLIR).*Methods and Materials This prospective study was approved by IRB, and informed consent was obtained from all the participants. From February to July 2020, 40 patients (mean age, 66±12; female 53%) underwent low-dose (CTDIvol, 0.96±0.15mGy) and ultralow-dose chest CT (CTDIvol, 0.12±0.01mGy) in a single CT vendor (Revolution CT, GE healthcare) and reconstructed with filtered back projection (FBP), adaptive statistical iterative reconstruction-V 50% (ASIR-V 50) and 100% (ASIR-V 100), and DLIR-high level (DLIR-H) technique. Objective image quality was calculated by the signal-to-noise ratio (SNR) in the whole lung area and pulmonary vessels using deep-learning-based chest CT segmentation tool (MEDIP, Medical IP). Two thoracic radiologists, blinded to the radiation dose and reconstruction algorithm, reviewed 20 patients' 160 CT and graded image noise, visibility of small structures, lesion conspicuity, overall image quality. Nodule detection sensitivity was evaluated with an automated lung nodule detection tool (VCAR, GE healthcare) in 28 patients' 43 pulmonary nodules larger than 4mm. Two thoracic radiologists reviewed 80 CT composed of 40 low-dose and 40 ultralow-dose CT with DLIR-H and detected nodules of Lung-RADS 1.1 category 3 or higher.*Results SNR was significantly higher in DLIR-H compared to ASIR-V 50 in low-dose chest CT (lung, -5.82±0.67 vs. -5.71±0.64, p<.001; vessel, -0.56±0.07 vs. -0.55±0.07, p<.001). SNR of lung was significantly higher in DLIR-H compared to ASIR-V 50 in ultralow-dose CT (-5.78±0.60 vs. -5.72±0.63, p<.001). DLIR-H yielded the best scores in small structures visibility, lesion conspicuity, overall image quality among the low-dose chest CT and ultralow-dose chest CT, respectively. Comparing the low-dose and ultralow-dose CT with DLIR-H, low-dose CT showed significantly better scores in every assessment category (all P<.001). Nodule detection sensitivity of VCAR was 70-74% for low-dose and 63-67% for ultralow-dose CT. Nodule detection sensitivity of observers in low-dose and ultralow-dose CT with DLIR-H was 75.6-88.2% and 64.7-82.4%, respectively.*Conclusions DLIR, compared to other conventional reconstruction techniques, showed better image quality in objective and subjective analyses in both low-dose and ultralow-dose chest CT. Comparing the low-dose and ultra-low dose CT with DLIR, low-dose CT yield a better image quality, however the CTDIvol was 8 times higher than that of ultralow-dose CT.*Clinical Relevance/Application Ultralow-dose CT with DLIR might have the potential of reducing radiation dose in certain patients who need frequent follow-up chest CT.

RESULTS

SNR was significantly higher in DLIR-H compared to ASIR-V 50 in low-dose chest CT (lung, -5.82±0.67 vs. -5.71±0.64, p<.001;

vessel, -0.56±0.07 vs. -0.55±0.07, p<.001). SNR of lung was significantly higher in DLIR-H compared to ASIR-V 50 in ultralow-dose CT (-5.78±0.60 vs. -5.72±0.63, p<.001). DLIR-H yielded the best scores in small structures visibility, lesion conspicuity, overall image quality among the low-dose chest CT and ultralow-dose chest CT, respectively. Comparing the low-dose and ultralow-dose CT with DLIR-H, low-dose CT showed significantly better scores in every assessment category (all P<.001). Nodule detection sensitivity of VCAR was 70-74% for low-dose and 63-67% for ultralow-dose CT. Nodule detection sensitivity of observers in low-dose and ultralow-dose CT with DLIR-H was 75.6-88.2% and 64.7-82.4%, respectively.

CLINICAL RELEVANCE/APPLICATION

Ultralow-dose CT with DLIR might have the potential of reducing radiation dose in certain patients who need frequent follow-up chest CT.

SDP-CH-7 Radiomic-based Prediction Of Hyperprogressive Disease To Immune Checkpoint Inhibitor: Special Considerations In Lesion-level Approach And Organ-specific Microenvironment.

Participants
Chorog Song, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Hyperprogressive disease (HPD) is a recognized pattern of tumor progression following immune checkpoint inhibitor (ICI) treatment. However, a biomarker to determine whether HPD will occur prior to treatment has not yet been established. The aim of this study is to evaluate radiomic features of HPD particularly in lesion-level and investigate its predictive potential.*Methods and Materials 196 advanced NSCLC patients treated with ICI monotherapy and underwent at least three CT scans from the pre-baseline, baseline, through the first follow-up were retrospectively enrolled, where a total of 621 lesions were determined for HPD using the TGK ratio. A multivariable logistic regression analysis of radiomics features from the baseline CT and clinicopathologic characteristics was used to develop a prediction model for HPD.*Results In a total of 621 lesions, there were 147 HPD lesions (23.7%) and 349 non-HPD lesions (56.2%). For each organ, 234 (47.2%) in lung, 65 (13.1%) in bone, 114 (23.0%) in LN, and 47 (9.5%) in livers. In addition, the number of HPD lesions was 80 (34.2%) in lung, with 15 (23.1%) in bone, 24 (21.1%) in LN and 21 (9.5%) in liver. There was no significant difference in clinicopathologic variables between HPD and non HPD lesions. The predictive model for HPD showed a discrimination performance of an area under the receiver operating characteristic curve (AUC) of 0.65 (p value< 0.002) with logUniformity_HIST1000 (p=0.001, OR=0.29) and log_Volume (p=0.002, OR=0.71) in the lung, AUC of 0.70 with LogUniformity_HIST1000 (p=0.017, OR=4.49) in bone, AUC of 0.60 with log_RMS (p=0.025, OR=3.88) in LN as well as AUC of 0.72 with cube_PH2_5 (p=0.006, OR=0.74) in liver.*Conclusions Our study shows different radiomic features per organ are concerned for HPD prediction, which would be observations reflecting the inter-tumor heterogeneity and organ-specific microenvironment.*Clinical Relevance/Application Our study shows that analysis using radiomic features has great potential for predicting HPD and understanding heterogenous tumor progression after ICI treatment.

RESULTS

In a total of 621 lesions, there were 147 HPD lesions (23.7%) and 349 non-HPD lesions (56.2%). For each organ, 234 (47.2%) in lung, 65 (13.1%) in bone, 114 (23.0%) in LN, and 47 (9.5%) in livers. In addition, the number of HPD lesions was 80 (34.2%) in lung, with 15 (23.1%) in bone, 24 (21.1%) in LN and 21 (9.5%) in liver. There was no significant difference in clinicopathologic variables between HPD and non HPD lesions. The predictive model for HPD showed a discrimination performance of an area under the receiver operating characteristic curve (AUC) of 0.65 (p value< 0.002) with logUniformity_HIST1000 (p=0.001, OR=0.29) and log_Volume (p=0.002, OR=0.71) in the lung, AUC of 0.70 with LogUniformity_HIST1000 (p=0.017, OR=4.49) in bone, AUC of 0.60 with log_RMS (p=0.025, OR=3.88) in LN as well as AUC of 0.72 with cube_PH2_5 (p=0.006, OR=0.74) in liver.

CLINICAL RELEVANCE/APPLICATION

Our study shows that analysis using radiomic features has great potential for predicting HPD and understanding heterogenous tumor progression after ICI treatment.

SDP-CH-8 A Wake-up Call For Non-predominant Pattern Within Invasive Lung Adenocarcinoma: Prognostic Dissection Focusing On A High-grade Pattern

Participants
Yeonu Choi, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Because most lung adenocarcinomas (ADCs) are mixed histologic patterns and the spectrum of actual prognosis varies widely among lung ADCs with the same most predominant pattern, prognostic considerations for non-predominant patterns are necessary. We aimed to identify prognostic stratification by second most predominant pattern of lung ADC. And to more accurately assess prognostic factor with CT imaging analysis, particularly enhancing non-predominant but high-grade pattern.*Methods and Materials In this prospective study, patients with early-stage lung ADC undergoing curative surgery underwent preoperative dual-energy CT (DECT) and positron emission tomography (PET)/CT. Histopathology of ADC, the most predominant and second most predominant histologic patterns, and preoperative imaging parameters were assessed and correlated with patient survival.*Results Among the 290 lung ADCs included in the study, 231 (79.7%) were mixed-pathologic pattern. When the most predominant histologic pattern was intermediate-grade, survival curves were significantly different among the three second most predominant subgroups (p=0.004; low, lepidic; intermediate, acinar and papillary; high, micropapillary and solid). When the second most predominant pattern was high-grade, recurrence risk increased by 4.2-fold compared with the low-grade group (p=0.005). To predict a non-predominant but high-grade pattern, the non-contrast CT value of tumor was meaningful with a lower HU value associated with the histologic combination of lower grade (low-grade as most predominant and intermediate-grade as second most predominant pattern, OR=6.15, p=0.005; intermediate-grade as most predominant and high-grade as second most predominant pattern, OR=0.10, p=0.033). SUVmax of the tumor was associated with the non-predominant but high-grade pattern, especially in the histologic combination of intermediate-high grade (OR=1.14, p=0.012).*Conclusions The second most predominant histologic pattern can stratify lung ADC patients according to prognosis. Also, imaging parameters of non-contrast CT value and SUVmax could be useful in predicting a non-predominant but high-grade histologic pattern.*Clinical Relevance/Application Predicting the malignant potential and establishing treatment policies should not rely only on the most predominant pattern. Non-contrast CT value and SUVmax may provide practical help in planning patient treatment in clinical practice.

RESULTS

Among the 290 lung ADCs included in the study, 231 (79.7%) were mixed-pathologic pattern. When the most predominant histologic

pattern was intermediate-grade, survival curves were significantly different among the three second most predominant subgroups (p=0.004; low, lepidic; intermediate, acinar and papillary; high, micropapillary and solid). When the second most predominant pattern was high-grade, recurrence risk increased by 4.2-fold compared with the low-grade group (p=0.005). To predict a non-predominant but high-grade pattern, the non-contrast CT value of tumor was meaningful with a lower HU value associated with the histologic combination of lower grade (low-grade as most predominant and intermediate-grade as second most predominant pattern, OR=6.15, p=0.005; intermediate-grade as most predominant and high-grade as second most predominant pattern, OR=0.10, p=0.033). SUVmax of the tumor was associated with the non-predominant but high-grade pattern, especially in the histologic combination of intermediate-high grade (OR=1.14, p=0.012).

CLINICAL RELEVANCE/APPLICATION

Predicting the malignant potential and establishing treatment policies should not rely only on the most predominant pattern. Non-contrast CT value and SUVmax may provide practical help in planning patient treatment in clinical practice.

SDP-CH-9   Primary Cystic And Cavitary Lung Cancer: Characteristic Features On CT And FDG-PET

Participants
Makiko Murota, MD, Kitagun, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The aim of the present study was to investigate the CT and FDG-PET feature of primary cystic and cavitary lung cancer (CCLC).*Methods and Materials We examined 869 patients who underwent pulmonary resection for primary lung cancer from March 2013 through September 2019 and searched for the presence of cystic and cavitary lesion on CT. The study included 102 consecutive patients (79 men, 23 women; mean age, 69.7 years old) presenting as the CCLC on CT. We evaluated the diameters of tumor and airspace, the morphologic patterns of the cystic and cavitary lesion which were classified as into 4 types: type 1) nodule extruding from the wall of the cavitary lesion; type 2) nodule within the cavitary lesion; type 3) thickening of the wall and/or soft tissue density around the cavitary lesion; and type 4) soft tissue density intermixed within clusters of the cavitary lesion, the presence of ground-glass opacity (GGO), and the loculation pattern including the presence of septum.*Results Because each of the two patients had two lesions, a total of 104 lesions with CCLC were included. Histological analysis showed adenocarcinoma (AD) (n=85) and squamous cell carcinoma (SCC) (n=19). Average tumor and airspace size of CCLC was 3.1cm and 1.9cm, respectively. The morphologic patterns of the CCLC were seen type 1 in 29, type 2 in 1, type 3 in 36, and type 4 in 38 lesions, respectively. The presence of GGO were observed 60 lesions in AD. Regarding the loculation pattern, unilocular, multilocular, unilocular and septum, and multilocular and septum were seen in 10, in 7, in 28, and in 59 lesions, respectively. Type 4 and multilocular and septum pattern were significantly more common in ADs than in SCCs (P=0.002 and P=0.002, respectively). SUVmax of ADs on PET was significantly lower than SCCs (P=0.001), whereas it was different among solid lesions. Among solid lesions, only multilocular and septum pattern was significantly more common in ADs (P=0.028).*Conclusions The CT feature of CCLC was most common in AD, especially with GGO and with multilocular and septum. The presence of multilocular and septum was found to be similarly common among solid lesions. The uptake of FDG in lesions in AD was significantly lower than in SCC, although there was no significant difference among solid lesions.*Clinical Relevance/Application CCLC in AD often shows multilocular and septum in the airspace on CT, even if the lesion is solid. It may be helpful in differentiating histological findings.

RESULTS

Because each of the two patients had two lesions, a total of 104 lesions with CCLC were included. Histological analysis showed adenocarcinoma (AD) (n=85) and squamous cell carcinoma (SCC) (n=19). Average tumor and airspace size of CCLC was 3.1cm and 1.9cm, respectively. The morphologic patterns of the CCLC were seen type 1 in 29, type 2 in 1, type 3 in 36, and type 4 in 38 lesions, respectively. The presence of GGO were observed 60 lesions in AD. Regarding the loculation pattern, unilocular, multilocular, unilocular and septum, and multilocular and septum were seen in 10, in 7, in 28, and in 59 lesions, respectively. Type 4 and multilocular and septum pattern were significantly more common in ADs than in SCCs (P=0.002 and P=0.002, respectively). SUVmax of ADs on PET was significantly lower than SCCs (P=0.001), whereas it was different among solid lesions. Among solid lesions, only multilocular and septum pattern was significantly more common in ADs (P=0.028).

CLINICAL RELEVANCE/APPLICATION

CCLC in AD often shows multilocular and septum in the airspace on CT, even if the lesion is solid. It may be helpful in differentiating histological findings.

Abstract Archives of the RSNA, 2021

Sub-Events

PH02-A10   Single-source Twin Beam Dual-energy CT: Radiation Dose And Image Quality

Participants
Srirajkumar Ranganathan, BS, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

To assess the radiation dose and image quality of abdominopelvic CT when using single-source twin beam dual-energy CT (tbDECT) scanner. This technique is the newest FDA-approved DECT technique which requires low pitch acquisition.*Methods and Materials In this IRB-approved retrospective study, imaging studies of adult patients who had abdominopelvic CT using tbDECT (SOMATOM X.Cite, Siemens) between October 2020 and February 2021 were investigated. Patients who had conventional CT examination (SOMATOM Drive, Force, Definition, Siemens) of the same region of body, using similar phase of contrast, within 6 months of tbDECT examination were selected for final analysis. Patient demographics, anthropomorphic parameters (weight, BMI, abdominal girth), CT dose descriptors (CTDIvol and dose-length product [DLP]), subjective image quality, and objective noise level (defined as standard deviation of the density in subcutaneous abdominal fat) were recorded. Dose metrics and noise levels were compared using paired t-test. Bland-Altman graphs were used to plot the intra-patient dose difference against the body size parameters. A p-value of <0.05 was set as a statistically significant difference.*Results 108 patients were included in the final analysis (53 female; mean age 57.8 ±15.6 years; mean BMI 27.9 ±8 kg/m²; mean abdominal girth 37.4±7.5 cm). Mean CTDIvol for tbDECT and conventional CTs were 10.29 ±7.26 mGy and 15.82±9.5 mGy, respectively, which were significantly different (p<0.001). All studies had acceptable subjective image quality, which was not different between the 2 groups. The objective noise level was higher for tbDECT with a mean difference of 1.2 HU (p<0.005). The intra-patient dose difference was not affected by weight, BMI, and abdominal girth (r=0.3, p<0.001).*Conclusions tbDECT offered diagnostic image quality and had lower radiation exposure compared to conventional CT across all different body sizes.*Clinical Relevance/Application Despite the low pitch acquisition, tbDECT has acceptable radiation exposure and can be safely used in all adult patients.

RESULTS

108 patients were included in the final analysis (53 female; mean age 57.8 ±15.6 years; mean BMI 27.9 ±8 kg/m²; mean abdominal girth 37.4±7.5 cm). Mean CTDIvol for tbDECT and conventional CTs were 10.29 ±7.26 mGy and 15.82±9.5 mGy, respectively, which were significantly different (p<0.001). All studies had acceptable subjective image quality, which was not different between the 2 groups. The objective noise level was higher for tbDECT with a mean difference of 1.2 HU (p<0.005). The intra-patient dose difference was not affected by weight, BMI, and abdominal girth (r=0.3, p<0.001).

CLINICAL RELEVANCE/APPLICATION

Despite the low pitch acquisition, tbDECT has acceptable radiation exposure and can be safely used in all adult patients.

PH02-A11   Preliminary Study Of CT Image Reconstruction From Limited-angular-range Data With Two-orthogonal-arc Configurations

Participants
Zheng Zhang, PhD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

We in this work investigate computed tomography (CT) image reconstruction from data collected over two non-overlapping, orthogonal arcs of limited-angular-ranges (LARs), and demonstrate it may lead to more accurate reconstruction than a single arc of the same total angular range.*Methods and Materials We design a class of two non-overlapping, orthogonal arcs of LARs a1 and a2, which are separated by 90o between the centers of the two arcs. We generate simulation data from a numerical chest phantom using such two-orthogonal-arc configurations, with total angular ranges at= a1+a2=18o, 24o, 36o, 60o, 90o, 120o, 150o, and 180o. For given at, multiple configurations with different a1 and a2 can be formed, specified by a2/at=0, 1/6, 1/3, 1/2, 2/3, 5/6, and 1. We then carry out image reconstruction by using a directional-total-variation (DTV) algorithm, which is based on a primal-dual framework solving an optimization problem with a data-L2-minimization term and image DTV constraints. For comparison, we also reconstruct images from data collected over a single arc covering the same total angular range of a two-orthogonal-arc configuration.*Results We evaluate reconstruction performance by using visual inspection and quantitative analysis such as normalized root mean square error (nRMSE), Pearson correlation coefficient (PCC), and normalized mutual information (nMI). Results show that a two-orthogonal-arc configuration generally yields improved reconstruction accuracy than its single-arc counterpart, especially for at less than 90o. In particular, we notice that the reconstruction accuracy enhances as the total angular range at increases, as expected. Moreover, with fixed at, the two-orthogonal-arc configuration with a1=a2 leads to more accurate image reconstruction than those with a1?a2.*Conclusions Appropriately designed two-orthogonal-arc configurations can improve image-reconstruction accuracy in CT imaging, especially with a significantly reduced total angular coverage.*Clinical Relevance/Application This work may provide insights to design innovative configurations with LARs for CT imaging to yield reduced radiation dose and imaging time, and/or for non-diagnostic CT, such as C-arm CT, to avoid collision during scan.

RESULTS

We evaluate reconstruction performance by using visual inspection and quantitative analysis such as normalized root mean square error (nRMSE), Pearson correlation coefficient (PCC), and normalized mutual information (nMI). Results show that a two-orthogonal-arc configuration generally yields improved reconstruction accuracy than its single-arc counterpart, especially for at less than 90o. In particular, we notice that the reconstruction accuracy enhances as the total angular range at increases, as expected. Moreover, with fixed at, the two-orthogonal-arc configuration with a1=a2 leads to more accurate image reconstruction than those with a1?a2.

CLINICAL RELEVANCE/APPLICATION

This work may provide insights to design innovative configurations with LARs for CT imaging to yield reduced radiation dose and imaging time, and/or for non-diagnostic CT, such as C-arm CT, to avoid collision during scan.

PH02-A3   The Effect Of Automated Tube Voltage Selection And Organ-based Tube Current Modulation Systems On Organ Equivalent Dose And Image Quality In Thorax CT

Participants
Antonios Papadakis, MSc, PhD, Heraklion, Greece (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to investigate the combined effect of automated tube voltage selection (ATVS) and organ-based tube current modulation (OTCM) systems on equivalent dose of primarily exposed radiosensitive organs and image quality in routine pediatric and adult thorax CT.*Methods and Materials Five physical anthropomorphic phantoms that simulate the average individual as a neonate, 1-, 5-, 10-years-old child and female adult were employed. Phantoms were scanned on a Revolution HD GE CT scanner with the ATVS+OTCM systems enabled. ATVS was operated in the non contrast soft tissue clinical diagnostic task. OTCM was activated within the region depicting breast. Whole body axial image series of the phantoms were used to generate age-specific voxelized phantoms, which were input to a Monte Carlo based simulation tool to generate three-dimensional radiation dose image maps. ATVS+OTCM disabled and ATVS+OTCM enabled acquisitions were simulated. The dose image maps were used to estimate breast, lung, esophagus, and thyroid equivalent doses. Percent reduction in organ equivalent dose achieved with ATVS+OTCM was determined. Image noise was measured as the standard deviation of the Hounsfield unit value at selected anatomical sites.*Results In ATVS+OTCM enabled acquisitions, breast equivalent dose ranged from 0.4 mGy in neonate to 3.0 mGy in adult. The corresponding organ equivalent doses for lung, esophagus and thyroid ranged from 0.5 mGy to 7.2 mGy, 0.6 mGy to 5.2 mGy, and 0.2 mGy to 1.9 mGy, respectively. ATVS+OTCM acquisitions resulted in a reduction of organ equivalent dose, which ranged from 44% for breast to 12% for thyroid. ATVS+OTCM increased noise by up to 18% in images located within the OTCM enabled region. Image noise increase was statistically significant (P<0.05) in all but neonate phantom. Noise was not significantly affected in images located outside the ODM enabled region (P>0.05).*Conclusions In non contrast enhanced CT where soft tissue anatomies are of primary diagnostic interest, ATVS+OTCM reduces organ equivalent dose to all major radiosensitive organs with the breast receiving the highest benefit. An increase in noise is however apparent in images located within the OTCM enabled imaged volume.This work has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 755523 (MEDIRAD).*Clinical Relevance/Application The results presented in this study highlight the importance of employing the ATVS and OTCM tools offered by the new CT scanner models to optimize radiation dose and image quality in CT.

RESULTS

In ATVS+OTCM enabled acquisitions, breast equivalent dose ranged from 0.4 mGy in neonate to 3.0 mGy in adult. The corresponding organ equivalent doses for lung, esophagus and thyroid ranged from 0.5 mGy to 7.2 mGy, 0.6 mGy to 5.2 mGy, and 0.2 mGy to 1.9 mGy, respectively. ATVS+OTCM acquisitions resulted in a reduction of organ equivalent dose, which ranged from 44% for breast to 12% for thyroid. ATVS+OTCM increased noise by up to 18% in images located within the OTCM enabled region. Image noise increase was statistically significant (P<0.05) in all but neonate phantom. Noise was not significantly affected in images located outside the ODM enabled region (P>0.05).

CLINICAL RELEVANCE/APPLICATION

The results presented in this study highlight the importance of employing the ATVS and OTCM tools offered by the new CT scanner models to optimize radiation dose and image quality in CT.

PH02-A6   Impact Of Technology On Local Clinical Diagnostic Reference Levels In Mdct

Participants
Hugues G. Brat, MD, Sion, Switzerland (*Presenter*) Speaker, General Electric Company

PURPOSE

To assess the impact of a deep learning image reconstruction (DL) algorithm on local clinical indication-based diagnostic reference levels (LcDRLs).*Methods and Materials Clinical-indication and body mass index (BMI;< 25/= 25) based abdomen (378) and chest (2314) CT series from 7 CT scanners were reconstructed with a DL algorithm (TrueFidelity, GE Healthcare) in a multicenter setting (Group 1, G1). LcDRLs were calculated as the third quartile of the median dose values (CTDIvol, DLP) for each CT scanner and compared as percent reduction to previously calculated (2017) LcDRLs (Group 0, G0), based on iterative reconstruction algorithm (iDose, Philips). The new LcDRLs were also compared to the anatomy-based P50 (achievable) national DRLs (NDRLs).*Results G1 BMI<25 average CTDIcol/DLP reduction was -41%/-46% for chest and -27%/-29% for abdomen. G1 BMI=25 average CTDIcol/DLP reduction was -37%/-43% for chest and -17%/-30% for abdomen. Highest dose reduction for BMI < 25/= 25 classes was observed for emphysema (-71%/-78%) and kidney stones (-62%/-55%) clinical indications. For chest, LcDRLs compared to P50 NDRLS were lower in all indications and BMI classes for CTDIvol (range 1.6-5.6 vs. 6.0 mGy) and DLP (62-181 vs. 210 mGycm). For abdomen, LcDRLs were lower or comparable to P50 NDRLS for CTDIvol (2.5-10.2 vs 10 mGy) and DLP (96-418 vs. 470mGycm). For urolithiasis LcDRls were below P50 NDRL for CTDIvol (2.5/3.6 vs. 4.0 mGy) and DLP (96/120 vs. 180 mGycm) in both BMI classes. For Liver LcDRls were below P50 NDRL for CTDIvol (4.8 vs. 9.0 mGy) and DLP (243 vs. 300 mGycm) only for BMI<25.*Conclusions DL reconstruction algorithms allow further optimization of CT doses at a local level. Combined with protocol stratification according to clinical indication and BMI, LcDRLs remain lower than national P50 DRLs for chest and abdomen CT examinations.*Clinical Relevance/Application DRLs can only be used successfully with a continuous improvement program and experienced staff to perform clinical audits and carry the optimization process forward.

RESULTS

G1 BMI<25 average CTDIcol/DLP reduction was -41%/-46% for chest and -27%/-29% for abdomen. G1 BMI=25 average

CTDIcol/DLP reduction was -37%/-43% for chest and -17/-30% for abdomen. Highest dose reduction for BMI < 25/= 25 classes was observed for emphysema (-71%/-78%) and kidney stones (-62%/-55%) clinical indications. For chest, LcDRLs compared to P50 NDRLS were lower in all indications and BMI classes for CTDIvol (range 1.6-5.6 vs. 6.0 mGy) and DLP (62-181 vs. 210 mGycm). For abdomen, LcDRLs were lower or comparable to P50 NDRLS for CTDIvol (2.5-10.2 vs 10 mGy) and DLP (96-418 vs. 470mGycm). For urolithiasis LcDRls were below P50 NDRL for CTDIvol (2.5/3.6 vs. 4.0 mGy) and DLP (96/120 vs. 180 mGycm) in both BMI classes. For Liver LcDRls were below P50 NDRL for CTDIvol (4.8 vs. 9.0 mGy) and DLP (243 vs. 300 mGycm) only for BMI<25.

CLINICAL RELEVANCE/APPLICATION

DRLs can only be used successfully with a continuous improvement program and experienced staff to perform clinical audits and carry the optimization process forward.

PH02-A7   In Vivo Quantification Of Bone Mineral Density Of Lumbar Vertebrae Using Fast Kvp Switching Dual-energy CT: Correlation With Quantitative Computed Tomography

Participants
Kun Zhang, MD, Changsha, China (*Presenter*) Nothing to Disclose

PURPOSE

Osteoporosis is a common, progressive disease related to low bone mineral density (BMD). If it can be diagnosed at an early stage, osteoporosis is treatable. Quantitative computed tomography (QCT) is one of the current reference standards of BMD measurement, but dual-energy computed tomography (DECT) is considered to be a potential alternative. This study aimed to evaluate the feasibility and accuracy of phantomless in vivo DECT-based BMD quantification in comparison with QCT.*Methods and Materials A total of 128 consecutive participants who underwent DECT lumbar examinations between July 2019 and February 2021 were retrospectively analyzed. The density of calcium (water), hydroxyapatite (water), calcium (fat), and hydroxyapatite (fat) [DCa(Wa), DHAP(Wa), DCa(Fat) and DHAP(Fat), respectively] were measured along with BMD in the trabecular bone of lumbar level 1-2 by DECT and QCT. Linear regression analysis was performed to assess the relationship between DECT- and QCT-derived BMD at both the participant level and the vertebral level. Linear regression models were quantitatively evaluated with adjusted R-square, normalized mean squared error (NMSE) and relative error (RE). Bland-Altman analysis was conducted to assess agreement between measurements. P<0.05 was considered statistically significant.*Results Strong correlations were observed between DECT- and QCT-derived BMD at both the participant level and the vertebral level (adjusted R2 =0.983-0.987; NMSE = 1.6-2.1%; RElinear =0.6-0.9%). Bland-Altman plots indicated high agreement between both measurements. DCa(Fat) and DHAP(Fat) showed relatively similar and optimal predictive capability for QCT-derived BMD (both: adjusted R2 =0.987, NMSE =1.6%, RElinear =0.6%).*Conclusions Fast kVp switching DECT enabled accurate phantomless in vivo BMD quantification of the lumbar spine. DCa(Fat) and DHAP(Fat) had relatively similar and optimal predictive capability.*Clinical Relevance/Application Dual-energy computed tomography (DECT) is a potential alternative tool to evaluate bone mineral density .

RESULTS

Strong correlations were observed between DECT- and QCT-derived BMD at both the participant level and the vertebral level (adjusted R2 =0.983-0.987; NMSE = 1.6-2.1%; RElinear =0.6-0.9%). Bland-Altman plots indicated high agreement between both measurements. DCa(Fat) and DHAP(Fat) showed relatively similar and optimal predictive capability for QCT-derived BMD (both: adjusted R2 =0.987, NMSE =1.6%, RElinear =0.6%).

CLINICAL RELEVANCE/APPLICATION

Dual-energy computed tomography (DECT) is a potential alternative tool to evaluate bone mineral density .

PH02-A8   Accuracy Of Iodine Quantification Using Single-source Split-filter Dual-energy CT Compared To Dual-source Scanners: Phantom Study

Participants
Anzi Zhao, MS, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

To compare the in-vitro accuracy of iodine quantification algorithm of single-source split-filter dual-energy CT (DECT) with dual-source DECT platforms, using a multi-energy CT phantom.*Methods and Materials A multi-energy CT quality assurance phantom (with cylinder and oval setup to evaluate the effect of body habitus) with various nominal iodine concentration inserts (2 to 15 mg/ml, and 1, 2, 4 mg/ml mixed with blood mimicking materials) were scanned with three DECT scanners (SOMATOM X.Cite, Drive, and Force, Siemens Healthcare) employing two different dual-energy acquisition mechanisms. Clinical abdomen/pelvis dual-energy scanning protocols with different kilovolt peak and different energy spectral separation settings were used. Automatic tube current modulation was employed. Scans were repeated with iodine inserts switched between central and peripheral holes. Iodine concentration measurements were made on the images generated on Siemens Syngo.via. Linearity of measured iodine concentrations with nominal known insert concentrations were assessed. The degree of error between the calculated and actual iodine concentration were also analyzed.*Results Measured iodine concentrations from all three scanners showed excellent linear correlation with nominal values, with R2 values ranging between 0.9958 and 1 (p<0.05). Error between the measured and actual iodine concentrations ranged from -1.4 to 1.0 mg/ml. Degree of absolute error was higher with high-concentration (10 and 15 mg/ml) inserts, especially when these inserts were placed in the periphery of the oval-shaped phantom. There was degradation of iodine quantification with scanners Drive and X.Cite when iodine inserts were placed in the oval-shaped phantom. Scanner X.Cite showed notable degradation in accuracy of iodine quantification when admixture of blood-mimicking fluid and iodine was used, particularly when those inserts were placed in the periphery of the oval-shaped phantom.*Conclusions Although the correlation between calculated and actual iodine concentrations was excellent across all 3 scanners, some variations in accuracy of iodine quantification were noted between the scanners. Locations of the iodine inserts (peripheral versus central) and size of the phantom affected the accuracy of iodine quantification. In general, accuracy of split-filter DECT for iodine quantification was inferior to the dual-source scanners.*Clinical Relevance/Application Split-filter DECT, which is the newest FDA-approved DECT technology, offers excellent linearity for in-vitro iodine quantification. This scanner may offer reasonable accuracy for in-vivo iodine quantification although further clinical studies are required to prove this.

RESULTS

Measured iodine concentrations from all three scanners showed excellent linear correlation with nominal values, with R2 values ranging between 0.9958 and 1 (p<0.05). Error between the measured and actual iodine concentrations ranged from -1.4 to 1.0 mg/ml. Degree of absolute error was higher with high-concentration (10 and 15 mg/ml) inserts, especially when these inserts were

placed in the periphery of the oval-shaped phantom. There was degradation of iodine quantification with scanners Drive and X.Cite when iodine inserts were placed in the oval-shaped phantom. Scanner X.Cite showed notable degradation in accuracy of iodine quantification when admixture of blood-mimicking fluid and iodine was used, particularly when those inserts were placed in the periphery of the oval-shaped phantom.

CLINICAL RELEVANCE/APPLICATION

Split-filter DECT, which is the newest FDA-approved DECT technology, offers excellent linearity for in-vitro iodine quantification. This scanner may offer reasonable accuracy for in-vivo iodine quantification although further clinical studies are required to prove this.

PH02-A-HC1 High Resolution CT Using Photon Counting Detector (PCD) CT: Methods, Challenges And Clinical Benefits

Participants
Michael R. Bruesewitz, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To explain the method of achieving high resolution using an investigational PCD-CT scanner • To demonstrate the advantage of PCD-CT high-resolution imaging compared to existing technology• To describe the challenges and pitfalls of high-resolution imaging and strategy to overcome these challenges • To illustrate benefits of high-resolution imaging using PCD-CT in clinical applications

TABLE OF CONTENTS/OUTLINE

1. What is PCD and how is it different from the energy integrating detectors (EID) used on commercial CT scanners? a. PCD: Directly convert X-ray into electronic signals, count individual photon and record its energy b. EID: Indirect, 2 stage conversion of X-ray to light then to electronic signal. No information on individual photon 2. How high-resolution is achieved in PCD-CT? a. Smaller detector cell with almost 100% fill factor due to absence of septa b. More dose efficient compared to other high-resolution techniques based on comb filter and/or EID 3. Challenges of high-resolution imaging and solutions a. Need dedicated high-resolution kernel b. High image noise due to increased spatial resolution and sharp kernel c. Need advanced noise reduction techniques i. Iterative noise reduction techniques using prior knowledge ii. AI-based denoising techniques 4. Clinical applications a. Chest b. Temporal Bone c. Sinus d. Vascular e. MSK

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Abstract Archives of the RSNA, 2021

RO01-A

Radiation Oncology Sunday Poster Discussions

Sub-Events

RO01-A1   Low Dose Radiotherapy In The Management Of COVID-19 Pneumonia (LOWRAD-Cov19)

Participants
Sara Gomez Pena, Madrid, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the safety and efficacy of Low-Dose Radiation (LD-RT) to treat COVID-19 pneumonia.*Methods and Materials We conducted a prospective phase I-II trial enrolling patients = 50 years-old, COVID-19 positive, with lung involvement at imaging study and oxygen requirement. Patients received 100 cGy to total lungs in a single fraction. Dose planning goals were PTV95>80% with Dmax< 115%. Primary outcome was radiological response assessed as severity and extension scores at days 0, +3 and +7. Secondary outcomes were toxicity (CTCAE v5.0), days of hospitalization, changes in inflammatory blood parameters (ferritin, lymphocytes, C-reactive protein, d-dimer and LDH) and SatO2/ FiO2 index (SAFI), at day +3 and +7. Descriptive analyses were summarized as means with standard deviation (SD) and medians with interquartile ranges (IQR). A Wilcoxon sign rank test for paired data was used to assess the CT scores and Chi Square was used to assess for comparison of categorical variables.*Results Forty-one patients were included. Three patients died <72h after LD-RT and were excluded from the analysis. Median age was 71 (IQR 60-84). Eighteen patients (47%) received previously any antiCOVID treatment (tocilizumab, lopinavir/ritonavir, remdesivir) and thirty-two patients (84%) received esteroids (GC) during LD-RT. Extension score improved significantly (p=0.02) on day +7; severity score was stable or slightly decreased (p=0.1). Median SAFI on day 0 was 147 (IQR 118-264), 230 (IQR 120-343) on day +3 and 293 (IQR 121-353) on day +7 (p<0.01). SAFI improvement was associated with overall survival (p=0.01). Significant decrease was found in C-reactive protein on day +7 (p=0.02) and in lymphocytes counts on day +3 and +7 (p=0.02). Median time to receive RT from the date of admission was 19 days (ranging 2-87). Median number of days in hospital after RT was 11 (4-78) and overall was 37 days (range 11-155). With a median follow-up of 67 days after LD-RT, 24 (63%) patients were discharged, twelve (32%) died and two (5%) are still inpatients.*Conclusions Our preliminary results show that LD-RT was feasible and well-tolerated treatment, with potential clinical improvement. Randomized trials are needed to establish whether LD-RT improves severe pneumonia.*Clinical Relevance/Application LD-RT is a feasible (transfer, planning, 1-hour treatment) and well-tolerated treatment for the treatment of COVID-19 pneumonia. Our results suggested moderate radiological improvement and significant improvement in SAFI.

RESULTS

Forty-one patients were included. Three patients died <72h after LD-RT and were excluded from the analysis. Median age was 71 (IQR 60-84). Eighteen patients (47%) received previously any antiCOVID treatment (tocilizumab, lopinavir/ritonavir, remdesivir) and thirty-two patients (84%) received esteroids (GC) during LD-RT. Extension score improved significantly (p=0.02) on day +7; severity score was stable or slightly decreased (p=0.1). Median SAFI on day 0 was 147 (IQR 118-264), 230 (IQR 120-343) on day +3 and 293 (IQR 121-353) on day +7 (p<0.01). SAFI improvement was associated with overall survival (p=0.01). Significant decrease was found in C-reactive protein on day +7 (p=0.02) and in lymphocytes counts on day +3 and +7 (p=0.02). Median time to receive RT from the date of admission was 19 days (ranging 2-87). Median number of days in hospital after RT was 11 (4-78) and overall was 37 days (range 11-155). With a median follow-up of 67 days after LD-RT, 24 (63%) patients were discharged, twelve (32%) died and two (5%) are still inpatients.

CLINICAL RELEVANCE/APPLICATION

LD-RT is a feasible (transfer, planning, 1-hour treatment) and well-tolerated treatment for the treatment of COVID-19 pneumonia. Our results suggested moderate radiological improvement and significant improvement in SAFI.

VA01-B

Vascular Imaging Sunday Poster Discussions

Sub-Events

VA01-B1   Validation Of A Deep Learning Tool For Automatic Aortic Dissection Detection

Participants
Joel McLouth, MD, Orange, California (*Presenter*) Nothing to Disclose

PURPOSE

Aortic dissection (AD) is a rare and uncommon disease, but with high morbidity requiring time-sensitive treatments. Therefore, rapid detection of AD is critical. Artificial intelligence tools allow prompt diagnosis that can improve clinical outcomes. However, the generalizability of these tools across different clinical settings is not well described. This study aims to assess a commercially available deep learning-based tool, CINA® CHEST v1.0 device (Avicenna.ai, La Ciotat, France), in detecting AD across a variety of hospital settings throughout the US.*Methods and Materials This was a retrospective, multicenter, and blinded study that evaluated 298 Thoraco-abdominal CT angiography (CTA) images provided from a teleradiology organization. Data spanned 200 U.S. cities and included 4 CT vendors. The performance of CINA in AD detection was evaluated. Ground truth was determined by three board-certified radiologists.*Results There were 137 (46%) positive AD cases. CINA correctly identified 289/298 cases as positive or negative. The sensitivity was 96.4%, specificity was 97.5%, accuracy was 97.0%, area under the curve was 0.97, and Matthews correlation coefficient (MCC) was 0.94. Mean "time-to-notification" was estimated to be 36.5 seconds.*Conclusions This deep learning-based tool is generalizable and able to detect AD throughout a variety of hospital systems. Four false positives (FP), including two within aortic aneurysms, suggest that FPs can sometimes be triggered by findings already of interest to the radiologist. While there were five false negatives (FN), these all occurred in Type B dissections, which are often medically managed versus surgical management with Type A dissections. Additionally, these FNs primarily occurred in complicated cases that even prompted disagreement among the radiologists. Regardless, the robustness of this tool has implications for widespread clinical use which could help radiologists with AD triage for ultimately life-saving interventions.*Clinical Relevance/Application This study validates a deep learning-based tool which can detect AD across a variety of practice environments, thus allowing for fast initiation of time-sensitive treatments.

RESULTS

There were 137 (46%) positive AD cases. CINA correctly identified 289/298 cases as positive or negative. The sensitivity was 96.4%, specificity was 97.5%, accuracy was 97.0%, area under the curve was 0.97, and Matthews correlation coefficient (MCC) was 0.94. Mean "time-to-notification" was estimated to be 36.5 seconds.

CLINICAL RELEVANCE/APPLICATION

This study validates a deep learning-based tool which can detect AD across a variety of practice environments, thus allowing for fast initiation of time-sensitive treatments.

VA01-B2   Where's The Leak? Contrast Enhanced Ultrasound In Problem Solving Endoleak Detection In Abdominal Aortic Aneurysms Post Endograft Repair. A Multimodality Review.

Participants
Kathryn McGillen, MD, Hershey, Pennsylvania (*Presenter*) Speaker, MRI Online

TEACHING POINTS

CTA is gold standard for diagnosing endoleak in abdominal aortic aneurysms (AAA), after endograft repair (EVAR).Ultrasound, specifically contrast ultrasound (CEUS) can play a role in diagnosing endoleaks, particularly in problem solving cases when the type or location is unclear.CEUS can help guide management - preprocedural planning for the interventional radiologist and/or vascular surgeon - differentiate between type II and III endoleaks, identify inflow vessels, particularly in patients with poor renal function.Allows for access side planning, which may streamline number of angiographic runs and total radiation for the procedure.

TABLE OF CONTENTS/OUTLINE

Review endoleak types in AAA, status post EVAR.Review appearances of endoleak on CTA, contrast ultrasound and correlate with findings on diagnostic and therapeutic angiography.Discuss multi-modality and interdisciplinary approach to these patients.

Abstract Archives of the RSNA, 2021

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CH03-C

Chest Tuesday Poster Discussions

Sub-Events

CH03-C1   **Bend But Don't Break: Experience Of A Diverse New York City Lung Cancer Screening Program During The COVID-19 Pandemic**

Participants
Maximilian C. Stahl, BA, Bronx, New York (*Presenter*) Nothing to Disclose

PURPOSE

The COVID-19 pandemic has led to the national shutdown and subsequent reopening of cancer screening programs. Our diverse inner-city program was affected by staffing redeployment, quarantine protocols, increased safety/social distancing measures, and changes in follow up. The purpose of this study was to analyze the effect of the COVID-19 pandemic on our lung cancer screening program.*Methods and Materials Retrospective chart review. All exams of patients enrolled in our New York City lung cancer screening program from March 2019 to March 2021 were included. The pre-pandemic and pandemic period were defined as 3/28/2019-3/21/2020 vs. 3/22/2020-3/17/2021, respectively, dichotomized by the New York State lockdown.*Results 1218 exams were performed in the pre-pandemic period and 857 exams in the pandemic period, a 29.6% decrease. The percentage of exams performed on newly enrolled patients pre-pandemic period vs pandemic period significantly decreased from 32.7% to 13.8% (p<0.001). Demographics for the pre-pandemic period and pandemic period were: mean age (66.9 ± 5.9 and 66.5 ± 6.0), women (51.9% and 51.6%), White (20.7% and 20.3%) Hispanic/Latino (42.0% and 36.3%). There was no significant difference in Lung-RADS scores when comparing the pre-pandemic and pandemic period (p>0.05).Exam volume decreased to a minimum in the initial New York State lockdown in April and May 2020, with 14 and 10 exams per month performed, respectively. From June 2020-November 2020 exam volume returned to a pre-pandemic baseline, with a peak of 131 exams in September 2020. Exam volume declined corresponding to the second COVID-19 wave from December 2020-March 2021, with a trough of 43 exams per month. This parabolic pattern was true across all demographic groups in the pandemic period.*Conclusions The COVID-19 pandemic significantly decreased lung cancer screening volume correlating with surges. New patient enrollment was significantly reduced. There was no significant change in the distribution of Lung-RADS scores when comparing the pre-pandemic and pandemic period.*Clinical Relevance/Application As the nation continues to adapt during the COVID-19 pandemic, it is important to continue to find ways to provide necessary patient care. With lung cancer screening proven to reduce lung cancer mortality, ongoing efforts are needed to overcome the impact of the pandemic on underserved communities.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

As the nation continues to adapt during the COVID-19 pandemic, it is important to continue to find ways to provide necessary patient care. With lung cancer screening proven to reduce lung cancer mortality, ongoing efforts are needed to overcome the impact of the pandemic on underserved communities.

CH03-C2   **Lung-RADS Learning Curve? Chest Vs. General Radiologists Over 6 Years**

Participants
Joey Gu, BS, Providence, Rhode Island (*Presenter*) Nothing to Disclose

PURPOSE

The Lung CT Screening Reporting and Data System (Lung-RADS) was introduced in 2014 to standardize the reporting and management of low-dose CT (LDCT) screening results. This study examined: 1) if Lung-RADS rates in our sample changed over the last 6 years; 2) if Lung-RADS rates differed between chest and general radiologists; 3) as a reference, if the Lung-RADS rates from both Aims 1 & 2 differed from the Lung-RADS rates reported in the literature.*Methods and Materials Aims 1 & 2 were screens from a community practice between March 2015-21 (N=11,142). IRB determined this study as a quality project. Aim 3 was a meta-analysis of papers using MEDLINE and EMBASE with PRISMA guidelines; eligible studies examined LDCT lung cancer screening at institutions in the U.S. and reported Lung-RADS scores between 2015-21. Lung-RADS rates 1) over time and 2) between general and chest radiologists and 3) compared with meta-analysis results were modeled using generalized mixed modeling.*Results Of the 11,142 screens, 56% of screens were current smokers and 52% were women. The mean Lung-RADS score was 2, which did not significantly change over the last 6 years (OR: 1.00, p=0.3). Over the last 6 years, Lung-RADS rates were 84.2%, 9.3%, and 6.5% for scores 1&2, 3, and 4, respectively, which were comparable to our meta-analysis results from 22 studies showing scores 1&2, 3,

and 4 to be 84.3% (95% CI [82.1%, 86.3%]), 7.0% (95% CI [5.9%, 8.3%]), and 5.4% (95% CI [4.6%, 6.3%]), respectively. When examining Lung-RADS rates over the last 6 years between 3 chest and 37 general radiologists, there was no difference between chest and general radiologists (p=0.7), nor were there differences observed as a function of time between the two (p=0.6).*Conclusions No differences were found in Lung-RADS scores between chest and general radiologists over 6 years. There was no evidence of a "learning curve" for general compared with chest radiologists; these rates reflect the literature.*Clinical Relevance/Application Lung-RADS scores are consistently applied to LDCT screening studies regardless of radiologist sub-specialization. General radiologists may perform as well as chest radiologists in a community-based lung cancer screening program.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Lung-RADS scores are consistently applied to LDCT screening studies regardless of radiologist sub-specialization. General radiologists may perform as well as chest radiologists in a community-based lung cancer screening program.

CH03-C4   Assessment Of Nodule Growth On Follow-up Screening Low Dose Cts To Detect Lung Cancer: Comparison Between Lung-rads, Nelson, And Subjective Assessment By Radiologist

Participants
Jong Hyuk Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate accuracies of lung cancer identification on follow-up screening low dose CTs (LDCTs), using different criteria for nodule growth evaluation: Lung-RADS version 1.1, volumetric criteria of NELSON, and subjective assessment of radiologist.*Methods and Materials We retrospectively collected baseline and follow-up LDCTs of lung cancer screening participants with an indeterminate nodule on baseline CT by NELSON criteria (solid component volume 50-500 mm3; non-solid component average diameter =8mm). Diameters and volumes of nodules were measured by semiautomated segmentation. Nodule growth (Lung-RADS, absolute diameter increase >1.5mm; NELSON, percentage volume increase =25%) and request for diagnostic procedures (Lung-RADS, category 4B; NELSON: volume doubling time <400 days or new solid component) were determined based on Lung-RADS and NELSON criteria. In addition, one radiologist subjectively reviewed LDCT images to determine nodule growth and request diagnostic procedures independently from semiautomated measurement. Sensitivities and specificities of nodule growth and request for diagnostic procedure defined by three criteria were evaluated against lung cancer diagnosis*Results Among 120 participants (median interval between CTs, 6 months), lung cancer was diagnosed in 30 (25%) participants. Nodule growth defined by Lung-RADS, NELSON criteria, and radiologist's subjective evaluation exhibited sensitivities of 70%, 80%, and 57%, specifities of 96%, 91%, and 99%, respectively. Nodule growth defined by NELSON criteria exhibited higher sensitivity (P=.046) and lower specificity (P=.046) than radiologist's subjective evaluation. Request for diagnostic procedures defined by Lung-RADS, NELSON criteria, and radiologist's subjective evaluation exhibited sensitivities of 40%, 63%, and 80%, specifities of 94%, 97%, and 97%, respectively. Request for diagnostic procedures defined by Lung-RADS exhibited lower sensitivity than NELSON criteria (P=.046) or radiologist's subjective evaluation (P=.001).*Conclusions Radiologist's subject evaluation was less sensitive in terms of nodule growth but more sensitive in terms of adjudication of diagnostic procedures than semiautomated measurements for identifying lung cancer on follow-up LDCTs.*Clinical Relevance/Application Apart from its lower sensitivity for nodule growth than semiautomated measurement, radiologist's subjective evaluations can sensitively identify lung cancer in follow-up screening LDCTs.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Apart from its lower sensitivity for nodule growth than semiautomated measurement, radiologist's subjective evaluations can sensitively identify lung cancer in follow-up screening LDCTs.

CH03-C5   Prevalence And Predictive Malignancy Features Of Isolated Mediastinal Or Hilar Lymphadenopathy On Low-dose Chest CT Screening For Lung Cancer

Participants
Eunhye Seo, Bucheon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the prevalence of enlarged mediastinal or hilar lymph nodes (MH-LNs) in low-dose CT (LDCT) screening and to identify features that distinguish benign from malignant lymph nodes.*Methods and Materials This study retrospectively reviewed 624 participants who took a baseline chest LDCT scan between 2017 and 2019 at a single tertiary hospital. Participants who had one or more enlarged (defined as 6 mm or larger) MH-LN on the initial CT scan and were followed up for at least one year were included in this study. For each MH-LN, eight features including the location, size (short and long axis), Hounsfield unit, calcification, fat, shape (oval, round, crescent), contour (sharp, ill-defined, lobulated) were reviewed. Other features related to the participant's underlying lung condition (interstitial lung abnormality, tuberculosis sequalae, emphysema, bronchiectasis, bronchitis), age, sex, and smoking pack-years were also reviewed. Multivariate logistic regression analysis and Mann-Whitney U test were used to detect and compare the features of malignant LN. Further analyses used synthetic minority oversampling techniques (SMOTE) due to the limited number of malignant cases.*Results A total of 531 MH-LNs were identified in 223 participants (mean age 62±6, male 99.1%),

of which 10 MH-LNs from 5 participants were diagnosed as malignant; 2 metastatic LN from pulmonary adenocarcinoma and 8 isolated malignant LN without an identified primary cancer. Short axis length was shown to be the single most significant factor in predicting whether the MH-LN may be malignant (odds ratio 3.409; P<0.001). The short axis length was statistically different when comparing between benign and malignant MH-LN groups (7.4±1.5 mm vs. 16.9±5.4 mm, P<0.001) and all patients with malignancy had at least one MH-LN that is at least 15 mm. After implementing SMOTE, shape (P=0.013), bronchitis (P=0.002), emphysema (P=0.026) also showed to have association with malignancy of MH-LNs.*Conclusions Among features that may suggest malignancy in isolated MH-LNs, short axis length of 15 mm or longer provide the most significant predictive value. Other features such as the shape of lymph node or underlying bronchitis or emphysema in the lung parenchyma may also be important factors when considering further cancer evaluation tests.*Clinical Relevance/Application The lung imaging reporting and data system (Lung-RADS) currently does not include any size criteria related to lymph node enlargement. This study proposes a need to specifically mention that isolated mediastinal or hilar lymph node enlargement of at least 15 mm in short axis length may be suggestive of a Lung-RADS score of 4X. Other features, such as shape, bronchitis, emphysema require further studies to confirm their relevance.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

The lung imaging reporting and data system (Lung-RADS) currently does not include any size criteria related to lymph node enlargement. This study proposes a need to specifically mention that isolated mediastinal or hilar lymph node enlargement of at least 15 mm in short axis length may be suggestive of a Lung-RADS score of 4X. Other features, such as shape, bronchitis, emphysema require further studies to confirm their relevance.

CH03-C6   Deep Learning-Based Autonomous Robotic Point Of Care Ultrasound Imaging For Detection And Monitoring Of COVID-19 Induced Pulmonary Diseases

Participants
Lidia Al-Zogbi, MS,BEng, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Point of care ultrasound (POCUS) imaging techniques have emerged as an important tool for diagnosis and staging of patients for COVID-19. In addition to the scarcity of highly skilled sonographers, POCUS requires close contact of radiologists and ultrasound (US) technicians with patients, increasing risk for infection. An autonomous robotic solution would enable a safe environment for medical personnel while facilitating repeated imaging of the same location for monitoring of the disease progression.*Methods and Materials A 6 degrees-of-freedom manipulator was employed for the autonomous US image collection process. A 3D deep convolutional network trained on 550 patients was used to predict 3D positions of 60 landmarks on a human ribcage from a torso surface. These landmarks combined with a patient surface model obtained from a depth camera were used to propose target US probe positions on the patient to image the lungs while avoiding rib obstruction. Due to registration errors and prediction inaccuracies, these algorithms were combined with a real-time force-displacement profile collection methodology to prevent skeletal obstruction during robotic acquisition of US images. The system was evaluated in simulation on n=3 patients and on n=1 full torso US phantom following an 8-point POCUS scanning protocol.*Results Using the L2 norm of the difference between the target and actual final US probe position as an accuracy metric, the methodology's error was 19.8±16.9mm in simulation across 240 data points, allowing the system to image all points of interest in the lungs in a pre-defined sweeping motion. The study on a custom-made full torso US phantom showed that 87.5% of the 24 autonomously acquired US images using real-time force feedback were unobstructed with >90% of the field of view interpretable and a non-shadowed goal point, compared to only 58.3% of the 24 images acquired without force feedback.*Conclusions We have demonstrated preliminary feasibility of a novel real-time solution for autonomously acquired robotic US lung scans by predicting anatomical features of a ribcage from a torso surface model, and using a force-displacement feedback methodology.*Clinical Relevance/Application The proposed robotic solution for POCUS mitigates the scarcity of highly skilled medical personnel and enhances the clinical practice for more consistent patient monitoring.

RESULTS

Using the L2 norm of the difference between the target and actual final US probe position as an accuracy metric, the methodology's error was 19.8±16.9mm in simulation across 240 data points, allowing the system to image all points of interest in the lungs in a pre-defined sweeping motion. The study on a custom-made full torso US phantom showed that 87.5% of the 24 autonomously acquired US images using real-time force feedback were unobstructed with >90% of the field of view interpretable and a non-shadowed goal point, compared to only 58.3% of the 24 images acquired without force feedback.

CLINICAL RELEVANCE/APPLICATION

The proposed robotic solution for POCUS mitigates the scarcity of highly skilled medical personnel and enhances the clinical practice for more consistent patient monitoring.

Abstract Archives of the RSNA, 2021

Sub-Events

NMMI01-A1 Preoperative Maximum Standardized Uptake Value Of Primary Lesions Predict Lymph Nodes Metastasis Superior To Traditional Positron Emission Tomography-computed Tomography Criterion With Higher Negative Predictive Value In Peripheral Clinical T1 Non-small-cell Lung Cancer

Participants
Xiaofeng Li, Xu Zhou, China (*Presenter*) Nothing to Disclose

PURPOSE

The sublobar resection is suitable for patients in peripheral cT1 non-small-cell lung cancer (NSCLC) without lymph node metastasis (LNM) according to the guidelines. The traditional Fluorine-18 fluorodeoxyglucose (18F-FDG) positron emission tomography-computed tomography (PET-CT) criterion based on hilar or mediastinal lymph nodes (LNs) = 1.0 cm or LN maximum standardized uptake value (SUVmax) = 2.5 for predicting LNM have unsatisfactory performance, especially for the low negative predictive value (NPV). Therefore, we aimed to explore the clinical role of preoperative SUVmax of the primary lesions for predicting peripheral cT1 NSCLC LNM.*Methods and Materials A total of 172 patients with peripheral cT1 NSCLC underwent preoperative 18F-FDG PET-CT were retrospectively analyzed. The enrolled cases were divided into the LNM group and the non-LNM group according to postoperative pathology. The differences of clinical variables, metabolic and morphological parameters of the primary lesions between the two groups were compared. The independent risk factors of peripheral cT1 NSCLC LNM were determined by univariate and multivariate analysis, and assessed the diagnostic efficacy with the receiver operating characteristic curve (ROC) and area under the ROC (AUC), then calculated the sensitivity (SEN), specificity (SPE), positive predictive value (PPV) and NPV.*Results According to postoperative pathology, the incidence of LNM was 23.8% among the enrolled cases. A univariate analysis showed that preoperative SUVmax, age, CTmean, size, SUVmean, and TLG were significantly correlated with the LNM, the ORs (95% CIs) were (19.80 (4.59-85.40)), (0.96 (0.92-1.01)), (1.01 (1.00-1.02), (2.08 (1.05-4.10)), (1.18 (1.08-1.28)), and (1.02 (1.01-1.04)), respectively. SUVmax > 6.2 of the primary lesions based on 18F-FDG PET-CT was the only independent risk factor of peripheral cT1 NSCLC LNM (OR 10.95, 95% CI, 2.43-49.36; p =0.002) by multivariate analysis. The AUC of SUVmax of the primary lesions to predict LNM was higher than the traditional 18F-FDG PET-CT criterion, and the difference was statistical significance (0.759 vs. 0.601, p-value<0.001). The sensitivity and NPV of SUVmax were superior to the traditional PET-CT criterion (95.1% vs. 80.5%, 97.1% vs. 86.7%). A Hosmer-Lemeshow test showed a goodness-of-fit (p-value 0.479).*Conclusions The preoperative SUVmax of the primary lesion based on 18F-FDG PET-CT to predict LNM has a high clinical role than the traditional PET-CT criterion, since the excellent sensitivity and NPV of the SUVmax could identify the patients at low-risk LNM in peripheral cT1 NSCLC.*Clinical Relevance/Application When SUVmax = 6.2 of the primary tumors in peripheral cT1 NSCLC, the sublobar resection should be performed.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

When SUVmax = 6.2 of the primary tumors in peripheral cT1 NSCLC, the sublobar resection should be performed.

NMMI01-A4 Application Of Dual-stream 3D Convolutional Neural Network Based On 18F-FDG PET/CT In Distinguishing Benign And Invasive Adenocarcinoma In Ground-glass Lung Nodules

Participants
Xiaonan Shao, Changzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

This work aims to train, validate and test a dual-stream three-dimensional convolutional neural network (3D-CNN) based on Fluorine 18 (18F)-fluorodeoxyglucose (FDG) PET/CT to distinguish benign lesions and invasive adenocarcinoma (IAC) in ground-glass nodules (GGNs).*Methods and Materials We retrospectively analyzed patients with suspicious GGNs who underwent 18F-FDG PET/CT examinations in our hospital from November 2011 to November 2020. The patients with benign lesions or IAC were selected for this study. According to the ratio of 7:3, the data was randomly divided into training data and testing data. Partial image feature extraction software was used to segment PET and CT images, and the training data after using the data augmentation was used for the training and validation (5-fold cross-validation) of the three CNNs (PET, CT, and PET/CT networks). According to the average accuracy, recall, and precision, the classification performance of different CNNs on the validation set and testing set was evaluated.*Results A total of 23 benign nodules and 92 IAC nodules from 106 patients were included in this study. In the validation

set, the performance of PET network (accuracy of 0.92 ± 0.02; recall and precision of 0.97 ± 0.03 and 0.94 ± 0.04) were better than CT network (accuracy of 0.84 ± 0.03; recall and precision of 0.90 ± 0.07 and 0.90 ± 0.04); in the testing set, the performance of both networks declined. However, when the precision was close, the accuracy and recall of PET network (0.79 ± 0.05 and 0.90 ± 0.05) were still higher than CT network (0.72 ± 0.05 and 0.79 ± 0.08). For the dual-stream PET/CT network, its performance was almost the same as PET network in the validation set; while in testing set, although its performance decreased (accuracy was 0.81 ± 0.03; recall and precision were 0.92 ± 0.03 and 0.86 ± 0.00), it was still higher than CT or PET networks. Moreover, the accuracy of PET/CT network was higher than two nuclear medicine physicians [Physician 1 (3-year experience): 0.70 and Physician 2 (10-year experience): 0.73].*Conclusions The 3D-CNN based on 18F-FDG PET/CT can be used to distinguish benign lesions and IAC in GGNs, and the performance is better when both CT and PET images are used together.*Clinical Relevance/Application Therefore, in the absence of well-trained and experienced physicians, this CNN may help the differentiation and clinical management of benign and malignant GGNs. Besides, we also expect clinicians to use this CNN for other tumor research suitable for PET/CT imaging.

RESULTS

A total of 23 benign nodules and 92 IAC nodules from 106 patients were included in this study. In the validation set, the performance of PET network (accuracy of 0.92 ± 0.02; recall and precision of 0.97 ± 0.03 and 0.94 ± 0.04) were better than CT network (accuracy of 0.84 ± 0.03; recall and precision of 0.90 ± 0.07 and 0.90 ± 0.04); in the testing set, the performance of both networks declined. However, when the precision was close, the accuracy and recall of PET network (0.79 ± 0.05 and 0.90 ± 0.05) were still higher than CT network (0.72 ± 0.05 and 0.79 ± 0.08). For the dual-stream PET/CT network, its performance was almost the same as PET network in the validation set; while in testing set, although its performance decreased (accuracy was 0.81 ± 0.03; recall and precision were 0.92 ± 0.03 and 0.86 ± 0.00), it was still higher than CT or PET networks. Moreover, the accuracy of PET/CT network was higher than two nuclear medicine physicians [Physician 1 (3-year experience): 0.70 and Physician 2 (10-year experience): 0.73].

CLINICAL RELEVANCE/APPLICATION

Therefore, in the absence of well-trained and experienced physicians, this CNN may help the differentiation and clinical management of benign and malignant GGNs. Besides, we also expect clinicians to use this CNN for other tumor research suitable for PET/CT imaging.

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Sub-Events

RI02-A1   Ferumoxytol-enhanced MRI Enables Visualization Of The Uteroplacental Interface In A Mouse Model Of Pregnancy

Participants
Andrew Badachhape, PhD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Consistent visualization of the uteroplacental interface, or retroplacental clear space (RPCS), has proven to be difficult with ultrasound and conventional magnetic resonance imaging (MRI). Contrast-enhanced MRI (CE-MRI) using conventional gadolinium (Gd) contrast agents is difficult to justify due to concerns over fetal Gd toxicity. While we have previously demonstrated a novel nanoparticle Gd agent that does not cross the placental barrier, it is not yet approved for clinical use. In this pre-clinical study, we evaluated ferumoxytol, an FDA-approved iron oxide nanoparticle agent that is used as a T1-weighted and T2-weighted contrast agent for MRI, for visualizing the retroplacental clear space in a mouse model of pregnancy.*Methods and Materials Imaging studies were performed on a 1T permanent magnet scanner. Ferumoxytol T1 relaxivity (r1) was calculated with inversion recovery spin echo (inversion times: 50-2500 ms). T2 relaxivity (r2) of ferumoxytol was calculated by mapping signal intensity at 4 echo times with a T2* spin echo sequence (TR: 2500 ms, TE: 20, 40, 60, 80 ms). To determine optimal ferumoxytol dose for in vivo T1w-MRI, non-pregnant mice were administered 0.5, 1, 2.5, 5, and 10 mg/kg of ferumoxytol and imaged using a T1-weighted gradient recalled echo (T1w-GRE) sequence (TR: 20 ms, TE: 3.5 ms, voxel size: 300 um3 isotropic). The inferior vena cava (IVC) was chosen as a large caliber blood vessel for assessing signal-to-noise ratio (SNR) relative to background noise. The optimal ferumoxytol dose was used for RPCS characterization in pregnant C57BL/6 mice. Ferumoxytol-enhanced T1w-MRI was performed in pregnant mice at early (12.5 days) and late (16.5 days) stages of gestation (denoted as E12.5 and E16.5). Signal-to-noise ration (SNR) and contrast-to-noise ratio (CNR) was computed for placenta and RPCS for all FPUs in ferumoxytol-enhanced MR images.*Results In vitro studies demonstrated ferumoxytol T1 relaxivity of 18 (mM.s)-1 and T2 relaxivity of 59 (mM.s)-1 at 1T MR field strength. Dose-optimization studies for T1w-MRI in non-pregnant mice demonstrated highest vascular enhancement at 5 mg/kg (SNR: 32.6). Ferumoxytol-enhanced MRI of pregnant mice enabled delineation of RPCS at both E12.5 (Placental-RPCS CNR: 6.9 ± 1.2, n = 29 FPUs) and E16.5 (Placental-RPCS CNR: 8.1 ± 1.5, n= 24 FPUs).*Conclusions Contrast-enhanced MR imaging using ferumoxytol at a dose of 5 mg/kg enabled clear visualization of placental margins and the retroplacental clear space at early and late gestational stages in a pregnant mouse model.*Clinical Relevance/Application Visualization of the retroplacental clear space at the early stages of pregnancy using an FDA approved MR contrast agent may provide a sensitive method for the early detection of invasive placentation.

RESULTS

In vitro studies demonstrated ferumoxytol T1 relaxivity of 18 (mM.s)-1 and T2 relaxivity of 59 (mM.s)-1 at 1T MR field strength. Dose-optimization studies for T1w-MRI in non-pregnant mice demonstrated highest vascular enhancement at 5 mg/kg (SNR: 32.6). Ferumoxytol-enhanced MRI of pregnant mice enabled delineation of RPCS at both E12.5 (Placental-RPCS CNR: 6.9 ± 1.2, n = 29 FPUs) and E16.5 (Placental-RPCS CNR: 8.1 ± 1.5, n= 24 FPUs).

CLINICAL RELEVANCE/APPLICATION

Visualization of the retroplacental clear space at the early stages of pregnancy using an FDA approved MR contrast agent may provide a sensitive method for the early detection of invasive placentation.

RI02-A2   Utility Of MRI In Identifying Uterine Pathology Prior To Uterine Artery Embolization

Participants
Nicole Zanolli, BA, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To understand frequency and concordance of imaging findings reported by pelvic ultrasound and MRI that can change treatment plan or eligibility for uterine artery embolization (UAE).*Methods and Materials Imaging findings were abstracted from radiology reports of women over the age of 18, who had undergone both a pelvic ultrasound and MRI at a single institution between 1/2014 and 12/2018. Patients were excluded if the ultrasound and MRI were performed for different indications. Women with two sets of imaging were recorded separately. Presence of uterine findings that could impact candidacy for UAE including adenomyosis, intracavitary fibroids, a thickened or heterogenous endometrial stripe/concern for uterine malignancy, concern for infection or non-enhancing fibroids were recorded.*Results A total of 1,128 sets of images were collected. Mean age of at the time of MRI was 47.8 years old. Patient self-identified race was Asian (4.4%), Black (43.3%), Hispanic/Latino (7.8%), White (41.8%), and Other (2.7%). The average BMI was 31.6 at the time of MRI. 110 (9.8%) had MRI prior to ultrasound, 32 (2.8%) were performed the same day and 986 (87.4%) had ultrasound prior to MRI. The mean length of time between the two sets of imaging was 1.6 months. Compared to the findings on ultrasound, additional findings made on MRI included adenomyosis (116 cases, 10.3% of total studies), intracavitary fibroids (38, 3.4%), thickened or heterogenous endometrial stripe/concern for uterine malignancy (45, 4.0%), concern for infection (6, 0.5%) and non-enhancing fibroids (28, 2.5%). In total 19.1% of patients had clinically relevant MRI findings not seen on ultrasound that may warrant additional workup or change in clinical management.*Conclusions In a set of 1,128 patients with both a pelvic ultrasound and MRI, 19.1% had MRI findings not seen on ultrasound that may result in consequential changes in

clinical management.*Clinical Relevance/Application Pelvic MRI frequently provides additional findings that are missed on ultrasound but determine candidacy for UAE; MRI should be routinely preformed prior to UAE to ensure appropriate patient care.

RESULTS

A total of 1,128 sets of images were collected. Mean age of at the time of MRI was 47.8 years old. Patient self-identified race was Asian (4.4%), Black (43.3%), Hispanic/Latino (7.8%), White (41.8%), and Other (2.7%). The average BMI was 31.6 at the time of MRI. 110 (9.8%) had MRI prior to ultrasound, 32 (2.8%) were performed the same day and 986 (87.4%) had ultrasound prior to MRI. The mean length of time between the two sets of imaging was 1.6 months. Compared to the findings on ultrasound, additional findings made on MRI included adenomyosis (116 cases, 10.3% of total studies), intracavitary fibroids (38, 3.4%), thickened or heterogenous endometrial stripe/concern for uterine malignancy (45, 4.0%), concern for infection (6, 0.5%) and non-enhancing fibroids (28, 2.5%). In total 19.1% of patients had clinically relevant MRI findings not seen on ultrasound that may warrant additional workup or change in clinical management.

CLINICAL RELEVANCE/APPLICATION

Pelvic MRI frequently provides additional findings that are missed on ultrasound but determine candidacy for UAE; MRI should be routinely preformed prior to UAE to ensure appropriate patient care.

RI02-A3   Placenta Accreta Spectrum Disorder: US And MRI Imaging Findings With Pathological Correlation.

Participants
Linda Kelahan, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

•Describe the normal imaging findings of the placenta both in US and MRI imaging. • Define the term placenta accreta spectrum (PAS) disorder. • Discuss common risk factors for placenta accreta spectrum. • Define ultrasound and MRI signs of placenta accreta spectrum with pathological correlation.

TABLE OF CONTENTS/OUTLINE

• Introduction. • Epidemiology and risk factors. • Pathological findings. • Normal placental anatomy and common variations. • Imaging of the normal placenta: - Ultrasound - MRI • Placenta accreta spectrum (overview with diagrammatic representation) o New FIGO 2019 classification. o Placenta previa. o Abnormal implantation into cesarean section scar. • New perspectives: uterine dehiscence, not invasion. • Structured reporting • Anatomic landmarks for surgical/IR planning• Ultrasound imaging of placenta accreta spectrum - B mode findings (placental lacunae, loss of retroplacental hypoechoic zone, myometrial thickness and decidua interruption). - Color Doppler findings. • MRI findings of placenta accreta spectrum. - Evolution of MRI imaging protocols for fetal and placental imaging. - MRI findings of placenta accreta spectrum. • Summary. • Take home messages.

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Abstract Archives of the RSNA, 2021

Sub-Events

HN05-B1 **Surface-based Amplitude Of Low Frequency Fluctuation Alterations In Patients With Tinnitus Before And After Sound Therapy: A Resting-state Functional MRI Study**

Participants
Xuan Wei, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Surface-based analysis is a more sensitive measure of cortical local information content than volume analysis.This study aimed to investigate abnormal tinnitus activity by evaluating brain surface-based amplitude of low-frequency fluctuation (ALFF) changes detected by resting-state functional magnetic resonance imaging (RS-fMRI) in patients with idiopathic tinnitus before and after 24 weeks of sound therapy.*Methods and Materials In this prospective observational study, we recruited thirty-three tinnitus patients who had undergone 24 weeks of sound therapy and twenty-six matched healthy controls (HCs).For all participants, 3.0T magnetic resonance imaging (MRI) was acquired with a resting-state functional images of all participants. For the two groups of subjects, we analyzed the spontaneous neural activity of tinnitus patients by cortical ALFF and detected its correlation with clinical indicators of tinnitus. Patients' Tinnitus Handicap Inventory (THI) scores were assessed to determine the severity of their tinnitus before and after treatment. Two-way mixed model analysis of variance (ANOVA) and Pearson's correlation analysis were used in the statistical analysis. Student-Newman-Keuls (SNK) tests were used in the post hoc analysis.*Results Interaction effects between the two groups and between the two scans revealing local neural activity as assessed by ALFF were observed in the bilateral dorsal stream visual cortex (DSVC), bilateral posterior cingulate cortex (PCC), bilateral anterior cingulate and medial prefrontal cortex (ACC&MPC), left temporo-parieto-occipital junction (TPOJ), left orbital and polar frontal cortex (OPFC), left paracentral lobular and mid cingulate cortex (PCL&MCC), right insular and frontal opercular cortex (IFOC) and left early visual cortex (EVC). Importantly, local functional activity in the left TPOJ and right PCC in the patient group was significantly lower than that in the HCs at baseline and was increased to relatively normal levels after treatment. The 24-week sound therapy tinnitus group demonstrated significantly higher ALFF in the left TPOJ and right PCC than in the tinnitus baseline group. Also, compared with the HC baseline group and the 24-week HC group, the 24-week sound therapy tinnitus group demonstrated slightly lower or higher ALFF in the left TPOJ and right PCC, and there were no significant differences between the 24-week sound therapy tinnitus and HC groups.*Conclusions Sound therapy can change auditory, vision, cognitive control and emotional processing, and surface-based RS-fMRI is a more sensitive method to judge local functional activity than other methods.*Clinical Relevance/Application Long-term sound therapy had a normalizing effect on tinnitus patients.

RESULTS

Interaction effects between the two groups and between the two scans revealing local neural activity as assessed by ALFF were observed in the bilateral dorsal stream visual cortex (DSVC), bilateral posterior cingulate cortex (PCC), bilateral anterior cingulate and medial prefrontal cortex (ACC&MPC), left temporo-parieto-occipital junction (TPOJ), left orbital and polar frontal cortex (OPFC), left paracentral lobular and mid cingulate cortex (PCL&MCC), right insular and frontal opercular cortex (IFOC) and left early visual cortex (EVC). Importantly, local functional activity in the left TPOJ and right PCC in the patient group was significantly lower than that in the HCs at baseline and was increased to relatively normal levels after treatment. The 24-week sound therapy tinnitus group demonstrated significantly higher ALFF in the left TPOJ and right PCC than in the tinnitus baseline group. Also, compared with the HC baseline group and the 24-week HC group, the 24-week sound therapy tinnitus group demonstrated slightly lower or higher ALFF in the left TPOJ and right PCC, and there were no significant differences between the 24-week sound therapy tinnitus and HC groups.

CLINICAL RELEVANCE/APPLICATION

Long-term sound therapy had a normalizing effect on tinnitus patients.

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RO03-B

Radiation Oncology Tuesday Poster Discussions

Sub-Events

RO03-B1 **Prognostication Of Survival After Yttrium-90 Radioembolization For Unresectable Colorectal Liver Metastases: The Benefit Of Volumetric Early Response Assessment With Contrast Enhanced MRI And Its Predictability At Baseline**

Participants
Johannes Kahn, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

This retrospective study seeks to identify responders of Y-90 radioembolization for colorectal liver metastases (CRLM) both before treatment and early after treatment using baseline clinical variables and volumetric tumor response assessment (quantitative EASL-[qEASL]) on contrast enhanced MRI. The predictability of MR-morphologic response is investigated.*Methods and Materials 155 patients with CRLM who underwent Y-90 radioembolization at our center between 08/2008 and 01/2020 were evaluated for tumour segmentation in arterial and portal venous contrast phase MRI. Exclusion criteria were missing MRI within a defined timeframe, disseminated disease that impeded segmentation and poor imaging quality. Pre- and post-treatment target lesion volumes were measured according to volumetric RECIST and qEASL criteria. The impact of clinical variables and imaging features at baseline as well as MR morphologic response on patient survival was analyzed with Cox regression models. Logistic regression analyses were used to evaluate predictors of MR-morphologic response at baseline.*Results 52 patients were eligible for tumour segmentation. Mean patients' age was 63 years (SD 11), 37% were female. Median survival after treatment was 312 days (95% confidence interval CI [233, 390]). Three months after treatment, application of the qEASL criteria in both arterial and portal venous contrast phases allowed for a significant (p<0.05) separation of the survival curves for partial response, stable disease and progressive disease with a median survival of 412 days (95% CI: [57, 767] in responders. Higher tumour burden and Tc99m lung shunting showed a significant inverse relationship with the probability of patient survival whereas KRAS mutational status and the localization of the primary tumour in either the right or the left hemicolon did not have a significant impact. MR-morphologic response was not predictable at baseline neither with imaging nor available clinical data.*Conclusions MR-morphologic response according to qEASL criteria is the most expedient variable to isolate and measure the impact of Y-90 radioembolization on patient survival. It is the result of a not yet fully understood biological dose-effect relationship and not predictable neither with tumour vascularity or any other baseline variable evaluated.*Clinical Relevance/Application Devascularization on both arterial and portal venous contrast phase MRI is a valuable surrogate endpoint for the benefit of Y-90 radioembolization. Robust biomarkers of radiosensitivity for colorectal cancer subtypes are needed to improve patient selection and dose calculation.

RESULTS

52 patients were eligible for tumour segmentation. Mean patients' age was 63 years (SD 11), 37% were female. Median survival after treatment was 312 days (95% confidence interval CI [233, 390]). Three months after treatment, application of the qEASL criteria in both arterial and portal venous contrast phases allowed for a significant (p<0.05) separation of the survival curves for partial response, stable disease and progressive disease with a median survival of 412 days (95% CI: [57, 767] in responders. Higher tumour burden and Tc99m lung shunting showed a significant inverse relationship with the probability of patient survival whereas KRAS mutational status and the localization of the primary tumour in either the right or the left hemicolon did not have a significant impact. MR-morphologic response was not predictable at baseline neither with imaging nor available clinical data.

CLINICAL RELEVANCE/APPLICATION

Devascularization on both arterial and portal venous contrast phase MRI is a valuable surrogate endpoint for the benefit of Y-90 radioembolization. Robust biomarkers of radiosensitivity for colorectal cancer subtypes are needed to improve patient selection and dose calculation.

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Abstract Archives of the RSNA, 2021

BR01-B

Breast Sunday Poster Discussions

Sub-Events

BR01-B10 Breast Oncoplasty: What Breast Imagers Should Know

Participants
Eric Fromke, BS, Chapel Hill, North Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Introduce the concept of breast oncoplasty.2) Understand surgical management algorithms of breast cancer, including breast oncoplasty via illustrated unique patient cases.3) Learn the common post-operative effects of breast oncoplasty, including fat necrosis.4) Identify these common post-operative imaging findings status post breast oncoplasty.5) Differentiate these common post-operative changes and conditions from tumor recurrence on imaging.

TABLE OF CONTENTS/OUTLINE

- History of breast cancer surgical treatment options- What is breast oncoplasty and who is eligible?- Common post-operative breast changes after breast oncoplasty- Fat necrosis status post breast oncoplasty: what is it and why does it happen?- How to discern between fat necrosis and tumor recurrence in breast tissue status post breast oncoplasty?- Conclusions

BR01-B3 The Meta-analysis Of The Diagnostic Value Of Contrast Enhanced Spectral Mammography Compared With Mri

Participants
Huizhi Cao, PhD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To systematically evaluate the accuracy of contrast enhanced spectral mammography(CESM) for diagnosis of breast cancer.*Methods and Materials Systematic review and meta-analysis of diagnosis performance of CESM in finding breast cancer. Literatures of CESM and MRI in diagnosis of breast lesions were retrieved, merged, extracted in the databases published from 2008 to 2021, including CNKI,CBM,Cochrance Library,Web of Science,Springerlink, Embase,PubMed, Wanfang and Ovid. Review Manager5.3 was applied to evaluate the publication bias. STATA13.0 software was applied to generate Deek's funnel plot. After testing the heterogeneity results of literature by using Meta Disc 14. we analyzed the sensitivity, specificity, PLR, NLR and DOR.*Results A total of 354 literatures were searched, 12 literatures were included in this study according to the inclusion and exclusion criteria. The results of summary evaluation for CESM and MRI in diagnosis of breast cancer as follow respectively: The sensitivity were 0.97 and 0.97; the specificity were 0.69 and 0.51; the DOR were 105.44 and 33.73; PLR were 2.94 and 1.95; NLR were 0.05 and 0.07; and the AUC and 95% CI were 0.9645(0.981552~0.9558) and 0.9198(0.946848~0.892752) respectively. The range of 95%CI of CESM didn't overlap that of MRI. the AUC of CESM was larger than MRI, which indicates that CESM had statistically significant difference in comparison with MRI. Deek's funnel plot showed that the publication bias was not significant (P>0.1) in the included articles.*Conclusions Meta-analysis indicates that CEMS is a valuable diagnostic method which had high veracity in the detecting breast cancer.*Clinical Relevance/Application With morphology and the enhancement characteristics of both malignant and benign lesions on contrast enhanced spectral mammography, patients with dense breasts can be benefit from CESM.

RESULTS

A total of 354 literatures were searched, 12 literatures were included in this study according to the inclusion and exclusion criteria. The results of summary evaluation for CESM and MRI in diagnosis of breast cancer as follow respectively: The sensitivity were 0.97 and 0.97; the specificity were 0.69 and 0.51; the DOR were 105.44 and 33.73; PLR were 2.94 and 1.95; NLR were 0.05 and 0.07; and the AUC and 95% CI were 0.9645(0.981552~0.9558) and 0.9198(0.946848~0.892752) respectively. The range of 95%CI of CESM didn't overlap that of MRI. the AUC of CESM was larger than MRI, which indicates that CESM had statistically significant difference in comparison with MRI. Deek's funnel plot showed that the publication bias was not significant (P>0.1) in the included articles.

CLINICAL RELEVANCE/APPLICATION

With morphology and the enhancement characteristics of both malignant and benign lesions on contrast enhanced spectral mammography, patients with dense breasts can be benefit from CESM.

BR01-B5 Background Parenchymal Enhancement In Contrast-Enhanced MR Imaging Suggests Systemic Effects Of Intrauterine Contraceptive Devices.

Participants
Luisa Huck, MD, Aachen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

BPE in DCE-MRI has been established as a sensitive marker of hormonal stimulation of the breast. Levonorgestrel-releasing

BPE in DCE-MRI has been established as a sensitive marker of hormonal stimulation of the breast. Levonorgestrel-releasing intrauterine contraceptive devices (LNG-IUDs) are designed to exhibit only local effects. However, emerging evidence suggests that LNG-IUDs can be associated with systemic side effects similar to those of systemic hormonal medication. We investigated the association between LNG-IUD use and BPE in breast MRI as an established imaging biomarker of hormonal stimulation, to further explore possible systemic effects of LNG-IUDs.*Methods and Materials Our hospital data base was searched to identify premenopausal women without personal history of breast cancer or hormone or antihormone intake who had undergone standardized DCE breast MRI for screening between 01-2014 and 06-2020 at least twice, once with and without an IUD in place, with a minimum time of 4 weeks after IUD placement or removal. To avoid confounding ageing-related effects on BPE, half of included women had to have their first MRI without, the other half had their first study with IUD in place. A total of 48 premenopausal women (mean age, 45 years) were identified. Median time between the two studies was 27 months (range 1-77 months). Degree of BPE was analyzed according to the ACR categories. Statistical analyses were performed on the ACR categories using the Wilcoxon-matched pairs signed-rank test. A p-value less than 0.05 was considered statistically significant.*Results In 24/48 women (50%; [95%-CI: 35.9%-64.1%]), ACR categories did not change with vs. without IUD. In 23/48 patients (48% [33.9%-62.1%]), the ACR category was higher with vs. without IUD; in 1/48 (2% [0%-6%]), the ACR category was lower with vs. without IUD. The change of ACR category depending on presence or absence of an IUD proved highly significant (p<0.001).*Conclusions The application of an IUD is associated with increased BPE in breast MRI. This suggests that IUDs do have a systemic hormonal effect.*Clinical Relevance/Application IUDs can lead to increased BPE with implications on diagnostic accuracy in breast MRI. Moreover, the observed increased BPE supports the observation that IUDs can lead to side effects similar to HRT.

RESULTS

In 24/48 women (50%; [95%-CI: 35.9%-64.1%]), ACR categories did not change with vs. without IUD. In 23/48 patients (48% [33.9%-62.1%]), the ACR category was higher with vs. without IUD; in 1/48 (2% [0%-6%]), the ACR category was lower with vs. without IUD. The change of ACR category depending on presence or absence of an IUD proved highly significant (p<0.001).

CLINICAL RELEVANCE/APPLICATION

IUDs can lead to increased BPE with implications on diagnostic accuracy in breast MRI. Moreover, the observed increased BPE supports the observation that IUDs can lead to side effects similar to HRT.

Abstract Archives of the RSNA, 2021

Sub-Events

MK04-D1   **Incidental Findings Detected On Preoperative CT Imaging Obtained For Robotic-assisted Joint Replacements: Clinical Importance And The Effect On The Scheduled Arthroplasty**

Participants
Gary Tran, MD, Ferndale, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

To determine the type and frequency of incidental findings detected on preoperative computed tomography (CT) imaging obtained for robotic-assisted joint replacements and their effect on the planned arthroplasty.*Methods and Materials All preoperative CT exams performed for a robotic-assisted knee or total hip arthroplasty were obtained. This resulted in 1432 exams performed at our institution. Using a diagnosis search, reports were reviewed by 1 musculoskeletal radiologist to catalog all incidental findings and classify as significant or non-significant findings. Significant incidental findings were reserved for those that warranted further work-up, those that could alter a planned surgery and those that would require prompt notification of the ordering orthopaedic surgeon. In those with significant findings, a chart review was performed to record the relevant work-up, outcomes and if the planned arthroplasty was affected. The association between the presence of a significant finding, demographics and type of preoperative CT was evaluated. In those in which the planned arthroplasty was altered due a significant finding, any association between demographics or the type of preoperative CT was assessed. The evaluations used chi-square tests for categorical data and 2-sided sample t-tests for numerical data. Given the samples size this resulted in a power of 0.90.*Results Incidental findings were diagnosed in 740 (51.7%) patients. Of those with incidental findings, 41 (5.5%) were considered significant. A significant finding was more likely to be detected in males (P = 0.007) and on the hip protocol CT (P = 0.014). In 8 patients, these diagnoses resulted in either delay or cancellation of the arthroplasty. A planned total hip arthroplasty was more likely to be altered as compared to a knee arthroplasty (P = 0.018).*Conclusions Incidental findings are commonly detected by radiologists on preoperative CT imaging for robotic-assisted joint replacement. Several were valuable findings and resulted in a delay or even cancellation of the planned arthroplasty after detection of critical diagnoses, which if not identified may have resulted in devastating outcomes.*Clinical Relevance/Application Incidental findings are commonly detected on the preoperative CT imaging for robotic-assisted joint replacement and several were valuable diagnoses, resulting in a delayed or cancelled arthroplasty.

RESULTS

Incidental findings were diagnosed in 740 (51.7%) patients. Of those with incidental findings, 41 (5.5%) were considered significant. A significant finding was more likely to be detected in males (P = 0.007) and on the hip protocol CT (P = 0.014). In 8 patients, these diagnoses resulted in either delay or cancellation of the arthroplasty. A planned total hip arthroplasty was more likely to be altered as compared to a knee arthroplasty (P = 0.018).

CLINICAL RELEVANCE/APPLICATION

Incidental findings are commonly detected on the preoperative CT imaging for robotic-assisted joint replacement and several were valuable diagnoses, resulting in a delayed or cancelled arthroplasty.

MK04-D2   **Weight-bearing Cone Beam CT Arthrogram Of The Ankle**

Participants
Mickael Tordjman, MD, Paris, France (*Presenter*) Nothing to Disclose

PURPOSE

To present the first results of weight-bearing Cone Beam Computed Tomography arthrography of the ankle*Methods and Materials Patients from Raymond Poincaré Hospital (greater Paris region, Assistance Publique des Hopitaux de Paris), France, were included.Weight-bearing Cone Beam Computed Tomography arthrogram (wCBCTA) was performed using PedCAT LineUp (Curvebeam) after intra-articular contrast injection +/- infiltration of steroids.This examen was performed to evaluate the performance of wCBCTA to detect cartilaginous lesions of the ankle (tibiotalar joint) in comparaison with CT arthrogram. 2 radiologists reviewed independently wCBCTA and CT arthrogram. Correlation coefficients between the readers were estimated. We also compared the mean radiation dose of arthro-CBCT with CT-arthrogram of the ankle.*Results 18 patients were included in this preliminary study.wCBCTA was as accurate as CT arthrogram to detect tibiotalar cartilage lesions (correlation coefficient>0.8), with good spatial resolution and image quality. It was helpful to evaluate the stability of osteochondral defects. Median radiation dose of wCBCTA (CTDI= 2.72 mGy) was decreased compared to CT arthrogram (CTDI=16.20 mGy).*Conclusions wCBCT arthrogram is an interesting exam with good evaluation of tibiotalar cartilage, and lower radiation dose compared to conventional CT arthrogram.*Clinical Relevance/Application With low radiation dose and good evaluation of cartilage lesions,wCBCT arthrogram could be an interesting alternative to CT arthrogram, with additional weight-bearing capabilities.

RESULTS

18 patients were included in this preliminary study.wCBCTA was as accurate as CT arthrogram to detect tibiotalar cartilage lesions (correlation coefficient>0.8), with good spatial resolution and image quality. It was helpful to evaluate the stability of

osteochondral defects. Median radiation dose of wCBCTA (CTDI= 2.72 mGy) was decreased compared to CT arthrogram (CTDI=16.20 mGy).

CLINICAL RELEVANCE/APPLICATION

With low radiation dose and good evaluation of cartilage lesions,wCBCT arthrogram could be an interesting alternative to CT arthrogram, with additional weight-bearing capabilities.

MK04-D3   Osteomyelitis On MRI As A Key Predictor Of Septic Shoulder Recurrence

Participants
Ji Hwan Kim, Yangsan-si, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the clinical and radiologic predictors of septic shoulder recurrence after surgery using multivariable analysis.*Methods and Materials Patients who underwent surgery for septic shoulder between January 2011 and October 2019 were retrospectively enrolled. An orthopedic surgeon assessed the clinical (age, sex, comorbidity, duration from symptom onset to MRI and surgery, surgery method, and antibiotic usage), laboratory (serum white blood cell [WBC] count, C-reactive protein [CRP] level, and synovial cell count), and surgical (culture, biopsy results) findings. Two musculoskeletal radiologists evaluated the MRI findings (bone marrow lesions [reactive osteitis, osteomyelitis, and osteochondral erosion] and soft tissue lesions [synovitis, bursitis, and muscle edema]). Septic shoulder recurrence was evaluated at a follow-up of at least 12 months. Univariable analysis, using the Mann-Whitney or Fisher's exact test, and multivariable logistic regression analysis were used to determine the best predictor of septic shoulder recurrence. Inter-reader reliability of MRI findings was also assessed.*Results Forty-three patients (mean age, 65 years ± 13 [standard deviation]; 24 women [56%]) were enrolled and the overall rate of septic shoulder recurrence was 32.5% (14/43). On univariable analysis, mean age (P=.04), mean duration from symptom onset to surgery (P=.02), serum WBC count (P=.04), CRP level (P=.01), and presence of osteomyelitis on MRI (P<.01 for both readers) significantly differed between patients with and without recurrence, whereas on multivariable analysis, only the presence of osteomyelitis on MRI was significantly associated with septic shoulder recurrence for both readers (P=.02 and .01 for each reader respectively). The inter-reader agreement was good (?=.62-.72) for all MRI findings, except for muscle edema (fair, ?=.37).*Conclusions Osteomyelitis on MRI was the best predictor associated with septic shoulder recurrence.*Clinical Relevance/Application We recommend that clinicians routinely check for the presence of osteomyelitis on T1-weighted MRI in patients with septic shoulder; if osteomyelitis is present, more aggressive surgical treatment should be considered.

RESULTS

Forty-three patients (mean age, 65 years ± 13 [standard deviation]; 24 women [56%]) were enrolled and the overall rate of septic shoulder recurrence was 32.5% (14/43). On univariable analysis, mean age (P=.04), mean duration from symptom onset to surgery (P=.02), serum WBC count (P=.04), CRP level (P=.01), and presence of osteomyelitis on MRI (P<.01 for both readers) significantly differed between patients with and without recurrence, whereas on multivariable analysis, only the presence of osteomyelitis on MRI was significantly associated with septic shoulder recurrence for both readers (P=.02 and .01 for each reader respectively). The inter-reader agreement was good (?=.62-.72) for all MRI findings, except for muscle edema (fair, ?=.37).

CLINICAL RELEVANCE/APPLICATION

We recommend that clinicians routinely check for the presence of osteomyelitis on T1-weighted MRI in patients with septic shoulder; if osteomyelitis is present, more aggressive surgical treatment should be considered.

MK04-D4   Multimodality Imaging Of Chronic Recurrent Multifocal Osteomyelitis

Participants
Sahejmeet Guraya, MD, Cleveland Heights, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

- CRMO is a diagnosis of exclusion, demonstrates a wide variability in terms of initial presentation, number of affected sites, rate of recurrence, and overall prognosis.- CRMO is an important pathology to recognize to avoid unnecessary biopsies, inappropriate surgeries, and antibiotic treatment.- The purpose of this educational exhibit is to present a multimodality imaging review of CRMO utilizing radiographs, CT, PET-CT, and MRI.- Understand how to distinguish CRMO from infectious and malignant processes.

TABLE OF CONTENTS/OUTLINE

Background :- Epidemiology- Etiology: Inflammatory versus autoimmune- Imaging approach Diagnostic Criteria- Diagnosis of exclusion : Rule out malignancy and infectious etiologies- Aseptic bone biopsy- Radiographic findings- CT findings- MR findings during active and chronic phases- Bone scintigraphy/PET Clinical Presentation- Onset- Duration (prolonged clinical course with multiple relapses)- Most frequently affected locations: Phenotypic differences based on location (spine vs tubular bones)- Associated conditions- SAPHO syndrome- Complications Differential Diagnosis- Infectious osteomyelitis- Eosinophilic granuloma- Hypophosphatemia- Osteonecrosis- Fracture- Bone contusion- Malignancies (leukemia, lymphoma, Ewing sarcoma, osteosarcoma, neuroblastoma metastasis, osteoid osteoma, osteoblastoma) Treatment- NSAIDS- TNF-alpha inhibitors- Alternative therapies

Abstract Archives of the RSNA, 2021

Sub-Events

NR02-B1   The Role Of Advanced Structural And Functional MRI Methods In The Diagnosis Of Epilepsy

Participants
Vasileios K. Katsaros, MD,PhD, Athens, Greece (*Presenter*) Nothing to Disclose

PURPOSE

In cases of focal epilepsy, localization of the epileptogenic zone is required for probable surgical planning if drug resistance is evident and symptoms are uncontrolled. Patients with MRI-defined lesions have a greater percentage of post surgery epileptic free status than those undergoing surgery with no MRI demonstrated lesions. The role of structural MRI is fundamental to the identification of lesions responsible for seizures, with some limitations, demanding the further practice of harmonized neuroimaging of epilepsy structural sequences-(HARNESS)-MRI protocol and post-processing methods such as Volumetry.*Methods and Materials This is a prospective single-center study in a cohort of 24 patients with a medical history of drug-resistant epilepsy and no identified brain lesion in conventional MRI. They were further examined with advanced MRI techniques by 3D-?1-weighted MPRAGE (voxel-size 1mm x 1mm x 1mm), before and after intravenous administration of 15ml Gadovist, 3D-SPACE-?2 weighted and 3D-SPACE-FLAIR-fat saturation (voxel size 0.9mm x 0.9mm x 0.9 mm) volumetric sequences. Echo-planar ?OLD (Blood Oxygenation Level Dependent) for task-based and resting state fMRI (RS-fMRI), as well as diffusion tensor imaging (DTI-FT) sequences were acquired in order to define lateralization of language and memory, and if possible, to visualize epileptogenic zones. For postprocessing of task-based fMRI and DTI-FT, BrainMagix (Imagilys- Belgium), for RS-fMRI GraphICA (Brainet-Canada), and for Volumetric Quantitative Evaluation SurferMagix (platform which integrates Free-Surfer into BrainMagix), were used.*Results Advanced and quantitative imaging techniques revealed lesions responsible for epileptic seizures in 19 out of 24 patients not detected by conventional MRI. After surgery, 15 out of 16 patients, were free of disabling seizures (Engel class I), with one-year follow-up, while 3 out of 19 patients have not yet undergone surgery*Conclusions HARNESS-MRI protocol combined with advanced and quantitative imaging techniques have the potential to reveal unidentified brain lesions by conventional MRI providing a delineating planning for surgery patients candidates by simultaneous defining the lateralization of language and memory, as a probable exclusion surgical criterion. *Clinical Relevance/Application The clinical relevance of this presentation is to delineate the importance of HARNESS-MRI protocol in patients with drug resistant epilepsy who are candidates for surgery.

RESULTS

Advanced and quantitative imaging techniques revealed lesions responsible for epileptic seizures in 19 out of 24 patients not detected by conventional MRI. After surgery, 15 out of 16 patients, were free of disabling seizures (Engel class I), with one-year follow-up, while 3 out of 19 patients have not yet undergone surgery

CLINICAL RELEVANCE/APPLICATION

The clinical relevance of this presentation is to delineate the importance of HARNESS-MRI protocol in patients with drug resistant epilepsy who are candidates for surgery.

NR02-B4   Ct Angiographic Radiomics Signature For Risk-Stratification In Anterior Large Vessel Occlusion (LVO) Stroke

Participants
Emily Avery, BA, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

As "time is brain" in acute stroke triage, the need for automated prognostic tools continues to increase, particularly in rapidly expanding tele-stroke settings. We aimed to predict discharge and long-term outcomes of anterior circulation LVO patients based on admission CTA radiomics to guide time-sensitive treatment decisions regarding implementation of endovascular thrombectomy (ET).*Methods and Materials We automatically extracted 1116 radiomics features from the anterior circulation territory on admission CTAs of 829 acute LVO patients who underwent ET in 2 academic centers. We trained, optimized, validated & compared different machine learning models to predict favorable outcome (modified Rankin Scale<3) at discharge and 3-month follow-up using 3 different input sets: "Radiomics", "Radiomics+Treatment" (reperfusion success mTICI), and "Combined" (clinical, radiomics & treatment variables).*Results Our datasets totaled 496 Yale patients for training (age 70.4±15.6, admission NIHSS 15(10-19), 46% female), 101 Yale patients for independent validation (age 69.2±14.0, NIHSS 15(7-19), 49% female), and 232 Geisinger Health patients for external validation (age 70.4±15.6, NIHSS 18(12-23), 46% female). For discharge outcome prediction, models were optimized/trained on n=494 and validated on n=100 patients from Yale. In receiver operating characteristic analysis of the independent validation cohort, there was no significant difference between Combined models (area under the curve, AUC=0.77) vs Radiomics+Treatment (AUC=0.78, p=0.78) or Radiomics (AUC=0.78, p=0.55). For long-term outcome prediction, models were optimized/trained on n=373 and validated on n=72 patients from Yale, as well as n=232 patients from Geisinger. In the Yale independent validation cohort, there was no significant difference between Combined models (AUC=0.76) vs Radiomics+Treatment (AUC=0.72, p=0.39) or Radiomics (AUC=0.72, p=0.39). However, in external validation, the Combined model (AUC=0.74) outperformed Radiomics+Treatment (AUC=0.66, p<0.001) and Radiomics (AUC=0.68, p<0.01) models for long-term prediction.*Conclusions We could successfully train and validate radiomics models for prediction of LVO outcome at both discharge

and long-term, even in the absence of clinical training data. Models including clinical input variables demonstrated more stable generalizability on external validation.*Clinical Relevance/Application Automated assessment of admission CTA radiomics can provide prognostic information in acute LVO stroke candidates for ET. Such objective and time-sensitive risk-stratification can guide treatment decisions, particularly in tele-stroke settings, and may help increase the number of patients eligible for ET.

RESULTS

Our datasets totaled 496 Yale patients for training (age 70.4±15.6, admission NIHSS 15(10-19), 46% female), 101 Yale patients for independent validation (age 69.2±14.0, NIHSS 15(7-19), 49% female), and 232 Geisinger Health patients for external validation (age 70.4±15.6, NIHSS 18(12-23), 46% female). For discharge outcome prediction, models were optimized/trained on n=494 and validated on n=100 patients from Yale. In receiver operating characteristic analysis of the independent validation cohort, there was no significant difference between Combined models (area under the curve, AUC=0.77) vs Radiomics+Treatment (AUC=0.78, p=0.78) or Radiomics (AUC=0.78, p=0.55). For long-term outcome prediction, models were optimized/trained on n=373 and validated on n=72 patients from Yale, as well as n=232 patients from Geisinger. In the Yale independent validation cohort, there was no significant difference between Combined models (AUC=0.76) vs Radiomics+Treatment (AUC=0.72, p=0.39) or Radiomics (AUC=0.72, p=0.39). However, in external validation, the Combined model (AUC=0.74) outperformed Radiomics+Treatment (AUC=0.66, p<0.001) and Radiomics (AUC=0.68, p<0.01) models for long-term prediction.

CLINICAL RELEVANCE/APPLICATION

Automated assessment of admission CTA radiomics can provide prognostic information in acute LVO stroke candidates for ET. Such objective and time-sensitive risk-stratification can guide treatment decisions, particularly in tele-stroke settings, and may help increase the number of patients eligible for ET.

NR02-B5 Comparison Of Quantification Software Tools For Reproducibility Of GABA+ In The Human Brain By Mr Spectroscopy At 3 Tesla

Participants
Xiaopeng Zhou, West Lafayette, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

GABA has been detected most widely with MEGA-PRESS [1] in healthy and diseased brain [2-5] and quantified with different software tools, such as LCModel [7], Gannet [8], or JMRUI [9]. A study [10] with MEGA-PRESS datasets from 2 GE and 2 Philips scanners showed that there was moderate agreement between software tools. However, there was no ground-truth GABA level to determine which software provided more accurate results. Another study [11] using phantoms with known GABA concentrations showed that LCModel can provide more accurate results, but Gannet was the most consistent tool among 5 software tools. In this study we extended this comparison of LCModel and Gannet to test the reproducibility of in vivo GABA measurements at 3 T.*Methods and Materials 8 healthy subjects (29 ± 2 years; 4 F) were scanned with MEGA-PRESS (TR/TE = 2000/68 ms, Averages =160) on a Siemens Prisma 3T scanner. Written consent was obtained from each subject. All scans were acquired in parietal lobe (voxel size of 3×3×3 cm3). Each subject underwent two sessions with the same MR sequences on the same day. Gannet [8] was used for preprocessing data with frequency and phase correction. Fitting of the preprocessed data to obtain GABA+/tCr was done once with Gannet, and once with LCModel. In LCModel, the special 'mega-press-2' scheme version 6.3-0L was used to fit the GABA-edited difference spectra. Edit-off spectra were fitted with LCModel to obtain tCr.*Results Inter-individual CVs and GABA/tCr (mean±SD) values were: LCModel, 7.1% and 0.13±0.01 for scan 1, 15.3% and 0.12±0.02 for scan 2; Gannet, 14.1% and 0.11±0.02 for scan 1, 10.5% and 0.11±0.01 for scan 2. Intra-individual CVs for repeated GABA+/tCr measurements were: 8.1± 10.0% for LCModel, 5.1 ± 3.7% for Gannet. Only LCModel and Gannet for scan1 GABA/tCr were significantly different (p=0.0049). A significant positive correlation was observed between GABA/tCr of test-repeat sessions with Gannet (r =0.79, p= 0.019), but not with LCModel. Our results suggest that results from Gannet and LCModel are comparable, but Gannet results are more reproducible. This finding agrees with the phantom study that showed higher reproducibility for Gannet.*Conclusions This finding suggests that Gannet and LCModel are comparable, but Gannet is more robust for reproducibility studies. Testing different settings for LCModel, and using data from more scanners with repeated sessions will be necessary to verify the performance of analysis tools for quantification of GABA and provide a standard for clinical studies.*Clinical Relevance/Application GABA is the primary inhibitory neurotransmitter, which is a potential biomarker for surrogating neurological and many psychiatric disorders. Accurately quantifying GABA is still challenging and needs continuing effort.

RESULTS

Inter-individual CVs and GABA/tCr (mean±SD) values were: LCModel, 7.1% and 0.13±0.01 for scan 1, 15.3% and 0.12±0.02 for scan 2; Gannet, 14.1% and 0.11±0.02 for scan 1, 10.5% and 0.11±0.01 for scan 2. Intra-individual CVs for repeated GABA+/tCr measurements were: 8.1± 10.0% for LCModel, 5.1 ± 3.7% for Gannet. Only LCModel and Gannet for scan1 GABA/tCr were significantly different (p=0.0049). A significant positive correlation was observed between GABA/tCr of test-repeat sessions with Gannet (r =0.79, p= 0.019), but not with LCModel. Our results suggest that results from Gannet and LCModel are comparable, but Gannet results are more reproducible. This finding agrees with the phantom study that showed higher reproducibility for Gannet.

CLINICAL RELEVANCE/APPLICATION

GABA is the primary inhibitory neurotransmitter, which is a potential biomarker for surrogating neurological and many psychiatric disorders. Accurately quantifying GABA is still challenging and needs continuing effort.

NR02-B6 Improved Statistical Confidence Via Locally Low-rank Denoising Of Task Functional MRI Data

Participants
Nolan Meyer, BS, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

This work applies locally low-rank (LLR) denoising of clinically specialized task-based functional MRI data to improve statistical confidence in localizing activation areas for motor and language tasks.*Methods and Materials Eleven healthy subjects were scanned under an IRB-approved protocol on a compact 3T MRI scanner with high spatial resolution (2.5mm and 1.9mm isotropic) echo planar imaging (EPI) pulse sequences during task-based fMRI studies. Tasks selected are used in clinical practice at our institution for presurgical language and motor mapping, including rhyming, sentence completion, and bilateral finger tapping. LLR denoising was completed on complex-valued EPI data. Conventional and LLR data were then processed equivalently with fMRI software used clinically at our institution.Assessment of fMRI results was completed by four board-certified neuroradiologists who set statistical thresholds of activation maps in consensus. For conventional, non-denoised data and LLR-denoised data, thresholds

were set for the supplementary motor area (SMA), cerebellum, non-dominant and dominant motor regions, and in aggregate for finger tapping data; and for Broca's area, Wernicke's area, and in aggregate for language data. Statistical threshold data were compared with nonparametric statistical tests. Matched-pairs rank-biserial correlations were computed as nonparametric effect size estimates.*Results LLR denoising required approximately 32 seconds per slice for 1.9 mm data and 9 seconds for 2.5 mm data. Reporting results as rank-biserial correlations r and p-values, LLR denoising produced statistically significant increases in neuroradiologists' consensus thresholds for all regions except the cerebellum ($r = 0.546$, $p = 0.062$). Consensus t-statistics were significantly increased for the SMA ($r = 0.606$, $p = 0.042$), non-dominant motor ($r = 0.879$, $p = 3.42 \times 10^{-3}$) and dominant motor ($r = 1$, $p = 4.88 \times 10^{-4}$) regions, and aggregate maps ($r = 0.849$, $p = 4.88 \times 10^{-3}$). Language thresholds were increased for Broca's area for rhyming ($r = 1$, $p = 4.88 \times 10^{-4}$) and sentence completion ($r = 0.964$, $p = 1.95 \times 10^{-3}$), Wernicke's area for rhyming ($r = 0.636$, $p = 0.042$) and sentence completion ($r = 1$, $p = 9.77 \times 10^{-4}$), and in aggregate for rhyming ($r = 0.849$, $p = 4.88 \times 10^{-3}$) and sentence completion ($r = 0.891$, $p = 4.88 \times 10^{-3}$).*Conclusions LLR denoising produces significant increases in t-statistic thresholds, set in consensus by four neuroradiologists, for task fMRI data. At thresholds selected for conventional data, additional active cortex areas are revealed on maps derived from denoised data.*Clinical Relevance/Application LLR denoising allows radiologists interpreting functional activation maps increased confidence in localizing eloquent cortex in presurgical imaging.

RESULTS

LLR denoising required approximately 32 seconds per slice for 1.9 mm data and 9 seconds for 2.5 mm data. Reporting results as rank-biserial correlations r and p-values, LLR denoising produced statistically significant increases in neuroradiologists' consensus thresholds for all regions except the cerebellum ($r = 0.546$, $p = 0.062$). Consensus t-statistics were significantly increased for the SMA ($r = 0.606$, $p = 0.042$), non-dominant motor ($r = 0.879$, $p = 3.42 \times 10^{-3}$) and dominant motor ($r = 1$, $p = 4.88 \times 10^{-4}$) regions, and aggregate maps ($r = 0.849$, $p = 4.88 \times 10^{-3}$). Language thresholds were increased for Broca's area for rhyming ($r = 1$, $p = 4.88 \times 10^{-4}$) and sentence completion ($r = 0.964$, $p = 1.95 \times 10^{-3}$), Wernicke's area for rhyming ($r = 0.636$, $p = 0.042$) and sentence completion ($r = 1$, $p = 9.77 \times 10^{-4}$), and in aggregate for rhyming ($r = 0.849$, $p = 4.88 \times 10^{-3}$) and sentence completion ($r = 0.891$, $p = 4.88 \times 10^{-3}$).

CLINICAL RELEVANCE/APPLICATION

LLR denoising allows radiologists interpreting functional activation maps increased confidence in localizing eloquent cortex in presurgical imaging.

NR02-B7   CT Myelography With Renal Contrast: Analysing Beyond CSF Leak

Participants
Mika Shibuya, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to demonstrate that the presence of early iodinated contrast in the renal excretory system in CT myelography can also be found in isolated leakage at the lumbar puncture site, even in patients without suspicion of CSF leak.*Methods and Materials Thirty-six CT myelography scans between June 2011 and December 2020 performed for different causes besides hypotension CSF were retrospectively evaluated by two neuroradiologists and one interventional radiologist for the presence of contrast in the renal excretory system, leakage at the lumbar puncture site and signs of CSF leak, like epidural collections or hyperdense paraspinal vein sign.*Results Among the 36 CT myelography evaluated, two were excluded for having performed a gadolinium MRI in the last 48 hours before CT myelography. Of the 34 exams, the presence of renal iodinated contrast excretion was found in 14 cases (41%), 5 with leakage at the puncture site (35,7%), 5 with both leakage at the puncture site and epidural / foraminal collection (35,7%), 3 only with epidural collection (21.4%) and 1 without epidural collection and neither leakage at the puncture site (7.2%).*Conclusions Although it is known that many cases of CSF leak, especially CSF venous fistulas, are difficult to diagnose and have already been associated with renal excretion of contrast media after intrathecal administration, we consider that the presence of renal iodinated contrast in CT myelography can also be found in cases of extravasation of the iodinated contrast at the puncture site, regardless of the epidural collections. Despite the limited sample of cases in our study, this finding is consistent with those found in radionuclide cisternographies, and should be carefully evaluated in cases of CSF leak.*Clinical Relevance/Application Despite the literature shows as a specific finding of CSF leak the presence of early renal excretion of the iodinated contrast in CT myelography, this finding must be carefully evaluated, since we found it in patients even without suspicion of CSF hypotension, especially when there is leakage of the iodinated contrast at the lumbar puncture site.

RESULTS

Among the 36 CT myelography evaluated, two were excluded for having performed a gadolinium MRI in the last 48 hours before CT myelography. Of the 34 exams, the presence of renal iodinated contrast excretion was found in 14 cases (41%), 5 with leakage at the puncture site (35,7%), 5 with both leakage at the puncture site and epidural / foraminal collection (35,7%), 3 only with epidural collection (21.4%) and 1 without epidural collection and neither leakage at the puncture site (7.2%).

CLINICAL RELEVANCE/APPLICATION

Despite the literature shows as a specific finding of CSF leak the presence of early renal excretion of the iodinated contrast in CT myelography, this finding must be carefully evaluated, since we found it in patients even without suspicion of CSF hypotension, especially when there is leakage of the iodinated contrast at the lumbar puncture site.

NR02-B9   Deep Learning With Graph Convolutional Neural Networks Using Connectivity-based Features From Functional MRI For Diagnosis Of Autism Spectrum Disorder

Participants
Axel Wismueller, MD,PhD, Pittsford, New York (*Presenter*) Research Grant, Aidoc Medical Ltd;Advisory Board Member, Aidoc Medical Ltd

PURPOSE

To develop, test, and evaluate a graph convolutional neural network deep learning framework using connectivity-based functional MRI features for classifying Autism Spectrum Disorder (ASD) patients in a large patient cohort (Autism Brain Imaging Data Exchange - ABIDE).*Methods and Materials It has been shown in the literature that Autism Spectrum Disorder (ASD) is associated with changes in brain network connectivity. ABIDE I is currently the largest publicly available preprocessed dataset for ASD collected from 16 international sites containing 1112 resting-state fMRI (rsfMRI) datasets, including 539 ASD patients and 573 typical controls. We used the data from the CPAC preprocessing pipeline, which encompasses two steps of structural and functional processing. The AAL human brain atlas was used to extract 116 brain region-specific fMRI time-series. A graph convolutional neural

network (GCN) with three layers including two convolution and average pooling layers and one fully-connected layer was trained for the classification task, where the upper triangle of the cross-correlation connectivity matrix for each dataset served as 6670-dimensional input feature vector to the GCN. Strict training/test data separation was performed in a 10-fold cross-validation approach.*Results Mean and best classification accuracies for identifying ASD patients in the ABIDE I dataset were 66±5 % and 74 %, respectively, which is comparable to the performance of the best state-of-the-art methods in the literature for this dataset. This is noteworthy, because only imaging-based features were used for classification in our study, whereas other studies frequently include non-imaging features, such as age and gender.*Conclusions Our results suggest that the connectivity structure derived from fMRI analysis can be used as an imaging biomarker for classifying ASD patients from control subjects. By combining deep learning with handcrafted brain connectivity features, state-of-the-art classification accuracy can be achieved on the challenging multi-institutional ABIDE I data.*Clinical Relevance/Application Combining graph-convolutional deep learning approaches with brain connectivity features shows potential for development of diagnostic fMRI biomarkers in Autism Spectrum Disorder.

RESULTS

Mean and best classification accuracies for identifying ASD patients in the ABIDE I dataset were 66±5 % and 74 %, respectively, which is comparable to the performance of the best state-of-the-art methods in the literature for this dataset. This is noteworthy, because only imaging-based features were used for classification in our study, whereas other studies frequently include non-imaging features, such as age and gender.

CLINICAL RELEVANCE/APPLICATION

Combining graph-convolutional deep learning approaches with brain connectivity features shows potential for development of diagnostic fMRI biomarkers in Autism Spectrum Disorder.

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Abstract Archives of the RSNA, 2021

Sub-Events

GI04-A10   Artificial Intelligence Can Aid In Predicting Individual Lymph Node Metastasis In Gastric Cancer

Participants

Yun Qin, MD, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

Accurate preoperative lymph node (LN) metastasis assessment in gastric cancer (GC) is imperative but challenging, particularly on a per-LN basis. Therefore, we aimed to develop an artificial intelligence (AI) model based on preoperative CT images to predict individual LN metastasis and to investigate whether it could be used to improve radiologist interpretation accuracies.*Methods and Materials Consecutive GC patients of whom the resected LNs could be matched rigidly on preoperative CT images were retrieved from a prospectively-collected database spanning 5 years. An AI model, integrating handcraft radiomics and deep learning features, was generated based on both the LNs and corresponding primary tumors. LN metastasis was predicted independently by three radiologists and the AI model against histopathology. Diagnostic performances were characterized by area under the receiver operating characteristic curve (AUC), sensitivity, specificity, accuracy, and net reclassification index (NRI).*Results A total of 1381 LNs (739 [53.5%] metastasis positive) in 666 patients (median age, 61 years; range, 29-86 years; 462 males) were included. In the validation set, the AUC of the AI model was 0.804 for predicting individual LN metastasis. Compared with radiologist consensus interpretation, the AI model demonstrated a higher specificity (70.6% vs. 58.5%, p<0.001) and accuracy (72.3% vs. 67.5%), but a lower sensitivity (73.9% vs. 85.8%, p<0.001). The NRI analysis revealed a 19.34% net diagnostic improvement of the AI model than radiologists (NRI: 0.1987, p<0.001). The specificity of radiologist consensus interpretation with AI assistance improved significantly than that without AI assistance (60.3% vs. 48.5%, p<0.001), whereas the sensitivities remained comparable (81.5% vs. 85.8%, p=0.052).*Conclusions In GC patients, we developed a CT-based AI model with high accuracy for predicting the metastasis status of individual LNs. The AI model also showed promise in assisting radiologists to improve their diagnostic accuracies.*Clinical Relevance/Application The CT-based AI model demonstrated high accuracy for predicting LNs metastasis which can help radiologists to improve diagnostic accuracies and clinicians to optimize treatment plan.

RESULTS

A total of 1381 LNs (739 [53.5%] metastasis positive) in 666 patients (median age, 61 years; range, 29-86 years; 462 males) were included. In the validation set, the AUC of the AI model was 0.804 for predicting individual LN metastasis. Compared with radiologist consensus interpretation, the AI model demonstrated a higher specificity (70.6% vs. 58.5%, p<0.001) and accuracy (72.3% vs. 67.5%), but a lower sensitivity (73.9% vs. 85.8%, p<0.001). The NRI analysis revealed a 19.34% net diagnostic improvement of the AI model than radiologists (NRI: 0.1987, p<0.001). The specificity of radiologist consensus interpretation with AI assistance improved significantly than that without AI assistance (60.3% vs. 48.5%, p<0.001), whereas the sensitivities remained comparable (81.5% vs. 85.8%, p=0.052).

CLINICAL RELEVANCE/APPLICATION

The CT-based AI model demonstrated high accuracy for predicting LNs metastasis which can help radiologists to improve diagnostic accuracies and clinicians to optimize treatment plan.

GI04-A2   The Value Of Multi-material Decomposition Algorithm Based On CT Spectral Imaging In Quantitative Diagnosis Of Chemotherapy Related Fatty Liver Disease

Participants

Mengyuan Jing, Lanzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore whether quantitative measurements of liver fat, based on multi-material decomposition (MMD) spectral imaging,may become a novel tool to evaluate chemotherapy related fatty liver disease (CRFLD).*Methods and Materials Eighty one patients who underwent enhanced CT spectral scans after chemotherapeutic treatment were retrospectively recruited. These patients had no history of fatty liver, liver disease, liver tumors and large alcohol intake before treatment. Due to the results of ultrasonic or magnetic resonance after chemotherapy, patients were divided into CRFLD group and non-CRFLD groups. Spectral data was post-processed by Hepatic VCAR to generate liver fat images in venous phase, on which three physicians measured the fat fraction(FF)of the whole liver. The average value of three measurements was calculated and regarded as the final value of FF. On unenhanced CT images, the same three doctors measured CT values of spleen and liver, and calculated average values to acquirethe Liver-to-spleen ratio (LSR,LSR = CT valueliver/CT valuespleen) . The FF and liver-to-spleen ratio (LSR) were compared between two groups. The receiver operating characteristics (ROC) curve was generated to evaluate the performance of FF and LSR.*Results Age and gender performed no significant difference between groups (P>0.05). The FF in CRFLD group was higher than that in non-CRFLD group (8.166±3.690 VS 3.801±1.266, P<0.05). The area under the curve (AUC) of FF in diagnosing CRFLD was 0.881 with the sensitivity and specificity of 82.4% and 87.2%, respectively. The LSR in CRFLD group was lower than that in non-CRFLD group(1.057±0.149 VS 1.173±0.119 P<0.05). The AUC of LSR was 0.740 with the sensitivity and specificity of 66.0% and 73.5%, respectively.*Conclusions MMD algorithm can provide whole liver FF using noninvasive method, which is a reliable indicator to quantitatively assess CRFLD.*Clinical Relevance/Application Quantitative CT measurement of liver fat based on the technique of

CT MMD spectral imaging is not only a novel tool for liver fat quantification, but also has high diagnostic efficiency.

RESULTS

Age and gender performed no significant difference between groups (P>0.05). The FF in CRFLD group was higher than that in non-CRFLD group (8.166±3.690 VS 3.801±1.266, P<0.05). The area under the curve (AUC) of FF in diagnosing CRFLD was 0.881 with the sensitivity and specificity of 82.4% and 87.2%, respectively. The LSR in CRFLD group was lower than that in non-CRFLD group(1.057±0.149 VS 1.173±0.119 P<0.05). The AUC of LSR was 0.740 with the sensitivity and specificity of 66.0% and 73.5%, respectively.

CLINICAL RELEVANCE/APPLICATION

Quantitative CT measurement of liver fat based on the technique of CT MMD spectral imaging is not only a novel tool for liver fat quantification, but also has high diagnostic efficiency.

GI04-A6   Prediction Early Recurrence Of <= 5cm Solitary Hepatocellular Carcinoma By Radiomic Analysis Of Mri

Participants
Leyao Wang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the value of radiomic model based on preoperative magnetic resonance images (MRI) in predicting early recurrence (ER, =2 years) of = 5cm solitary hepatocellular carcinoma (HCC) after radical hepatectomy.*Methods and Materials 190 HCC patients confirmed by pathology in our hospital from January 2012 to December 2017 were enrolled retrospectively. All patients were divided into training and validation cohort according to 7:3 proportion, and subdivided into ER and non-ER subgroups. 1316 radiomics features were extracted from preoperative MRI in regions of the entire tumor. General univariate analysis, correlation analysis, mRMR and LASSO regression model, was applied to select features and construct model. Multivariate logistic regression analysis was used to determine the factors associated with ER. The prediction performance was evaluated by area under the receiver operation characteristic curves (AUC), sensitivity, specificity and accuracy.*Results This study included 80 patients in ER group and 110 patients in non-ER group. Multivariate analysis showed that cirrhosis (OR, 2.98 [95%CI, 1.20 to 7.39], P=0.019), non-smooth tumor margin (OR, 0.42 [95%CI, 0.16 to 1.05], P=0.064), arterial peritumoral enhancement (OR, 5.03 [95%CI, 1.18 to 21.43], P=0.029), satellite nodule (OR, 6.21 [95%CI, 1.45 to 26.62], P=0.014), serosal invasion (OR, 2.08 [95%CI, 0.91 to 4.73], P=0.082) and ALB (OR, 0.89 [95%CI, 0.80 to 0.99], P=0.032) were associated with ER.The above imaging features and clinicopathological factors were used to construct the combined radiomics-clinicopathological nomogram. The AUC value, sensitivity, specificity and accuracy of the combined nomogram in the training group and the validation group were 0.90, 71.83%, 91.94%, 81.20% and 0.88, 85.71%, 83.33%, 84.21%, respectively. The calibration prediction curve fits well with the standard curve.*Conclusions The nomogram incorporating clinicopathological factors and radiomic features derived from MRI achieved satisfactory prediction of the individualized risk of ER in patients with =5 cm solitary HCC.*Clinical Relevance/Application In patients with early-stage HCC, liver resection is accepted as the first-line treatment option. Nevertheless, the long-term outcome remains unsatisfactory because of the high recurrence incidence up to 70% within 5 years. The time to recurrence is an independent survival factor, and HCC patients with ER after hepatic resection tend to have lower overall survival and poor prognosis. Thus, it is crucial to identify sensitive biomarkers related to the ER of HCC to guide further surveillance and treatment.

RESULTS

This study included 80 patients in ER group and 110 patients in non-ER group. Multivariate analysis showed that cirrhosis (OR, 2.98 [95%CI, 1.20 to 7.39], P=0.019), non-smooth tumor margin (OR, 0.42 [95%CI, 0.16 to 1.05], P=0.064), arterial peritumoral enhancement (OR, 5.03 [95%CI, 1.18 to 21.43], P=0.029), satellite nodule (OR, 6.21 [95%CI, 1.45 to 26.62], P=0.014), serosal invasion (OR, 2.08 [95%CI, 0.91 to 4.73], P=0.082) and ALB (OR, 0.89 [95%CI, 0.80 to 0.99], P=0.032) were associated with ER.The above imaging features and clinicopathological factors were used to construct the combined radiomics-clinicopathological nomogram. The AUC value, sensitivity, specificity and accuracy of the combined nomogram in the training group and the validation group were 0.90, 71.83%, 91.94%, 81.20% and 0.88, 85.71%, 83.33%, 84.21%, respectively. The calibration prediction curve fits well with the standard curve.

CLINICAL RELEVANCE/APPLICATION

In patients with early-stage HCC, liver resection is accepted as the first-line treatment option. Nevertheless, the long-term outcome remains unsatisfactory because of the high recurrence incidence up to 70% within 5 years. The time to recurrence is an independent survival factor, and HCC patients with ER after hepatic resection tend to have lower overall survival and poor prognosis. Thus, it is crucial to identify sensitive biomarkers related to the ER of HCC to guide further surveillance and treatment.

Abstract Archives of the RSNA, 2021

VA01-A

Vascular Imaging Sunday Poster Discussions

Sub-Events

VA01-A2   **Advances In Vascular Ultrasound**

Awards
Certificate of Merit

Participants
Margarita Revzin, MD, Wilton, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Familiarize radiologists with current problems and limitations of traditional vascular ultrasound imaging 2. Review various new ultrasound technologies that are available on a market for evaluation of slow flow, their benefits and limitations 3. Discuss role of new vascular imaging in identification of slow flow with specific emphasis on basic principles and image optimization of new vascular US techniques as a key to accurate interpretation 4. Recognize future directions and challenges in vascular ultrasound

TABLE OF CONTENTS/OUTLINE

1. Traditional Doppler US and its limitations 2. Advancements in vascular US imaging: basic principles, usage, limitations, availability 3. Role of advanced vascular US: a. Directional power Doppler (flow direction) b. Contrast-enhanced US (tumor neovascularity, thrombosis, post EVAR eval) c. B-flow imaging (plaque ulceration, flow sensitivity) d. Microvascular flow (neovascularity, thrombosis, stenosis) e. Photo-acoustic imaging (acute vs chronic blood clot, vulnerable plaque, patency of peripheral arterial system) f. Intravascular imaging (IR guidance (stent and catheter placement), endoluminal measurement, guidance for dissection flap fenestration) g. Elastography (vascular wall disease, acute vs chronic clot) h. 3D vascular imaging (3D imaging of neck vasculature & abdominal aorta, plaque characterization) 4. Future directions and challenges of the vascular US (market availability, research & data driven projects, cost analysis, comparison to other modalities: CTA and MRA)

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Sub-Events

IR01-A1   Immune Modulation Following Radioembolization: An Observational Studies.

Participants
Shamar Young, MD, Minnespolis, Minnesota (*Presenter*) Consultant, Boston Scientific Corporation;Consultant, BTG International Ltd;Consultant, Galil Medical Ltd;Consultant, Galvanize

PURPOSE

The ability to deliver very high doses of radiation to the tumor suggest that radioembolization may be an ideal candidate for synergistic treatment algorithms with immunotherapies. However, little data is available in terms of immunomodulatory effects of radioembolization, this study aims to fill that gap.*Methods and Materials This is a prospective observational study (NCT03889093). Patients who enrolled had blood draws prior to radioembolization and then at 1, 4, and 12 weeks following treatment. They also underwent biopsy prior to and 2 weeks after treatment. The blood was separated into cellular and serum components and then stored for batch analysis. To date 11 patients have enrolled with several still in the collection phase. Data from the first 5 patients is presented here.*Results Cytokines and peripheral blood monocytes were collected at on the day of but prior to treatment and at 1, 4, and 12 weeks. The mean serum TNF-a was 4.62 ± 2.31, 3.55 ± 1.69, 3.19 ± 1.09, and 2.05 ± 0.31 respectively (p=0.05). The average serum IFN-? was 0.45 ± 0.57, 0.42 ± 0.57, 0.29 ± 0.35, and 0.11 ± 0.16 respectively (p=0.18). The average serum IL-6 was 5.84 ± 5.69, 6.31 ± 4.91, 5.3 ± 6.61, and 6.96 ± 9.03 respectively (p=0.41). The average serum Fit-3 ligand was 74.49 ± 35.07, 82.62 ± 10.78, 64.6 ± 11.48, and 66.71 ± 14.56 31 respectively (p=0.36). The mean population of CD4+CD45RA+CCR7- cells at baseline, 1, 4 and 12 weeks was 1.41 ± 0.78, 1.31 ± 0.79, 0.93 ± 0.19, and 0.65 ± 0.16 respectively. The mean population of CD4+CD45RA-CCR7- cells was 22.36 ± 6.8, 17.58 ± 8.82, 17.72 ± 9.85, and 13.54 ± 9.25 respectively. The mean population of CD4+CD45RA-CD27- cells was 15.36 ± 9.21, 14.37 ± 8.08, 14.23 ± 11.54, and 9.8 ± 8.95 respectively. The mean population of CD8+CD45RA+CCR7- cells was 35.36 ± 29.49, 26.92 ± 33.89, 32.21 ± 33.36, and 33.54 ± 47.2 respectively. The mean population of CD8+CD45RA-CCR7- cells was 12.98 ± 6.38, 5.21 ± 1.21, 8.54 ± 4.08, and 4.01 ± 1.15 respectively. The mean population of CD8+CD45RA-CD27- cells was 4.9 ± 2.4, 3.85 ± 3.03, 4.68 ± 3.84, and 1.81 ± 0.62 respectively. The mean number of natural killer T cells was 7.49 ± 14.94, 8.56 ± 18.14, 6.92 ± 12.86, 12.7 ± 20.56 respectively.*Conclusions This early data suggests that radioembolization does have the ability to modulate the immune system, however, further data is needed to determine the extent and specific clonal populations being effected.*Clinical Relevance/Application The development of immunotherapies has revolutionized cancer therapy. The next phase will likely be synergistic treatment algorithms with immunotherapies and loco-regional treatments. This trial provides information on the immunomodulatory effects of radioembolization, an important building block to design synergistic trials.

RESULTS

Cytokines and peripheral blood monocytes were collected at on the day of but prior to treatment and at 1, 4, and 12 weeks. The mean serum TNF-a was 4.62 ± 2.31, 3.55 ± 1.69, 3.19 ± 1.09, and 2.05 ± 0.31 respectively (p=0.05). The average serum IFN-? was 0.45 ± 0.57, 0.42 ± 0.57, 0.29 ± 0.35, and 0.11 ± 0.16 respectively (p=0.18). The average serum IL-6 was 5.84 ± 5.69, 6.31 ± 4.91, 5.3 ± 6.61, and 6.96 ± 9.03 respectively (p=0.41). The average serum Fit-3 ligand was 74.49 ± 35.07, 82.62 ± 10.78, 64.6 ± 11.48, and 66.71 ± 14.56 31 respectively (p=0.36). The mean population of CD4+CD45RA+CCR7- cells at baseline, 1, 4 and 12 weeks was 1.41 ± 0.78, 1.31 ± 0.79, 0.93 ± 0.19, and 0.65 ± 0.16 respectively. The mean population of CD4+CD45RA-CCR7- cells was 22.36 ± 6.8, 17.58 ± 8.82, 17.72 ± 9.85, and 13.54 ± 9.25 respectively. The mean population of CD4+CD45RA-CD27- cells was 15.36 ± 9.21, 14.37 ± 8.08, 14.23 ± 11.54, and 9.8 ± 8.95 respectively. The mean population of CD8+CD45RA+CCR7- cells was 35.36 ± 29.49, 26.92 ± 33.89, 32.21 ± 33.36, and 33.54 ± 47.2 respectively. The mean population of CD8+CD45RA-CCR7- cells was 12.98 ± 6.38, 5.21 ± 1.21, 8.54 ± 4.08, and 4.01 ± 1.15 respectively. The mean population of CD8+CD45RA-CD27- cells was 4.9 ± 2.4, 3.85 ± 3.03, 4.68 ± 3.84, and 1.81 ± 0.62 respectively. The mean number of natural killer T cells was 7.49 ± 14.94, 8.56 ± 18.14, 6.92 ± 12.86, 12.7 ± 20.56 respectively.

CLINICAL RELEVANCE/APPLICATION

The development of immunotherapies has revolutionized cancer therapy. The next phase will likely be synergistic treatment algorithms with immunotherapies and loco-regional treatments. This trial provides information on the immunomodulatory effects of radioembolization, an important building block to design synergistic trials.

IR01-A7   Pictorial Storyboard Of Uterine Artery Embolization Complications: What Every Radiology Trainee Ought To Know

Awards
Certificate of Merit

Participants
Shuchi Zinzuwadia, Forest Park, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.Discuss the spectrum of complications after uterine artery embolization. Complication rarity and low index of suspicion can lead to

delay in diagnosis and poor outcomes2. Recognize the key imaging features of a broad spectrum of uterine artery embolization complications3. Outline the clinical and periprocedural considerations necessary to prevent and manage the critical and delayed complications of uterine artery embolization

TABLE OF CONTENTS/OUTLINE

1. Differentiate clinical presentations of post embolization syndrome and infection2. Understand the complications, sequalae and management of fibroid expulsiona. Fibroid size and location are important risk factors to consider prior to UAEb. MR imaging is helpful to characterize location of fibroid, degree of infarction and uterine wall attachment, presence of pus or fluid, and state of cervix, and if tissue is prolapsing through the cervix3. Inflammatory adhesions post UAE can lead to bowel and urinary tract obstruction. Larger fibroids are more likely to develop adhesions compared to smaller fibroids.4. Recognize imaging features of leiomyomas and leiomyosarcoma.5. Recognize vascular access complications post procedure6. Prevention, recognition and management of critical early and delayed complications of an uterine artery embolization including fibroid expulsion, infection, inflammatory adhesions leading to obstruction, venous thromboembolic events, access site thrombosis, and missed uterine malignancies.

Printed on: 06/28/22

Sub-Events

CH05-A1   Relationship Between Quantitative Features Of Thoracic Aorta Measured By Artificial Intelligence On Non-enhanced Chest CT And Hypertension

Participants
Jinrong Yang, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To analyze the relationship between quantitative features of thoracic aorta and hypertension, and the predictive risk and diagnostic efficacy of these quantitative features for hypertension were further evaluated.*Methods and Materials A total of 804 patients who were admitted to the geriatric department of our hospital and underwent chest CT examination were included. Morphological features (including diameters and areas at nine levels recommended by the AHA guidelines, and volume and length at two adjacent levels) of the thoracic aorta were automatically measured by AI on non-enhanced chest CT. Next, we analyzed the relationship between these morphological features and age, blood pressure, and further evaluated the predictive risk and diagnostic value of these morphological features for hypertension.*Results All the diameters, areas, volumes and length of ascending aorta (L2_3, L3_4) and descending aorta (L6_7, L7_8) were different between the hypertensive group and the non-hypertensive group (P<0.01). Only the diameter and area of the 7th level (MD), and the volume (V6_7, V7_8) and length (L6_7, L7_8) of descending aorta were different among the grades of hypertension (P<0.05). The diameter and area of MD level, the volume (V6_7, V7_8) and length (L6_7, L7_8) of descending aorta were relatively strong correlated with age and SBP. When SBP was in the range of 110mmHg~160mmHg, the diameters and areas of 9 levels increased with the increase of SBP, otherwise they decreased with the increase of SBP. The volume (V6_7, V7_8) and length (L6_7, L7_8) of descending aorta increased rapidly at first and then slowly with the increase of SBP. The diameter and area of 7th level (MD) was an independent predictor of hypertension (OR=1.168,1.460) after adjusted for clinical data and they were most effective at identifying patients with hypertension (AUC=0.740). The volume (V6_7, V7_8) and length (L6_7, L7_8) of descending aorta had a higher predictive effect on hypertension (AUC =0.602~ 0.717).*Conclusions The diameter and area of the 7th level (MD), and the volume (V6_7, V7_8) and length (L6_7, L7_8) of descending aorta had a relatively strong correlation with blood pressure. The morphological features of thoracic aorta measured by AI were of great value for further understanding the influence of hypertension on thoracic aorta morphology.*Clinical Relevance/Application We analyzed the relationship between the morphological features of thoracic aorta calculated by AI and blood pressure, and evaluated the predictive risk and diagnostic efficacy for hypertension, which had a practical guiding role in evaluating the relationship between the degree of vascular deformation and blood pressure in clinical practice.

RESULTS

All the diameters, areas, volumes and length of ascending aorta (L2_3, L3_4) and descending aorta (L6_7, L7_8) were different between the hypertensive group and the non-hypertensive group (P<0.01). Only the diameter and area of the 7th level (MD), and the volume (V6_7, V7_8) and length (L6_7, L7_8) of descending aorta were different among the grades of hypertension (P<0.05). The diameter and area of MD level, the volume (V6_7, V7_8) and length (L6_7, L7_8) of descending aorta were relatively strong correlated with age and SBP. When SBP was in the range of 110mmHg~160mmHg, the diameters and areas of 9 levels increased with the increase of SBP, otherwise they decreased with the increase of SBP. The volume (V6_7, V7_8) and length (L6_7, L7_8) of descending aorta increased rapidly at first and then slowly with the increase of SBP. The diameter and area of 7th level (MD) was an independent predictor of hypertension (OR=1.168,1.460) after adjusted for clinical data and they were most effective at identifying patients with hypertension (AUC=0.740). The volume (V6_7, V7_8) and length (L6_7, L7_8) of descending aorta had a higher predictive effect on hypertension (AUC =0.602~ 0.717).

CLINICAL RELEVANCE/APPLICATION

We analyzed the relationship between the morphological features of thoracic aorta calculated by AI and blood pressure, and evaluated the predictive risk and diagnostic efficacy for hypertension, which had a practical guiding role in evaluating the relationship between the degree of vascular deformation and blood pressure in clinical practice.

CH05-A2   CT Lung Parenchymal Patterns As Significant Prognostic Imaging Biomarkers In Pulmonary Hypertension With Lung Disease

Participants
Krit Dwivedi, MD, Sheffield, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Pulmonary hypertension (PH) is a heterogenous, incurable condition with untreated survival poorer than most cancers. Patients presenting with CT features of both PH and lung disease pose a diagnostic dilemma between two phenotypes - idiopathic pulmonary arterial hypertension (IPAH) and PH secondary to chronic lung disease (PH-CLD). Accurate phenotyping is vital as it informs treatment, management and prognosis. Only patients with IPAH are eligible for PAH therapeutic agents, which significantly improve survival. The prognostic significance of commonly identified CT lung parenchymal patterns is unknown.*Methods and Materials All patients with IPAH or PH-CLD between Feb 2001 - Jan 2019 were identified in a specialist tertiary PH referral centre using the ASPIRE (Assessing the Spectrum of Pulmonary Hypertension Identified at a Referral Centre) registry. CT scans performed within one

year prior to diagnosis were termed 'incident'. All scans and reports were analysed blinded to clinical data. CT reports were searched using a regular expression string-search for 6 CT features - emphysema, ground glass (GG), centrilobular ground glass (CGG), consolidation and fibrosis. Emphysema and fibrosis severity was scaled as mild, moderate or severe. Results were manually validated to ensure they represented true positives. Multivariate regression analysis was performed adjusting for known significant predictors of age, gender and mean pulmonary arterial pressure.*Results Cohort included 660 consecutive incident patients (335 IPAH, 325 PH-CLD) over 18 years. Honeycombing (HR 2.79), fibrosis (HR 2.38), emphysema (HR 2.09) and combined emphysema and fibrosis (CPFE, HR 2.20) were highly significant (p<0.001) adverse predictors of increased mortality. GG (HR 0.53) and CGG (HR 0.36) were highly significant (p<0.001) protectors. The prognostic effect of fibrosis (mild HR 1.94; moderate HR 2.74; severe HR 3.18) and emphysema (mild HR 1.77; moderate HR 2.17; severe HR 2.92) scaled with severity and was highly significant (p<0.001) at each level. CGG (HR 0.51), fibrosis (HR 1.79), emphysema (HR 1.53) and CPFE (HR 1.53) remained significant (p<0.02) at multivariate analysis.*Conclusions This study demonstrates commonly encountered lung CT patterns prognosticating PH patients with lung disease and being imaging biomarkers for mortality. Presence of emphysema and fibrosis predict poor survival. Ground glass change, including centrilobular ground glass change, predicts better survival, as these more likely represent patients with IPAH.*Clinical Relevance/Application Prognostic significance of CT lung parenchymal disease patterns in PH is unknown. This study identifies significant protective & adverse patterns as imaging biomarkers that predict survival.

RESULTS

Cohort included 660 consecutive incident patients (335 IPAH, 325 PH-CLD) over 18 years. Honeycombing (HR 2.79), fibrosis (HR 2.38), emphysema (HR 2.09) and combined emphysema and fibrosis (CPFE, HR 2.20) were highly significant (p<0.001) adverse predictors of increased mortality. GG (HR 0.53) and CGG (HR 0.36) were highly significant (p<0.001) protectors. The prognostic effect of fibrosis (mild HR 1.94; moderate HR 2.74; severe HR 3.18) and emphysema (mild HR 1.77; moderate HR 2.17; severe HR 2.92) scaled with severity and was highly significant (p<0.001) at each level. CGG (HR 0.51), fibrosis (HR 1.79), emphysema (HR 1.53) and CPFE (HR 1.53) remained significant (p<0.02) at multivariate analysis.

CLINICAL RELEVANCE/APPLICATION

Prognostic significance of CT lung parenchymal disease patterns in PH is unknown. This study identifies significant protective & adverse patterns as imaging biomarkers that predict survival.

CH05-A5   **Fourier Decomposition Magnetic Resonance Imaging (FD-MRI) For Non-contrast-enhanced Assessment Of Lung Perfusion In Patients With Cystic Fibrosis During Respiratory Tract Exacerbation**

Participants
Andrea Mazzaro, MD, Verona, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate Fourier Decomposition MRI (FD-MRI) to assess respiratory tract exacerbation (RTE) in cystic fibrosis (CF) patients.*Methods and Materials CF patients underwent clinical examination, pulmonary function test (PFT) and chest-MRI on the same day. Patients with RTE were identified using Rosenfeld criteria. A follow-up examination was performed after antibiotic therapy in the RTE group and after 20-30 days in the stable group. MRI protocol consisted of untriggered coronal 2D SSFP sequence. SSFP data were converted into perfusion maps using FD brand software. Two readers independently analyzed FD maps for perfusion defects using a field-based semi-quantitative scoring system. Intra- and inter-rater agreement was assessed with k statistics. Ability to differentiate RTE and stable patients was performed with Odds Ratio (OR) and correlation with PFT using Kendall's Tau test.*Results We selected 32 consecutive CF patients (median age: 21 years, range: 13-58). Fourteen (14) patients met the RTE criteria (median: 21 years, range: 17-41[PC2] [PC3]). Inter- and intra-rater agreement was good to excellent with K of 0.85 and 0.93 (p<0.05) respectively. RTE patients had a significantly higher amount of perfusion defects than stable CF patients at baseline (OR:4.0, C.I. 95%:1.4-12.3), but not at follow-up (OR:1.1, C.I. 95%:0.4-2.5). The perfusion score showed a negative moderate correlation with PFT parameters in RTE patients, both at baseline (Tau range: -0.58;-0.66, p<0,05) and follow-up examination (Tau range: -0.41;-0.58, p<0.05). No correlation was found for stable patients.*Conclusions The score applied to FD-MRI perfusion maps showed a good reproducibility and it appeared to be effective in differentiating CF patients with pulmonary exacerbation. It also seems useful in detecting after therapy changes demonstrating a good correlation with spirometry parameters.*Clinical Relevance/Application Lung perfusion assessment with FD-MRI can differentiate CF patients with resiratory tracts exacerbation and can be used as a monitoring tool to assess response to treatment, providing functional informations without the use of contrast agents and of ionizing radiations.

RESULTS

We selected 32 consecutive CF patients (median age: 21 years, range: 13-58). Fourteen (14) patients met the RTE criteria (median: 21 years, range: 17-41[PC2] [PC3]). Inter- and intra-rater agreement was good to excellent with K of 0.85 and 0.93 (p<0.05) respectively. RTE patients had a significantly higher amount of perfusion defects than stable CF patients at baseline (OR:4.0, C.I. 95%:1.4-12.3), but not at follow-up (OR:1.1, C.I. 95%:0.4-2.5). The perfusion score showed a negative moderate correlation with PFT parameters in RTE patients, both at baseline (Tau range: -0.58;-0.66, p<0,05) and follow-up examination (Tau range: -0.41;-0.58, p<0.05). No correlation was found for stable patients.

CLINICAL RELEVANCE/APPLICATION

Lung perfusion assessment with FD-MRI can differentiate CF patients with resiratory tracts exacerbation and can be used as a monitoring tool to assess response to treatment, providing functional informations without the use of contrast agents and of ionizing radiations.

Abstract Archives of the RSNA, 2021

Sub-Events

NR02-A11 **A Deep-learned Time-signal Intensity Pattern Analysis Characterizes Magnetic Resonance Perfusion Heterogeneity For Epidermal Growth Factor Receptor Amplification In Glioblastoma**

Participants
Suyoung Yun, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Dynamic susceptibility contrast (DSC) MRI retains complex dynamic information of time-signal intensity curves that may hold information of common molecular subtype of epidermal growth factor receptor (EGFR). An autoencoder can learn representative time-signal intensity patterns to improve molecular subtyping using perfusion MRI. The aim of this study was to investigate whether an autoencoder-based pattern analysis in tumor and peritumoral area using perfusion MRI predicts EGFR mutation in isocitrate dehydrogenase [IDH]-wild type glioblastoma.*Methods and Materials Preoperative DSC-MRI were obtained for 93 patients with IDH-wild type glioblastoma and known EGFR mutation status. The autoencoder was applied DSC MRI time-signal intensity curves on tumor and peritumoral area. Representative perfusion patterns were defined by voxel-wise k-means clustering using autoencoder latent features. The perfusion patterns were analyzed for baseline, signal drop, and percent recovery. The prediction performance for EGFR mutation using percentage of perfusion patterns in tumor and peritumoral area was calculated with logistic regression analysis and measured using area under the curve (AUC) of the receiver operating characteristics analysis.*Results Total 93 patients were enrolled (41 amplified and 52 nonamplified EGFR). Autoencoder obtained 3 time-signal intensity patterns in each tumor and peritumoral area, characterized tissues of hypovascular tumor, arterial-dominant tumor, and venous-dominant tumor (Figure 1). Proportion of all tumor characters were significantly different between amplified and nonamplified group in both tumor and peritumoral area (largest P = 0.013), with a proportion of arterial-dominant tumor become a significant predictor (P <0.001) for EGFR amplification. The autoencoder predicted EGFR with AUC of 0.78 (95% confidence interval 0.71-0.89).*Conclusions The autoencoder perfusion pattern analysis enables tissue characterization within tumor and peritumoral area, which may be useful imaging biomarkers for EGFR amplification in IDH-wild type glioblastoma and will augment perfusion analysis by providing heterogeneity and dynamic information.*Clinical Relevance/Application EGFR mutation is known to be associated with perfusion parameters, but previous perfusion studies utilized model-based calculation of relative cerebral blood volume requires sophisticated assumption. Noninvasive prediction of the EGFR amplification status using time-signal intensity patterns may improve clinical decision-making by enabling recognition of subgroups of patients who may benefit from treatment.

RESULTS

Total 93 patients were enrolled (41 amplified and 52 nonamplified EGFR). Autoencoder obtained 3 time-signal intensity patterns in each tumor and peritumoral area, characterized tissues of hypovascular tumor, arterial-dominant tumor, and venous-dominant tumor (Figure 1). Proportion of all tumor characters were significantly different between amplified and nonamplified group in both tumor and peritumoral area (largest P = 0.013), with a proportion of arterial-dominant tumor become a significant predictor (P <0.001) for EGFR amplification. The autoencoder predicted EGFR with AUC of 0.78 (95% confidence interval 0.71-0.89).

CLINICAL RELEVANCE/APPLICATION

EGFR mutation is known to be associated with perfusion parameters, but previous perfusion studies utilized model-based calculation of relative cerebral blood volume requires sophisticated assumption. Noninvasive prediction of the EGFR amplification status using time-signal intensity patterns may improve clinical decision-making by enabling recognition of subgroups of patients who may benefit from treatment.

NR02-A12 **Pineal Abnormalities In The Pediatric Population - Review Of Anatomy, Histology, Immunochemistry, Pathology And Imaging.**

Participants
Carol C. V. Lima, MEd, Troy, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- Pineal gland lesions are responsible for 3-8% of pediatric intracranial tumors.2- Our aim is to review anatomy, histology, normal development, immunochemistry tumor markers, imaging and pathology of pineal gland lesions in the pediatric population.3- Radiologists should be aware of the peculiarities of these lesions to minimize errors of interpretation.

TABLE OF CONTENTS/OUTLINE

1. Anatomy, histology and normal development of the pineal gland.2. Germ cell tumor types and tumor markers. Image 1: Germinoma secondary to synchronous development at multiple sites. Post-contrast MRI reveals multiple areas of enhancement including the foramen of Monroe and basal cisterns. 3. Pineal parenchymal tumors and immunohistochemistry. Image 2: Pineoblastoma. CT/MRI showing mass effect and CNS spread.4. Glial Tumors and Pineal cystic lesions. Image 3: Multiloculated partially cystic process in the pineal gland with enhancement along the septations. The second one is a pineal cyst case with hemorrhage. 5. Miscellaneous. Image 4 showing an Atypical teratoid/rhabdoid tumor with CNS spread to pineal gland.

NR02-A2   Classification Of Paediatric Posterior Fossa Tumors Using Radiomics Features Of T2w Images.

Participants
ABHILASHA INDORIA, MENG,BEng, Bengaluru, India (*Presenter*) Nothing to Disclose

PURPOSE

About half of the major paediatric tumours (Medulloblastoma, Ependymoma and Pilocytic Astrocytoma) originate in the posterior fossa. Knowing the tumor type pre-operatively is desirable because of different management strategies and outcomes. These three tumors can demonstrate similar visual appearance on an MRI scan which is the key technique for visualization and management of all brain tumors. Histopathological examination of biopsy samples, which is an invasive technique, is the gold standard for definite diagnoses. The purpose of this study is to explore the machine learning classification model using radiomics features of T2-weighted images for discriminating between major paediatric posterior fossa brain tumors non-invasively.*Methods and Materials 87 subjects (32 Medulloblastoma, 30 Ependymoma and 25 Pilocytic astrocytoma) MRI data was retrieved from PACS. ROI was manually drawn on pre-processed T2W images using 3D slicer. 18 first order and 23 GLCM features were extracted. Dataset was split into training and testing data. Features were reduced based on feature importance calculated from training dataset using randomized search cross validation. Boxplots were created to study the relation of selected features with tumor type. Fourfold cross validation was carried out on the training dataset to obtain the cross-validation score. Random forest classifier was trained on reduced feature set and performance was assessed. Average intensity histogram for the ROIs were calculated for the three groups.*Results 87% mean accuracy score was achieved after cross validation. The classifier also performed well on the test dataset with an accuracy of 83.14%. Calculation of average intensity histogram revealed the intensity overlap between the three groups. A higher feature importance score was assigned to second-order features as compared to first-order features by a randomized search algorithm. The top three features in the analysis included only the second-order features i.e., 'glcm IMC1', 'glcm jointenergy' and 'glcm InverseVariance'. First-order features included in the analysis are 'skewness', 'energy', and 'minimum'.*Conclusions First order statistical features derived from T2W images are useful for discriminating between the three major paediatric brain tumors.*Clinical Relevance/Application This study provides a foundation for utilization of radiomics and machine learning methods to create tools that can assist in making an early diagnosis, reduction in invasive methods for diagnosis and improve management of paediatric tumors.

RESULTS

87% mean accuracy score was achieved after cross validation. The classifier also performed well on the test dataset with an accuracy of 83.14%. Calculation of average intensity histogram revealed the intensity overlap between the three groups. A higher feature importance score was assigned to second-order features as compared to first-order features by a randomized search algorithm. The top three features in the analysis included only the second-order features i.e., 'glcm IMC1', 'glcm jointenergy' and 'glcm InverseVariance'. First-order features included in the analysis are 'skewness', 'energy', and 'minimum'.

CLINICAL RELEVANCE/APPLICATION

This study provides a foundation for utilization of radiomics and machine learning methods to create tools that can assist in making an early diagnosis, reduction in invasive methods for diagnosis and improve management of paediatric tumors.

NR02-A3   A Magnetic Resonance Imaging Based Radiomics Model To Predict Mitosis In Cerebral Meningioma Grading Prior To Surgery

Participants
Hermann Kraehling, MD, Muenster, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Image analysis of intracranial tumors by machine learning is a highly evolving part of modern medicine. The aim of this study was to develop a magnetic resonance imaging (MRI) based Radiomics model to predict mitosis cycles in cerebral meningioma grading prior to surgery.*Methods and Materials Preoperative contrast-enhanced T1 weighted cerebral MRI imaging data of 172 meningioma patients from the years 2015 to 2020 were obtained, preprocessed and segmented using the 3D Slicer software and the PyRadiomics plugin. In total 158 Radiomics features of the T1 post contrast MRI images were computed. Data processing involved Yeo-Johnson-Transformation, followed by the stepwise reduction of variables to receive a final training model with only 18 features using the ´Naive-Bayes-Procedure´. For comparison, alternative models based on the 18 final variables using ´logistic regression´ or ´LASSO´ regression were performed as well.*Results The Radiomics features correlated with histologically found number of mitosis in CNS meningiomas. Performance of the ´Naive-Bayes-Procedure´ showed an accuracy of the training data of 76,81% (Receiver operating characteristics ROC AUC 0,77) and test data accuracy was 73,53%. Performance of the ´logistic regression with stepwise procedure´ showed an accuracy of the training data of 78,26%, ROC 71,6 %, test data accuracy was 70,59%. Performance of the ´least absolute shrinkage and selection operator (LASSO)´ Regression showed an accuracy of the training data of 77,54%, ROC 74,6 %, test data accuracy was 70,59%.*Conclusions The MRI-based Radiomics prediction of mitosis cycles in cerebral meningioma is a reliable prediction model prior to surgery and might have broad perspectives for clinical practice.*Clinical Relevance/Application The MRI-based Radiomics prediction of cerebral meningiomas could be a new reliable diagnostic tool prior to surgery.

RESULTS

The Radiomics features correlated with histologically found number of mitosis in CNS meningiomas. Performance of the ´Naive-Bayes-Procedure´ showed an accuracy of the training data of 76,81% (Receiver operating characteristics ROC AUC 0,77) and test data accuracy was 73,53%. Performance of the ´logistic regression with stepwise procedure´ showed an accurancy of the training data of 78,26%, ROC 71,6 %, test data accuracy was 70,59%. Performance of the ´least absolute shrinkage and selection operator (LASSO)´ Regression showed an accuracy of the training data of 77,54%, ROC 74,6 %, test data accuracy was 70,59%.

CLINICAL RELEVANCE/APPLICATION

The MRI-based Radiomics prediction of cerebral meningiomas could be a new reliable diagnostic tool prior to surgery.

NR02-A5   Deep Learning-based Thin-section MRI Reconstruction Improves Tumour Detection and Delineation In Pre- and Post-treatment Pituitary Adenoma

Participants
Da Hyun Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning-based reconstruction (DLR) using magnetic resonance imaging (MRI) enables high-resolution thin-section imaging with noise reduction. In the present study, we compared the performance of 1-mm DLR MRI with that of 3-mm routine MRI to detect and delineate pituitary adenoma.*Methods and Materials This single-institution retrospective study included 201 patients (mean age ± standard deviation: 52 ± 14 years; 113 women) who underwent a combined imaging protocol including 3-mm routine MRI and 1-mm DLR to evaluate pituitary adenoma between August 2019 and October 2020. Four readers (two experienced and two less-experienced) assessed the adenoma detection and delineation preferences of the normal pituitary stalk and gland in a pairwise fashion, with 1-mm DLR compared with 3-mm routine MRI. The signal-to-noise ratio was quantitatively assessed. Detection accuracy and image preference data were analysed and compared according to the readers' experience using the McNemar test.*Results New detection of adenoma by 1-mm DLR that was not visualised using 3-mm routine MRI (overall: 6.5% [13/201]) was more common than the inverse. To delineate normal pituitary stalk and gland, readers preferred 1-mm DLR over 3-mm routine MRI (overall superiority 56%). The less-experienced readers preferred 1-mm DLR over 3-mm routine (69% and 82%, p < 0.001). The signal-to-noise ratio of 1-mm DLR was 1.25-times higher than that of the 3-mm routine.*Conclusions The 1-mm DLR thin-slice sectioning achieved higher sensitivity in the detection of pituitary adenoma and provided better delineation of normal pituitary gland than 3-mm routine MRI with incremental clinical value.*Clinical Relevance/Application 1. Deep learning-based reconstruction (DLR) enables thin slice section and achieves new detection of pituitary adenoma. 2. Neuroradiologists preferred 1mm-DLR over 3-mm routine MRI for delineation of pituitary adenoma and pituitary stalk.3. DLR provides higher signal-to-noise ratio compared with routine MRI.

RESULTS

New detection of adenoma by 1-mm DLR that was not visualised using 3-mm routine MRI (overall: 6.5% [13/201]) was more common than the inverse. To delineate normal pituitary stalk and gland, readers preferred 1-mm DLR over 3-mm routine MRI (overall superiority 56%). The less-experienced readers preferred 1-mm DLR over 3-mm routine (69% and 82%, p < 0.001). The signal-to-noise ratio of 1-mm DLR was 1.25-times higher than that of the 3-mm routine.

CLINICAL RELEVANCE/APPLICATION

1. Deep learning-based reconstruction (DLR) enables thin slice section and achieves new detection of pituitary adenoma. 2. Neuroradiologists preferred 1mm-DLR over 3-mm routine MRI for delineation of pituitary adenoma and pituitary stalk.3. DLR provides higher signal-to-noise ratio compared with routine MRI.

NR02-A6 Artificial Intelligence Substantially Improves Differential Diagnosis Of Dementia - Added Diagnostic Value Of Rapid Brain Volumetry

Participants
Jens Opalka, MD, Berlin, Germany (*Presenter*) Employee, Mediaire GmbH

PURPOSE

Brain volumetry is a key aspect in dementia diagnostics. We applied an artificial intelligence (AI) system based on a Convolutional Neural Network (CNN) which aims to perform lobe-separated rapid brain volumetry (< 1/2 hour) of three-dimensional T1-weighted magnetic resonance imaging (MRI) with automated segmentation as well as comparison to age- and gender-adapted percentiles. Our aim was to quantify the added value in the differential diagnostics of dementia.*Methods and Materials A total of 55 patients - 17 with confirmed diagnosis of Alzheimer's disease (AD), 18 with confirmed diagnosis of frontotemporal dementia (FTD) and 20 healthy controls - received T1-weighted three- dimensional Magnetization Prepared - RApid Gradient Echo (MP-RAGE) MRI. Images were retrospectively assessed by one board-certified neuroradiologist (BCNR) and two radiology residents (RR) - one of whom had received 6 months of neuroradiology training (RR1). All cases were evaluated in a two-step reading process - beginning without AI-support and followed by an AI-supported reading (AI tool: mdbrain version 3.3.0). For each subject, the suspected diagnostic category (AD, FTD and healthy controls) was determined using a likelihood score (0-5), adding up to a sum of 5 for all three diagnostic categories. Individual reader performance with and without AI support was statistically evaluated using receiver operating characteristics (ROC).*Results AI support substantially improved AD diagnosis in all three readers. The effect was most pronounced for RR2 who had not undergone neuroradiology training (area under the curve [AUC] without AI support [- AI]: 0.629, AI supported [+ AI]: 0.885). But, even for the BCNR, a substantial benefit was measurable (AUCs: BCNR - AI: 0.827, + AI: 0.882; RR1 - AI: 0.713, + AI: 0.834). In diagnosing FTD RR2 improved with AI support (AUCs: - AI: 0.610, + AI: 0.754), while BCNR and RR1 had comparable reading performances with and without AI support (AUCs: BCNR - AI: 0.843, + AI: 0.828; RR1 - AI: 0.865, + AI: 0.868).*Conclusions Even experienced BCNR can improve their diagnostic accuracy for AD by using AI based rapid brain volumetry and readily available comparison with the age- and gender-matched reference cohorts. In diagnosing FTD, especially radiologists who are less experienced in dementia differential diagnosis can strongly benefit from AI support.*Clinical Relevance/Application AI support in the radiological work-up of dementia patients is feasible and can substantially improve diagnostic accuracy, which might lead to earlier diagnosis and therefore optimized patient management. The presented AI tool is readily available in the reporting workflow as it offers rapid data processing and full PACS integration.

RESULTS

AI support substantially improved AD diagnosis in all three readers. The effect was most pronounced for RR2 who had not undergone neuroradiology training (area under the curve [AUC] without AI support [- AI]: 0.629, AI supported [+ AI]: 0.885). But, even for the BCNR, a substantial benefit was measurable (AUCs: BCNR - AI: 0.827, + AI: 0.882; RR1 - AI: 0.713, + AI: 0.834). In diagnosing FTD RR2 improved with AI support (AUCs: - AI: 0.610, + AI: 0.754), while BCNR and RR1 had comparable reading performances with and without AI support (AUCs: BCNR - AI: 0.843, + AI: 0.828; RR1 - AI: 0.865, + AI: 0.868).

CLINICAL RELEVANCE/APPLICATION

AI support in the radiological work-up of dementia patients is feasible and can substantially improve diagnostic accuracy, which might lead to earlier diagnosis and therefore optimized patient management. The presented AI tool is readily available in the reporting workflow as it offers rapid data processing and full PACS integration.

NR02-A7 Incorporating Algorithmic Uncertainty Into A Clinical Deep Learning Algorithm For Head CTs

Participants
Byung Yoon, MD,PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Me t   b y th   d   t ti   f i t   i l h   m

Most algorithms developed for the detection of intracranial abnormalities rely on dichotomous classification where an algorithm determines whether an abnormality is present or not. However, many imaging findings may be indeterminate. We incorporated the concept of "algorithmic uncertainty" and investigated whether acute findings on head CT can be classified into 2 categories based on high and low probabilities for abnormality, and a separate algorithmically uncertain category. Any differences in clinical outcomes were also evaluated.*Methods and Materials 1000 consecutive noncontrast head CTs (855 adult patients, some with multiple scans) obtained at our institution between 10/26/2020 and 11/13/2020 were processed by the AI algorithm, which was originally developed for acute intracranial hemorrhage detection (PMID: 30948806) but was found to detect other acute abnormalities. After exclusion of algorithmically uncertain (AU) cases, algorithm results were classified into high (IC+) and low (IC-) probability for significant intracranial abnormalities that included acute hemorrhage, large lesion, or edema with extensive tissue shift, and diffuse cerebral edema. Infarcts were not evaluated by the algorithm.*Results Among 1000 cases, 164 were deemed uncertain, leaving 103 IC+ cases (93 true positives and 10 false positives) and 733 IC- cases (686 true negatives, 47 false negatives). The positive and negative predictive values were 0.903 and 0.936, respectively. The rates of admission, 30-day mortality, neurointervention were 75%, 10%, and 35%, respectively for IC+, compared to 43%, 3%, and 4% for IC- with odds ratios (95% CI) of 3.83 (2.13, 6.88; p<0.001), 3.43 (1.33, 8.89; p=0.011), and 11.95 (6.32, 22.61; p<0.001). The respective rates for AU were 53%, 9%, and 12%.*Conclusions Incorporating uncertainty into a deep learning algorithm for head CTs results in refined algorithmic results with high positive and negative predictive values that are clinically useful. The rate of algorithmic uncertain cases is substantial at 16.4% and is a focus of further research with respect to the causes and possible reduction.*Clinical Relevance/Application Incorporation of uncertainty may result in more clinically relevant algorithms with high predictive values and help expedite identification and triage of patients that need urgent medical care.

RESULTS

Among 1000 cases, 164 were deemed uncertain, leaving 103 IC+ cases (93 true positives and 10 false positives) and 733 IC- cases (686 true negatives, 47 false negatives). The positive and negative predictive values were 0.903 and 0.936, respectively. The rates of admission, 30-day mortality, neurointervention were 75%, 10%, and 35%, respectively for IC+, compared to 43%, 3%, and 4% for IC- with odds ratios (95% CI) of 3.83 (2.13, 6.88; p<0.001), 3.43 (1.33, 8.89; p=0.011), and 11.95 (6.32, 22.61; p<0.001). The respective rates for AU were 53%, 9%, and 12%.

CLINICAL RELEVANCE/APPLICATION

Incorporation of uncertainty may result in more clinically relevant algorithms with high predictive values and help expedite identification and triage of patients that need urgent medical care.

Abstract Archives of the RSNA, 2021

Sub-Events

BR04-A3 Breast Cancer During Pregnancy And Lactation In Brca Carriers

Participants
Renata Faermann, MD, Kiryat Ono, Israel (*Presenter*) Nothing to Disclose

PURPOSE

Women harboring BRCA1 or BRCA2 germline pathogenic sequence variants (PSVs) mutations have a substantially increased lifetime risk for developing breast cancer estimated at 70-75%, at times diagnosed at an early age (<40 years). Approximately 12% of women whose breast cancer was diagnosed = 40 years carry BRCA1 or BRCA2 PSVs. While breast cancer surveillance imaging including MRI alternating with mammography from age 25-30 years is well established for BRCA PSV carriers, optimal breast imaging surveillance during pregnancy and breastfeeding is not well established. At our institute, we offer breast exam and breast ultrasound (US) every 3 months for pregnant and breastfeeding BRCA carriers. The aim of our study was to assess the utility and yield of this screening protocol.*Methods and Materials A retrospective, IRB approved observational study, evaluating pregnant and breastfeeding BRCA PSV carriers who are being followed up at the Meirav high risk clinic during 2015-2021. Using the OpisoftCare software, all patients undergoing surveillance, during pregnancy and lactation were identified. Breast imaging examinations, biopsies, and number of cancers were retrieved for all pregnant and breastfeeding patients.*Results During the study period, 593 breast ultrasounds were performed in 263 pregnant BRCA carriers and 409 breast ultrasounds for 175 breastfeeding women. Thirty two of the breastfeeding women had a mammogram in addition to the breast US. Overall, 36 biopsies in pregnant women were performed, and in 2 (2/263=0.7% - 5.5% of biopsies) breast cancer was detected (one invasive ductal carcinoma and one invasive lobular carcinoma, both triple negative), and 2 of 23 biopsies that were performed in breastfeeding women (2/175=1.1% - 8.7% of biopsies) were malignant (both invasive ductal carcinoma, one triple negative and the other estrogen receptor positive).*Conclusions Breast cancer during pregnancy and lactation in BRCA patients is rare, and rates of detection are below 2% in our center. Moreover, even when radiologically suspicious lesions are detected, positive predictive value was 5.5-8.7% in pregnant and breastfeeding women, respectively. Based on these preliminary data, imaging surveillance with ultrasound at longer intervals during pregnancy and breastfeeding, should be considered and validated in a larger dataset.*Clinical Relevance/Application Although young patients harboring BRCA1 or BRCA2 mutations have a substantially increased lifetime risk for developing breast cancer, we show that it is rare during pregnancy and lactation, suggesting that imaging surveillance with ultrasound at longer intervals during pregnancy and breastfeeding should be considered.

RESULTS

During the study period, 593 breast ultrasounds were performed in 263 pregnant BRCA carriers and 409 breast ultrasounds for 175 breastfeeding women. Thirty two of the breastfeeding women had a mammogram in addition to the breast US. Overall, 36 biopsies in pregnant women were performed, and in 2 (2/263=0.7% - 5.5% of biopsies) breast cancer was detected (one invasive ductal carcinoma and one invasive lobular carcinoma, both triple negative), and 2 of 23 biopsies that were performed in breastfeeding women (2/175=1.1% - 8.7% of biopsies) were malignant (both invasive ductal carcinoma, one triple negative and the other estrogen receptor positive).

CLINICAL RELEVANCE/APPLICATION

Although young patients harboring BRCA1 or BRCA2 mutations have a substantially increased lifetime risk for developing breast cancer, we show that it is rare during pregnancy and lactation, suggesting that imaging surveillance with ultrasound at longer intervals during pregnancy and breastfeeding should be considered.

BR04-A4 First Results Of Dynamic Contrast-enhanced (DCE) Photon-counting Breast CT (PC-BCT) Imaging Of DCIS

Participants
Caroline Wilpert, MD, Aachen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Photon counting breast CT (PC-BCT) is a novel method that offers a substantially higher spatial and contrast resolution than conventional CT, at a significantly lower radiation dose; therefore, dynamic image acquisitions similar to DCE-MRI is feasible. We describe enhancement patterns of DCIS in DCE PC-BCT, in direct comparison to MRI.*Methods and Materials Intra-individual comparative study on 18 patients (mean aged 57.2 ± 9.3 years) with biopsy-confirmed DCIS who underwent breast MRI and PC-BCT either on the same day or within a maximum of 2 days. A dedicated photon counting breast CT scanner (Nu:View) was used that operates with an ultra-high-resolution CdTe detector suitable for single-breast imaging. Images were acquired with 60kV, 32 mAs at a 691 x 691 matrix, yielding a non-interpolated spatial resolution of 0.3 x 0.3 x 0.3 mm. Dynamic contrast enhanced PC-BCT was performed before and three times after bolus injection of 1.5 ml/kg BW iodinated contrast agent @ 3 ml/s. Each dynamic scan took 26 sec to acquire, plus 23 sec data handling time, yielding a temporal resolution of 49 seconds. Breast MRI was acquired at 1.5 T using a multichannel breast coil before and after 4 times bolus injection of 0.1 ml/kg BW Gadobutrol @ 3 ml/s, temporal resolution 60 s; spatial resolution 0.4 x 0.5 x 3 mm.*Results There was non-mass related enhancement observable, although to a variable degree, in DCIS lesions on post-contrast subtracted PC-BCT images. Mean CNR increased from 23.6 ± 17 to 35.2 ± 22 after

contrast injection. Relative CNR increase (CNRpost vs. CNRpre-contrast) in PC-CT was similar to relative SI increase observable in breast MRI (65% ± 59% vs. 49% ± 33%). Comparing CNR of both methods, CNR of PC-BCT (5,0 ± 4,5) was significantly lower than that of MRI (11,8 ± 15); p<0.017. DCIS exhibited steady enhancement, with maximum enhancement achieved in the respective last dynamic acquisition, with similar maximum enhancement (100% vs. 94%) for PC-BCT vs. MRI.*Conclusions DCIS that is associated with enhancement on breast MRI appears to be also associated with contrast enhancement on PC-BCT.*Clinical Relevance/Application PC-BCT allows detection of microcalcifications (abstract no 14812) and of contrast enhancement of DCIS. PC-BCT may thus combine advantages of mammography with those of breast MRI for detection/characterization of DCIS.

RESULTS

There was non-mass related enhancement observable, although to a variable degree, in DCIS lesions on post-contrast subtracted PC-BCT images. Mean CNR increased from 23.6 ± 17 to 35.2 ± 22 after contrast injection. Relative CNR increase (CNRpost vs. CNRpre-contrast) in PC-CT was similar to relative SI increase observable in breast MRI (65% ± 59% vs. 49% ± 33%). Comparing CNR of both methods, CNR of PC-BCT (5,0 ± 4,5) was significantly lower than that of MRI (11,8 ± 15); p<0.017. DCIS exhibited steady enhancement, with maximum enhancement achieved in the respective last dynamic acquisition, with similar maximum enhancement (100% vs. 94%) for PC-BCT vs. MRI.

CLINICAL RELEVANCE/APPLICATION

PC-BCT allows detection of microcalcifications (abstract no 14812) and of contrast enhancement of DCIS. PC-BCT may thus combine advantages of mammography with those of breast MRI for detection/characterization of DCIS.

BR04-A8 The Impact Of Screening Intervals On Stage Of Breast Cancer At Time Of Detection Using Real-world Evidence

Participants
Emily F. Conant, MD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Hologic, Inc;Advisory Panel, Hologic, Inc;Research Grant, OM1, Inc;Research Grant, iCad, Inc;Advisory Panel, iCad, Inc;Speaker, Medscape, LLC

PURPOSE

Early detection of breast cancer (BC) with screening mammography improves patient outcomes. Longer screening intervals (SIs) due to pandemic-related or other delays and/or decreases in screenings are of concern. Using retrospective multi-center BC screening data, this study examined the association between SIs and cancer size and stage at detection to estimate effects of screening delays on patient outcomes to inform screening recommendations.*Methods and Materials The study used integrated EMR, RIS, and tumor registry data from 4 large healthcare organizations. Women 40-79 years old with =1 screening mammogram and incident BC from 2015-2019 were included. Women with prior breast implants or BC were excluded. SI was defined as the time between the last 2 screens for women with =2 screens or the time from site data availability to screen date for women with 1 screen. Advanced BC was defined as TNM stage =II at diagnosis. Chi-square test, analysis of variance, and logistic regression were used to compare patient characteristics and BC outcomes by SI (>24 vs. = 24 months).*Results Among 701,207 women screened, 2,844 women had incident BC. Compared to the 81% with SI =24 months, women with SI >24 months were younger (mean: 59 vs. 61 years), less often had heterogeneously (42% vs. 47%) or extremely dense breasts (5% vs. 9%), were screened more often with digital breast tomosynthesis vs. digital mammography at BC detection (78% vs. 62%), and had larger tumors (mean: 17 vs. 14mm) (all p<0.01). A higher proportion of women with SI >24 months had advanced BC (p=0.02) and/or tumors =21mm, and a lower proportion had tumors <11mm (Figure 1). Tumor size differences, however, were not statistically significant (p=0.16). After adjustment for age, modalities, and density, the odds ratio for advanced BC in women with SI >24 vs. =24 months was 1.21 (95% confidence interval: 0.95,1.54). When restricted to women with =2 screens (n=1,110), trends for status and tumor size remained but differences were not statistically significant.*Conclusions More advanced BC and larger tumor sizes were observed for SI >24 months, suggesting that longer SIs may adversely impact patient outcomes.*Clinical Relevance/Application Compared to =24 months, a mammography screening interval >24 months increased likelihood of advanced breast cancer at diagnosis. Repeat screening within 24 months may improve breast cancer outcomes.

RESULTS

Among 701,207 women screened, 2,844 women had incident BC. Compared to the 81% with SI =24 months, women with SI >24 months were younger (mean: 59 vs. 61 years), less often had heterogeneously (42% vs. 47%) or extremely dense breasts (5% vs. 9%), were screened more often with digital breast tomosynthesis vs. digital mammography at BC detection (78% vs. 62%), and had larger tumors (mean: 17 vs. 14mm) (all p<0.01). A higher proportion of women with SI >24 months had advanced BC (p=0.02) and/or tumors =21mm, and a lower proportion had tumors <11mm (Figure 1). Tumor size differences, however, were not statistically significant (p=0.16). After adjustment for age, modalities, and density, the odds ratio for advanced BC in women with SI >24 vs. =24 months was 1.21 (95% confidence interval: 0.95,1.54). When restricted to women with =2 screens (n=1,110), trends for status and tumor size remained but differences were not statistically significant.

CLINICAL RELEVANCE/APPLICATION

Compared to =24 months, a mammography screening interval >24 months increased likelihood of advanced breast cancer at diagnosis. Repeat screening within 24 months may improve breast cancer outcomes.

BR04-A9 Distance Of Largest Axillary Lymph Node To Axillary Vein Can Predict Reactive Versus Malignant Lymphadenopathy On Breast MRI

Participants
Beatriu Reig, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To develop a simple imaging metric to differentiate vaccine-related lymphadenopathy (LAD) from metastatic axillary LAD on breast MRI.*Methods and Materials We retrospectively reviewed breast MRI reports between 7/1/2019 and 11/30/2020 to identify patients with breast cancer and biopsy-proven metastatic axillary LAD; patients with mastectomy, prior axillary surgery, or neoadjuvant therapy were excluded. We reviewed breast MRI reports between 1/1/2021 and 4/1/2021 to identify patients with recent COVID-19 vaccine and ipsilateral LAD seen on MRI; patients with concurrent ipsilateral breast cancer were excluded. One radiologist reviewed the images and recorded: the number of enlarged lymph nodes (LN), and axillary levels (I, II, III) with LAD. The distance from the largest LN (based on short axis measurement on axial images) to the axillary vein on sagittal postcontrast fat-saturated T1-weighted images was measured. Whether the largest LN was the most inferior lymph node identified on axial images was recorded. Mann-Whitney U test was calculated in SPSS.*Results 15 patients were identified in each group. The distance of the largest LN to

the axillary vein was significantly different between the groups. The distance ranged 17-86 mm (mean 41 mm) in the malignant LAD group, versus 1-45 mm (mean 11.7 mm) in the vaccine LAD group (p=.0001). All cancer patients had a distance of greater than 15 mm, while only 3/15 vaccine patients had a distance greater than 15 mm. The largest LN was the most inferior LN identified on axial images in 9/15 cancer patients, and only in 1/15 vaccine patients. Only level I (not level II or III) axillary LN were involved in 12/15 cancer patients, and in 6/15 vaccine patients. 4/15 vaccine patients had involvement of levels I and II, while 5/15 patients had involvement of levels I, II, and III.*Conclusions Vaccine-related LAD is closer to the axillary vessels while malignant LAD is closer to the breast, which may be expected given lymphatic drainage patterns of the deltoid muscle and breast. A simple test to determine whether axillary LAD seen on MRI could be malignant is the measurement of the largest LN to the axillary vein on sagittal view. A cut-off value of > 15 mm would identify potentially malignant LAD, which could be further evaluated with ultrasound or biopsy. Patients with LAD </= 15 mm from the axillary vein could be considered reactive and may not need follow up. Vaccine-related LAD often involves deep axillary levels (II and III), and this extensive involvement should not dissuade radiologists from diagnosing reactive LAD.*Clinical Relevance/Application Incidental vaccine-related LAD has been identified on breast MRI and a simple at-the-workstation test could help triage patients in order to avoid unnecessary follow up exams.

RESULTS

15 patients were identified in each group. The distance of the largest LN to the axillary vein was significantly different between the groups. The distance ranged 17-86 mm (mean 41 mm) in the malignant LAD group, versus 1-45 mm (mean 11.7 mm) in the vaccine LAD group (p=.0001). All cancer patients had a distance of greater than 15 mm, while only 3/15 vaccine patients had a distance greater than 15 mm. The largest LN was the most inferior LN identified on axial images in 9/15 cancer patients, and only in 1/15 vaccine patients. Only level I (not level II or III) axillary LN were involved in 12/15 cancer patients, and in 6/15 vaccine patients. 4/15 vaccine patients had involvement of levels I and II, while 5/15 patients had involvement of levels I, II, and III.

CLINICAL RELEVANCE/APPLICATION

Incidental vaccine-related LAD has been identified on breast MRI and a simple at-the-workstation test could help triage patients in order to avoid unnecessary follow up exams.

Abstract Archives of the RSNA, 2021

Sub-Events

RI04-B1   **Prenatal Brain Volumetry In Fetal Growth Restriction With Superresolution Fetal MRI**

Participants
Gregor Dovjak, MD, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

Fetal growth restriction (FGR) is associated with different short- and long-term complications such as perinatal asphyxia, hypoglycemia, necrotizing enterocolitis, chronic lung disease and cognitive impairment. Furthermore, FGR newborns are more susceptible to infections and more likely to develop allergies and chronic diseases such as diabetes and hypertension. Therefore, an early diagnosis and subsequent monitoring is crucial. Fetal MRI is particularly well suited for detailed imaging of the fetal brain and provides an advanced, complementary imaging tool to assess brain maturation and also the volumes of different fetal brain compartments.*Methods and Materials This study aimed to compare the transverse cerebellar diameter (TCD) and the volumes of the supratentorial brain, ventricles, cerebellum, brainstem and the supra- and infratentorial cerebrospinal fluid (CSF) spaces between FGR fetuses and age-matched normal fetuses. Fetal MRI with an isovoxel "superresolution" sequence, reconstructed from 1.5 Tesla or 3 Tesla T2-weighted sequences in all three planes, were included. The volumes were three-dimensionally segmented with the open-source software ITK-SNAP.*Results A total of 26 fetuses (13 FGR fetuses and 13 age-matched normal fetuses) with a gestational age of 27.0 ± 3.9 weeks (mean ± standard deviation) ranging from 20+0 to 35+5 weeks were included. In the FGR group, all assessed volumes except for the brainstem were smaller compared to the control group. The supratentorial brain volume (p=0.018), cerebellar volume (p=0.005), supra- (p=0.002) and infratentorial CSF spaces (p=0.04) were significantly smaller in the FGR group, whereas the ventricles (p=0.058) and brainstem (p=0.676) volume, as well as the TCD (p=0.154) showed no significant differences between groups.*Conclusions This study implemented a high-quality fetal MRI based superresolution quantification of intracranial compartments and identified volume changes of specific fetal brain regions. Cerebellar hypoplasia is strongly associated with FGR and is exclusively detectable by three-dimensional fetal MRI volumetry.*Clinical Relevance/Application High-quality reconstructed "superresolution" fetal MRI volumetry quantifies FGR associated volume changes of the fetal brain, which are undetectable by linear measurements.

RESULTS

A total of 26 fetuses (13 FGR fetuses and 13 age-matched normal fetuses) with a gestational age of 27.0 ± 3.9 weeks (mean ± standard deviation) ranging from 20+0 to 35+5 weeks were included. In the FGR group, all assessed volumes except for the brainstem were smaller compared to the control group. The supratentorial brain volume (p=0.018), cerebellar volume (p=0.005), supra- (p=0.002) and infratentorial CSF spaces (p=0.04) were significantly smaller in the FGR group, whereas the ventricles (p=0.058) and brainstem (p=0.676) volume, as well as the TCD (p=0.154) showed no significant differences between groups.

CLINICAL RELEVANCE/APPLICATION

High-quality reconstructed "superresolution" fetal MRI volumetry quantifies FGR associated volume changes of the fetal brain, which are undetectable by linear measurements.

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Abstract Archives of the RSNA, 2021

Sub-Events

RI01-B1   **Characterization Of Abnormal Vascularization And Loss Of The Retroplacental Clear Space In A Murine Model Of Placenta Accreta Spectrum (PAS) Using Nanoparticle Contrast-enhanced MRI**

Participants
Andrew Badachhape, PhD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Placenta Accreta Spectrum (PAS) is a condition where placental tissue invades the myometrium and complicates delivery. This condition, seen in 1 in 1000 pregnancies, is responsible for severe morbidity at delivery. Visualization of the uteroplacental interface, or retroplacental clear space (RPCS), is an indicator of normal placentation, but is difficult to assess with ultrasound and conventional magnetic resonance imaging (MRI). In this study, we demonstrate use of a liposomal gadolinium (liposomal-Gd) MRI contrast agent to identify disruption of the RPCS in a mouse model of PAS.*Methods and Materials In vivo studies were performed on the 16th day of gestation in GAB3-/- mice that demonstrate placental invasion in fetoplacental units (FPUs) across the RPCS. Pregnant GAB3+/+ mice that do not express this phenotype were used as controls. Contrast-enhanced MRI (CE-MRI) was performed on a 1T scanner using a T1-weighted 2D gradient-recalled echo sequence (100x100x600 um3 voxels). Post-contrast images were acquired following intravenous administration of liposomal-Gd (0.15 mmol Gd/kg). Contrast-enhanced computed tomography (CE-CT), using a liposomal-iodine contrast agent (1.1 g I/kg), was performed to acquire higher spatial resolution (70 um voxels) images. CE-MR images underwent blinded review by two observers to assess RPCS conspicuity (0 - obscured, 1 - partially obscured, 2 - not obscured). Signal-to-noise ratio (SNR) was computed for placenta and RPCS for all FPUs. This enabled estimation of contrast-to-noise ratio (CNR) which was the difference in RPCS and placental SNR. Post-mortem histological analysis of FPUs was performed for comparison.*Results CE-MR and CE-CT images in GAB3-/- FPUs demonstrated a heterogeneous and interrupted RPCS relative to GAB3+/+ counterparts. Histological analysis of FPUs from GAB3-/- mice confirmed placenta accreta as evidenced by a higher degree of vascularization and the invasion of placental cells across the RPCS. Blinded review of CE-MR images demonstrated lower mean visibility score of the RPCS in GAB3-/- mice (28 FPUs,1.10 ± 0.48) relative to GAB3+/+ (30 FPUs,1.55 ± 0.43) mice. Higher Placental-RPCS CNR values in GAB3+/+ FPUs indicated that GAB3-/- FPUs had higher RPCS SNR and thus a higher degree of vascularization and infiltration across the RPCS.*Conclusions Contrast-enhanced MRI using a liposomal-Gd blood-pool agent enabled visualization of placental invasion across the RPCS in a mouse model of PAS.*Clinical Relevance/Application An MRI-based method for visualizing the RPCS in a mouse model of PAS will enable the translation of sensitive early detection methods for clinical diagnosis of invasive placentation.

RESULTS

CE-MR and CE-CT images in GAB3-/- FPUs demonstrated a heterogeneous and interrupted RPCS relative to GAB3+/+ counterparts. Histological analysis of FPUs from GAB3-/- mice confirmed placenta accreta as evidenced by a higher degree of vascularization and the invasion of placental cells across the RPCS. Blinded review of CE-MR images demonstrated lower mean visibility score of the RPCS in GAB3-/- mice (28 FPUs,1.10 ± 0.48) relative to GAB3+/+ (30 FPUs,1.55 ± 0.43) mice. Higher Placental-RPCS CNR values in GAB3+/+ FPUs indicated that GAB3-/- FPUs had higher RPCS SNR and thus a higher degree of vascularization and infiltration across the RPCS.

CLINICAL RELEVANCE/APPLICATION

An MRI-based method for visualizing the RPCS in a mouse model of PAS will enable the translation of sensitive early detection methods for clinical diagnosis of invasive placentation.

Abstract Archives of the RSNA, 2021

Sub-Events

PD01-A3   **Role Of Imaging In Pediatric Epilepsy Surgery- All You Wanted To Know But Were Afraid To Ask!**

Participants
Alexandra Foust, DO, North Royalton, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understanding the goals of epilepsy surgical procedures can help improve the quality and utility of radiology reports of imaging studies in pediatric patients with drug-resistant epilepsy.2. Multimodality fusion improves surgical planning in pediatric epilepsy.3. Knowledge about intraoperative and post-operative appearances in these patients can aid in differentiate complications from expected post-surgical change and identify residual abnormalities causing seizure recurrence.

TABLE OF CONTENTS/OUTLINE

1. Familiarise radiologists with goals & techniques of common neurosurgical interventions undertaken to treat medically resistant pediatric epilepsy.2. Illustrate typical intraoperative, immediate, and longer-term postoperative findings on imaging studies acquired after procedures including grids & strips placement, stereo EEG placement, lobectomies, lesionectomies, lobar disconnection procedures, functional hemispherectomy, corpus callosotomy, non-lesional cortical resection, multiple subpial transections, and laser interstitial thermal therapy.3. Discuss the role of palliative procedures including VNS, DBS, and RNS.4. Highlight the role of advanced imaging techniques and multimodality fusion to combine information from multiple data sources with case examples.5. List key points to include on reports of pre, intra- & post-operative pediatric epilepsy imaging studies.

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Abstract Archives of the RSNA, 2021

Sub-Events

MS02-B1   **Traumatic Intracranial Hemorrhage In Adult Patients On Antithrombotic Therapy After Ground Level Fall**

Participants
Zeynep Vardar, MD, Worcester, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Anticoagulant and antiplatelet medications increase the risk and severity of traumatic intracranial hemorrhage (tICH), even with minor head trauma. Our objective was to examine the rate and characteristics of tICH in antithrombotic (AT) therapy patients with minor head injuries after ground-level fall.*Methods and Materials We performed a retrospective analysis of all trauma patients age = 18 at a level 1 trauma center, who fell from ground-level height with minimal-mild head trauma (initial ED Glasgow Coma Scale score >13) between January 1 and December 31, 2020. Based on the electronic medical record, patients who had preinjury use of AT therapy were selected. The control group of patients had no AT use was matched for age and mechanism of injury. Demographic, hospital course and outcome data were analyzed. Head CT images were analyzed for presence/type of tICH, midline shift and regional mass effect.*Results A total of 1630 patients (mean age 80 years ± 12 years, 42.5% male) were included in the analysis. 954 were on AT therapy (608 anticoagulant, 226 antiplatelet, and 120 both) and 676 were not. The overall tICH rate was 3.9% (95% CI = 2.9-4.8%). The tICH rate in the AT group was 4.4%, not significantly different than the 3.1% rate in the control group (p=0.24). Patients on anticoagulants had a tICH rate of 4.6% (95% CI = 2.9%-6.3%), patients on antiplatelets 0.4% (95% CI = 1.4%-6.5%), and patients on both 4.2% (%95 CI = 0.6%-7%). Most tICH had a subdural component (38% in AT, 62% in control group). The rate of hematoma expansion in the AT group was 21% (n=9), whereas no hematoma expansion was observed in the control group (p= 0.04). The rate of midline shift was 7% in AT group and 4.8% in the control group (p=0.7). Regional mass effect rate was 23% in AT group and 9.5% in the control group (p=0.2).*Conclusions There was no statistical difference in the rate of tICH between patients on AT therapy versus those not on AT therapy, after falling from standing height with good neurological status. The results suggest that AT therapy does not independently cause tICH but promotes and increases the extent of bleeding once hemorrhage has occurred.*Clinical Relevance/Application Antithrombotic therapy does not independently cause traumatic intracranial hemorrhage in adult patients suffering minor head injury after ground-level fall but promotes hematoma expansion once hemorrhage has occurred.

RESULTS

A total of 1630 patients (mean age 80 years ± 12 years, 42.5% male) were included in the analysis. 954 were on AT therapy (608 anticoagulant, 226 antiplatelet, and 120 both) and 676 were not. The overall tICH rate was 3.9% (95% CI = 2.9-4.8%). The tICH rate in the AT group was 4.4%, not significantly different than the 3.1% rate in the control group (p=0.24). Patients on anticoagulants had a tICH rate of 4.6% (95% CI = 2.9%-6.3%), patients on antiplatelets 0.4% (95% CI = 1.4%-6.5%), and patients on both 4.2% (%95 CI = 0.6%-7%). Most tICH had a subdural component (38% in AT, 62% in control group). The rate of hematoma expansion in the AT group was 21% (n=9), whereas no hematoma expansion was observed in the control group (p= 0.04). The rate of midline shift was 7% in AT group and 4.8% in the control group (p=0.7). Regional mass effect rate was 23% in AT group and 9.5% in the control group (p=0.2).

CLINICAL RELEVANCE/APPLICATION

Antithrombotic therapy does not independently cause traumatic intracranial hemorrhage in adult patients suffering minor head injury after ground-level fall but promotes hematoma expansion once hemorrhage has occurred.

MS02-B2   **Vitamins - Imaging The "Highs ; Lows"**

Participants
Melih Akyuz, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Vitamins are essential micronutrients to sustain normal daily body functions. Since the discovery precise daily requirement has been controversial. 2. Vitamin imbalance is a broad term including both vitamin deficiency and excess, both of which have been a worldwide public health concern since the discovery of the first vitamin in the early 20th century. 3. Not all vitamin imbalances have imaging manifestations. Most common vitamin deficiencies with imaging manifestations include Vitamin D [Rickets & osteomalacia], B1 [Wernicke encephalopathy], B12 [subacute combined degeneration], & C [Scurvy]. Other vitamin deficiencies might present with nonspecific imaging findings. 4. Excess fat-soluble vitamins with imaging manifestations include hypervitaminosis A & D. 5. Excess water-soluble vitamins are rare and most commonly secondary to overtreatment and do not have imaging manifestations. 6. Untreated vitamin imbalances might increase morbidity/mortality, such as hypovitaminosis B1 might complicate with 'Karsakoff syndrome' or hypervitaminosis C might complicate with 'obstructive uropathy' etc.

TABLE OF CONTENTS/OUTLINE

1. List various vitamin imbalance & their clinical manifestations with emphasis on those with imaging manifestations2. Briefly discuss

the sources, mechanisms of actions of different vitamins, risk factors, and management of vitamin imbalance3. Case-based imaging review of vitamin abnormalities in both children and adults. Approach to making diagnosis and evaluating the probable complications.

NR01-A

Neuroradiology Sunday Poster Discussions

Sub-Events

NR01-A10   Assessment Of Tripod Adherence In Articles Applying Machine Learning For Differentiation Of Glioma From Brain Metastasis

Participants
Leon Jekel, Essen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Machine learning (ML) applications in predictive models in neuro-oncology have become an increasingly investigated subject of research. For their incorporation into clinical workflow, rigorous assessment and validation to reduce bias is needed. Several reports have indicated utility of ML applications in differentiation of glioma from brain metastasis. However, a systematic assessment of quality of methodology and reporting in these studies has not been done yet. We examined the adherence of 29 published reports in this field to the TRIPOD (Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis) statement.*Methods and Materials Our systematic review was conducted in accordance with PRISMA guidelines. Four databases, Ovid Embase, Ovid MEDLINE, Cochrane trials (CENTRAL) and Web of science core-collection were searched, first in October 2020 and a second time in February 2021. Keywords and controlled vocabulary included artificial intelligence, machine learning, deep learning, radiomics, magnetic resonance imaging, glioma, and glioblastoma. Assessment of TRIPOD adherence was performed by an AI graduate student and a medical student according to reporting guidelines. Individual item performance was assessed by adherence index (ADI), generated by dividing the mean achieved score of screened reports by highest possible score per TRIPOD item.*Results In a preliminary analysis of 8 out of 29 studies, average TRIPOD adherence score was found to be 0.48 (i.e., 14.25 out of 30 TRIPOD items were fulfilled) with the individual scores ranging from 0.27 (8/30) to 0.60 (18/30). Best overall item performance was seen in item 3 (background/objectives), 16 (model performance), 19 (interpretation), which were satisfied in every study. With an ADI of 0, poorest performance was detected in item 1 (Title) and 2 (abstract), followed by item 7 (predictors) and 9 (missing data) with an ADI of 0.19 and 0.13, respectively.*Conclusions Preliminary TRIPOD analysis results confirm the concern of lack of reproducibility in studies employing ML models for distinction between glioma and brain metastasis. An average TRIPOD adherence score of 0.48 indicates insufficient quality of reporting and outlines the need for increased utilization of quality scoring systems in study design and documentation. Systematic evaluation of quality score adherence will allow us to identify common flaws in this field of research and to formulate recommendations for translation of models into clinical workflow.*Clinical Relevance/Application Clinical translation of ML for differentiation of glioma from brain metastases provides a non-invasive approach for diagnosis but requires further research to address the systematic biases in the literature.

RESULTS

In a preliminary analysis of 8 out of 29 studies, average TRIPOD adherence score was found to be 0.48 (i.e., 14.25 out of 30 TRIPOD items were fulfilled) with the individual scores ranging from 0.27 (8/30) to 0.60 (18/30). Best overall item performance was seen in item 3 (background/objectives), 16 (model performance), 19 (interpretation), which were satisfied in every study. With an ADI of 0, poorest performance was detected in item 1 (Title) and 2 (abstract), followed by item 7 (predictors) and 9 (missing data) with an ADI of 0.19 and 0.13, respectively.

CLINICAL RELEVANCE/APPLICATION

Clinical translation of ML for differentiation of glioma from brain metastases provides a non-invasive approach for diagnosis but requires further research to address the systematic biases in the literature.

NR01-A11   Approach To High Resolution CNS MRI Of Vascular Wall (VW) Imaging: What Radiologists Need To Know?

Awards
Certificate of Merit

Participants
Moataz Ahmed Sayed Mohammed Soliman, BMBCh, CHICAGO, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Understand the imaging protocols and technical factors involved in vascular wall imaging. - Identify different indications and the added value of VW imaging. - Recognize imaging characteristics of various VW diseases. - Structured reporting of vascular wall imaging studies. - Identifying common imaging pitfalls.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Evolution of cerebral vascular wall imaging. 3. Technique:- Preprocedural patient preparation.- Imaging protocol.- Contrast-enhanced images. 4. Advantages (added value) of vessel wall imaging. • Targeted vessel biopsy • Role in multiple aneurysms • Prediction of complications in un-ruptured intracranial aneurysms 5. Vascular wall diseases: • Atherosclerotic plaque (site, activity) • Arterial dissection • Aneurysm • Vasospastic conditions • Vessel wall inflammation (vasculitis) • Infections and viral infectious diseases (e.g. Varicella-zoster vasculopathy) 6. Important imaging pitfalls: • Slow flow • Vasa vasorum • Veins

assessment • Post thrombectomy evaluation 7. Study interpretation: • Anatomical background: - Gross anatomy of the cerebral circulation. - Vascular wall histology. • Clinical evaluation • Imaging interpretation- Anatomical evaluation- Vasculitic vascular luminal narrowing- Atherosclerotic plaques (site, activity)- Aneurysm (site, size, neck, wall thickness, wall enhancement)- Non-specific vascular wall enhancement- Post embolectomy vascular wall changes. 8. Future perspectives

NR01-A2 Application of Single Rotation on Wide-detector CT in The Examination Of Adult Patients With Acute Cerebral Hemorrhage

Participants
Jiandong Lai, Ankang, China (*Presenter*) Nothing to Disclose

PURPOSE

To demonstrate the advantages of single rotation on 16cm wide-detector CT in the examination of adult patients with acute cerebral hemorrhage.*Methods and Materials 45 patients (Group 1,29male and 16 female, age range 40-90 years) with acute cerebral hemorrhage (1.5-10 hours) were prospectively enrolled and scanned on a 256-row, 16cm detector CT system using single rotation axial scan mode with 120kVp/120mA and 1.0s/r. Images were reconstructed using ASIR-V at 70% level. The scan parameters (exposure time and radiation dose), quantitative image quality (CT value and SD value of the hemorrhage, cerebellar hemisphere, centrum semiovale (background), signal to noise ratio (SNR), contrast noise ratio (CNR)) and qualitative image quality were compared with those of a historic group (Group 2, n=45,25male and 20 female, age range 41-80 years) scanned on a 64-row CT with 4cm detector in axial scan mode using multiple rotations with 120kVp/180mA and 0.5s/r. Images were reconstructed using a conventional filtered back projection in Group 2. Statistical analysis was performed using SPSS 2.0 software, the independent samples Student t test was used to assess continuous variables, and Mann-Whitney rank test was used to evaluate image quality.*Results The exposure time in Group 1 was 1.0s, 90.8% faster than the 10.9±1.14s in Group 2; The two groups had similar CT value in the hemorrhage (p>0.05). There was no difference in radiation dose between the two groups (240.82±12.33mGy vs. 233.96±21.94mGy, p>0.05), however, Group 1 on the 16cm CT system had significantly lower image noise (3.70±0.57HU vs. 6.35±0.58HU in the centrum semiovale) and higher SNR and CNR values than Group 2 (all p<0.001). All images were acceptable for diagnosis, but group 1 had better image quality than Group 2 in terms of motion artifacts,beam hardening artifacts,contrast between grey and white matters,contrast between hemorrhagic and peripheral edema,overall image quality) (p<0.05). In addition, Group 1 required 0 repeat scan while Group 2 required 5 (out of 45) repeat scans due to motion artifacts.*Conclusions Single rotation axial scan on 16cm wide-detector can reduce examination time, improve the success rate and improve the image quality for patients with acute cerebral hemorrhage, compared with narrow collimation CT systems.*Clinical Relevance/Application Compared to 64-row CT, 16cm wide-detector system enables fast and wide coverage to generate high quality images for patients with acute cerebral hemorrhage.

RESULTS

The exposure time in Group 1 was 1.0s, 90.8% faster than the 10.9±1.14s in Group 2; The two groups had similar CT value in the hemorrhage (p>0.05). There was no difference in radiation dose between the two groups (240.82±12.33mGy vs. 233.96±21.94mGy, p>0.05), however, Group 1 on the 16cm CT system had significantly lower image noise (3.70±0.57HU vs. 6.35±0.58HU in the centrum semiovale) and higher SNR and CNR values than Group 2 (all p<0.001). All images were acceptable for diagnosis, but group 1 had better image quality than Group 2 in terms of motion artifacts,beam hardening artifacts,contrast between grey and white matters,contrast between hemorrhagic and peripheral edema,overall image quality) (p<0.05). In addition, Group 1 required 0 repeat scan while Group 2 required 5 (out of 45) repeat scans due to motion artifacts.

CLINICAL RELEVANCE/APPLICATION

Compared to 64-row CT, 16cm wide-detector system enables fast and wide coverage to generate high quality images for patients with acute cerebral hemorrhage.

NR01-A4 Brain Metastases In Non-small Cell Lung Cancer: Fully Automated Detection And Segmentation Using A Trained Deep Learning Model

Participants
Ulrike Hoyer, MD, Cologne, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Non-small cell lung cancer (NSCLC) is the most common tumor entity spreading to the brain with up to 50% of patients developing brain metastases (BMs). Detection of BMs on MRI proves to be challenging with an inherent risk of missed diagnosis. The purpose of this study was to train and evaluate a deep learning model (DLM) for fully automated detection and 3D segmentation of BMs in NSCLC on clinical routine MRI.*Methods and Materials This was a retrospective study that included 98 patients who were treated for NSCLC at a tertiary care university hospital and received MRI of the head to screen for BMs between January 2012 and March 2020. Multiparametric MRI datasets (T1-/T2-weighted, T1-weighted contrast-enhanced (T1CE), and FLAIR) at 1.0, 1.5, and 3.0 T from various vendors acquired at a single-center in 65 patients and at referring institutions in 33 patients were used. Patients were randomly allocated into a training (66 patients/248 BMs, pre-treatment) as well as independent test (17 patients/67 BMs, pre-treatment) and control sets (15 patients/0 BMs). A 3D convolutional neural network (DeepMedic) was trained on the training cohort using five-fold-cross-validation and evaluated on the test and control sets employing a majority-voting scheme to fuse the five individual models from the five-fold-cross-validation training approach. 3D voxel-wise manual segmentations of BMs by a neurosurgeon and a radiologist on T1CE (consensus reading) served as the reference standard. To compare the spatial overlap between manual and automated segmentations, the dice similarity coefficient (DSC) was calculated. Pearson's correlation coefficient (r) was determined to evaluate the relationship between quantitative volumetric measurements of segmentations.*Results In the test set, the fused DLM detected 57 of the 67 BMs (mean volume: 0.99±4.24 cm3; sensitivity of 85.1%) while FP findings of 1.5 per scan were observed. Missed BMs had a significantly smaller volume (0.05±0.04 cm3) than detected BMs (0.96±2.4 cm3, P=.0009). Compared to the reference standard, automated segmentations achieved a median DSC of 0.72 and a good volumetric correlation (r=0.95). In the control set, 1.8 FPs/scan were observed.*Conclusions Despite the small lesion size, deep learning provides a high detection sensitivity and good segmentation performance for BMs in NSCLC on heterogeneous scanner data while yielding a low number of FP findings.*Clinical Relevance/Application Without being impaired by a high number of FP findings, the proposed DLM can assist physicians by automated detection of BMs while providing 3D segmentation of BMs for lesion contouring in radiosurgery or for assessment of tumor burden.

RESULTS

In the test set, the fused DLM detected 57 of the 67 BMs (mean volume: 0.99±4.24 cm3; sensitivity of 85.1%) while FP findings of

1.5 per scan were observed. Missed BMs had a significantly smaller volume (0.05±0.04 cm3) than detected BMs (0.96±2.4 cm3, P=.0009). Compared to the reference standard, automated segmentations achieved a median DSC of 0.72 and a good volumetric correlation (r=0.95). In the control set, 1.8 FPs/scan were observed.

CLINICAL RELEVANCE/APPLICATION

Without being impaired by a high number of FP findings, the proposed DLM can assist physicians by automated detection of BMs while providing 3D segmentation of BMs for lesion contouring in radiosurgery or for assessment of tumor burden.

NR01-A5   Calibrated Multiphase CT Angiography Perfusion (mCTA Perfusion) Thresholds For Acute Ischemic Stroke

Participants
Luis Souto Maior Neto, MSc, Calgary, Alberta (*Presenter*) Developer, Circle Cardiovascular Imaging Inc

PURPOSE

Multiphase CT Angiography (mCTA) is the addition of two low radiation CTA Head acquisitions to single phase CT angiography Head and Neck in acute ischemic stroke. The StrokeSENS mCTA Perfusion software uses mCTA to estimate CT perfusion (CTP) parameters (mCTA Perfusion). In this report, we validate a calibration process to improve the accuracy of perfusion maps derived from mCTA when compared to CTP.*Methods and Materials 390 studies with mCTA and CTP were included. TMAX perfusion maps were extracted using GE CTP 4D and StrokeSENS mCTA Perfusion. A derivation subset (n=312) was used to calibrate the mCTA TMAX predictions via optimization of thresholded map agreement. Thresholds ranging from 0 to 23 seconds were applied to both mCTA TMAX and CTP TMAX. For each threshold in the CTP TMAX, we evaluated the lesion volume mean absolute difference (MAD) in the corresponding mCTA TMAX maps at multiple threshold levels. A mapping from CTP lesion threshold to optimal mCTA lesion threshold based on the minimum lesion volume MAD was calculated and applied to calibrate the mCTA TMAX maps. In the remaining unseen 78 test cases, predicted mCTA and reference CTP maps were compared at a lesion threshold of TMAX>15.8s. Regional accuracy in estimating lesion was evaluated via ASPECTS AUC, and affected side prediction accuracy, and volumetric accuracy was evaluated via MAD and Intraclass Correlation Coefficient (ICC).*Results For both calibrated and non-calibrated algorithms, the affected side was predicted correctly in 100% of the cases. Significant improvement in lesion volume performance was observed with calibrated MAD (33ml) vs. non-calibrated MAD (46ml), one-sided t-test p-value<0.001. ICC improved from 60.3% (non-calibrated) to 77.9% (calibrated). Regional lesion estimation accuracy improved from an ASPECTS AUC of 85.9% (95% CI: [0.802,0.915]) non-calibrated to 91.9% (95% CI: [0.881,0.957]) on the calibrated TMAX map, with some overlap in the confidence interval range.*Conclusions Calibration during image post-processing improves estimation of TMAX maps derived from multiphase CT angiography when compared to CT perfusion.*Clinical Relevance/Application CT perfusion (CTP) is used to assess the extent and degree of severity of acute ischemic stroke in affected brain regions. CTP is often inaccessible outside large academic centres, needs expertise in acquiring and interpreting, and results in additional radiation and contrast exposure to the patient. Multiphase CTA, on the other hand, is an extension of standard care single-phase CTA, is widely available, requires no additional contrast and only minimal additional radiation. In this work, we show that Perfusion maps generated from mCTA post-processed via calibration are comparable to CTP Perfusion maps.

RESULTS

For both calibrated and non-calibrated algorithms, the affected side was predicted correctly in 100% of the cases. Significant improvement in lesion volume performance was observed with calibrated MAD (33ml) vs. non-calibrated MAD (46ml), one-sided t-test p-value<0.001. ICC improved from 60.3% (non-calibrated) to 77.9% (calibrated). Regional lesion estimation accuracy improved from an ASPECTS AUC of 85.9% (95% CI: [0.802,0.915]) non-calibrated to 91.9% (95% CI: [0.881,0.957]) on the calibrated TMAX map, with some overlap in the confidence interval range.

CLINICAL RELEVANCE/APPLICATION

CT perfusion (CTP) is used to assess the extent and degree of severity of acute ischemic stroke in affected brain regions. CTP is often inaccessible outside large academic centres, needs expertise in acquiring and interpreting, and results in additional radiation and contrast exposure to the patient. Multiphase CTA, on the other hand, is an extension of standard care single-phase CTA, is widely available, requires no additional contrast and only minimal additional radiation. In this work, we show that Perfusion maps generated from mCTA post-processed via calibration are comparable to CTP Perfusion maps.

NR01-A6   3D U-Net For Automated Detection Of Multiple Sclerosis Lesions

Participants
Stephen Wahlig, MD, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

To establish the effect of number of training cases on automated MS-lesion segmentation U-net performance.*Methods and Materials Sixty FLAIR sequences from MS follow-up studies from our institution were manually segmented and randomly split into 50 training studies and 10 test studies. A baseline 3D patch-based U-Net model for disease-invariant FLAIR lesion segmentation (Duong et al., 2019, AJNR), previously trained on 51 studies with varying pathologies causing FLAIR abnormality, was fine-tuned by training with varying numbers of MS-specific training data. As a comparison, the same U-Net architecture was trained from scratch with the same MS-specific training data. Performance of these models on the test data was assessed using the Dice coefficient (DSC) and lesion-wise sensitivity (L-Sens). L-Sens performance was also stratified by individual lesion size. Statistical analysis was performed with Wilcoxon signed rank tests (median DSC) and paired t-tests (mean L-Sens), with Bonferroni correction.*Results Compared to the baseline generic FLAIR model (DSC 0.40±0.21, L-Sens 0.38±0.14), using only 10 disease-specific training studies for either fine-tuning (0.59±0.15 p=0.006, 0.67±0.12 p<0.001) or for training a new model (0.56±0.16 p=0.007, 0.59±0.15 p=0.007) yielded significantly improved results in line with those in the published literature. Only slight further improvement was seen with 50 training studies for fine-tuning (0.66±0.12 p=0.12, 0.69±0.12 p=0.42) or a new model (0.65±0.13 p=0.03, 0.69±0.13 p=0.02). There was no significant difference in DSC between the fine-tuning and new model methods within each training set size (p>0.01) and a small but significant difference in L-Sens at 10 (fine-tune 0.67±0.12, new 0.59±0.15 p=0.004) and 20 training studies (0.62±0.14, 0.49±0.17 p=0.001). All models demonstrated improved L-Sens with increasing lesion size.*Conclusions An effective automated U-Net model for segmentation of MS-specific FLAIR lesions can be generated with as few as 10 manually segmented studies. There was a small but significant benefit to fine-tuning a baseline generic FLAIR model versus training a new model when using fewer than 30 training studies.*Clinical Relevance/Application This study explores how to use minimal manually segmented training data to create an effective automated model for detection of MS FLAIR lesions.

RESULTS

Compared to the baseline generic FLAIR model (DSC 0.40±0.21, L-Sens 0.38±0.14), using only 10 disease-specific training studies for either fine-tuning (0.59±0.15 p=0.006, 0.67±0.12 p<0.001) or for training a new model (0.56±0.16 p=0.007, 0.59±0.15 p=0.007) yielded significantly improved results in line with those in the published literature. Only slight further improvement was seen with 50 training studies for fine-tuning (0.66±0.12 p=0.12, 0.69±0.12 p=0.42) or a new model (0.65±0.13 p=0.03, 0.69±0.13 p=0.02). There was no significant difference in DSC between the fine-tuning and new model methods within each training set size (p>0.01) and a small but significant difference in L-Sens at 10 (fine-tune 0.67±0.12, new 0.59±0.15 p=0.004) and 20 training studies (0.62±0.14, 0.49±0.17 p=0.001). All models demonstrated improved L-Sens with increasing lesion size.

CLINICAL RELEVANCE/APPLICATION

This study explores how to use minimal manually segmented training data to create an effective automated model for detection of MS FLAIR lesions.

NR01-A7   Automated Correction Of Background Phase Error For Cerebrovascular 4D Flow MRI

Participants
Shanmukha Srinivas, La Jolla, California (*Presenter*) Nothing to Disclose

PURPOSE

During 4D Flow MRI acquisition, electromagnetic induced eddy currents may cause phase error. In this study, we assessed the impact of eddy current-related background phase error on flow measurement in the cerebral vasculature, evaluated the benefit of manual image-based correction, and developed a convolutional neural network (CNN) approach to automate correction for cerebrovascular 4D Flow MRI.*Methods and Materials This study was performed with IRB waiver of informed consent. We retrospectively identified 98 MRI exams from 48 patients with cerebral arteriovenous malformations undergoing 4D Flow MRI as part of routine clinical care at one institution from October 2015 to October 2020. Manual correction was performed using segmented static tissue. Data from 23 scans (11 patients) were reserved for testing. Remaining data was used to train a U-Net CNN. Volumetric flow measurements of the anterior, posterior, and venous circulation were performed to assess inflow-outflow consistency and the benefit of phase-error correction. Statistical analyses included Bland-Altman, F-tests, Wilcoxon-signed rank (WSR) tests and Spearman correlation.*Results For all patients, without correction, there was a difference (L/min) between inflow and outflow (median: -0.040, 95% CI: -0.208, 0.117) with the largest discrepancy in the venous circulation (median: -0.080, 95% CI: -0.273, 0.103). For each location, manual phase error correction improved inflow-outflow consistency with improved correlation (?=0.835-0.936 to ?=0.950-0.985) and decreased variance (p<0.001, F-test) between inflow and outflow. In the test cases, fully automated CNN correction was non-inferior to manual correction with no significant differences in variance (p=0.087, F-test), bias (p=0.802, WSR) or correlation (?=0.978 vs ?=0.987) for inflow and outflow measurements.*Conclusions We confirm that background phase error affects cerebrovascular flow volume measurements, and that agreement between inflow and outflow improves with both manual and CNN correction.*Clinical Relevance/Application Deep learning can facilitate phase error correction to improve cerebrovascular blood flow measurements within 4D Flow MRI. This may improve the availability of 4D Flow MRI for guiding clinical management of patients with cerebrovascular disease.

RESULTS

For all patients, without correction, there was a difference (L/min) between inflow and outflow (median: -0.040, 95% CI: -0.208, 0.117) with the largest discrepancy in the venous circulation (median: -0.080, 95% CI: -0.273, 0.103). For each location, manual phase error correction improved inflow-outflow consistency with improved correlation (?=0.835-0.936 to ?=0.950-0.985) and decreased variance (p<0.001, F-test) between inflow and outflow. In the test cases, fully automated CNN correction was non-inferior to manual correction with no significant differences in variance (p=0.087, F-test), bias (p=0.802, WSR) or correlation (?=0.978 vs ?=0.987) for inflow and outflow measurements.

CLINICAL RELEVANCE/APPLICATION

Deep learning can facilitate phase error correction to improve cerebrovascular blood flow measurements within 4D Flow MRI. This may improve the availability of 4D Flow MRI for guiding clinical management of patients with cerebrovascular disease.

NR01-A8   Appearance Of Medullary And Cortical Veins On Multiphase CT-angiography In Patients With Acute Ischemic Stroke

Participants
Aleksandr Drozdov, MD, El Paso, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Previous studies suggest reduced cortical (CV) or medullary venous (MV) drainage demonstrated on CT angiogram (CTA) can independently predict clinical outcomes in patients with acute ischemic stroke (AIS). We sought to determine if of the combined findings of reduced CV and MV drainage can provide a more accurate prediction of outcome in patients with AIS when compared to reduced CV or MV drainage alone.*Methods and Materials We retrospectively reviewed a database of patients with AIS in a middle cerebral artery (MCA) distribution, who were evaluated by multiphase CTA. The pre-treatment CTAs were reviewed, cortical veins were evaluated by adopted Prognostic Evaluation based on Cortical vein score difference In Stroke (PRECISE) system and MV were evaluated by the presence of asymmetry between hemispheres as we described in the previous publication. A good clinical outcome was defined as a Modified Rankin Scale (mRS) of 0-2 at 90 days.*Results 64 patients with MCA distribution AIS were included. The adopted PRECISE score was associated with a good clinical outcome in patients with AIS (OR=3.29; 95% CI: 1.16 - 9.30; p=0.023), and had a stronger association with clinical outcome (AUC=0.644) as compared to the asymmetry of MV (AUC=0.609). In a multivariable logistic regression model, the combined MV and the adapted PRECISE score were independently associated with clinical outcome. The multivariable model resulted in AUC=0.721.*Conclusions This study shows that 1) CV status, measured by adopted PRECISE score, is associated with clinical outcome in patients with AIS independently from MV status, 2) combined CV and MV status has a stronger predictor of clinical outcome compared to CV or MV status alone.*Clinical Relevance/Application In this report we were able to demonstrate that the cortical and medullary systems not only independently predict the clinical outcome, but that the combined status of the MV and CV significantly increase the accuracy of stratification for the clinical outcome. As far as we are aware, this observation has not been previously reported.

RESULTS

64 patients with MCA distribution AIS were included. The adopted PRECISE score was associated with a good clinical outcome in

patients with AIS (OR=3.29; 95% CI: 1.16 - 9.30; p=0.023), and had a stronger association with clinical outcome (AUC=0.644) as compared to the asymmetry of MV (AUC=0.609). In a multivariable logistic regression model, the combined MV and the adapted PRECISE score were independently associated with clinical outcome. The multivariable model resulted in AUC=0.721.

CLINICAL RELEVANCE/APPLICATION

In this report we were able to demonstrate that the cortical and medullary systems not only independently predict the clinical outcome, but that the combined status of the MV and CV significantly increase the accuracy of stratification for the clinical outcome. As far as we are aware, this observation has not been previously reported.

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![RSNA 2021 Redefining Radiology November 28 to December 2]

Abstract Archives of the RSNA, 2021

Sub-Events

PH04-A1 **Semantic Segmentation Of Multi-class Regions In Supine And Prone Breast Mr Images With Convolutional Neural Network**

Participants
Sungwon Ham, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate robust breast segmentation in breast MRI without considering supine and prone position using transfer learning with convolutional neural net (CNN).*Methods and Materials All the breasts flipped into right breast (N=116) of 29 patients with supine and prone MRIs were used. Prone-supine paired breast MRIs with T1-weighted contrast-enhanced images were acquired at XX. The four classes including lungs and heart, muscles and bones, parenchyma with cancer, and skin and fat were manually confirmed by an expert surgeon. Various kinds of semantic segmentations including 2D U-Net, 2D nnU-Net, 3D U-Net and 3D nnU-Net with each single breast MRI of supine, prone, transferred from prone to supine, and pooled supine and prone MRIs were trained and their performances of a test set were compared by evaluating Dice Similarity Coefficient (DSC), Jaccard Similarity Coefficient (JSC), and Hausdorff distance (HD).*Results The average DSCs of the lungs and heart, muscles and bones, parenchyma with cancer, and skin and fat were 0.987 ± 0.003, 0.966 ± 0.011, 0.870±0.085 and 0.956 ± 0.016 in prone and 0.988 ± 0.001, 0.953 ± 0.021, 0.8068 ± 0.115 and 0.943 ± 0.030 in supine of the pooled data of 2D U-Net. While there are significant differences among the 2D nnU-Net, 3D U-Net and 3D nnU-Net models, 2D U-Net with the pooled data shows significant better accuracies.*Conclusions 2D and 3D semantic segmentations with base U-Net, nnU-Net with or without considering supine and prone position were performed. 2D U-Net with the pooled data shows significant better accuracies, which could be used in the actual clinical settings.*Clinical Relevance/Application This automatic multi-class regions segmentation algorithm in breast MRIs will help to reduce time when printing models for volumetric analysis, 3D planning, 3D printing and virtual and augmented reality, which could be used to quantitatively evaluate changes in volume or area of ??tissues and cancer around the breast in time.

RESULTS

The average DSCs of the lungs and heart, muscles and bones, parenchyma with cancer, and skin and fat were 0.987 ± 0.003, 0.966 ± 0.011, 0.870±0.085 and 0.956 ± 0.016 in prone and 0.988 ± 0.001, 0.953 ± 0.021, 0.8068 ± 0.115 and 0.943 ± 0.030 in supine of the pooled data of 2D U-Net. While there are significant differences among the 2D nnU-Net, 3D U-Net and 3D nnU-Net models, 2D U-Net with the pooled data shows significant better accuracies.

CLINICAL RELEVANCE/APPLICATION

This automatic multi-class regions segmentation algorithm in breast MRIs will help to reduce time when printing models for volumetric analysis, 3D planning, 3D printing and virtual and augmented reality, which could be used to quantitatively evaluate changes in volume or area of ??tissues and cancer around the breast in time.

PH04-A10 **Evaluation Of Image Reconstruction Algorithms For A Helical Tomotherapy System**

Participants
Riley Tegtmeier, BS, Middleton, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate available image reconstruction algorithms on the Radixact helical tomotherapy system used in image-guided and adaptive radiation therapy.*Methods and Materials A Catphan CT image quality phantom was scanned across all available image acquisition modes and images were reconstructed using both the Standard filtered backprojection (FBP) and IR General iterative reconstruction (IR) algorithms available to the user. Image quality metrics including noise, uniformity, contrast, spatial resolution, mean CT numbers, and CT number linearity were evaluated and compared for both algorithms.*Results Application of the IR algorithm reduced noise levels by over 50% when compared to the FBP algorithm. IR performed best for contrast metrics, as contrast-to-noise ratio and low contrast visibility were both improved by at least a factor of two on average. Slight "capping" artifact was evident in both reconstructed sets, while FBP showed improved image uniformity as differences in CT numbers between periphery and center regions of interest in a homogenous phantom module were roughly half those seen in IR. Spatial resolution was also better for FBP, as average MTF values at both the 50% and 10% critical frequencies were improved by approximately 10-15%. Mean CT numbers for each algorithm differed by less than 1% on average across all phantom inserts, and both algorithms exhibited near perfect CT number linearity.*Conclusions The IR algorithm showed explicit improvement over the FBP algorithm for metrics most important to IGRT and ART - mainly image contrast and noise - allowing for improved target localization and contour refinement and reduced dosimetric uncertainties. While uniformity and spatial resolution were worse for IR, these values were still within vendor specifications and should not appreciably hinder the system in its uses. The algorithms performed equally well for CT number linearity, which is one possible indication of the ability to produce accurate dose calculations in a treatment planning system using these images.*Clinical Relevance/Application The addition of an IR algorithm is a notable improvement between Radixact and its predecessor, TomoTherapy. While both FBP and IR algorithms are available to the user for MVCT image reconstruction, the authors are not aware of any previous study that objectively compares the quality of reconstructed images for each method on this system. This work illustrates the overall improvement in image quality using the IR algorithm, a clear benefit to

any clinical routine. It is important to note as well that since all other imaging parameters remain the same between each algorithm, the application of IR allows for noise reduction and much improved image contrast without increasing imaging dose.

RESULTS

Application of the IR algorithm reduced noise levels by over 50% when compared to the FBP algorithm. IR performed best for contrast metrics, as contrast-to-noise ratio and low contrast visibility were both improved by at least a factor of two on average. Slight "capping" artifact was evident in both reconstructed sets, while FBP showed improved image uniformity as differences in CT numbers between periphery and center regions of interest in a homogenous phantom module were roughly half those seen in IR. Spatial resolution was also better for FBP, as average MTF values at both the 50% and 10% critical frequencies were improved by approximately 10-15%. Mean CT numbers for each algorithm differed by less than 1% on average across all phantom inserts, and both algorithms exhibited near perfect CT number linearity.

CLINICAL RELEVANCE/APPLICATION

The addition of an IR algorithm is a notable improvement between Radixact and its predecessor, TomoTherapy. While both FBP and IR algorithms are available to the user for MVCT image reconstruction, the authors are not aware of any previous study that objectively compares the quality of reconstructed images for each method on this system. This work illustrates the overall improvement in image quality using the IR algorithm, a clear benefit to any clinical routine. It is important to note as well that since all other imaging parameters remain the same between each algorithm, the application of IR allows for noise reduction and much improved image contrast without increasing imaging dose.

PH04-A11   Improvement Of Stent Image Quality In High-resolution Coronary Computed Tomography Angiography Using A New Deep Learning Image Reconstruction Algorithm

Participants
Fang Wang, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the performance of deep learning reconstruction technology (DLIR) for noise reduction in high resolution coronary stent imaging with 256 row detector CT.*Methods and Materials 25 stents of 14 patients undergoing coronary CT angiography (CCTA) using high resolution (Hi-Res) acquisition mode on a 256 row detector scanner (Revolution CT, GE Healthcare)were included in this study after PCI operation. Images were reconstructed with sharp kernels of detail, HD-detail and deep learning reconstruction respectively. In-stent contrast attenuation and image noise were assessed. CT value difference between inside stent and outside stent were calculated and compared among groups. Image quality was subjectively by two radiologists on a 5-points Likert scale(5 for excellence and 1 for poor). One-way ANOVA and Kruskall-Wallis test were used to compare quantitative and subjective data respectively; p value <0.05 was considered significant.*Results There was no significant difference in CT values between detail, HD-detail, DLIR-H among three reconstructions (108.44 ±94.28), (101.56 ±93.07), (97.09 ±51.95) (F = 0.145, P = 0.865). SD value was found the lowest in DLIR-H reconstruction group (31.32 ± 10.38), which was significantly different from those in detail (47.78 ±14.07) and HD-detail (77.24 ± 19.34) groups (F = 59.719, P1 < 0.001, P2 < 0.001, P3 < 0.001).Subjective image score of stent was found significantly different among three reconstruction groups(H=45.689, P<0.001).*Conclusions Compared with sharp kernels of Detail and HD-detail, deep learning reconstruction (DLIR) with high resolution acquisition mode can significantly reduce the image noise in stent lumen and improve the image quality of coronary stent.*Clinical Relevance/Application By reducing image noise, DLIR could expand the use of Hi-Res acquisition mode for CCTA in clinical routine and improve coronary stenosis depiction.

RESULTS

There was no significant difference in CT values between detail, HD-detail, DLIR-H among three reconstructions (108.44 ±94.28), (101.56 ±93.07), (97.09 ±51.95) (F = 0.145, P = 0.865). SD value was found the lowest in DLIR-H reconstruction group (31.32 ± 10.38), which was significantly different from those in detail (47.78 ±14.07) and HD-detail (77.24 ± 19.34) groups (F = 59.719, P1 < 0.001, P2 < 0.001, P3 < 0.001).Subjective image score of stent was found significantly different among three reconstruction groups(H=45.689, P<0.001).

CLINICAL RELEVANCE/APPLICATION

By reducing image noise, DLIR could expand the use of Hi-Res acquisition mode for CCTA in clinical routine and improve coronary stenosis depiction.

PH04-A12   Effect Of Deep Learning Reconstruction Algorithms On The Visualization Of Small-diameter Coronary Stents

Participants
Fang Wang, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the visibility of mall-diameter coronary stents under different levels of deep learning reconstruction algorithms using 256-detector CT scanner.*Methods and Materials 19 stents (<3mm) of 11 patients undergoing coronary CT angiography (CCTA) on a 256 row detector scanner (Revolution CT, GE Healthcare) were evaluated in this study. Images were reconstructed with three levels of deep learning reconstruction (DLIR-L, DLIR-M, DLIR-H) respectively. In-stent contrast attenuation and image noise were assessed. CT value difference between inside stent and outside stent were calculated and compared among groups. Image quality improved by removing the hardening beam artifacts was subjectively evaluated by two radiologists on a 5-points Likert scale (5 for excellence and 1 for poor). One-way ANOVA and Kruskall-Wallis test were used to compare quantitative and subjective data respectively; p value <0.05 was considered significant.*Results Interobserver agreement was excellent regarding image quality (kappa=0.84). Image quality in DLIR-H group (4.47±0.61) was significantly better than that in DLIR-M group (3.95±0.78) and DLIR-L group (3.16±0.60), (H=22.916, P<0.001).There was no significant difference in the CT attenuation difference inside stent and outside stent among groups (108.41±51.76 vs 102.01± 49.64 vs 101.65±57.90)(F = 0.097, P = 0.908).In-stent noise decreased with the increase of reconstruction intensity (52.51±15.79 vs 42.11±15.42 vs 33.34±12.01) (P = 0.095, P < 0.001, P = 0.204).*Conclusions High level of deep learning reconstruction (DLIR-H) can significantly remove the hardening beam artifacts of small-diameter coronary stents and improve in-stent luminal visualization and image quality.*Clinical Relevance/Application Deep learning reconstruction algorithm is a better way to enhance the in-stent assessment while decreasing image noise and artifact.

RESULTS

Interobserver agreement was excellent regarding image quality (kappa=0.84). Image quality in DLIR-H group (4.47±0.61) was

interobserver agreement was excellent regarding image quality (kappa=0.84). Image quality in DLIR-H group (4.47±0.61) was significantly better than that in DLIR-M group (3.95±0.78) and DLIR-L group (3.16±0.60), (H=22.916, P<0.001).There was no significant difference in the CT attenuation difference inside stent and outside stent among groups (108.41±51.76 vs 102.01± 49.64 vs 101.65±57.90)(F = 0.097, P = 0.908).In-stent noise decreased with the increase of reconstruction intensity (52.51±15.79 vs 42.11±15.42 vs 33.34±12.01) (P = 0.095, P < 0.001, P = 0.204).

CLINICAL RELEVANCE/APPLICATION

Deep learning reconstruction algorithm is a better way to enhance the in-stent assessment while decreasing image noise and artifact.

PH04-A3   A Novel Deep Learning Pipeline For Simultaneous Segmentation Of Lung And COVID-19 Involvement In Thoracic CT Scans

Participants
Elise Katsnelson, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

To develop a fast and efficient deep learning model for segmenting total lung tissue and lung tissue diseased with COVID-19 on thoracic CT scans via a novel dual-headed U-Net architecture.*Methods and Materials A dataset of 31 thoracic CT scans (each with approximately 500 slices) from 18 patients were manually segmented for lung tissue and COVID-19 involvement by a trained expert radiologist. Features associated with COVID-19 disease were identified, including ground glass opacity, consolidation, linear/reticular opacities, crazy paving, nodules, and architectural distortions. Subsequently, a novel deep learning pipeline was developed by using a modified two-headed U-Net architecture for automatic, simultaneous segmentation of lung tissue and COVID-19 involvement for each input slice of the CT scan, and was trained and evaluated on this data set (split up into training, validation, and testing subsets). The Dice similarity coefficient from the testing subset was used as a measure of accuracy for this model. After training and evaluation, this model was then used to automatically segment the lungs and COVID-19 involvement on 865 thoracic CT scans, and quantitative features, such as shape, intensity, texture, and ratio of diseased to total tissue, were extracted to make clinically useful recommendations.*Results The Dice coefficients for the dual-segmentation U-Net model were 0.91 for the total lung tissue and 0.55 for COVID-19 involvement.*Conclusions Given the variation of COVID-19 segmentations amongst radiologists due to its many presentations, the novel U-Net architecture provides adequate and streamlined automatic simultaneous segmentations of the lungs and COVID-19 involvement for thoracic CT scans. This approach provides potential for faster and more efficient COVID-19 diagnostic performance without compromising cost.*Clinical Relevance/Application Due to the urgency and strained resources caused by the COVID-19 pandemic, there is a need to make efficient and rapid decisions to inform patient care and treatment based on the extent of COVID-19 severity and presentation to ensure hospital preparedness, minimize the length of hospital stay, and optimize care.

RESULTS

The Dice coefficients for the dual-segmentation U-Net model were 0.91 for the total lung tissue and 0.55 for COVID-19 involvement.

CLINICAL RELEVANCE/APPLICATION

Due to the urgency and strained resources caused by the COVID-19 pandemic, there is a need to make efficient and rapid decisions to inform patient care and treatment based on the extent of COVID-19 severity and presentation to ensure hospital preparedness, minimize the length of hospital stay, and optimize care.

PH04-A5   Effects Of Megavoltage Cross-scatter On Kilovoltage CBCT Image Quality In Image Guided Radiation Therapy

Participants
Farhang Bayat, Aurora, Colorado (*Presenter*) Nothing to Disclose

PURPOSE

Target tracking during image-guided radiation delivery is an active area of research to improve accuracy of radiation delivery. While 2D-3D kilovoltage (kV) imaging can be used for real-time target tracking during treatment delivery, the detrimental effects of megavoltage (MV) cross-scatter can degrade the quality of kV images and visualization of targets. Thus, in this work, we studied the effects of MV cross-scatter both in kV projections and CBCT reconstructions.*Methods and Materials A Varian TrueBeam linac was operated in Developer Mode to deliver MV beams during kV CBCT acquisitions in offset kV detector geometry. Using pelvis-sized phantoms, two sets of kV CBCT projections were acquired, one with and one without MV beam delivery during CBCT scans. To study MV cross-scatter, 200 cGy was delivered at isocenter using 3X3 and 15X15 cm2 field sizes. Experiments were repeated using 6 and 10 MV beams, and flattening filter free (FFF) modes. For evaluations, MV scatter to kV intensity ratio (MVkV-Ratio) was calculated in projections. In addition, contrast-to-noise (CNR) and Hounsfield Unit (HU) loss due to MV cross-scatter were calculated in CBCT images.*Results For 3X3 field size, MVkV-ratio varied between 0.1-1 for all MV beam energies. When field size was increased to 15X15, MVkV-ratio increased by a factor of 14-39, and it was in the range of 4-10. 6 MV beam yielded the highest scatter intensity in experiments using FFF. For 15X15 field, MV-cross scatter introduced severe cupping artifacts in CBCT images. CNR loss was in the range of 60- 88% and HU loss was in the range of 263-457.*Conclusions Our study indicates that MV cross-scatter has significant impact on kV image quality. Robust MV cross-scatter mitigation methods are needed to be able to perform real-time kV imaging during MV beam delivery. While our study employed static MV beams, effect of dynamic beam delivery in the context of stereotactic body radiation therapy will also be investigated in feature experiments.*Clinical Relevance/Application This work characterizes the detrimental effects of MV cross-scatter on kV CBCT image quality during intra-beam delivery kV CBCT scans in radiation therapy.

RESULTS

For 3X3 field size, MVkV-ratio varied between 0.1-1 for all MV beam energies. When field size was increased to 15X15, MVkV-ratio increased by a factor of 14-39, and it was in the range of 4-10. 6 MV beam yielded the highest scatter intensity in experiments using FFF. For 15X15 field, MV-cross scatter introduced severe cupping artifacts in CBCT images. CNR loss was in the range of 60- 88% and HU loss was in the range of 263-457.

CLINICAL RELEVANCE/APPLICATION

This work characterizes the detrimental effects of MV cross-scatter on kV CBCT image quality during intra-beam delivery kV CBCT

scans in radiation therapy.

PH04-A6 The Application Value Of Artificial Intelligence In Vessel Identification And Stenosis Diagnosis In Coronary CT Angiography

Participants
Shumeng Zhu, Xi'an, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the application value of artificial intelligence (AI) in automatically identifying coronary arteries and significant stenosis diagnosis in coronary CT angiography (CCTA).*Methods and Materials 60 patients (aged 54.90±10.81y, weight 61.39±11.90kg, and BMI 23.56±2.76 kg/m2) with suspected coronary heart disease for CCTA were enrolled. Patients underwent CCTA on a 256-row Revolution CT with 100kVp, automatic tube current. Images were reconstructed at 0.625mm with 70%ASIR-V and were transferred to a CAD AI Assisted Diagnosis System (CAD-AI-ADS). CAD-AI-ADS automatically processed the CCTA images to perform coronary artery segmentation and stenosis diagnosis. Meanwhile, manual image processing and stenosis diagnosis of coronary arteries were performed by 2 radiologists independently, and the results were used as reference standard for evaluating the ability of CAD-AI-ADS to recognize the right coronary artery (RCA), left anterior descending (LAD) and left circumflex (LCX), and the diagnostic ability of more than 50% stenosis in RCA (proximal, middle and distal), LAD (proximal, middle and distal) and LCX (proximal, mid-distal).*Results In total there were 480 vessel segments. CAD-AI-ADS performed significantly faster than radiologists in identifying coronary arteries (0.41±0.89 vs 7.35±2.64min, p < 0.001). The image processing accuracy of CAD-AI-ADS for identifying and segmenting RCA, LAD and LCX and their branches was 96.67%, 96.67% and 93.33%, respectively. The diagnostic accuracy, sensitivity and specificity of CAD-AI-ADS for coronary arteries with more than 50% stenosis were 85.21%, 57.76% and 93.96%, respectively. The positive predictive value and negative predictive value were 75.28% and 87.47%, respectively.*Conclusions Compared with image processing by radiologists, CAD-AI-ADS can significantly improve work efficiency on the basis of ensuring the same recognition accuracy. However, the sensitivity of CAD-AI-ADS for diagnosing coronary arteries with more than 50% stenosis is relatively low, and there is a certain rate of missed diagnosis, which still needs to be reviewed by doctors.*Clinical Relevance/Application CAD-AI-ADS can significantly improve work efficiency on the basis of ensuring the same recognition accuracy.

RESULTS

In total there were 480 vessel segments. CAD-AI-ADS performed significantly faster than radiologists in identifying coronary arteries (0.41±0.89 vs 7.35±2.64min, p < 0.001). The image processing accuracy of CAD-AI-ADS for identifying and segmenting RCA, LAD and LCX and their branches was 96.67%, 96.67% and 93.33%, respectively. The diagnostic accuracy, sensitivity and specificity of CAD-AI-ADS for coronary arteries with more than 50% stenosis were 85.21%, 57.76% and 93.96%, respectively. The positive predictive value and negative predictive value were 75.28% and 87.47%, respectively.

CLINICAL RELEVANCE/APPLICATION

CAD-AI-ADS can significantly improve work efficiency on the basis of ensuring the same recognition accuracy.

PH04-A8 Personalized Quantitative Perfusion MRI Parametric Mapping Using High Spatiotemporal Resolution Grasp And Patient-specific Estimation Of The Arterial Input Function In Gynecologic Tumors

Participants
Yousef Mazaheri, PhD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To develop a personalized quantitative dynamic contrast enhanced MRI (DCE-MRI) technique using golden-angle radial sparse parallel MRI (GRASP) with high spatial and temporal resolution and estimation of arterial input function (AIF) directly from the data in each patient.*Methods and Materials Six patients referred for pelvic MRI to assess gynecologic cancer were included in this IRB approved single institution prospective study. DCE-MRI was performed with a 3T MRI scanner (MR750w, GE Healthcare) using the GRASP technique and retrospective image reconstruction of image series at dual temporal resolution (1 s/frame and 5 s/frame). A 4D (3D+time) supervoxel method was used to cluster voxels within the tumor volume based on both contrast enhancement patterns and spatial distance. Joint estimation of AIF and pharmacokinetic parameters was achieved with an algorithm that iteratively alternates between estimation of AIF and pharmacokinetic parameters constructed based on images reconstructed at 1 s/frame. Voxelwise pharmacokinetic analysis using extended Tofts model was performed with images reconstructed at 5 s/frame using cluster-specific AIF. Maps of volume transfer constant (Ktrans), extravascular extracellular fractional volume (ve), and blood plasma volume fraction (vp) were generated.*Results The use of dual temporal resolution of 1-5 s/frame yield less than 5% error in the estimation of pharmacokinetic parameters. Using personalized AIF, the normalized root-mean-square error (mean ± std. dev.) was 0.16±0.04 as compared to 0.22±0.05 using population-averaged AIF. The figure demonstrates the ability of patient specific AIF to 1) better account for tumor heterogeneity as demonstrated by the higher dynamic range of Ktrans and kep maps and higher count of non-zero vp voxels and 2) improved goodness of fit as demonstrated by near zero nRMSE values for most voxels for patient-specific AIF.*Conclusions The proposed patient-specific GRASP results in pharmacokinetic model parameter estimates which are less biased as compared to population-averaged AIF. The spatial-temporal characteristics of localized AIF could provide information regarding the network organization of the tumor microvasculature that leads to contrast agent transport.*Clinical Relevance/Application This work represents a step toward promoting GRASP as a one-stop-shop approach for quantitative DCE-MRI and alleviating the need for population-based AIF, the highest sources of quantitative DCE-MRI bias.

RESULTS

The use of dual temporal resolution of 1-5 s/frame yield less than 5% error in the estimation of pharmacokinetic parameters. Using personalized AIF, the normalized root-mean-square error (mean ± std. dev.) was 0.16±0.04 as compared to 0.22±0.05 using population-averaged AIF. The figure demonstrates the ability of patient specific AIF to 1) better account for tumor heterogeneity as demonstrated by the higher dynamic range of Ktrans and kep maps and higher count of non-zero vp voxels and 2) improved goodness of fit as demonstrated by near zero nRMSE values for most voxels for patient-specific AIF.

CLINICAL RELEVANCE/APPLICATION

This work represents a step toward promoting GRASP as a one-stop-shop approach for quantitative DCE-MRI and alleviating the need for population-based AIF, the highest sources of quantitative DCE-MRI bias.

Abstract Archives of the RSNA, 2021

Sub-Events

NMMI03-D2 **Impact Of Hypothyroidism Status On Renal Function Prior To Radioiodine Remnant Ablation In Patients With Differentiated Thyroid Carcinoma.**

Participants
Jaime Amaya Saumet, MD, Palma de Mallorca, Spain (*Presenter*) Nothing to Disclose

PURPOSE

Achieving the elevation of thyroid stimulating hormone (TSH) prior to ablative treatment of differentiated thyroid cancer (DTC), must be caused either by suspending replacement therapy with maintenance with Liothyronine (LT3) or by administering parenteral human recombinant TSH (rhTSH). It is known that hypothyroidism leads to a decrease in the glomerular filtration rate (GFR), so we wanted to compare its impact according to the protocol used.*Methods and Materials We carried out a retrospective study of 192 patients (W: 151, M: 41, Mean age: 45 years) since 2014, with a histological diagnosis of DTC referred to the Nuclear Medicine Service of the Hospital Universitario Son Espases for radioiodine ablation of remnant thyroid tissue. 49 patients with the rhTSH protocol (Group A) and 143 with the TL3 protocol (Group B) were selected with three different regimens of substitution treatment (B1:45comp [43], B2:30comp [50], B3:20comp [50]). The GFR was calculated with the MDRD-4 formula prior to therapy (FG?), on the day of treatment (GFR?) and at 6 months (GFR??) with dosimetric recording during their hospitalization.*Results The decrease in the FG? is 2% in Group A and 19.2% in Group B. The variation of the GF?/FG? was less than 1mL/min/1.73m2 in Group A while Group B presented a decrease close to 3mL/min/1.73m2, being the subgroup B1 the one that presented the greatest decrease (6mL/min/1.73m2). The lowest GFR showed an elimination of less than 50% at 48 hours, which for some cases and depending on the dose, imply exceeding the recommended limits. Radiopharmaceutical was slightly higher in Group A.*Conclusions The faster elimination in Group A seems to depend only on the absence of deterioration of the GFR. Low GFR should be avoided, administering rhTSH in patients with borderline rate and reducing the dose in patients with a low baseline GFR.*Clinical Relevance/Application The functional impact of this research will allow establishing an individualized and more efficient protocol for each of these patients.

RESULTS

The decrease in the FG? is 2% in Group A and 19.2% in Group B. The variation of the GF?/FG? was less than 1mL/min/1.73m2 in Group A while Group B presented a decrease close to 3mL/min/1.73m2, being the subgroup B1 the one that presented the greatest decrease (6mL/min/1.73m2). The lowest GFR showed an elimination of less than 50% at 48 hours, which for some cases and depending on the dose, imply exceeding the recommended limits. Radiopharmaceutical was slightly higher in Group A.

CLINICAL RELEVANCE/APPLICATION

The functional impact of this research will allow establishing an individualized and more efficient protocol for each of these patients.

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PD04-C

Pediatric Wednesday Poster Discussions

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Sub-Events

PD02-A1   Ultralow Dose Computed Tomography For The Evaluation Of Pediatric Pectus Excavatum: Evaluation Of Radiation Dose, Image Quality And Diagnostic Performance.

Participants
Sebastian Gallo-Bernal, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To compare the radiation dose, image quality, and diagnostic performance of a new ultralow (UL) dose protocol versus standard thoracic CT for the evaluation of pediatric patients with pectus excavatum*Methods and Materials In this IRB approved and HIPPA compliant retrospective study, we searched electronic health records (EHR) to identify all pediatric patients who underwent a CT (standard or UL) as part of the standard of care evaluation of pectus excavatum between 2010-20. The UL protocol consisted of a low voltage (70-90 kV) and low current (50 mAs) setting with iterative construction. An equal number of standard and UL CT scans were included. EHR imaging and clinical follow up were reviewed for at least 1 year after CT to evaluate for potentially missed thoracic pathology. Size-specific dose estimates and effective radiation doses were calculated following AAPM guides. Signal to noise and contrast to noise ratios were calculated. Subjective image quality was assessed by 2 expert radiologists using a 5 point Likert scale. Variables were compared using parametric and non-parametric tests in R v.4.0.5*Results 208 pectus excavatum thoracic CTs [104 UL (age 14.14±2.15); 104 standard (age 14.84±2.7)] corresponding to 174 patients were included for analysis. The UL group had statistically significant reductions (p<0.001) in effective radiation dose (0.144 vs 1.075 mSv) and SSDE (0.504 vs. 3.434 mGy) compared with the standard protocol. Objective (SNR (23.7 vs 34.9) and CNR (21.6 vs 38.4)) and subjective measures of image quality (bone (4.0 vs 4.6), lung (3 vs 4.4) and soft tissue (2.2 vs 3.8)) were also significantly different (p<0.001). No differences were seen in the pulmonary nodules' number and size (1.36 ± 0.56 vs 1.54 ± 0.88 nodules per scan; nodule size 4.5±0.96 vs 4.4±1.5 mm). Clinical and imaging follow up (clinical follow up 19.83 ± 12.4 mos; imaging follow up 11.17±8.85 mos) of all 104 patients undergoing UL CT demonstrated no evidence of symptomatic thoracic pathology besides pectus. 46/104 of UL CT patients underwent a follow up thoracic CT within 36 mos; 6 patients had pulmonary nodules. A single 2 mm pulmonary nodule was seen on follow up CT not visible on the UL CT performed 6 months prior: all other nodules on the follow up CT were present on the original UL CT and unchanged in size (10 nodules; diameter 4.5 mm)*Conclusions Ultralow dose thoracic CT is a viable option for imaging pediatric patients with pectus excavatum, with effective radiation dose comparable to chest radiographs and mild increase in image noise that did not significantly reduce detection of thoracic pathology including small pulmonary nodules.*Clinical Relevance/Application UL pediatric thoracic CT can be adopted in routine clinical practice for specific indications including pectus excavatum

RESULTS

208 pectus excavatum thoracic CTs [104 UL (age 14.14±2.15); 104 standard (age 14.84±2.7)] corresponding to 174 patients were included for analysis. The UL group had statistically significant reductions (p<0.001) in effective radiation dose (0.144 vs 1.075 mSv) and SSDE (0.504 vs. 3.434 mGy) compared with the standard protocol. Objective (SNR (23.7 vs 34.9) and CNR (21.6 vs 38.4)) and subjective measures of image quality (bone (4.0 vs 4.6), lung (3 vs 4.4) and soft tissue (2.2 vs 3.8)) were also significantly different (p<0.001). No differences were seen in the pulmonary nodules' number and size (1.36 ± 0.56 vs 1.54 ± 0.88 nodules per scan; nodule size 4.5±0.96 vs 4.4±1.5 mm). Clinical and imaging follow up (clinical follow up 19.83 ± 12.4 mos; imaging follow up 11.17±8.85 mos) of all 104 patients undergoing UL CT demonstrated no evidence of symptomatic thoracic pathology besides pectus. 46/104 of UL CT patients underwent a follow up thoracic CT within 36 mos; 6 patients had pulmonary nodules. A single 2 mm pulmonary nodule was seen on follow up CT not visible on the UL CT performed 6 months prior: all other nodules on the follow up CT were present on the original UL CT and unchanged in size (10 nodules; diameter 4.5 mm)

CLINICAL RELEVANCE/APPLICATION

UL pediatric thoracic CT can be adopted in routine clinical practice for specific indications including pectus excavatum

PD02-A2   Developmental Dysplasia Of The Hip: A Plain Film Deep Learning Approach

Participants
Marcelo Takahashi, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

To develop an artificial intelligence algorithm capable of automatically classifying pediatric frontal hip plain films as either well positioned or rotated, measure the acetabular index, identify the location of femoral head ossification center and generate an overlay of the Hilgenreiner and line and Perkins.*Methods and Materials This is an ongoing IRB approved research. Two hundred and fity hip plain films of children between 0 and 36 months of age (mean 28 months), 181 female and 119 male, were retrieved from PACS. The images were manually annotated (masks of the iliac bones, femoral head ossification centers, obturator foramina and coordinates for the lateral and medial borders of the acetabular roofs) by two radiologists. Two hundred labelled images were utilized for training an AI algorithm based on the popular U-net architecture and the remaining 50 labelled images were utilized for testing. Algorithm's output was set as both an overlay image with calculated acetabular index as well as a rotation index (based on the ratio of iliac bones areas and obturator foramina areas).*Results One exam was excluded from test set due to poor quality. Iliac

bone, obturator foramen and femoral head segmentation was considered adequate for 47/49 test exams.Automated acetabular index had a good correlation with manually calculated acetabular index, with a Spearmans correlation of 0.707.*Conclusions Although this AI model is still in a very initial stage, it has already demonstrated the capacity of not only identifying missaligned pediatric hip plain films (by comparing the area of the iliac bones and obturator foramina) but also the capacity of automatically plotting the main radiologic lines and calculating the acetabular index.*Clinical Relevance/Application With further research and a larger dataset as to improve generalization our algorithm could be used as a helpfull tool for the evaluation of hip dysplasia in locations were radiologic and/or orthopedi image consultation is not feasible

RESULTS

One exam was excluded from test set due to poor quality. Iliac bone, obturator foramen and femoral head segmentation was considered adequate for 47/49 test exams.Automated acetabular index had a good correlation with manually calculated acetabular index, with a Spearmans correlation of 0.707.

CLINICAL RELEVANCE/APPLICATION

With further research and a larger dataset as to improve generalization our algorithm could be used as a helpfull tool for the evaluation of hip dysplasia in locations were radiologic and/or orthopedi image consultation is not feasible

PD02-A3   Imaging The Pediatric Mandible

Participants
Jacob McCallum, DO, Grand Rapids, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to:Review common and uncommon conditions affecting the mandible in pediatrics

TABLE OF CONTENTS/OUTLINE

Conditions that affect the mandible in infancy. For example Caffey disease and child abuseConditions that affect the mandible in older children and young adults. Benign odontogenic lesions: bacterial osteomyelitis/periapical abscess, dentigerous cyst, ameloblastoma.Malignant odontogenic: ameloblastic carcinomaBenign non-odontogenic: fibrous dysplasia, cherubism, juvenile ossifying fibroma, central giant cell granuloma, chronic nonbacterial osteomyelitisMalignant non-odontogenic: Ewing sarcoma, neuroblastoma, leukemia/lymphomaConditions that affect the temporomandibular joint. For example juvenile idiopathic arthritis, non-inflammatory disk disease, idiopathic condylar resorption, unilateral condylar hyperplasia .

PD02-A4   Skeletal Dysplasia Families: A Comprehensive Review

Awards
Identified for RadioGraphics

Participants
Atsuhiko Handa, MD, Iowa City, Iowa (*Presenter*) Nothing to Disclose

TEACHING POINTS

Skeletal dysplasias encompass a heterogeneous group of over 400 disorders. They are individually rare, but collectively common with an approximate incidence of 1/5000; thus, radiologists occasionally encounter skeletal dysplasias in daily practice. Most skeletal dysplasias have their characteristic pattern of skeletal changes, and the diagnosis rests on pattern recognition. A group of skeletal dysplasias that share a distinctive radiological pattern can be grouped into a "skeletal dysplasia family" that generally shares a common pathogenesis. Since major skeletal dysplasia families are limited in number, the radiologists can become readily familiar with their diagnostic patterns. The purpose of this exhibit is to 1) demonstrate the radiological characteristics of major skeletal dysplasia families and 2) review their clinical and genetic features that help radiologists to participate in multidisciplinary care. After completion of this presentation, the learners will have an overall picture of the entire world of skeletal dysplasias.

TABLE OF CONTENTS/OUTLINE

- Introduction - Approach to skeletal dysplasias - FGFR3 (achondroplasia) family - COMP family - Type II collagenopathies - Dysostosis multiplex family (mucopolysaccharidoses and mucolipidoses) - TRPV4 (metatropic dysplasia) family - Skeletal ribosomopathies (eg. Schwachman Diamond) - DTDST (diastrophic dysplasia) family - Filaminopathies - Punctata group - Skeletal ciliopathies - Osteogenesis imperfecta group - Osteopetrosis group

Abstract Archives of the RSNA, 2021

IN04-A

Informatics Wednesday Poster Discussions

Sub-Events

IN04-A1 **Visual Transformers Do Not Outperform Convolutional Neural Networks For Disease Detection In Chest Radiographs**

Participants
Zachary Murphy, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Recently, visual transformer (VT) architectures have shown better classification performance than convolutional neural networks (CNN) on general image datasets like ImageNet. However, it is unclear how well these VT models perform in medical imaging tasks, such as disease detection in chest radiographs (CXRs).In this work, we performed extensive tuning of CNN and VT models on publicly available CXR datasets for detection of 14 diseases and compared their performance on internal and external datasets.*Methods and Materials We compared DenseNet121 CNN and Facebook's Data-efficient Image Transformers (DeiT) VT architectures, both pre-trained on ImageNet. We chose DenseNet121, as it forms the basis of CheXnet, a well-known model for detection of diseases in CXRs with benchmark comparisons to other state of the art models. The DeiT model is one of the first VTs that performs well on ImageNet without large amounts of data.We fine tuned these models on the NIH CXR14 dataset containing 112,120 CXRs annotated for 14 disease labels. Data were split into train, validation, and test subsets according to a 70/10/20% split. After hyperparameter optimization with grid search on train and validation sets, final models were trained by combining the train and validation sets. Test performance was assessed on the held-out NIH CXR14 test set and external datasets of 25,000 images each from CheXpert, PadChest, and MIMIC datasets.For each set, we calculated AUC for detection of each label and the prevalence-weighted average with confidence intervals using 1,000-sample bootstrapping. Time required for model training was also evaluated.*Results The DeiT model had a weighted AUC of 0.777 on the internal NIH CXR14 test set, while the DenseNet121 model had a higher weighted AUC of 0.789 (p<0.001). Performance on individual classes showed similar differences, with DeiT performing at or below DenseNet121 for each label (Figure 1A).Similar findings were observed on the external test sets (Figures 1B, C, & D), with DeiT weighted AUC 0.003 to 0.012 lower than DenseNet121 with non-overlapping confidence intervals.The DeiT and DenseNet 121 models took an average of 72.6 and 34.3 minutes/epoch, respectively, on a Quadro RTX 5000 GPU.*Conclusions The DeiT VT model performed marginally worse than the DenseNet121 model on internal and external test sets. Furthermore, DeiT models required >2x the amount of time to train per epoch. While VTs have shown improvements over CNNs in general imaging datasets, our results suggest that they may not yet be ready to replace CNNs in CXR disease detection.*Clinical Relevance/Application While recent advances are promising, VTs may not be ready to replace convolutional models for medical domain-specific tasks such as chest radiograph disease detection.

RESULTS

The DeiT model had a weighted AUC of 0.777 on the internal NIH CXR14 test set, while the DenseNet121 model had a higher weighted AUC of 0.789 (p<0.001). Performance on individual classes showed similar differences, with DeiT performing at or below DenseNet121 for each label (Figure 1A).Similar findings were observed on the external test sets (Figures 1B, C, & D), with DeiT weighted AUC 0.003 to 0.012 lower than DenseNet121 with non-overlapping confidence intervals.The DeiT and DenseNet 121 models took an average of 72.6 and 34.3 minutes/epoch, respectively, on a Quadro RTX 5000 GPU.

CLINICAL RELEVANCE/APPLICATION

While recent advances are promising, VTs may not be ready to replace convolutional models for medical domain-specific tasks such as chest radiograph disease detection.

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Abstract Archives of the RSNA, 2021

GU04-B

Genitourinary Wednesday Poster Discussions

Sub-Events

GU04-B1   Prospective Validation Of The Novel Scoring System For Prostate Cancer Recurrence Detection: The Prostate Imaging For Local Recurrence Reporting, PI-RR

Participants
Martina Pecoraro, MD, Roma, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To prospectively validate a recently released scoring system (PI-RR) for the standardized interpretation and reporting of prostate cancer (PCa) local recurrence diagnosis after radical prostatectomy (RP) and radiation therapy (RT).*Methods and Materials Patients with clinical suspicion of prostate cancer recurrence (diagnosis of biochemical recurrence or PSA above nadir or according to risk grouping) were enrolled and underwent mpMRI of the prostatic bed/prostate. Two radiologists independently analyzed the images using the novel Prostate Imaging for local Recurrence Reporting (PI-RR). According to the PI-RR a cutoff = 3 and 4 was set for suspicion of recurrence. Follow-up, histopathology, when available, and nuclear medicine modalities were used as standard of reference.*Results A total of 77 patients were enrolled. Multiparametric MRI showed a sensitivity, specificity, PPV, and NPV for recurrence detection of 88.5% (95% confidence interval [CI]: 79.2-95.4), 93.5% (95% CI: 87.9-96.7), 73.9% (95% CI: 62.5-85.6), and 78.9% (95% CI: 84.3-88.2), respectively. The area under the curve (AUC) was 0.89 (95% CI: 0.86-0.95). Minimum follow-up was of 12 months.*Conclusions Detection of prostate cancer local recurrence is crucial to guide treatment decisions. PI-RR proved to be an accurate tool for recurrence detection, improving patient's management.*Clinical Relevance/Application PI-RR proved to be a valuable guide to improve the management of men with recurrent prostate cancer by achieving better diagnostic performance and personalized treatment tailored to the specific patients.

RESULTS

A total of 77 patients were enrolled. Multiparametric MRI showed a sensitivity, specificity, PPV, and NPV for recurrence detection of 88.5% (95% confidence interval [CI]: 79.2-95.4), 93.5% (95% CI: 87.9-96.7), 73.9% (95% CI: 62.5-85.6), and 78.9% (95% CI: 84.3-88.2), respectively. The area under the curve (AUC) was 0.89 (95% CI: 0.86-0.95). Minimum follow-up was of 12 months.

CLINICAL RELEVANCE/APPLICATION

PI-RR proved to be a valuable guide to improve the management of men with recurrent prostate cancer by achieving better diagnostic performance and personalized treatment tailored to the specific patients.

GU01-A

Genitourinary Sunday Poster Discussions

Sub-Events

GU01-A3   **Application Value Of 3D Isotropic T2 Weighted Images For Assessing Vaginal Fornix Invasion Of Cervical Cancer**

Participants
Xing Meng, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the value of curved planar reformation (CPR) on 3D isotropic (3D-ISO) T2WI imaging for assessing vaginal fornix invasion of cervical cancer.*Methods and Materials 33 cervical cancer patients with cervical cancer confirmed by pathology admitted were enrolled in this study. All patients underwent 2D sagittal T2WI and 3D-ISO T2WI scans on Ingenia 3.0T CX (Philips Healthcare, Best, the Netherlands) scanner, and CPR on 3D-ISO was performed on Philips IntelliSpace Portal workstation. Two physicians evaluated whether the uterine fornix of cervical cancer patients was involved in the 3D-ISO CPR image and T2WI sagittal image, respectively, and compared the results with the postoperative pathology to observe the accuracy of the 3D-ISO sequence curved reconstruction in the diagnosis of vaginal fornix involvement. The ?2 test was used to compare the results of the two groups.*Results Compared with T2WI, there were truer positive (4 vs. 6) and true negatives (20 vs. 22) cases in the 3D-ISO assessment of vaginal fornix invasion, and fewer false positive (6 vs. 4) and false negative (3 vs. 1) cases. The accuracy of 3D-ISO sequence and T2WI were 84.85% and 72.73%, the sensitivity was 85.71% and 57.14%, and the specificity was 84.62% and 76.92%, respectively. The accuracy, sensitivity and specificity of 3D-ISO sequence were higher than that of T2WI. There was no statistically significant difference (P > 0.05).*Conclusions CPR on 3D-ISO T2WI has considerable clinical value for diagnosis of vaginal fornix invasion of cervical cancer, which provides a reliable reference for clinical pathological staging and treatment plan, and is worthy to be promoted in clinical experiment.*Clinical Relevance/Application Compared with 2D T2WI, 3D-ISO T2WI CPR is more accurate in the assessment of vaginal fornix involvement and can help in the staging of cervical cancer, which is of great value in the accurate formulation of treatment plan.

RESULTS

Compared with T2WI, there were truer positive (4 vs. 6) and true negatives (20 vs. 22) cases in the 3D-ISO assessment of vaginal fornix invasion, and fewer false positive (6 vs. 4) and false negative (3 vs. 1) cases. The accuracy of 3D-ISO sequence and T2WI were 84.85% and 72.73%, the sensitivity was 85.71% and 57.14%, and the specificity was 84.62% and 76.92%, respectively. The accuracy, sensitivity and specificity of 3D-ISO sequence were higher than that of T2WI. There was no statistically significant difference (P > 0.05).

CLINICAL RELEVANCE/APPLICATION

Compared with 2D T2WI, 3D-ISO T2WI CPR is more accurate in the assessment of vaginal fornix involvement and can help in the staging of cervical cancer, which is of great value in the accurate formulation of treatment plan.

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Abstract Archives of the RSNA, 2021

Sub-Events

CH03-B3   **Impact Of A Nurse Practitioner In A Diverse Inner-city Academic Lung Cancer Screening Program**

Participants
Maximilian C. Stahl, BA, Bronx, New York (*Presenter*) Nothing to Disclose

PURPOSE

The lung cancer screening program at our inner-city academic medical center cares for an under-served, majority ethnic minority population. In April 2018, a full-time nurse practitioner (NP) joined the team to focus on patient encounters, outreach, and intensified patient and referrer communication. The purpose of this study was to determine the impact of this intervention on exam volume and patient compliance.*Methods and Materials Retrospective chart review. All patients enrolled in our screening program from June 2016 to February 2020 were included. The pre-intervention and post-intervention period were 6/1/2016-3/31/2018 and 4/1/2018-2/29/2020, respectively, dichotomized by the implementation of the NP.*Results 3947 screening exams were performed on 2097 patients (mean age 67.7y± 5.8y, 51.3% women). 22.5% were White and 30.7% were Black. 36.7% identified as Hispanic. Median smoking history was 51.2 pack-years. Mean monthly volumes increased 33.0% (75.4±19.5 vs 100.0±11.1 exams/month, p<0.001) when comparing the 22 months pre and post intervention for the overall population and for all demographics [Men: 34.0% (36.4±10.4 vs 48.9±6.5 exams/month, p<0.0005), Women: 31.0% (39.0±11.2 vs 51.1±8.2 exams/month, p<0.0001), White: 20.0% (17.9±6.6 vs 21.5±5.5, p<0.05)], Non-White: 37.0% (57.5±14.5 vs 78.6±9.7, p<0.0001), Hispanic/Latino: 45.0% (26.2±7.0 vs 38.1±7.4 , p<0.0001), Non-Hispanic/Latino: 25.0% (39.6±11.0 vs 49.5±9.1, p<0.01)]. First follow-up compliance for new patients was unaffected by the intervention, 42.0% (139/328) vs 39.0% (301/781) (p=0.23). The proportion of Lung RADS 3 and 4 exams resulting in biopsy did not significantly differ (20.0% vs. 20.2%, p=0.98).*Conclusions The introduction of a full-time NP to our diverse urban lung cancer screening program significantly improved exam volume across all demographics. Patient compliance was not affected and requires further investigation*Clinical Relevance/Application Addition of an NP to our lung cancer screening program improved volume significantly across all demographics; further innovation is needed to impact compliance.

RESULTS

3947 screening exams were performed on 2097 patients (mean age 67.7y± 5.8y, 51.3% women). 22.5% were White and 30.7% were Black. 36.7% identified as Hispanic. Median smoking history was 51.2 pack-years. Mean monthly volumes increased 33.0% (75.4±19.5 vs 100.0±11.1 exams/month, p<0.001) when comparing the 22 months pre and post intervention for the overall population and for all demographics [Men: 34.0% (36.4±10.4 vs 48.9±6.5 exams/month, p<0.0005), Women: 31.0% (39.0±11.2 vs 51.1±8.2 exams/month, p<0.0001), White: 20.0% (17.9±6.6 vs 21.5±5.5, p<0.05)], Non-White: 37.0% (57.5±14.5 vs 78.6±9.7, p<0.0001), Hispanic/Latino: 45.0% (26.2±7.0 vs 38.1±7.4 , p<0.0001), Non-Hispanic/Latino: 25.0% (39.6±11.0 vs 49.5±9.1, p<0.01)]. First follow-up compliance for new patients was unaffected by the intervention, 42.0% (139/328) vs 39.0% (301/781) (p=0.23). The proportion of Lung RADS 3 and 4 exams resulting in biopsy did not significantly differ (20.0% vs. 20.2%, p=0.98).

CLINICAL RELEVANCE/APPLICATION

Addition of an NP to our lung cancer screening program improved volume significantly across all demographics; further innovation is needed to impact compliance.

CH03-B5   **Prevalence And Predictors Of Severity Of Bronchiectasis In Participants In Low-dose CT Screening For Lung Cancer**

Participants
Qiang Cai, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Bronchiectasis is responsible for loss of lung function, significant use of health care resources, and can result in increased morbidity and mortality in people with specific cardiopulmonary diseases. This report is to assess the frequency and severity of bronchiectasis of participants in a low-dose CT (LDCT) screening program.*Methods and Materials We re-reviewed the initial LDCTs of all smokers, aged 40 to 85, enrolled in the Mount Sinai Early Lung and Cardiac Action Program (MS-ELCAP) from 2010 to 2019. The ELCAP Bronchiectasis Score (ELCAP-BrS) used four scales, the severity of bronchial dilatation, the extent of bronchial dilatation, bronchial wall thickening, and endobronchial mucoid impaction, to document bronchiectasis for each of six lung regions with the lingula regarded as a separate lobe, also to summarize by combing the right and left upper, mid, and lower lungs.*Results Re-review of LDCTs of 2191 screening participants identified bronchiectasis in 504 (23.0%) of 2191 participants, but it had not been reported on the original report for 461 (91.5% underreporting). Median ELCAP-BrS was 12 (IQR: 9-16). Overall, bronchiectasis was the lower lobe predominant with involvement increasing from 57.4% to 78.4% to 91.2% to 93.4% in the 1st, 2nd, 3rd, and 4th quartiles respectively. However, mid lung involvement increased significantly (p<0.001) from the 2nd to 4th quartile (from 46.8% to 72.8% to 97.7%) and was the most affected region in the 4th quartile. Multivariable logistic analysis showed that bronchiectasis increased with increasing age (OR=2.0 per decade;95%CI:1.7-2.4), former smokers (OR=1.34;95%:CI:1.02-1.74), self-reported COPD (OR=1.41;95%CI:1.04-1.91), and elevated diaphragm (OR=4.1;95%CI:1.6-11.0), but decreased in overweight (OR=0.6;95%CI:0.5-0.9) or obese (OR=0.5;95%CI:0.4-0.8) participants.*Conclusions The prevalence of bronchiectasis in smokers undergoing LDCT screening was high and underreported. We recommend that bronchiectasis be reported in LDCT screening programs as its potential

progression over the entire period of enrollment can be followed, thus enabling assessment of the benefits of early management of bronchiectasis.*Clinical Relevance/Application Bronchiectasis and its severity and extent are important and we recommend that reporting of bronchiectasis findings on LDCTs should be encouraged, particularly as older smokers are at increased risk.

RESULTS

Re-review of LDCTs of 2191 screening participants identified bronchiectasis in 504 (23.0%) of 2191 participants, but it had not been reported on the original report for 461 (91.5% underreporting). Median ELCAP-BrS was 12 (IQR: 9-16). Overall, bronchiectasis was the lower lobe predominant with involvement increasing from 57.4% to 78.4% to 91.2% to 93.4% in the 1st, 2nd, 3rd, and 4th quartiles respectively. However, mid lung involvement increased significantly (p<0.001) from the 2nd to 4th quartile (from 46.8% to 72.8% to 97.7%) and was the most affected region in the 4th quartile. Multivariable logistic analysis showed that bronchiectasis increased with increasing age (OR=2.0 per decade;95%CI:1.7-2.4), former smokers (OR=1.34;95%:CI:1.02-1.74), self-reported COPD (OR=1.41;95%CI:1.04-1.91), and elevated diaphragm (OR=4.1;95%CI:1.6-11.0), but decreased in overweight (OR=0.6;95%CI:0.5-0.9) or obese (OR=0.5;95%CI:0.4-0.8) participants.

CLINICAL RELEVANCE/APPLICATION

Bronchiectasis and its severity and extent are important and we recommend that reporting of bronchiectasis findings on LDCTs should be encouraged, particularly as older smokers are at increased risk.

CH03-B6   Reversed Halo Sign And Associated Features With Correlation To The Final Diagnosis

Participants
Felipe Camara, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

to correlate the reversed halo sign (RHS) and its imaging features to the final diagnosis.*Methods and Materials This is a retrospective study, performed in a tertiary hospital to characterize the associated tomographic features of the RHS and correlate them with the final diagnosis. Inclusion criterion: at least one chest CT scan performed in the 2015-2020 period with one or more RHS. All chest CT performed in that period containing "reversed halo" description in the report were retrieved through an electronic search engine. These cases were anonymized and evaluated by 2 researchers blinded to both the clinical history and the final diagnosis, who evaluated the following image characteristics: distribution, number of RHS, location, and type of halo: nodular, smooth, or thickened (consolidation margin > = 1,0 cm). Researchers blinded to the images evaluated the electronic medical records of these patients and retrieved the following clinical information: definitive diagnosis, age, sex, and comorbidities. Exclusion criteria: the absence of a defined final diagnosis, images not found in the system, and absence of RHS at the images.*Results 351 patients fulfilled the inclusion criteria, of which 65 were excluded. The mean age was 56.3 years and 90.5% (259 patients) had some type of associated comorbidity. A total of 207 patients (72.2%) had "smooth halo", 53 (18.6%) had "thick halo" and 26 (9.2%) had "nodular halo". 267 patients (93.3%) of the total had the RHS preferentially in a peripheral location and 19 (6.6%) in a central location. Pulmonary thromboembolism was the diagnosis most frequently found with 120 cases (41.9%), most of them with a "smooth halo" (81.6%) and almost all of them with a preferentially peripheral location with 99.1% of the cases. Other diagnoses found were cryptogenic organizing pneumonia (17.1%), bacterial pneumonia/septic embolism (15.7%), viral pneumonia by the new coronavirus and H1N1 (12.9%), granulomatous diseases infections (6.5%) and miscellaneous (5.9%).*Conclusions The morphological features and distribution of RHS may contribute to narrowing the differential diagnosis. Associated with the patient's clinical data, this information may help to find the final diagnosis in many cases.*Clinical Relevance/Application This is the largest sample in the literature evaluating the RHS, its imaging features, and correlating both with the final diagnosis. It is also the first study of its kind to be carried out after the COVID-19 pandemic.

RESULTS

351 patients fulfilled the inclusion criteria, of which 65 were excluded. The mean age was 56.3 years and 90.5% (259 patients) had some type of associated comorbidity. A total of 207 patients (72.2%) had "smooth halo", 53 (18.6%) had "thick halo" and 26 (9.2%) had "nodular halo". 267 patients (93.3%) of the total had the RHS preferentially in a peripheral location and 19 (6.6%) in a central location. Pulmonary thromboembolism was the diagnosis most frequently found with 120 cases (41.9%), most of them with a "smooth halo" (81.6%) and almost all of them with a preferentially peripheral location with 99.1% of the cases. Other diagnoses found were cryptogenic organizing pneumonia (17.1%), bacterial pneumonia/septic embolism (15.7%), viral pneumonia by the new coronavirus and H1N1 (12.9%), granulomatous diseases infections (6.5%) and miscellaneous (5.9%).

CLINICAL RELEVANCE/APPLICATION

This is the largest sample in the literature evaluating the RHS, its imaging features, and correlating both with the final diagnosis. It is also the first study of its kind to be carried out after the COVID-19 pandemic.

Abstract Archives of the RSNA, 2021

HN05-A

Head and Neck Thursday Poster Discussions

Sub-Events

HN05-A1 Prevalence Of Sigmoid Sinus Diverticulum And Dehiscence And Their Association With Tinnitus.

Participants
Pradeep Kiresur, MBBS,DMRD, Bangalore, India (*Presenter*) Nothing to Disclose

PURPOSE

Studies have shown the association of Sigmoid sinus diverticulum and dehiscence to be associated with tinnitus. However, there are no enough studies on prevalence of Sigmoid sinus diverticulum and dehiscence. The study is aimed to look at the prevalence of sigmoid sinus diverticulum and dehiscence and their association with tinnitus.*Methods and Materials A retrospective review of all the temporal bone imaging (Computed tomography) from January 2018 to March 2021 done in a tertiary hospital in Bengaluru was performed. Sigmoid sinus diverticulum was defined as focal out pouching of the normal semicircular sigmoid sinus groove. The dehiscence was defined as cortical bone defect with air on sinus sign. The presence and laterality of sigmoid sinus diverticulum and dehiscence were recorded. Electronic medical records were reviewed to obtain history of tinnitus and exclude other causes.*Results A total of 560 studies were reviewed. Seven patients (1.3%) had sigmoid sinus diverticulum with sigmoid sinus dehiscence(SSDD). Nine patients (1.6%)had sigmoid sinus dehiscence with no diverticulum(SSDh). Two patients (0.4%)had sigmoid sinus diverticulum but no dehiscence(SSD). Of these eighteen patients eleven (61 %) patients were symptomatic with tinnitus (SSDD -3, SSD-2, SSDh-6), 4 (22%) were asymptomatic (SSDD-2, SSDh-2) and for three patients history was not available. Of these eleven symptomatic patients seven had tinnitus on the corresponding side and two patients had bilateral tinnitus. Two patients had tinnitus not corresponding to the side of sigmoid sinus diverticulum and dehiscence. Review of available magnetic resonance venogram for the symptomatic patients showed the presence of sigmoid sinus stenosis in three cases (SSDD-2, SSDh-1).*Conclusions The prevalence of SSD and SSDh (total 3.2%) is low but when present most had symptoms of tinnitus suggesting a causal association of these lesions.*Clinical Relevance/Application Tinnitus is caused by multiple pathologies. Our study showed that Sigmoid sinus diverticulum and dehiscence has low prevalence in population but still can be the cause for tinnitus.

RESULTS

A total of 560 studies were reviewed. Seven patients (1.3%) had sigmoid sinus diverticulum with sigmoid sinus dehiscence(SSDD). Nine patients (1.6%)had sigmoid sinus dehiscence with no diverticulum(SSDh). Two patients (0.4%)had sigmoid sinus diverticulum but no dehiscence(SSD). Of these eighteen patients eleven (61 %) patients were symptomatic with tinnitus (SSDD -3, SSD-2, SSDh-6), 4 (22%) were asymptomatic (SSDD-2, SSDh-2) and for three patients history was not available. Of these eleven symptomatic patients seven had tinnitus on the corresponding side and two patients had bilateral tinnitus. Two patients had tinnitus not corresponding to the side of sigmoid sinus diverticulum and dehiscence. Review of available magnetic resonance venogram for the symptomatic patients showed the presence of sigmoid sinus stenosis in three cases (SSDD-2, SSDh-1).

CLINICAL RELEVANCE/APPLICATION

Tinnitus is caused by multiple pathologies. Our study showed that Sigmoid sinus diverticulum and dehiscence has low prevalence in population but still can be the cause for tinnitus.

HN05-A2 MRI-based Assessment Of The Mylohyoid Muscle In Squamous Cell Cancer Of The Floor Of Mouth: A 7-points Score Method

Participants
Jasmina De Groodt, MD, Trieste, Italy (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to identify preoperative MR imaging characteristics of mylohyoid muscle that predispose the outcome of surgical intervention toward an insecure (positive or close) surgical margin in squamous cell carcinoma of the floor of mouth.*Methods and Materials Between March 2010 and March 2021, 80 consecutive patients with diagnosis of squamous cell carcinoma of the floor of mouth underwent surgical intervention at our institution. Among these, 55 with preoperative MR imaging and postoperative pathologic reports after surgery were included. Two neuroradiologists evaluated retrospectively the preoperative MR imaging scans to predict the tumor spread through the mylohyoid muscle using a 7-point scale: 1, distance between tumor and mylohyoid = 5 mm; 2, distance < 5 mm but no contact; 3, tumor in contact with mylohyoid; 4, bulging of mylohyoid; 5, thinned and/or irregular mylohyoid; 6, full-thickness signal alteration; 7, signal alteration trough mylohyoid in submandibular space.*Results A score of >4 could predict an insecure margin with same sensitivity in both neuroradiologists assessment (90,91%, C.I. 0.57±0.99) and with specificity respectively of 56,82% (C.I. 0.41±0.71) and 59,09% (C.I. 0.49±0.73). The interobserver agreement of MR imaging scores was excellent in specificity (Chi-squared 0.095, P=0.7584) with a high negative predictive value (96%, C.I. 0.77±0.99).*Conclusions The pre-surgery MR imaging scoring system for the mylohyoid muscle is a promising predictor of the surgical margin in floor of mouth squamous cell carcinoma.*Clinical Relevance/Application Preoperative MRI score-based assessment of mylohyoid muscle's infiltration could guide surgeon in predicting surgical invasiveness and complexity as well as in reconstruction planning.

RESULTS

A score of >4 could predict an insecure margin with same sensitivity in both neuroradiologists assessment (90,91%, C.I. 0.57±0.99) and with specificity respectively of 56,82% (C.I. 0.41±0.71) and 59,09% (C.I. 0.49±0.73). The interobserver agreement of MR imaging scores was excellent in specificity (Chi-squared 0.095, P=0.7584) with a high negative predictive value (96%, C.I. 0.77±0.99).

CLINICAL RELEVANCE/APPLICATION

Preoperative MRI score-based assessment of mylohyoid muscle's infiltration could guide surgeon in predicting surgical invasiveness and complexity as well as in reconstruction planning.

Abstract Archives of the RSNA, 2021

MS01-A

Multisystem Sunday Poster Discussions

Sub-Events

MS01-A2   **Computational Modeling Using Automated DL-based Quantitative CT Visualization Of Traumatic Hemothorax And Point-of-care Clinical Parameters Predicts Hemorrhage Related Outcomes.**

Participants
Bryan Nixon, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

We develop and test a computational model for prediction of exsanguination-related complications from traumatic hemothorax (massive transfusion (MT) and in-hospital mortality (IHM)) incorporating automated voxelwise deep learning (DL)-based quantitative visualization (QV) combined with relevant clinical variables available at point of care. Model performance is compared to QV measurements (HTXvol-auto) alone, and subjective consensus grading (HTX-subj: small, moderate, large) by an expert trauma and chest radiologist. HTXvol-auto with the best performing algorithm (FAN U-Net) are validated against manual ground truth (HTXvol-manual), and results are compared to U-Net and 3D U-Net as baseline.*Methods and Materials The study included manually-labeled admission chest computed tomography (CT) images from 77 adult patients with traumatic hemothorax (HTX) between 2016-2018 from one trauma center. DL results including Dice similarity coefficients (DSCs) from 4-fold cross-validation were compared for 3D U-Net, U-Net, and FAN U-Net (a multiscale feature extraction model with scale invariant attention mechanism). FAN U-Net HTXvol-auto was incorporated into a random forest (RF) multivariable model including age, injury mechanism (blunt or penetrating), HR, SBP, and lactate. Performance of the RF model, HTXvol-auto alone, and HTX-subj was evaluated for the composite outcome (MT + IHM).*Results Mean DSCs for 3D U-Net, U-Net, and FAN U-Net were 0.37±0.14, 0.60±0.13, and 0.61±0.14, respectively. HTXvol-auto had excellent agreement (ICC=0.76) and correlation (Pearson r=0.91) to HTXvol-manual, with -0.6 mL mean under-measurement bias. The RF model, HTXvol-auto alone, and HTX-subj had area under receiver operating characteristic (auROC) of 0.94, 0.71, and 0.76, respectively. Using peak Mathews correlation coefficient, optimal predictive HTXvol-auto threshold was 318 mL.*Conclusions The RF model incorporating HTXvol-auto and clinical variables available at the point of care showed improved accuracy over automated volumes and subjective grading alone for predicting hemorrhage-related outcomes.*Clinical Relevance/Application HTX is often described subjectively. We demonstrate the value of a multivariable model using objective, interpretable QV and clinical data for personalized hemorrhage-related outcome prediction.

RESULTS

Mean DSCs for 3D U-Net, U-Net, and FAN U-Net were 0.37±0.14, 0.60±0.13, and 0.61±0.14, respectively. HTXvol-auto had excellent agreement (ICC=0.76) and correlation (Pearson r=0.91) to HTXvol-manual, with -0.6 mL mean under-measurement bias. The RF model, HTXvol-auto alone, and HTX-subj had area under receiver operating characteristic (auROC) of 0.94, 0.71, and 0.76, respectively. Using peak Mathews correlation coefficient, optimal predictive HTXvol-auto threshold was 318 mL.

CLINICAL RELEVANCE/APPLICATION

HTX is often described subjectively. We demonstrate the value of a multivariable model using objective, interpretable QV and clinical data for personalized hemorrhage-related outcome prediction.

MS01-A3   **Radiologic Manifestations Of Turner Syndrome**

Participants
Eric Crotty, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Turner Syndrome (TS) is the most common sex chromosome disorder in females and is caused by the loss of part or all of an X chromosome. Multiple genotypes and phenotypes exist with varying extent of multisystem involvement.2) Radiologists may encounter TS patients in a variety of settings and from varied referral sources. Knowledge of the multisystemic involvement and the diverse appearance on different modalities can result in earlier diagnosis and help improve outcomes by directing patients to appropriate resources.3) Systems affected include cardiovascular, musculoskeletal, genitourinary, immune, and auditory systems.

TABLE OF CONTENTS/OUTLINE

1) Brief overview of Turner Syndrome and the role of the radiologist2) Radiology of findings in Turner Syndrome to include anomalies of the following systems: a) Cardiovascular- Cardiac- Arterial- Venous- Lymphaticb) Renalc) Reproductived) Musculoskeletale) Immunef) Ear

Abstract Archives of the RSNA, 2021

Sub-Events

MS01-B1 Resident-Attending Discrepancy Rates For Two Consecutive Versus Nonconsecutive Weeks Of Overnight Shifts

Participants
Ryan Rigsby, MD, Loma Linda, California (*Presenter*) Nothing to Disclose

PURPOSE

In 2017, the ACGME revised its night float policy by permitting residents to train more than 6 consecutive shifts. At our institution, two senior radiology residents dictate urgent/emergent studies from 9pm-8am. They are assigned 6 shifts in a row with 14 shifts in a 4-week block. Residents voiced personal preferences, however, to work either 7 or 14 shifts in a row. This was permitted on a voluntary basis for resident convenience. Those choosing 7 shifts typically had a mix of day shifts and days off between their first and second 7-night blocks. We retrospectively analyzed resident-attending discrepancy rates comparing those choosing 14 consecutive nights vs. split 7-night shifts (nonconsecutive) hypothesizing increased second-week discrepancy rates for the consecutive group.*Methods and Materials In 2020, 24 consecutive weeks were analyzed. Database searches used departmentally standardized terms for discrepancies, which were counted if significant enough to warrant attending contact of the care team. Studies were counted as positive or negative for discrepancy. Cross-sectional (CS; i.e., MR and CT), radiograph plus occasional fluoroscopy (XR), ultrasound (US), and overall discrepancy rates were calculated. Paired and unpaired t tests were performed with significance considered p less than 0.05. IRB waiver was obtained.*Results Eighteen residents (8 R4s, 10 R3s) were on rotation with 6 rotating twice. For the 24 sets of two-weeks covered, 8 were nonconsecutive and 16 were consecutive. All residents were compliant with ACGME duty hours. Total studies were 27,906 with 35% CS (including 5% MR), 55% XR, 10% US. Pediatric cases comprised 20%. For week 1, nonconsecutive vs. consecutive discrepancy rates were 2.2 vs. 1.4% CS, 0.1 vs. 0.2% XR, 0.2 vs. 0.2% US, 0.9 vs. 0.6% overall. For week 2, nonconsecutive vs. consecutive discrepancy rates were 2.0 vs. 1.9% CS, 0.3 vs. 0.2% XR, 1.1 vs. 0.7% US, 1.0 vs. 0.9% overall. There was no significant difference in the overall rates for week 1 vs. 2 within the nonconsecutive group (p=0.64), within the consecutive group (p=0.19), or between the groups for week 1 (p=0.32) or week 2 (p=0.60).*Conclusions Overnight discrepancy rates were not significantly different for residents working 14 consecutive vs. nonconsecutive shifts and were = 1.0% overall, similar to rates in the literature.*Clinical Relevance/Application Fatigue and its potential impact on patient care are important topics of medical training. Progressive autonomy is needed to produce competent, independent radiologists, but trainee autonomy must not compromise high quality patient care. This single-institution pilot study shows that residents who chose 14 consecutive overnight shifts performed similarly to those who worked nonconsecutive shifts.

RESULTS

Eighteen residents (8 R4s, 10 R3s) were on rotation with 6 rotating twice. For the 24 sets of two-weeks covered, 8 were nonconsecutive and 16 were consecutive. All residents were compliant with ACGME duty hours. Total studies were 27,906 with 35% CS (including 5% MR), 55% XR, 10% US. Pediatric cases comprised 20%. For week 1, nonconsecutive vs. consecutive discrepancy rates were 2.2 vs. 1.4% CS, 0.1 vs. 0.2% XR, 0.2 vs. 0.2% US, 0.9 vs. 0.6% overall. For week 2, nonconsecutive vs. consecutive discrepancy rates were 2.0 vs. 1.9% CS, 0.3 vs. 0.2% XR, 1.1 vs. 0.7% US, 1.0 vs. 0.9% overall. There was no significant difference in the overall rates for week 1 vs. 2 within the nonconsecutive group (p=0.64), within the consecutive group (p=0.19), or between the groups for week 1 (p=0.32) or week 2 (p=0.60).

CLINICAL RELEVANCE/APPLICATION

Fatigue and its potential impact on patient care are important topics of medical training. Progressive autonomy is needed to produce competent, independent radiologists, but trainee autonomy must not compromise high quality patient care. This single-institution pilot study shows that residents who chose 14 consecutive overnight shifts performed similarly to those who worked nonconsecutive shifts.

MS01-B2 Traumatic Abdominal Wall Hernias In The Pediatric Population

Participants
Grant VanNess, BS, Westfield, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

Pediatric traumatic abdominal wall hernias (TAWH) are rare but potentially devastating injuries, classically considered to be caused by handlebar injuries from bicycle accidents. However, our anecdotal experience suggests pediatric TAWH are far more likely following road traffic accidents and have a high association with other significant intra-abdominal injuries. Therefore, the purpose of this study was to determine the incidence, mechanisms of injury, associated injuries, and outcomes of TAWH in the pediatric population.*Methods and Materials This retrospective observational study used data from two large urban level 1 trauma centers. Institutional trauma registries were queried from January 1, 2008 to December 31, 2020 for patients under 18 years old diagnosed with traumatic abdominal wall hernias, excluding those without initial abdominopelvic CT imaging. Finalized CT reports and images were reviewed to confirm the presence of a TAWH and document any associated secondary injuries. The medical record was used to extract pertinent physical findings, interventions performed, and outcomes.*Results A total of 14 patients met inclusion criteria with an incidence of 6.4 cases/100,000 patients-year, a mean age of 11.5 (range 7-17), 8 males (57.1%), and mean Injury

Severity Score (ISS) of 17.9 (range 1-48, with 57.1% with ISS &gt 15). The most common mechanism of injury was motor vehicle collision (N=8, 57.1%) followed by bicycle accident (N=3, 21.4%). The mean hospital stay was 11.5 days with 2.8 days in the ICU. All 14 required surgery, including 11 acute primary hernia repairs and 1 delayed primary hernia repair. A total of 12 (85.7%) had associated injuries, including 8 (57.1%) with intestinal injuries, 2 (14.3%) with splenic injuries, 2 (14.3%) with kidney injuries, 3 (21.4%) with pelvic fractures, 3 (21.4%) with femur fractures, and 1 (7.1%) with a Chance fracture of the lumbar spine.*Conclusions Pediatric TAWH are more likely due to motor vehicle collisions, with a majority (85.7%) suffering other significant injuries, most frequently to the bowel (57.1%). The classic handlebar injury seen in a minority of cases was much less likely to be associated with additional injuries.*Clinical Relevance/Application Current data on pediatric TAWH is limited primarily to case reports and case series, with fewer than 100 documented. A large-scale study is needed to better characterize this rare disease entity.

RESULTS

A total of 14 patients met inclusion criteria with an incidence of 6.4 cases/100,000 patients-year, a mean age of 11.5 (range 7-17), 8 males (57.1%), and mean Injury Severity Score (ISS) of 17.9 (range 1-48, with 57.1% with ISS &gt 15). The most common mechanism of injury was motor vehicle collision (N=8, 57.1%) followed by bicycle accident (N=3, 21.4%). The mean hospital stay was 11.5 days with 2.8 days in the ICU. All 14 required surgery, including 11 acute primary hernia repairs and 1 delayed primary hernia repair. A total of 12 (85.7%) had associated injuries, including 8 (57.1%) with intestinal injuries, 2 (14.3%) with splenic injuries, 2 (14.3%) with kidney injuries, 3 (21.4%) with pelvic fractures, 3 (21.4%) with femur fractures, and 1 (7.1%) with a Chance fracture of the lumbar spine.

CLINICAL RELEVANCE/APPLICATION

Current data on pediatric TAWH is limited primarily to case reports and case series, with fewer than 100 documented. A large-scale study is needed to better characterize this rare disease entity.

Printed on: 06/28/22

Sub-Events

NMMI01-B1   Predicting Patient Response To Y-90 Selective Internal Radiation Therapy (SIRT) Using Tumor-to-Normal Tissue (T/N) Dosimetry Ratios

Participants
Munir Ghesani, MD, New York, New York (*Presenter*) Author, Siemens AG;Speaker, Siemens AG

PURPOSE

The purpose of our work is to predict response in patients undergoing locoregional therapy to the liver with Y-90 microspheres using tumor-to-normal tissue (T/N) dosimetry ratios.*Methods and Materials 39 patients (7 femal:32 male, mean age 68.3± 7.6y), underwent PET/CT imaging after treatment with Y-90 microspheres. For attenuation correction and localization of the Y-90 microspheres, the low mA, non-diagnostic CT images from PET/CT were used. The acquisition took 15 min and the reconstruction matrix size was 200x200x75 mm and voxel size of 4.07x4.07x3.00 mm. For dosimetry calculations the local deposition method with known activity of Y-90 was used. For each patient, regions-of-interest (ROIs) for tumor(s) and whole liver were manually created; the normal tissue ROI was created automatically. mRECIST criteria on MRI done at a month post treatment and subsequently every three months after Y-90 treatment, were used to assess response.*Results For 39 patients, the mean liver, tumor, and normal tissue doses (mean ± SD) were, 55.17±26.04 Gy, 911.87±866.54 Gy and 47.79 ±20.47 Gy respectively. Among these patients, 31 (79%) showed complete response (CR) and 8 (21%) showed progression of disease (PD). For patients with CR, the mean T/N dose ratio obtained was 24.91 (range 3.09 - 80.12) and for patients with PD, the mean T/N dose ratio was significantly lower, at 6.69 (range 0.36-14.75).*Conclusions According to our results, we conclude that patients with CR have a statistically higher T/N dose ratio than those with PD. For patients with low T/N ratios, close to or less than 1.0, thorough follow-up is required, and repeated treatment may be necessary. Because, the number of PD cases was limited, partial volume effect was not considered and motion correction was not applied for lesions in superior hepatic lobes, further investigation is highly desirable.*Clinical Relevance/Application Tumor-to-normal tissue dosimetry ratios can be used for predicting response in patients undergoing locoregional therapy to the liver with 90Y microspheres.

RESULTS

For 39 patients, the mean liver, tumor, and normal tissue doses (mean ± SD) were, 55.17±26.04 Gy, 911.87±866.54 Gy and 47.79 ±20.47 Gy respectively. Among these patients, 31 (79%) showed complete response (CR) and 8 (21%) showed progression of disease (PD). For patients with CR, the mean T/N dose ratio obtained was 24.91 (range 3.09 - 80.12) and for patients with PD, the mean T/N dose ratio was significantly lower, at 6.69 (range 0.36-14.75).

CLINICAL RELEVANCE/APPLICATION

Tumor-to-normal tissue dosimetry ratios can be used for predicting response in patients undergoing locoregional therapy to the liver with 90Y microspheres.

NMMI01-B4   Tailored Gadolinium-based Nanoparticles Escorting Mesenchymal Stem Cells For Ischemic Stroke Therapy

Participants
Shiman Wu, MD, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

A gadolinium(Gd)-based nanoparticles(NPs) with protective effect was designed for escorting mesenchymal stem cells (MSCs) for ischemic stroke therapy and in vivo tracking by MRI, so as to protect MSCs from the excessive Ca2+ and reactive oxygen species (ROS) microenvironment due to ischemia.*Methods and Materials NaGdF4 nanoparticles were synthesized, coated with polydopamine (PDA) for scavenging ROS, and conjugated with alendronate sodium (ALD) for chelating the intracellular Ca2+. Ischemic stroke model was induced by middle cerebral artery occlusion (MCAO) on rats. MSCs labeled with NaGdF4@PDA@ALD NPs (NPANs-MSCs), non-labelled MSCs and the same volume of saline were stereotaxtically injected into the brain of MCAO rats. All rats were monitored over time T1 weighted imaging(T1WI) and the arterial spin labeling (ASL) sequence via MRI.*Results NaGdF4@PDA@ALD NPs (NPANs) exhibited with high r1 longitudinal relaxivity (17.16 mm-1 s-1). In NPANs-MSCs group, prominent hyperintense signal was observed in the striatum (the ischemic core) and cortex (peri-infarct region) 7, 14, 21 days after stroke. Both NPANs-MSCs and non-labelled MSCs groups showed relatively higher cerebral blood flow (rCBF) compared with the saline-control group on post-stroke day 7. Besides, compared with day 7 after stroke, NPANs-MSCs group demonstrated significantly increased reperfusion in striatum at day 14, while non-labeled MSCs group did not. On day 21 after stroke, the ischemic left brain showed similar pattern of cerebral blood flow as the contralateral right brain.*Conclusions Transplanted NPANs-MSCs were successfully migrated, showing enhanced signal intensity in ischemic stroke areas and increased blood flow. The protecting property of NPANs-MSCs could improve the therapeutic effect of MSCs towards stroke.*Clinical Relevance/Application Based on the challenge of transplanted MSCs, NPANs were specifically tailored to help MSCs overcome the oxidate stress due to ischemia. Meanwhile, Gd-based NPs could help track MSCs on T1WI in vivo, avoiding the ambiguity between iron-based-NPs-labelled cells and microbleeds on T2WI. Though Gd-based NPs might cause adverse effect due to Gd deposition, it can help us initially investigate the mechanism of the migration of MSCs and can be switched into non-Gd-based NPs for in vivo tracking for further study. In summary,

NPANs-MSCs would be a new approach to accelerate the clinical translation of stem cell therapy, and shed light on new nanomedicine designation and development.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Based on the challenge of transplanted MSCs, NPANs were specifically tailored to help MSCs overcome the oxidate stress due to ischemia. Meanwhile, Gd-based NPs could help track MSCs on T1WI in vivo, avoiding the ambiguity between iron-based-NPs-labelled cells and microbleeds on T2WI. Though Gd-based NPs might cause adverse effect due to Gd deposition, it can help us initially investigate the mechanism of the migration of MSCs and can be switched into non-Gd-based NPs for in vivo tracking for further study. In summary, NPANs-MSCs would be a new approach to accelerate the clinical translation of stem cell therapy, and shed light on new nanomedicine designation and development.

NMMI01-B5 Advances In Nuclear Medicine Imaging For Detection Of Alzheimer Disease

Participants
Pokhraj Suthar, MBBS, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

Various PET agents available for detection of Alzheimer's disease (AD), with examples.Study important signs in PET (Amyloid and FDG) imaging for diagnosis of AD.Clinical application of Amyloid PET and F-18 FDG PET imaging in Dementia.

TABLE OF CONTENTS/OUTLINE

Alzheimer disease(AD) is progressive neurodegenerative disease characterized by impairments in memory & cognitive functions accounting for 60% to 80% cases of dementia. Pathophysiology of AD includes deposition of beta-amyloid & tau tangles leading to synaptic dysfunction & death of neuronal/glial cells. Various imaging modalities used for diagnosis of AD. MRI brain demonstrate cortical atrophy in advance cases of AD. FDG PET imaging demonstrate hypometabolism. Amyloid PET imaging targets early deposition of amyloid in the gray matter. FDA approved PET agent for imaging of amyloid are F-18 Florbetapir, Florbetaben, Flutemetamol and for imaging of tau protein is F-18 Flortaucipir(Tauvid). F-18 GTP1(Genentech Tau Probe 1) is a radioligand for detecting neurofibrillary tangle tau protein in AD. Increased F-18 labelled amyloid agents uptake in gray matter & is early biomarker and can be detected in patients before appearance of clinical symptoms of AD or prior to changes evident on F-18 FDG PET. Regional distribution of tau in brain has better correlation with disease progression & it may become positive before amyloid imaging. Through this exhibit, we intend to strategically discuss important signs, artifacts & clinical applications of PET brain imaging radiopharmaceuticals in AD.

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GI03-A

Gastrointestinal Tuesday Poster Discussions

Sub-Events

GI03-A11   Evaluation Of Her2 Expression In Gastric Cancer Using Quantitative Ct Perfusion Parameters

Participants
Zhang Min, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the feasibility of multiple CT perfusion parameters in distinguishing expression of HER2 in gastric cancer preoperatively.*Methods and Materials 68 patients confirmed of gastric cancer with gastroscopy were preoperatively examined perfusion CT (PCT) and curative gastrectomy. The enrolled patients were divided according to HER2 expression in term of positive and negative group. PCT parameters, blood-flow (BF), blood volume (BV), mean transmit time(MTT),time to peak (TTP) and permeability surface(PS)were calculated. The differences of parameters in HER2 groups were calculated with student t test. A receiver operating characteristic (ROC) analysis was applied to evaluate the diagnostic performance of meaningful PCT parameters.*Results PS and BV in HER2 negative group were 35.82±5.67 (ml/100g/min) and 4.42±1.13 (ml/100g). They were 45.32±8.40(ml/100g/min) and 5.96±1.35(ml/100g) in HER2 positive group. There were statistical differences in PS and BV between HER2 positive group and negative group. The area under the ROC curve for the diagnosis of HER2 positive gastric cancer by BV and PS was 0.843(sensitivity, 73.6%; specificity, 93.3%) and 0.819(sensitivity, 77.4%; specificity, 80.0%), with the cut-off value of 38.25 ml/100g/min and 5.01ml/100g, respectively.*Conclusions PCT can quantitatively evaluate HER2 expression in gastric cancer, a prognostic indicator related to gastric cancer.*Clinical Relevance/Application PCT quantitative parameters are potential in disguising HER2 expressions in gastric cancer.

RESULTS

PS and BV in HER2 negative group were 35.82±5.67 (ml/100g/min) and 4.42±1.13 (ml/100g). They were 45.32±8.40(ml/100g/min) and 5.96±1.35(ml/100g) in HER2 positive group. There were statistical differences in PS and BV between HER2 positive group and negative group. The area under the ROC curve for the diagnosis of HER2 positive gastric cancer by BV and PS was 0.843(sensitivity, 73.6%; specificity, 93.3%) and 0.819(sensitivity, 77.4%; specificity, 80.0%), with the cut-off value of 38.25 ml/100g/min and 5.01ml/100g, respectively.

CLINICAL RELEVANCE/APPLICATION

PCT quantitative parameters are potential in disguising HER2 expressions in gastric cancer.

GI03-A3   Artificial Intelligence-based Analysis Of Body Composition - A New Software Tool For Rapid Fully Automatic Image Segmentation

Participants
Nick Beetz, MD, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate a new artificial intelligence (AI)-based workflow, trained to automatically detect a selected computed tomography (CT) slice at the third lumbar vertebra (L3) and automatically perform complete image segmentation for analysis of body composition, and to compare its performance to an established semi-automatic segmentation tool in regard of speed and quality of the measurements.*Methods and Materials For fully automatic analysis of body composition, a U-Net was trained using 200 axial CT images at L3 (Visage). A second U-Net was trained to identify the L3 vertebra along the sagittal direction of the image data. For semi-automatic analysis of body composition, a conventional image segmentation software (sliceOmatic v5.0, Tomovision) was used. Using both segmentation methods the tissue was differentiated into psoas muscle, skeletal muscle, visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT). The area in square centimeters (cm2) of each segmented tissue class was calculated. To evaluate both methods, DICOM slice files of 20 random CT at L3 were segmented with both methods. Semi-automatic image segmentation was performed by two radiologists and compared to the fully automatic workflow with L3 recognition. Quality of the segmentations was compared using the relative difference between the measurements.*Results Success rate of L3 recognition was 100 % for the AI-based workflow. Compared to the semi-automatic segmentation fully automatic AI-based segmentation of the different tissue areas yielded a relative difference of 0.22 % for skeletal muscle, 0.49 % for psoas muscle, 1.34 % VAT und 0.18 % SAT in the first reader, and a relative difference of 0.17 % for skeletal muscle, 0.49 % for psoas muscle, 2.61 % for VAT und 0.19 % for SAT in the second reader. AI-based segmentation was significantly faster than semi-automatic segmentation (Visage 3 ± 0 seconds versus sliceOmatic 170 ± 40 seconds, p< 0,001, for reader 1, and 152 ± 40 seconds, p< 0,001, for reader 2).*Conclusions Fully automatic AI-based, PACS-integrated analysis of body composition with L3 recognition is feasible and easily available from CT imaging. Fully automatic AI-based assessment of body composition using Visage shows almost identical measurements of body composition parameters compared to conventional semi-automatic image segmentation. The embedded solution also offers the familiar clinical tools and does not require any transfer of data. This AI-based software solution alleviates the need for external software and enables future studies to analyze body composition in large patient populations.*Clinical Relevance/Application Rapid and accurate fully automatic AI-based analysis of body composition may aid in risk stratification and improvement of patient care.

RESULTS

Success rate of L3 recognition was 100 % for the AI-based workflow. Compared to the semi-automatic segmentation fully automatic AI-based segmentation of the different tissue areas yielded a relative difference of 0.22 % for skeletal muscle, 0.49 % for psoas muscle, 1.34 % VAT und 0.18 % SAT in the first reader, and a relative difference of 0.17 % for skeletal muscle, 0.49 % for psoas muscle, 2.61 % for VAT und 0.19 % for SAT in the second reader. AI-based segmentation was significantly faster than semi-automatic segmentation (Visage 3 ± 0 seconds versus sliceOmatic 170 ± 40 seconds, p< 0,001, for reader 1, and 152 ± 40 seconds, p< 0,001, for reader 2).

CLINICAL RELEVANCE/APPLICATION

Rapid and accurate fully automatic AI-based analysis of body composition may aid in risk stratification and improvement of patient care.

GI03-A4   Abdomen Radiographs In The CT/MR Era, Update 2021: The Surprising Numbers And Implications For Training

Participants
Yang Jiang, DO, Jacksonville, Florida (*Presenter*) Nothing to Disclose

PURPOSE

Purpose: An analysis of abdomen radiograph nationwide utilization trends over the past two decades, with particular emphasis on the implications for trainees*Methods and Materials Medicare procedure volumes from 2000 through 2019 were analyzed with respect to 3 studies: single view abdomen; two view abdomen; two view abdomen plus chest filmMedicare volumes can then be extrapolated to approximate nationwide procedure utilization.*Results In 2019, 10.1 million abdomen radiographs were performed in the U.S.Over the twenty year span, the number of single view abdomen studies actually rose significantly, from 5.5 million in 2000 to 7.4 million in 2019 -- a surprising 34% increase.*Conclusions Despite the primacy of cross-sectional imaging, abdomen radiograph utilization remains remarkably durable, with over 10 million studies yearly.*Clinical Relevance/Application Abdomen radiograph interpretation will be a necessary patient care skill in radiology practices for years to come, and so instruction directed toward that skill should should remain part of our standard resident curriculum.

RESULTS

In 2019, 10.1 million abdomen radiographs were performed in the U.S.Over the twenty year span, the number of single view abdomen studies actually rose significantly, from 5.5 million in 2000 to 7.4 million in 2019 -- a surprising 34% increase.

CLINICAL RELEVANCE/APPLICATION

Abdomen radiograph interpretation will be a necessary patient care skill in radiology practices for years to come, and so instruction directed toward that skill should should remain part of our standard resident curriculum.

GI03-A5   Factors Affecting MRI Scanner Efficiency In An Academic Center

Participants
Paul Smereka, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To investigate patient level factors affecting liver MRI exam time, with an aim to improve efficiency by allotting different scanner slot times based on patient characteristics.*Methods and Materials Scan times for all extracellular contrast enhanced Liver MRI exams performed on a 1.5T and 3T scanner in 2019 were assessed at an outpatient facility. To measure the scan times on our different scanners, we developed an open-source software tool that automatically transmits information about executed sequences to a central intranet server where the sequence data are aggregated by examinations for retrospective analysis. Here, scan time is defined as the duration between the start of the first adjustment scan to the end of last imaging sequence. Any patient symptoms and breathing issues during the exam were recorded by the technologist. Additional patient characteristics were determined using review of EMR. Welch's T-test and Pearson's Chi Square Test were used to assess continuous and categorical values. Patients with breathing issues during exam (i.e could not follow breathing instructions, difficulty with breath hold sequences) were compared to those who did not.*Results 322 total scans were performed with median scan time 19.24 minutes. Scan times were significantly increased for patients with breathing issues during exam (N=49, median=23.98 minutes) versus not (N=273, median = 18.69 minutes, p<.001). When scans were separated into groups with/without breathing issues, the group with breathing issues had a significantly higher proportion of patients for whom English was not their first language (21/49 [43%] vs 28/207 [14%] , p = 0.007), and who used a translator during the exam (14/49 [29%] vs 35/273 [13%], p=0.01) . Patients who had breathing issues were also significantly older (mean 63.11 vs 58.12, p=0.02). No other patient characteristics were significantly different: sex (p=0.29), BMI(p=0.98), hearing problem(p=0.11), vision problem (p=.30), claustrophobia (p=0.67), asthma (p=0.849, COPD (p=0.67), other lung disease(p=0.15), CHF (p=0.39), other heart disease (p=0.61), or prior MRI (p=0.62).*Conclusions The ability to follow breathing instructions and complete breath hold sequences has a significant impact on patient scan time. Older patients and those who are not native English speakers had more breathing issues during scans requiring increase in scan time. Future educational efforts will target improving scan time in these patients.*Clinical Relevance/Application Implementing clearer instructions in different languages, and allotting more time per scan for older patients and non-native English speakers my improve MRI scanner efficiency.

RESULTS

322 total scans were performed with median scan time 19.24 minutes. Scan times were significantly increased for patients with breathing issues during exam (N=49, median=23.98 minutes) versus not (N=273, median = 18.69 minutes, p<.001). When scans were separated into groups with/without breathing issues, the group with breathing issues had a significantly higher proportion of patients for whom English was not their first language (21/49 [43%] vs 28/207 [14%] , p = 0.007), and who used a translator during the exam (14/49 [29%] vs 35/273 [13%], p=0.01) . Patients who had breathing issues were also significantly older (mean 63.11 vs 58.12, p=0.02). No other patient characteristics were significantly different: sex (p=0.29), BMI(p=0.98), hearing problem(p=0.11), vision problem (p=.30), claustrophobia (p=0.67), asthma (p=0.849, COPD (p=0.67), other lung disease(p=0.15), CHF (p=0.39), other heart disease (p=0.61), or prior MRI (p=0.62).

CLINICAL RELEVANCE/APPLICATION

Implementing clearer instructions in different languages, and allotting more time per scan for older patients and non-native English

speakers my improve MRI scanner efficiency.

GI03-A6   Contrast-enhanced Endoscopic US Of Sentinel Lymph Nodes In Esophageal Cancer Following Peri-tumoral Injection

Participants
Priscilla Machado, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

In patients with early-stage esophageal cancers, lymph node (LN) positivity stratifies patients that might benefit from neoadjuvant therapy prior to resection. The US contrast agent Sonazoid (GE Healthcare, Oslo, Norway) has been shown to be a useful lymphatic tracer following peri-tumoral injection. Hence, we evaluated the performance of contrast-enhanced endoscopic US (CE-EUS) guided fine needle aspiration (FNA) following peri-tumoral inject of sentinel lymph nodes (SLNs) compared to standard EUS guided FNA for nodal staging in esophageal cancer patients.*Methods and Materials In this IRB- and FDA-approved pilot study, patients with newly-diagnosed esophageal cancer undergoing staging EUS provided informed consent to undergo CE-EUS. A Prosound F75 US system (Hitachi Medical Systems, Tokyo, Japan) with harmonic contrast software and a GF-UCT180 curvilinear endoscope (Olympus, Tokyo, Japan) was utilized. All lymph nodes identified by EUS were noted. Sonazoid (dose: 1 mL) was then administered into the submucosal plane peri-tumorally and all detected SLNs underwent FNA. Per standard-of-care, FNA was also performed on LNs considered suspicious by EUS alone. Performance of each modality was compared against cytology.*Results Twenty patients were enrolled and completed to date. No adverse events were observed following peri-tumoral injection of Sonazoid under EUS guidance. A total of 92 nodes were identified. Standard EUS identified 28 LNs as high risk with 10 amenable to biopsy. Of these 10, 4 were found to contain metastatic disease (cytological yield = 40%). CE-EUS identified a total of 38 enhancing nodes out of which 35 were amenable to biopsy. Of these 35 nodes, 17 were found to contain metastatic disease (cytological yield = 49%). Importantly, 5 patients (25% of study total) had their nodal status upgraded with the addition of CE-EUS, directly altering their course of therapy.*Conclusions Initial results suggest CE-EUS may increase FNA cytologic yield by ruling out nodes not associated with the tumor drainage pattern and also identifying SLNs with metastatic deposits that would not be biopsied under standard EUS criteria.*Clinical Relevance/Application CE-EUS with peri-tumoral injection of a microbubble agent can improve SLN identification and characterization in esophageal cancer patients by offering more reliable tumor staging for clinical decision-making.

RESULTS

Twenty patients were enrolled and completed to date. No adverse events were observed following peri-tumoral injection of Sonazoid under EUS guidance. A total of 92 nodes were identified. Standard EUS identified 28 LNs as high risk with 10 amenable to biopsy. Of these 10, 4 were found to contain metastatic disease (cytological yield = 40%). CE-EUS identified a total of 38 enhancing nodes out of which 35 were amenable to biopsy. Of these 35 nodes, 17 were found to contain metastatic disease (cytological yield = 49%). Importantly, 5 patients (25% of study total) had their nodal status upgraded with the addition of CE-EUS, directly altering their course of therapy.

CLINICAL RELEVANCE/APPLICATION

CE-EUS with peri-tumoral injection of a microbubble agent can improve SLN identification and characterization in esophageal cancer patients by offering more reliable tumor staging for clinical decision-making.

GI03-A8   End-to-end Automated Body Composition Analyses With Integrated Quality Control For Opportunistic Assessment Of Sarcopenia In CT

Participants
Maike Theis, MSc, Bonn, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To automate body composition analysis and the assessment of fatty degeneration of skeletal muscle tissue on abdominal CT-scans with focus on integrated quality control (QC) required for large-scale application in clinical routine practice.*Methods and Materials The developed pipeline consists of two main steps, each followed by a quality control step. For extraction of a single slice at the L3/L4 lumbar level, a convolutional neural network (CNN) was trained on 240 3D CT-scans using the nnU-Net framework. For 2D segmentation of visceral and subcutaneous adipose tissue and skeletal muscle (VAT, SAT, SM), a fully convolutional 2D U-Net with competitive maxout units was developed separately on 1143 CT images. Fatty-muscle fraction (FMF) was determined in a post-processing step. Automated quality control was integrated by a logistic regression model classifying the presence of L3/L4 in the 3D CT-scan and a linear regression model for individual prediction of the segmentation quality in terms of the Dice-score. Both models were based on the predictions of the respective CNN.The performance of the slice extraction part, the tissue segmentation part, and of the entire pipeline was evaluated on 364 independent CT data from two centers and compared to manual analyses.*Results Excellent results were obtained on the dual-center test set. For slice extraction, mean z-deviation was 2.46±6.20mm and for tissue segmentation Dice-scores were 0.95±0.04 (SM), 0.98±0.02 (VAT) and 0.97±0.04 (SAT). For these evaluations, 10 patients with metallic implants were manually excluded.Importantly, no data were excluded for evaluation of the end-to-end performance of the entire pipeline with integrated QC. With restrictive setting of quality control, 39 of 364 cases were flagged as possibly having limited segmentation quality, including 8 patients with severe artefacts caused by metallic implants. With QC, high agreement was achieved between manual and fully automated analyses with mean relative area-deviations of ?SM=3.3±4.1%, ?VAT=3.0±4.7%, ?SAT=2.7±4.3% and ?FMF=4.3±4.4%.*Conclusions The proposed pipeline enables large-scale assessment of body composition metrics in clinical routine without the need for any manual interaction.*Clinical Relevance/Application End-to-End automation with integrated QC allows routine application of body composition analyses, e.g. for opportunistic assessment of sarcopenia.

RESULTS

Excellent results were obtained on the dual-center test set. For slice extraction, mean z-deviation was 2.46±6.20mm and for tissue segmentation Dice-scores were 0.95±0.04 (SM), 0.98±0.02 (VAT) and 0.97±0.04 (SAT). For these evaluations, 10 patients with metallic implants were manually excluded.Importantly, no data were excluded for evaluation of the end-to-end performance of the entire pipeline with integrated QC. With restrictive setting of quality control, 39 of 364 cases were flagged as possibly having limited segmentation quality, including 8 patients with severe artefacts caused by metallic implants. With QC, high agreement was achieved between manual and fully automated analyses with mean relative area-deviations of ?SM=3.3±4.1%, ?VAT=3.0±4.7%, ?SAT=2.7±4.3% and ?FMF=4.3±4.4%.

CLINICAL RELEVANCE/APPLICATION

End-to-End automation with integrated QC allows routine application of body composition analyses, e.g. for opportunistic

assessment of sarcopenia.

CH04-B

Chest Wednesday Poster Discussions

Sub-Events

CH04-B1 Pulmonary Fibrosis In Patients With COVID-19 Pneumonia Treated With Low-dose Radiotherapy. Preliminary Results

Participants
Sara Gomez Pena, Madrid, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the findings on chest computed tomography (CT) in patients who received 4-7 months before low-dose radiotherapy (LD-RT) and to assess whether they present more fibrosis compared to patients who have not received LD-RT.*Methods and Materials Two expert cardiothoracic radiologists analyzed the chest CTs realized in patients who received 100 cGy to total lungs in a single fraction in order to treat COVID-19 pneumonia, the day of the LD-RT (0), day +7 and 4-7 months later. A semi-quantitative CT score was calculated based on the extent of lobar involvement (0: 0%; 1: <5%; 2: 5-25%, 3: 26-50%; 4: 51-75%; 5: 76-100%; global score 0-25). To be able to determine the degree of fibrosis we assessed among other radiological findings: ground glass opacities (GGO), consolidations, crazy-paving pattern, interstitial thickening, subpleural lines, parenchymal bands, bronchial dilatations, adenopathy and pleural effusion. We also evaluated the distribution and predominance of the findings and determined the predominant pattern in each lobe (A: GGO, B: consolidation, C: linear opacities, D: fibrosis). We used the Kappa coefficient for the qualitative variables and the intraclass correlation coefficient (ICC) for the quantitative variables. A Wilcoxon sign rank test for paired data was used to assess the variables.*Results Of the 41 patients who received LD-RT, 13 have died. To date, of the remaining 28, 16 patients have already undergone a chest CT at 4-7 months. We aimed to carry out the rest in the coming months. Median age was 63.5 (IQR 57-76). With almost perfect agreement, the extension score improved significantly (p=0.004; p=0.001) on day 7 and at 4-7 months (p=0.003; p=0.002). At 4-7 months there were a significant decreased in consolidation (p=0.009; p=0.009), also with almost perfect agreement. There were no other significant changes in the evaluated radiological findings. Median time to undergo the last chest CT was 159 days (ranging 141.5-165.5).*Conclusions Our preliminary results show that LD-RT produces a radiological improvement of COVID-19 pneumonia and that there is no significant increase in fibrosis parameters. Randomized trials are needed to establish whether there is a higher degree of fibrosis in those patients treated with LD-RT.*Clinical Relevance/Application LT-RT could be a feasible and well-tolerated treatment, without worsening the degree of fibrosis in patients with CPVOD-19 pneumonia.

RESULTS

Of the 41 patients who received LD-RT, 13 have died. To date, of the remaining 28, 16 patients have already undergone a chest CT at 4-7 months. We aimed to carry out the rest in the coming months. Median age was 63.5 (IQR 57-76). With almost perfect agreement, the extension score improved significantly (p=0.004; p=0.001) on day 7 and at 4-7 months (p=0.003; p=0.002). At 4-7 months there were a significant decreased in consolidation (p=0.009; p=0.009), also with almost perfect agreement. There were no other significant changes in the evaluated radiological findings. Median time to undergo the last chest CT was 159 days (ranging 141.5-165.5).

CLINICAL RELEVANCE/APPLICATION

LT-RT could be a feasible and well-tolerated treatment, without worsening the degree of fibrosis in patients with CPVOD-19 pneumonia.

CH04-B2 Ct Morphological Features Of The Mediastinal Drowning Sign In Pulmonary Diffuse Lymphangiomatosis

Participants
Qi Hao, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to identify morphological characteristics of the mediastinal drowning sign (MDS) on chest CT in patients with diffuse pulmonary lymphangiomatosis (DPL) that may aid the diagnosis of this congenital lymphtic disease.*Methods and Materials We retrospectively reviewed chest CT images from 38 patients with surgery proven DPL who demonstrated the MDS. Direct lymphangiography and thorax and abdominal MSCT examination were performed in all patients. Among them, 18 cases underwent enhanced MSCT examination. Two chest radiologists analysed the morphological characteristics of the MDS and others findings of the lesion and reached decisions by consensus.*Results The mediastinal drowning sign was seen in all patients with DPL. The typical imaging features of MDS were diffuse homogeneous (32/38, 84%) or inhomogeneous (16%) water-like or mucous density (32/38, 84%) in the whole aidpose region of the mediastinum without displacement and deformation of the trachea and large vessels. MSCT lymphangiography showed extensive deposition and leakage of contrast-medium (Ultra-liquid iodized oil) distributed along the mediastinum, the bilateral pulmonary hilum and the peribronchovascular bundles, which suggests lymphangiogenesis, lymphatic dilatation and reflux. The other accompanying findings includes Obstruction of thoracic duct (100%) and right lymphatic duct (12/38, 32%), dilated bronchomediastinal trunk (6/38, 16%), bronchovascular bundle and interlobular septal thickening (35/38, 92%), diffuse inhomogeneous GGO (35/38, 92%), chylothorax or extrapleural soft tissue thickening (30/38, 79%) and abnormal lymphatic vessels in the abdomen and bone (9/38, 24%).*Conclusions Our data suggest that

morphological characteristics of the MDS on chest CT, such as the presence of diffuse homogeneous water-like or mucous density in the whole fatty tissue region of the mediastinum with deposition and leakage of lymphatic contrast-medium, no displacement and deformation of the trachea and large vessels, as well as the association with other pulmonary interstitial thickening and chylothorax, should lead radiologists to to take the diagnosis and differentiation of DPL.*Clinical Relevance/Application Diffuse pulmonary lymphangiomatosis (DPL) is a rare congenital lymphtic developmental malformation in thorax. The mediastinal drowning sign (MDS) is one of the important manifestations of DPL and has important significance for the early diagnosis with pulmonary interstitial thickening and of chylothorax. This sign has not been reported in the literature by our knowledge.

RESULTS

The mediastinal drowning sign was seen in all patients with DPL. The typical imaging features of MDS were diffuse homogeneous (32/38, 84%) or inhomogeneous (16%) water-like or mucous density (32/38, 84%) in the whole aidpose region of the mediastinum without displacement and deformation of the trachea and large vessels. MSCT lymphangiography showed extensive deposition and leakage of contrast-medium (Ultra-liquid iodized oil) distributed along the mediastinum, the bilateral pulmonary hilum and the peribronchovascular bundles, which suggests lymphangiogenesis, lymphatic dilatation and reflux. The other accompanying findings includes Obstruction of thoracic duct (100%) and right lymphatic duct (12/38, 32%), dilated bronchomediastinal trunk (6/38, 16%), bronchovascular bundle and interlobular septal thickening (35/38, 92%), diffuse inhomogeneous GGO (35/38, 92%), chylothorax or extrapleural soft tissue thickening (30/38, 79%) and abnormal lymphatic vessels in the abdomen and bone (9/38, 24%).

CLINICAL RELEVANCE/APPLICATION

Diffuse pulmonary lymphangiomatosis (DPL) is a rare congenital lymphtic developmental malformation in thorax. The mediastinal drowning sign (MDS) is one of the important manifestations of DPL and has important significance for the early diagnosis with pulmonary interstitial thickening and of chylothorax. This sign has not been reported in the literature by our knowledge.

CH04-B4 Post COVID-19 Interstitial Lung Syndrome (PCOILS): A Fibrosing Or Non-fibrosing Disease?

Participants
Diletta Cozzi, MD, Prato, Italy (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study is to describe HRTC interstitial changes occurring 6-months after the admission for COVID-19.*Methods and Materials This is a single-center interim-analysis of a larger prospective-multicenter-national trial (12 Italian referral centers for ILDs). We describe the first cases enrolled in the period September 2020 - March 2021 at our university hospital and we collect data of patients at baseline and after 6 (+/-1) months after hospital discharge.HRCT changes at 6 months involving more than 5% of the total lung volume were considered significant. Patients with significant HRCT changes will undergo BAL and/or cryobiopsy and a subsequent follow-up with HRCT and lung function evaluation at 12(+/-1) and 18 (+/-1) months. A team of dedicated-thoracic radiologists evaluated at 6-months all patients that recovered from COVID-19. Radiologists were asked to define each HRCT as negative for pleural-parenchymal alterations, alterations' extension <less than 5%, positive for alterations major than 5% (whether the alterations were predominantly fibrosing-like or non-fibrosing).*Results 142 HRCT were evaluated. In particular 71/142 (50%) had a complete remission from lung involvement. The remains 71 patients had interstitial lung changes (both fibrosing-like and non-fibrosing): 41/142 less than 5%, 30/142 more than 5%. Of these, 26/142 (18.3%) showed interstitial fibrotic changes (with UIP pattern, NSIP and/or OP pattern and indeterminate pattern with diffuse ground glass). A small minority (1.4%) presents with the typical UIP pattern observed in IPF: we can't exclude that this might be expression of a pre-existing non-recognized UIP/IPF.*Conclusions These preliminary results show that a half of patients that recovered from COVID-19 have persistent HRCT changes 6-months after the acute infection. The trial was designed to define the risk factors for development of long-term-pulmonary sequelae of COVID-19, detect possible novel biomarkers for disease progression (including BAL and histopathology assessment). The analysis confirms that after COVID-19 infection a large minority of patients (18.3%) develops interstitial lung changes mostly with NSIP-OP, indeterminate features or ground glass, possible expression of the slow-healing OP/DAD pattern observed in the acute phase.*Clinical Relevance/Application The clinical meaning of the observed HRCT changes remains unclear. These results need further evaluations, especially after the 12-month-HRCT follow up, in order to define if HRCT findings are the expression of a real fibrosing disease. We are nowadays evaluating the first HRCT after 1 year-follow up.

RESULTS

142 HRCT were evaluated. In particular 71/142 (50%) had a complete remission from lung involvement. The remains 71 patients had interstitial lung changes (both fibrosing-like and non-fibrosing): 41/142 less than 5%, 30/142 more than 5%. Of these, 26/142 (18.3%) showed interstitial fibrotic changes (with UIP pattern, NSIP and/or OP pattern and indeterminate pattern with diffuse ground glass). A small minority (1.4%) presents with the typical UIP pattern observed in IPF: we can't exclude that this might be expression of a pre-existing non-recognized UIP/IPF.

CLINICAL RELEVANCE/APPLICATION

The clinical meaning of the observed HRCT changes remains unclear. These results need further evaluations, especially after the 12-month-HRCT follow up, in order to define if HRCT findings are the expression of a real fibrosing disease. We are nowadays evaluating the first HRCT after 1 year-follow up.

VA04-B

Vascular Imaging Wednesday Poster Discussions

Sub-Events

VA04-B1   **Imaging Of Venous Thrombosis With Ferumoxytol Enhanced Magnetic Resonance Angiography**

Participants
Sipan Mathevosian, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

Ferumoxytol is a vascular contrast agent increasingly being used as an alternative to gadolinium-based agents, especially in critically ill patients and those with renal failure. Ferumoxytol enhanced magnetic resonance angiography (FE-MRA) is useful for a broad variety of arterial and venous applications. However, existing data on the utility of FE-MRA in the detection of deep venous thrombus (DVT) is limited, especially in critically ill patients. The purpose of this study was to evaluate the utility of FE-MRA for imaging of DVT in a large cohort of patients.*Methods and Materials After IRB approval, a single-center retrospective review was performed on all patients undergoing FE-MRA. A total of 798 patients with MR Angiograms and MR Venograms of the neck, chest, abdomen, pelvis, and extremities from July 2013 to June 2020 were included in this study. Reports from these studies were reviewed for presence of DVT. In all cases, patients had a history of chronic renal failure with contraindication to Gadolinium-based contrast agents. Vascular enhancement was achieved via administration of ferumoxytol (Feraheme, AMAG pharmaceuticals - Waltham, MA) at a dose of 4 mg/kg.Examinations were performed on Siemens 1.5T and 3.0T MR scanners. All studies included multiplanar post-contrast high-resolution breath-held 3D MRA. Post processing included reconstruction of multiplanar images, MIP images and 3-D volume rendered images in OsiriX software (Pixmeo - Bernex, Switzerland) and Vitrea software (Vital Images - Minnetonka, MN).*Results Venous thrombosis was identified in 83 of 798 studies (10.4%). 40 of 83 (48.2%) of DVT positive studies had a specific indication to evaluate for venous stenosis or thrombosis. Venous thrombosis was identified in a number of vascular beds with many patients having overlapping sites, and included: central thoracic veins (n=56), IVC or iliac veins (n=25), portomesenteric veins (n=9), peripheral extremity veins (n=4), renal veins (n=2), pulmonary veins (n=1), and intracardiac thrombus that included right atrial and Fontan conduit thrombus (n=2). Average patient age was 41.2 ± 22.6 years (0.4 - 78.3). 48 patients were male and 35 were female. Average patient weight was 64.1 ± 28.4 kg (6.5 - 131.5) and average weight-based contrast dose was 8.7 ± 4.0 mL (0.9 - 17). There were no adverse reactions.*Conclusions In patients with allergy or contraindication to conventional contrast mediums, ferumoxytol enhanced MRA is promising as an efficient and effective modality for detection of venous thrombosis in a variety of vascular beds.*Clinical Relevance/Application In patients with allergy or contraindication to conventional contrast mediums, FE-MRA is a promising modality for detection of venous thrombosis in a variety of vascular beds.

RESULTS

Venous thrombosis was identified in 83 of 798 studies (10.4%). 40 of 83 (48.2%) of DVT positive studies had a specific indication to evaluate for venous stenosis or thrombosis. Venous thrombosis was identified in a number of vascular beds with many patients having overlapping sites, and included: central thoracic veins (n=56), IVC or iliac veins (n=25), portomesenteric veins (n=9), peripheral extremity veins (n=4), renal veins (n=2), pulmonary veins (n=1), and intracardiac thrombus that included right atrial and Fontan conduit thrombus (n=2). Average patient age was 41.2 ± 22.6 years (0.4 - 78.3). 48 patients were male and 35 were female. Average patient weight was 64.1 ± 28.4 kg (6.5 - 131.5) and average weight-based contrast dose was 8.7 ± 4.0 mL (0.9 - 17). There were no adverse reactions.

CLINICAL RELEVANCE/APPLICATION

In patients with allergy or contraindication to conventional contrast mediums, FE-MRA is a promising modality for detection of venous thrombosis in a variety of vascular beds.

Abstract Archives of the RSNA, 2021

Sub-Events

CH04-D1   Clinical Evaluation Of An Artificial Intelligence Algorithm For The Detection Of Incidental Pulmonary Emboli On Routine Contrast Enhanced Chest CT

Participants
Yin Xi, PhD, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate an incidental pulmonary embolism (iPE) Artificial Intelligence (AI) algorithm in patients referred for routine, contrast-enhanced CT (CECT)of the chest at two healthcare systems served by the same radiologists. We examined the performance of the algorithm, impact of different patient populations and conditions associated with misclassification.*Methods and Materials The iPE algorithm was prospectively applied to Contrast enhanced Chest CT (CECCT)exams between September 2019 and February 2020 at a safety net hospital (SNH) and academic referral hospital (ARH). Clinical reads were performed by radiologists serving both institutions. A consensus overread was performed on algorithm and/or clinical report positive exams. In addition, exams were reviewed to assess for etiologies which could contribute to misclassification.*Results The iPE algorithm analyzed 7,466 CECT exams (mean age: 59±15, 3,811 women). The algorithm had a sensitivity of 83.3%, specificity of 99.8%, and negative predictive value of 99.7%. Significant differences in age, gender, percentage of outpatients, percentage of urgent and stat cases, and prevalence of associated cancer diagnosis between the two institutions did not alter the positive rates for detection of iPE (SNH: 1.26% vs ARH: 1.77%, P=NS). Several factors contributed to misclassification, including anatomy altered by prior surgery and rim enhancement of metastatic lesions.*Conclusions The AI-algorithm had moderate sensitivity but a high specificity and negative predictive value in detecting iPE. The detection rate was similar at 2 hospitals with different patient populations and referral patterns. We also identified several sources of misclassification which could serve as targets to potentially improve the performance of the algorithm*Clinical Relevance/Application Incidental pulmonary embolism (iPE) is a finding on routine CT exams ordered for other reasons and is associated with increased mortality and morbidity. An Artificial Intelligence (AI) algorithm that detected iPE could be beneficial to radiologists. However, the variability in contrast timing, underlying pathology, and patient referral pose significant challenges to an algorithm for iPE.

RESULTS

The iPE algorithm analyzed 7,466 CECT exams (mean age: 59±15, 3,811 women). The algorithm had a sensitivity of 83.3%, specificity of 99.8%, and negative predictive value of 99.7%. Significant differences in age, gender, percentage of outpatients, percentage of urgent and stat cases, and prevalence of associated cancer diagnosis between the two institutions did not alter the positive rates for detection of iPE (SNH: 1.26% vs ARH: 1.77%, P=NS). Several factors contributed to misclassification, including anatomy altered by prior surgery and rim enhancement of metastatic lesions.

CLINICAL RELEVANCE/APPLICATION

Incidental pulmonary embolism (iPE) is a finding on routine CT exams ordered for other reasons and is associated with increased mortality and morbidity. An Artificial Intelligence (AI) algorithm that detected iPE could be beneficial to radiologists. However, the variability in contrast timing, underlying pathology, and patient referral pose significant challenges to an algorithm for iPE.

CH04-D4   Utilizing Artificial Intelligence To Determine Morphological Features Of Thoracic Aorta Via Non-contrast Chest Computed Tomography

Participants
Jinrong Yang, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To preliminarily explore the feasibility of using artificial intelligence to automatically measure the morphological features of thoracic aorta on non-enhanced chest CT, so as to understand the anatomical morphological characteristics of thoracic aorta.*Methods and Materials Retrospectively collected 156 participants who underwent chest CT examination and had no disease affecting the morphology of aorta. In this paper, the AI based method is used as a research tool to calculate the related parameters automatically. Utilizing AI to measure the morphological features of the thoracic aorta (including diameters and areas at nine levels recommended by the AHA guidelines, volume and length at two adjacent levels, and total volume and length). The AI method proposes a framework of aortic segmentation based on deep learning network. According to the aortic segmentation results and its anatomical characteristics, a method of straightening the tubular structure of the aorta by aligning the centerline is used to reconstruct the results of the aorta, which simplifies the calculation process. And we further explore the anatomical morphological characteristics of the normal thoracic aorta stratified by sex and age.*Results It is feasible to use AI to automatically measure the morphological features of thoracic aorta, which is in good agreement with the results of manual measurement. In quantitative terms, the AI-based results achieved the mean Dice scores of 0.9511. Based on this, we conducted a comparative study on the morphology of aorta. The morphological features values of male were greater than that of female. The diameter and area of MD level had the strongest correlation with age (R=0.59). The diameter and area of MAs increased rapidly with age, and they increased by 2.05mm and 1.06cm2 respectively with age increasing by 10 years. The volume and length of the descending aorta (from PD to DP level) had the strongest correlation with age (R=0.63,0.46). Correspondingly, the volume and length of the V6_7 segment were

greatly affected by age, which increased by 9.03ml or 6.41mm with age increased by 10 years.*Conclusions AI can automatically measure the morphological features of thoracic aorta on non-enhanced chest CT, so that we can further understand the anatomical morphological features of normal thoracic aorta, and then establish the anatomical morphological basis for the diagnosis and treatment of thoracic aortic diseases.*Clinical Relevance/Application Automatic quantification of thoracic aorta using AI makes it possible to further understand the anatomical morphology of thoracic aorta, which helps to provide an anatomical basis for the diagnosis of thoracic aortic dilatation disease and the development of endovascular repair in surgery in the future.

RESULTS

It is feasible to use AI to automatically measure the morphological features of thoracic aorta, which is in good agreement with the results of manual measurement. In quantitative terms, the AI-based results achieved the mean Dice scores of 0.9511. Based on this, we conducted a comparative study on the morphology of aorta. The morphological features values of male were greater than that of female. The diameter and area of MD level had the strongest correlation with age (R=0.59). The diameter and area of MAs increased rapidly with age, and they increased by 2.05mm and 1.06cm2 respectively with age increasing by 10 years. The volume and length of the descending aorta (from PD to DP level) had the strongest correlation with age (R=0.63,0.46). Correspondingly, the volume and length of the V6_7 segment were greatly affected by age, which increased by 9.03ml or 6.41mm with age increased by 10 years.

CLINICAL RELEVANCE/APPLICATION

Automatic quantification of thoracic aorta using AI makes it possible to further understand the anatomical morphology of thoracic aorta, which helps to provide an anatomical basis for the diagnosis of thoracic aortic dilatation disease and the development of endovascular repair in surgery in the future.

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Abstract Archives of the RSNA, 2021

Sub-Events

HN04-B2 **Predictive Value Of Multiparametric MRI For Response To Single Cycle Induction Chemo-immunotherapy In Locally Advanced Head And Neck Squamous Cell Carcinoma**

Participants
Tobias Baeuerle, MD, Erlangen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To assess the value of multiparametric MRI for treatment response evaluation to induction chemo-immunotherapy in locally advanced head and neck squamous cell carcinoma (HNSCC).*Methods and Materials Patients with locally advanced, histologically confirmed HNSCC (n=21) were enrolled in the prospective multicenter phase II CheckRad-CD8 trial. All patients that received contrast enhanced MRI at baseline and in week 4 after single cycle induction therapy with cisplatin/docetaxel combined with the immune checkpoint inhibitors tremelimumab (anti-CTLA4) and durvalumab (anti-PDL1) were included. In week 4 re-biopsy was performed to assess tumor response and density of intratumoral CD8+ cells. In baseline and follow-up the primary tumors were segmented on MRI for assessment of the following parameters: Tumor volume, T1 signal intensity (SI), STIR SI, apparent diffusion coefficient (ADC) and dynamic contrast enhanced (DCE) values. A model based on parallel random forests incorporating the MRI parameters was used to predict tumor response to therapy at baseline MRI. All parameters were correlated with histologic tumor response.*Results Fifteen patients (71.4 %) showed pathologic complete response in the re-biopsy, while six patients revealed a residual tumor (28,6 %). In patients with complete pathologic response and residual tumor following treatment, the primary tumor volume was significantly lower after treatment, respectively (p<0.05). The MRI parameters T1 ratio, STIR ratio and ADC values of the tumors could not discriminate between the complete response and residual tumor groups or predict treatment response. The DCE parameters time to peak (TTP) and wash out (WO) on the contrary, indicated a significant difference between the complete response and residual tumor groups at follow-up (p<0.05). Using a model based on parallel random forests, therapy response could be predicted with a sensitivity of 78.7 % and a specificity of 78.6 % based on DCE parameters TTP and WO. The model featured an area under the Receiver Operating Characteristic curve of 0.866.*Conclusions Morphological MRI and ADC could not assess or predict response to single cycle induction chemo-immunotherapy in locally advanced HNSCC. However, DCE parameters indicated treatment response at follow-up, and a machine learning algorithm using parallel random forests based on these parameters was able to predict treatment response to chemo-immunotherapy.*Clinical Relevance/Application Quantitative imaging biomarkers are needed to assess and predict response from emerging treatment strategies including immunotherapy. Here we show that DCE MRI parameters are promising candidates for that purpose in locally advanced HNSCC.

RESULTS

Fifteen patients (71.4 %) showed pathologic complete response in the re-biopsy, while six patients revealed a residual tumor (28,6 %). In patients with complete pathologic response and residual tumor following treatment, the primary tumor volume was significantly lower after treatment, respectively (p<0.05). The MRI parameters T1 ratio, STIR ratio and ADC values of the tumors could not discriminate between the complete response and residual tumor groups or predict treatment response. The DCE parameters time to peak (TTP) and wash out (WO) on the contrary, indicated a significant difference between the complete response and residual tumor groups at follow-up (p<0.05). Using a model based on parallel random forests, therapy response could be predicted with a sensitivity of 78.7 % and a specificity of 78.6 % based on DCE parameters TTP and WO. The model featured an area under the Receiver Operating Characteristic curve of 0.866.

CLINICAL RELEVANCE/APPLICATION

Quantitative imaging biomarkers are needed to assess and predict response from emerging treatment strategies including immunotherapy. Here we show that DCE MRI parameters are promising candidates for that purpose in locally advanced HNSCC.

Printed on: 06/28/22

> BR03-A
>
> **Breast Tuesday Poster Discussions**

Sub-Events

BR03-A10   Imaging Of Unusual Male Breast Lesions With Histopathologic Correlation

Awards
Certificate of Merit

Participants
Brian Guarnieri, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review male breast anatomy and development2. Characterize the mammographic, sonographic and MRI imaging findings of a spectrum of benign and malignant male breast lesions3. Correlate the imaging findings with the underlying histopathologic findings4. Discuss management and treatment for these male breast lesions

TABLE OF CONTENTS/OUTLINE

IntroductionMale breast anatomyMale breast developmentImaging protocols for male breast concernsCharacteristics and imaging overview of male breast lesionsWorkup of male breast lesionsDiscuss cases and imaging/pathology findings:Benign:MyofibroblastomaAngiolipomaLipomaGynecomastiaTubular adenomaAbscess cavityTraumatic fat necrosisSebaceous/epidermal inclusion cystMalignant:Lymphoma (T cell)Adenoid cystic carcinomaMetastasis to the breast (esophageal adenocarcinoma, melanoma)DCIS with intraductal papillomaInvasive ductal carcinoma subtypesInvasive locular carcinomaConclusionUnderstanding male breast anatomy is important to interpreting breast imaging studies and developing an appropriate differentialAlthough most breast conditions in men are benign, breast radiologists must be aware of imaging features in male breast lesions that warrant biopsy as approximately 1% of new breast cancers occur in menSpecific histopathologic findings of different male breast lesions allows for appropriate management and treatment of these patients

BR03-A2   Effect Of Artificial Intelligence Software On Digital Breast Tomosynthesis Screening Cancer Detection And Abnormal Interpretation Rates Among Subspecialized Breast Radiologists: A Real World Experience

Participants
Haley Letter, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study is to assess the "real world" impact of an artificial intelligence (AI) tool designed to detect breast cancer in digital breast tomosynthesis (DBT) screening exams. We estimated the effects of the AI tool on cancer detection rate per 1000 screened (CDR) and abnormal interpretation rate percent (AIR) following 6 months of utilization in a subspecialized academic breast center.*Methods and Materials Following IRB approval, Mammography Quality Standards Act (MQSA) reports were retrospectively generated for each of 5 subspecialized radiologists (breast imaging experience ranging 3-35 years) for each of 3 MQSA-accredited breast imaging centers during the time frame of September 1, 2020 through March 1, 2021. All mammograms included in the audit were performed with DBT (Hologic Dimensions®) and interpreted on Visage® PACS. Location 1 had the AI tool (iCAD ProFound AI® V2.0) available during the 6-month time period while the other two locations (Locations 2 and 3) did not. All 5 radiologists interpreted screening DBT studies at all 3 locations; 3,073 studies with AI and 3,690 studies without AI. All exams had follow-up up to May 4, 2021. The co-primary endpoints were estimation of CDR and AIR with and without AI available (Location 1 vs Locations 2 and 3 combined). Differences between the two groups in CDR and AIR were calculated with two-sided 95% confidence intervals (CIs) for each radiologist and summarized across radiologists using generalized estimating equations to perform logistic regression.*Results CDR per 1000 screened was 6.4 with AI, 5.3 without AI (odds ratio 1.2, 95% CI: 0.6, 2.3). AIR was 11.2% with AI, 10.2% without AI (odds ratio 1.1, 95% CI: 0.9, 1.3). Four of the 5 radiologists demonstrated increased CDR with AI compared to without. Three of the 5 radiologists saw a stable or decreased AIR.*Conclusions While we are unable to show statistically significant changes in CDR and AIR outcomes in the two groups given the low numbers of total cancers and relatively short time period, the results are consistent with prior reader studies. There are modest, yet noticeable, improvements in CDR with AI, without significant increases in AIR with AI. We expect to obtain more accurate estimates of the impact of DBT-AI as we accrue more patients.*Clinical Relevance/Application To our knowledge, our study is the first to assess the real-world application of a DBT-based AI algorithm to assist radiologists in the detection of breast cancer in screening exams.

RESULTS

CDR per 1000 screened was 6.4 with AI, 5.3 without AI (odds ratio 1.2, 95% CI: 0.6, 2.3). AIR was 11.2% with AI, 10.2% without AI (odds ratio 1.1, 95% CI: 0.9, 1.3). Four of the 5 radiologists demonstrated increased CDR with AI compared to without. Three of the 5 radiologists saw a stable or decreased AIR.

CLINICAL RELEVANCE/APPLICATION

To our knowledge, our study is the first to assess the real-world application of a DBT-based AI algorithm to assist radiologists in the detection of breast cancer in screening exams.

BR03-A3   High Performance Of An FDA-cleared Platform For Mammography Triage

Participants
Tara Retson, MD,PhD, San Diego, California (*Presenter*) Research writing, CureMetrix Inc

PURPOSE

Recent studies suggest that artificial intelligence (AI) based triage programs could improve detection of breast cancer on screening mammography and expedite radiologist workflow. Here, we sought to evaluate the performance of a commercial AI-based triage algorithm on exams with varying breast densities and lesion types.*Methods and Materials This retrospective, multi-center, and multi-vendor study examined 1255 screening mammograms consisting of 4 standard views (LCC, LMLO, RCC, RMLO). The population was enriched with biopsy-confirmed cancers, containing 400 positive and 855 normal (BIRADS 1 and 2) studies. Images were analyzed by a commercially available AI algorithm (cmTriage, Curemetrix) and given a quantitative score based on suspicion for cancer or recall. Triage was performed at a study level where exams were labeled "suspicious," or left unlabeled (indicating a low suspicion exam).*Results The algorithm demonstrated an area under the curve (AUC) of 0.95 (95% CI: 0.94 - 0.96) for lesion identification. This AUC held across densities (0.95) and lesion types (masses: 0.94, 95% CI: 0.92 to 0.96; or microcalcifications: 0.97, 95% CI: 0.96 to 0.99). While the algorithm has a default sensitivity of 93% (modifiable up to 99%), to evaluate real world performance we used 86.9% sensitivity (95% CI: 83.6% to 90.2%), as was observed for practicing radiologists by the Breast Cancer Surveillance Consortium (BCSC) study. Resulting algorithm specificity was 88.5% (95% CI: 86.4% to 90.7%), similar to BCSC radiologist specificity of 88.9%, and indicating that algorithm performance may be comparable to real-world practice.*Conclusions AI-based triage software can perform at and above the level of practicing radiologists. It has been shown that when radiologists work with AI there is a synergistic effect. By drawing attention to suspicious exams, AI triage may provide positive reader bias to improve accuracy, and act as a second reader, particularly for negative exams. As a workflow improvement, it could enable faster recall and immediate patient notification of low suspicion studies, reducing patient stress and improving care.*Clinical Relevance/Application AI-based triage software can perform at and above the level of practicing radiologists, is posed to streamline workflow, and step into the role of second reader.

RESULTS

The algorithm demonstrated an area under the curve (AUC) of 0.95 (95% CI: 0.94 - 0.96) for lesion identification. This AUC held across densities (0.95) and lesion types (masses: 0.94, 95% CI: 0.92 to 0.96; or microcalcifications: 0.97, 95% CI: 0.96 to 0.99). While the algorithm has a default sensitivity of 93% (modifiable up to 99%), to evaluate real world performance we used 86.9% sensitivity (95% CI: 83.6% to 90.2%), as was observed for practicing radiologists by the Breast Cancer Surveillance Consortium (BCSC) study. Resulting algorithm specificity was 88.5% (95% CI: 86.4% to 90.7%), similar to BCSC radiologist specificity of 88.9%, and indicating that algorithm performance may be comparable to real-world practice.

CLINICAL RELEVANCE/APPLICATION

AI-based triage software can perform at and above the level of practicing radiologists, is posed to streamline workflow, and step into the role of second reader.

BR03-A4   Subgroup Analysis Highlights Fairness Challenges For Deep Learning Algorithms In Breast Density Estimation

Participants
Charles Lu, Charlestown, Massachusetts (*Presenter*) Institutional support, General Electric Company;Institutional support, NVIDIA Corporation;Institutional support, Nuance Communications, Inc

PURPOSE

We investigate the impact of sampling strategies on performance disparities in patient race/ethnicity subgroups during the training of deep learning (DL) algorithms to automatically assess breast density (BD) in mammography.*Methods and Materials 108,190 mammograms were obtained from 21,759 patients (mean age 54 +/- 10 years old) through the Digital Mammographic Imaging Screening Trial (33 clinical sites). Each exam was interpreted by experts using ACR BI-RADS criteria We train a deep learning system to classify BD using different sampling techniques (randomly and equally adjusted for frequency between classes). We measure subgroup performance using linearly weighted Cohen's Kappa statistic with bootstrapping for 95% confidence interval.*Results The dataset had a BD distribution of 8% fatty, 33% scattered, 41% heterogeneously dense, and 18% extremely dense and had patient race demographics of 79% white, 15% black, 4% Hispanic, 2% Asian, <1% "other" or unknown. On a held-out validation set of 38,936 mammographs (8250 patients), we attain similar overall Kappa for both random and equal sampling, 0.67 [0.66-0.68] and 0.67 [0.66-0.68] respectively; however, we observe significant difference between racial subgroups. Notably, non-white patients show less agreement than white patients. For random sampling: White 0.67 [0.66-0.69], Black 0.65 [0.61-0.68], Hispanic 0.61 [0.55-0.67], Asian 0.64 [0.55-0.72], and Other 0.55 [0.41-0.66]. For equal sampling: White 0.67 [0.66-0.68], Black 0.63 [0.60-0.66], Hispanic 0.62 [0.56-0.68], Asian 0.64 [0.55-0.72], and Other 0.72 [0.60-0.82]. The equal sampling by race strategy performed significantly better on the "other" / unknown subgroup but not on other minority subgroups. Additionally, there were substantial differences in the important "dense" class between sampling strategies by class that was obscured by the overall performance metric as seen in figure 1.*Conclusions Overall performance metrics of DL algorithms can obscure differences in sub-classes or sub-groups. The optimal algorithm should be selected only after sub-group analysis to balance fairness constraints.*Clinical Relevance/Application Uninterpretable deep learning systems may exacerbate existing disparities in healthcare between protected subpopulations such as race. Subgroup analysis is a simple yet effective technique for uncovering disparate impact in black box tools.

RESULTS

The dataset had a BD distribution of 8% fatty, 33% scattered, 41% heterogeneously dense, and 18% extremely dense and had patient race demographics of 79% white, 15% black, 4% Hispanic, 2% Asian, <1% "other" or unknown. On a held-out validation set of 38,936 mammographs (8250 patients), we attain similar overall Kappa for both random and equal sampling, 0.67 [0.66-0.68] and 0.67 [0.66-0.68] respectively; however, we observe significant difference between racial subgroups. Notably, non-white patients show less agreement than white patients. For random sampling: White 0.67 [0.66-0.69], Black 0.65 [0.61-0.68], Hispanic 0.61 [0.55-0.67], Asian 0.64 [0.55-0.72], and Other 0.55 [0.41-0.66]. For equal sampling: White 0.67 [0.66-0.68], Black 0.63 [0.60-0.66], Hispanic 0.62 [0.56-0.68], Asian 0.64 [0.55-0.72], and Other 0.72 [0.60-0.82]. The equal sampling by race strategy performed significantly better on the "other" / unknown subgroup but not on other minority subgroups. Additionally, there were substantial differences in the important "dense" class between sampling strategies by class that was obscured by the overall performance metric as seen in figure 1.

BR03-A5   Replacing A Radiologist By AI In Dutch Population Based Breast Cancer Screening And The Impact Of Breast Density On Performance

Participants
Suzanne Van Winkel, RN,MSc, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Validation of the performance of a commercially available artificial intelligence (AI) system in the population based breast cancer screening program, considering the implementation of AI as a second reader, and to assess the effect of breast density.*Methods and Materials 2D Digital screening mammograms from a consecutive cohort including 43666 women screened between 2013 and 2014 in a region of the Dutch breast screening program were retrospectively collected. All exams were assigned a level of suspicion by an AI system on a continuous scale (Transpara, ScreenPoint Medical). Presence of cancers was verified using data from the national Dutch Cancer Registration (NKR - IKNL) until 2019. For each woman, 4-5 year of complete follow-up data on screen detected (SD), interval (IC) and future breast cancers (FBC) was available. Sensitivity, specificity and recall rate were compared for different reading scenarios: first reader (R1), stand-alone AI (recall rate R1 as operating point), double reading (R1 & R2), first reader and AI (R1&AI). Differences found were tested by McNemar and Wald tests. To examine the effect of density on cancers identified by human reading versus AI, volumetric density scores were obtained (Volpara). Differences were descriptively analyzed and tested by Wilcoxon signed-rank test.*Results The cohort included 987 cancers: 312 SD, 222 IC (within two years after screening) and 453 FBC (screen detected next round or after). 1071 cases were recalled by R1 (2.5.%, 95% CI = 2.3-2.6%), including 291 SD cancers, 3 IC and 16 FBC (sensitivity 31.4%, 95% CI =28.5-34.4%). The AI system recalled 1071 cases with 244 SD cancers, 23 IC and 69 FBC (sensitivity 34.0%, 95% CI = 31.1-37.1%). R1&R2 recalled 1143 cases after consensus (2.6%, 95%C =2.5-2.8%), including 312 SD, 2 IC and 18 FBC (sensitivity 33.6%, CI =30.7-36.7%). Replacing the second reader by AI (R1&AI) resulted in 1796 recalls (4.1%, 95% CI = 3.9-4.3%), including 306 SD, 26 IC and 74 FBC (sensitivity 41.1%, 95%CI = 38.0-44.3%), improving the sensitivity with 7.5% (95%CI=5.6-9.4%, p < 0.05). There was no significant difference in the relative performance of R1 and AI over density categories (p=0.4857). However, the additional cancers (n= 26) identified by the AI system and not by R1, were most observed in category A (+33.3% n=5) and D (+32.1% n=9) breasts.*Conclusions AI provides higher sensitivity than R1 and is complementary. AI has potential as second reader, but an effective arbitration process is necessary. This effect seems independent of breast density, albeit a remarkable amount of additional cancers detected was in highest and lowest density categories.*Clinical Relevance/Application The high rate of IC and FBC detected by AI, may enable earlier breast cancer detection using AI as second reader.

RESULTS

The cohort included 987 cancers: 312 SD, 222 IC (within two years after screening) and 453 FBC (screen detected next round or after). 1071 cases were recalled by R1 (2.5.%, 95% CI = 2.3-2.6%), including 291 SD cancers, 3 IC and 16 FBC (sensitivity 31.4%, 95% CI =28.5-34.4%). The AI system recalled 1071 cases with 244 SD cancers, 23 IC and 69 FBC (sensitivity 34.0%, 95% CI = 31.1-37.1%). R1&R2 recalled 1143 cases after consensus (2.6%, 95%C =2.5-2.8%), including 312 SD, 2 IC and 18 FBC (sensitivity 33.6%, CI =30.7-36.7%). Replacing the second reader by AI (R1&AI) resulted in 1796 recalls (4.1%, 95% CI = 3.9-4.3%), including 306 SD, 26 IC and 74 FBC (sensitivity 41.1%, 95%CI = 38.0-44.3%), improving the sensitivity with 7.5% (95%CI=5.6-9.4%, p < 0.05). There was no significant difference in the relative performance of R1 and AI over density categories (p=0.4857). However, the additional cancers (n= 26) identified by the AI system and not by R1, were most observed in category A (+33.3% n=5) and D (+32.1% n=9) breasts.

CLINICAL RELEVANCE/APPLICATION

The high rate of IC and FBC detected by AI, may enable earlier breast cancer detection using AI as second reader.

BR03-A7   Diagnostic Value Of Enhanced Spectral Mammography With Low Dose Contrast Agent In Comparison To Magnetic Resonance Imaging In Detecting Breast Cancer

Participants
Huizhi Cao, PhD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic performance of contrast enhanced spectral mammography (CESM) wtih low contrast protocol to magnetic resonance imaging (MRI) in a prospective multi-center study.*Methods and Materials Three hundred fifty-one women with suspected breast abnormalities by clinical examination or mammography underwent CESM and MRI examination. Contrast medium protocol was used as 1.0ml/kg, decreased by 30% compared to that of standard protocol. Using histopathologic results as the criterion standard, the diagnostic performance of CESM and MRI was investigated. Receiver-operating characteristic (ROC) curves were compared. Size measurements for the lesions detected by all readers in each modality were correlated with pathology.*Results Three hundred seventy-four breast lesions were found in 351 patients, in which 264 were malignant and 110 were benign. By evaluating the diagnostic value, sensitivity, positive predictive value, negative predictive value, and false-negative rate from CESM examination were comparable to those from MRI (89.2%, 90.2%, 81.3%, and 9.2% vs 91.2%, 90.5%, 80.4%, and 8.9%). Importantly, the accuracy and the specificity were higher for CESM than those for MRI (84.2% and 89.5% vs 82.3% and 84.4%), whereas the false-positive rate was lower (12.5% vs 18.6%). The areas under receiver operating characteristic curves of CESM and MRI were 0.92 and 0.91, displaying the equivalent diagnostic efficiency (P = 0.45). For the agreement between measurements, mean tumor sizes were 2.9 cm for CESM and 3.2 cm for MRI compared with 3.1 cm on histopathologic results. The Pearson correlation coefficient of CESM versus histopathology (r = 0.732, P = 0.000) was consistent with MRI versus histopathology (r = 0.741, P = 0.000).*Conclusions In this study, CESM has comparable diagnostic performance (ROC-AUC) to MRI for breast cancer diagnostics. Contrast-enhanced spectral mammography displayed a good correlation with histopathology in assessing the lesion size of breast cancer.*Clinical Relevance/Application CESM with low contrast medium is as accurate as MRI. Patients with dense breasts benefitted most from CESM with the smallest additional dose compared to MG.

RESULTS

Three hundred seventy-four breast lesions were found in 351 patients, in which 264 were malignant and 110 were benign. By evaluating the diagnostic value, sensitivity, positive predictive value, negative predictive value, and false-negative rate from CESM

examination were comparable to those from MRI (89.2%, 90.2%, 81.3%, and 9.2% vs 91.2%, 90.5%, 80.4%, and 8.9%). Importantly, the accuracy and the specificity were higher for CESM than those for MRI (84.2% and 89.5% vs 82.3% and 84.4%), whereas the false-positive rate was lower (12.5% vs 18.6%). The areas under receiver operating characteristic curves of CESM and MRI were 0.92 and 0.91, displaying the equivalent diagnostic efficiency (P = 0.45). For the agreement between measurements, mean tumor sizes were 2.9 cm for CESM and 3.2 cm for MRI compared with 3.1 cm on histopathologic results. The Pearson correlation coefficient of CESM versus histopathology (r = 0.732, P = 0.000) was consistent with MRI versus histopathology (r = 0.741, P = 0.000).

CLINICAL RELEVANCE/APPLICATION

CESM with low contrast medium is as accurate as MRI. Patients with dense breasts benefitted most from CESM with the smallest additional dose compared to MG.

BR03-A8   First Experiences With Dedicated Photon-counting CT Of The Breast For Detection Of Microcalcifications.

Participants
Luisa Huck, MD, Aachen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

We present our first clinical experiences with a dedicated Photon-Counting breast CT (PC-BCT) system designed to offer unprecedented spatial resolution at low radiation dose on patients with microcalcifications.*Methods and Materials Intra-individual comparative study on 14 patients (mean age 57; 42-76) with microcalcs who underwent DBT and PC-BCT. DBT (Hologic) was performed in MLO/ML and CC projection plus C-view reconstruction (angle 15°). PC-BCT was obtained in prone position, one single breast at a time, at 60 kV, 32 mAs, with a non-interpolated spatial resolution of 0.15x0.15x0.15 mm (high resolution, HR); a second data set was reconstructed at 0.3x0.3x0.3 mm (standard resolution, SR). Two radiologists independently rated detectability of microcalcs on a 5-point scale and counted their number on (a) SR images, (b) HR images, and (c) regional MIPs (10 mm thick, reconstructed from HR). Then, on HR images and MIPs, radiologists independently compared morphology (roundish vs. not), and distribution.*Results Of the 14 patients, 10 had malignant lesions (DCIS or invasive cancer), and 4 had benign changes. In 2/14 (14%), calcifications were located in the back of the breast and were therefore not included in the PC-BCT volume. Considering only those women whose DBT findings were included in the volume, microcalcs were visible in all 12. Mean scores for detectability of microcalcs was: 1.5 ± 0.9 (SR) vs. 3.2 ± 0.6 (HR) vs. 4.7 ± 0.5 (MIP) vs. 4.9 ± 0.3 (DBT). On HR images and MIPs, morphology of individual calcifications appeared similar to DBT in 10/12; in the remaining 2 cases, calcifications were rated as "not round" on PC-BCT but "round" on DBT; one of them was a HG DCIS, the other adenosis. The total number of visible individual microcalcs was 31 on SR, 62 on HR, 126 on MIPs, and 197 on DBT. Distribution of microcalcs was identical on MIPs and on DBT in 11/12. Cohens ? for detectability of microcalcs yielded perfect agreement (? = 0,9) between readers.*Conclusions Our initial experience with head-to-head comparison of women with known microcalcs suggests that PB-CT depicts microcalcs with high sensitivity, and allows the assessment of their distribution and also of the morphology of individual calcium deposits, thus enabling a categorization of microcalcs that appears similar to DBT.*Clinical Relevance/Application PC-BCT allows detection and characterization of microcalcifications similar to DBT.

RESULTS

Of the 14 patients, 10 had malignant lesions (DCIS or invasive cancer), and 4 had benign changes. In 2/14 (14%), calcifications were located in the back of the breast and were therefore not included in the PC-BCT volume. Considering only those women whose DBT findings were included in the volume, microcalcs were visible in all 12. Mean scores for detectability of microcalcs was: 1.5 ± 0.9 (SR) vs. 3.2 ± 0.6 (HR) vs. 4.7 ± 0.5 (MIP) vs. 4.9 ± 0.3 (DBT). On HR images and MIPs, morphology of individual calcifications appeared similar to DBT in 10/12; in the remaining 2 cases, calcifications were rated as "not round" on PC-BCT but "round" on DBT; one of them was a HG DCIS, the other adenosis. The total number of visible individual microcalcs was 31 on SR, 62 on HR, 126 on MIPs, and 197 on DBT. Distribution of microcalcs was identical on MIPs and on DBT in 11/12. Cohens ? for detectability of microcalcs yielded perfect agreement (? = 0,9) between readers.

CLINICAL RELEVANCE/APPLICATION

PC-BCT allows detection and characterization of microcalcifications similar to DBT.

BR03-A9   Artificial Intelligence For Digital Breast Tomosynthesis: A Tool To Enhance Radiologist'S Performance And Efficiency

Participants
Pierre Fillard, PhD, Paris, France (*Presenter*) Employee, Therapixel SA;Stockholder, Therapixel SA

PURPOSE

To demonstrate and estimate the benefits that an artificial intelligence (AI) tool could bring to digital breast tomosynthesis (DBT) interpretation time and accuracy.*Methods and Materials An AI system was evaluated in a retrospective multi-reader multi-case study where 22 breast specialist radiologists (in practice from 3 to 37 years - median 10 years) were asked to interpret 240 DBT examinations with and without the help of AI. The dataset included 114 biopsy-proven cancers, 36 of which were classified as false negative, i.e., screening negative cases with a positive result at follow-up within 18 months. Performances were measured in terms of area under the receiver operating characteristic curve (AUC), sensitivity, specificity and reading time and analyzed with statistical methods for reader studies. As the sample was enriched with cancers, we applied an inverse probability weighting to obtain estimates of reading time reduction in a screening population. The study was conducted in accordance to the Health Insurance Portability and Accountability Act and approved by an institutional review board.*Results The average AUC across readers was 0.79 (95% CI: 0.75 to 0.84) without AI and 0.83 (95% CI: 0.79 to 0.87) with AI. Average improvement was 0.04 (95% CI: 0.02 to 0.06, P < 0.001). Sensitivity improved from 80% to 82% when using AI (2%; 95% CI: -0.4% to 0.4%). Average specificity increased from 56% without AI to 61% with AI (5%; 95% CI: 1.5% to 8.7%). Average reading time was 74.7 seconds without AI and 70.9 seconds with AI (average difference: -3.8; 95% CI: -8.4 to 0.8). The reading time reduction was found to vary in accordance with the likelihood of malignancy assigned by the AI going from -15.6% for cases assigned with a low likelihood of malignancy to -0.5% for the most suspicious cases. When transposing these results to a screening population, observed reading time was on average 76.2s without the help of AI, which lies in the lower bound of the reading time reported for real-word practice. Nonetheless, an average reduction of 8% (95% CI: -13% to 3.1%) was observed in assisted readers, which indicates that a regular batch reading (i.e., a sequential interpretation of screening mammograms without interruption) could include until 13% more cases (about 7 cases per hour) thus improving the efficiency of the screening program and reducing the time-to-diagnosis for

patients.*Conclusions We demonstrated that the concurrent use of an AI tool could improve the diagnostic performance of radiologists in the detection of breast cancer with DBT and the efficiency of their workflow.*Clinical Relevance/Application This AI system can be integrated into screening practice to improve both efficiency and accuracy of DBT.

RESULTS

The average AUC across readers was 0.79 (95% CI: 0.75 to 0.84) without AI and 0.83 (95% CI: 0.79 to 0.87) with AI. Average improvement was 0.04 (95% CI: 0.02 to 0.06, P < 0.001). Sensitivity improved from 80% to 82% when using AI (2%; 95% CI: -0.4% to 0.4%). Average specificity increased from 56% without AI to 61% with AI (5%; 95% CI: 1.5% to 8.7%). Average reading time was 74.7 seconds without AI and 70.9 seconds with AI (average difference: -3.8; 95% CI: -8.4 to 0.8). The reading time reduction was found to vary in accordance with the likelihood of malignancy assigned by the AI going from -15.6% for cases assigned with a low likelihood of malignancy to -0.5% for the most suspicious cases. When transposing these results to a screening population, observed reading time was on average 76.2s without the help of AI, which lies in the lower bound of the reading time reported for real-word practice. Nonetheless, an average reduction of 8% (95% CI: -13% to 3.1%) was observed in assisted readers, which indicates that a regular batch reading (i.e., a sequential interpretation of screening mammograms without interruption) could include until 13% more cases (about 7 cases per hour) thus improving the efficiency of the screening program and reducing the time-to-diagnosis for patients.

CLINICAL RELEVANCE/APPLICATION

This AI system can be integrated into screening practice to improve both efficiency and accuracy of DBT.

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Abstract Archives of the RSNA, 2021

Sub-Events

MK04-B4   **Escaping The Quadrilateral Space: Review Of Anatomy, Pathology And Ultrasound Guided Injection Technique**

Participants
Peter Cormier, MD, Detroit, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review of the anatomy of the Quadrilateral Space on Ultrasound and MRI 2. Review of Quadrilateral Space Syndrome with differential diagnosis 3. Technique and approach for US guided intervention within the Quadrilateral Space

TABLE OF CONTENTS/OUTLINE

• Review of Anatomy of the Quadrilateral Space on Ultrasound and MRI o Contents o Anatomic boundaries and landmarks o Ultrasound technique and approach for imaging the quadrilateral space • Review of Quadrilateral Space Syndrome (QSS) with Differential Diagnoses o Definition of QSS o Presenting Symptoms o Relevant Imaging Findings o Differential Diagnosis • Technique and Approach for Intervention o Optimal Patient and Probe Position for Ultrasound Guided Intervention o Static and Dynamic images of US guided steroid injection into the Quadrilateral space with select MRI images for anatomic reference. • Summary

Printed on: 06/28/22

GI05-B

Gastrointestinal Thursday Poster Discussions

Sub-Events

GI05-B7   Additional MRI For Initial M-staging In Pancreatic Cancer: A Cost-effectiveness Analysis

Participants
Felix Gassert, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Pancreatic cancer (PDAC) is portrayed to become &9;the second leading cause of cancer-related death within the next years. Potentially complicating surgical resection and high toxicity of combination chemotherapy regimens emphasize the importance of an accurate TNM classification in the primary staging. In particular, the failure to detect metastases has profound consequences on patient outcomes and economic costs due to incorrect indication to resection. In the detection of liver metastases, contrast-enhanced MRI showed high sensitivity and specificity, however, the cost-effectiveness compared to the standard of care imaging (SCI) remains unclear. The aim of this study was to analyze whether combined contrast enhanced MRI and contrast enhanced computed tomography (CE-MR/CT) is a cost effective approach compared to routinely acquired contrast enhanced computed tomography (CE-CT) in detecting liver metastasis.*Methods and Materials To evaluate the cost-effectiveness of CE-MR/CT to CE-CT in detecting liver metastases in PDAC patients, a decision model based on Markov simulation was developed to estimate the quality-adjusted life-years (QALYs) and lifetime costs of the diagnostic modalities. Model input parameters were assessed based on evidence from recent literature. The willingness-to-pay (WTP) was set to $100,000/QALY. To evaluate model uncertainty, deterministic and probabilistic sensitivity analysis of the input parameters based on a Monte-Carlo simulation with 30000 iterations were performed.*Results In the base-case analysis the model yielded a total cost of 153367 $ and an effectiveness of 2,344 QALYs for CE-MR/CT and 155956 $ and 2,333 QALYs for CE-CT respectively. With a net monetary benefit (NMB) of 81004 $, CE-MR/CT is shown to be superior to CE-CT with a NMB of 77422 $. Deterministic and probalistic survival analysis showed model robustness for varying input parameters.*Conclusions Based on our results, combined CE-MR/CT can be regarded as a cost-effective imaging strategy for staging of pancreatic cancer.*Clinical Relevance/Application Based on our results, combined CE-MR/CT can be regarded as a cost-effective imaging strategy for staging of pancreatic cancer with high robustness for varying iput-parameters.

RESULTS

In the base-case analysis the model yielded a total cost of 153367 $ and an effectiveness of 2,344 QALYs for CE-MR/CT and 155956 $ and 2,333 QALYs for CE-CT respectively. With a net monetary benefit (NMB) of 81004 $, CE-MR/CT is shown to be superior to CE-CT with a NMB of 77422 $. Deterministic and probabilistic survival analysis showed model robustness for varying input parameters.

CLINICAL RELEVANCE/APPLICATION

Based on our results, combined CE-MR/CT can be regarded as a cost-effective imaging strategy for staging of pancreatic cancer with high robustness for varying iput-parameters.

GI05-B8   Diagnostic Value Of Dynamic CT Perfusion Imaging To Predict Tumor Response To Anti-angiogenic Therapy In Patients With Advanced HCC Lesions

Participants
Cesare Maino, MD, Milano, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To determine the efficacy of perfusion-CT (p-CT) imaging to evaluate both the inhibition of tumor neo-angiogenesis induced by Sorafenib and the survival during treatment in patients with advanced hepatocellular carcinoma (HCC).*Methods and Materials A total of ninety-eight p-CT examinations were performed on a 256-slice MDCT scanner, before treatment and every 2 months during administration of Sorafenib, in 29 cirrhotic patients with a diagnosis of advanced HCC.Perfusion parameters related to "responder" (complete response, stable disease or partial response) and "non responder" (progressive disease) groups were considered and compared according to baseline CT and follow-up CT scans.Kaplan-Meier analyses estimated the time-to-survival in the overall population, after stratifying patients according to mRECIST.*Results The "responder" group showed a significant reduction of perfusion values in HCC target lesions after anti-angiogenic therapy (p = 0.01), in comparison with the "non responder" group which demonstrated an increase or no significant variation. When patients were stratified according to mRECIST, higher survival rate was observed in "responder" group compared to the "non responder" one (48.6% vs 28.6%), and statistically significant correlation (p=0.01) was found between percentage variation of perfusion parameters and overall survival rate, in pre- and post-treatment CT scans.*Conclusions The quantitative assessment of perfusion parameters represents a prognostic indicator useful in the evaluation of response to anti-angiogenic therapy.*Clinical Relevance/Application The quantitative assessment of perfusion parameters with p-CT should be considered a useful tool for the optimization of individualized treatment.

RESULTS

The "responder" group showed a significant reduction of perfusion values in HCC target lesions after anti-angiogenic therapy (p = 0.01), in comparison with the "non responder" group which demonstrated an increase or no significant variation. When patients

were stratified according to mRECIST, higher survival rate was observed in "responder" group compared to the "non responder" one (48.6% vs 28.6%), and statistically significant correlation (p=0.01) was found between percentage variation of perfusion parameters and overall survival rate, in pre- and post-treatment CT scans.

CLINICAL RELEVANCE/APPLICATION

The quantitative assessment of perfusion parameters with p-CT should be considered a useful tool for the optimization of individualized treatment.

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Abstract Archives of the RSNA, 2021

Sub-Events

NR04-B1   Monitoring Hydrocephalus Using Portable, Low-Field Magnetic Resonance Imaging

Participants
Thomas Arnold, PhD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Patients with hydrocephalus require repeated neuroimaging to monitor ventricular volumes and avoid complications. Standard of care (SOC) imaging includes routine CT or MRI though both have some disadvantages. CT uses ionizing radiation and provides less soft-tissue contrast. MRI is less widely available, more expensive, and subject to imaging artifact from commonly used programmable ventricular shunts. Strong magnetic fields also change programmable shunt settings. Here we present early results on the use of a recently FDA-cleared, portable, low-field strength (64mT) MRI scanner to monitor hydrocephalus. We hypothesized that low-field imaging would provide a comparable and more convenient point-of-care assessment for alterations in ventricle size, less shunt-related artifact, and less need for programmable shunt checks.*Methods and Materials As part of an ongoing trial, we collected same-day low-field MRI and outpatient SOC imaging for 22 patients with known or suspected hydrocephalus (CT=10, MRI=12). Low-field images were acquired on a 64mT system (Hyperfine, Guilford, CT) and included T1w, T2w, and T2-FLAIR sequences. A neuroradiologist (JMS) qualitatively assessed ventricles as abnormally increased, decreased or within expected limits. Semi-automated ventricular volume segmentations were also generated for clinical MRI scans and compared to deep-learning based volumes automatically provided by the low-field device. For programmable shunts, we recorded shunt settings before and after low-field imaging.*Results Radiological assessments were comparable between low-field MRI and SOC imaging. In one patient, a shunt related hemorrhage was evident on both modalities. We found a strong correlation (R=0.97, p<0.001) between lateral ventricle volume measurements on low-field and clinical MRI. Low-field MRI demonstrated less signal dropout near programmable shunts. Programmable shunts were present in 10/22 patients and shunt settings were altered by the low-field MRI in 9/10 cases.*Conclusions Initial results suggest low-field MRI offers comparable performance to SOC imaging for following hydrocephalus and that deep-learning based lateral ventricle volume estimates from low-field MRI are accurate. Programmable shunts must still be checked by the clinical care team after low-field imaging.*Clinical Relevance/Application Low-field MRI may offer a cost-effective, radiation-free alternative to monitor ventricular volume changes in patients with hydrocephalus.

RESULTS

Radiological assessments were comparable between low-field MRI and SOC imaging. In one patient, a shunt related hemorrhage was evident on both modalities. We found a strong correlation (R=0.97, p<0.001) between lateral ventricle volume measurements on low-field and clinical MRI. Low-field MRI demonstrated less signal dropout near programmable shunts. Programmable shunts were present in 10/22 patients and shunt settings were altered by the low-field MRI in 9/10 cases.

CLINICAL RELEVANCE/APPLICATION

Low-field MRI may offer a cost-effective, radiation-free alternative to monitor ventricular volume changes in patients with hydrocephalus.

NR04-B2   Radiation Distribution In A Hybrid Operating Room, Utilizing Three Different Intraoperative X-ray Imaging Systems: Investigations To Minimize Occupational Exposure.

Participants
Paulina Cewe Jonsson, MD, Stockholm, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

Evaluate the occupational radiation environment in a hybrid operating room (OR) used in neurosurgical procedures, considering typical staff positions, different free-standing protective lead shields and various x-ray imaging equipment.*Methods and Materials Radiation dose was measured using personal dosimeters and a large-volume ionization chamber. Patient x-ray scatter was simulated using a whole-body anthropomorphic phantom, spine levels Th11 - L4, and standard clinical imaging protocols for three different types of x-ray systems: hybrid ceiling-mounted c-arm cone-beam CT (hCBCT), o-arm cone-beam CT (oCBCT), and a 2D c-arm fluoroscopy system. Different lead protection shields at various positions were evaluated.*Results Scatter dose from the hCBCT system was consistently lower by about 30% (9.4 µGy/rotation) compared to the oCBCT system (12.9 µGy/rotation). One rotational acquisition using the hCBCT and oCBCT system corresponded, respectively, to 12 and 16 minutes of flouroscopy imaging with the 2D c-arm. A wider and thicker lead protection shield provided a reduction in the scatter dose compared to a smaller shield, as expected. Radiation dose measured behind both protective shields, increased as the distance from the shield increased, up to a maximum at approximately 0.6 meter from the shield. This build-up being caused by tertiary scatter from walls and ceiling in the OR. Scatter dose subsequently decreased with further increased distance from the shield and was negligible outside a 3-m radius behind the protective shield.*Conclusions Scatter radiation to staff can be reduced by using hCBCT compared to oCBCT during spine surgery in a hybrid OR. Radiation to staff can be lowered by optimal use of protective shielding, proper staff positioning and considering the proximity of walls and ceiling in the OR. Staff in a hybrid OR can during rotational (CBCT) imaging use free-standing protective lead shields instead of heavy protective aprons, achieving the same dose reduction while preventing possible future ergonomic injuries and fatigue.*Clinical Relevance/Application Occupational radiation is reduced using hCBCT compared to oCBCT.

Lead shields achieve the same dose reduction as heavy protective aprons, preventing possible future ergonomic injuries and fatigue.

RESULTS

Scatter dose from the hCBCT system was consistently lower by about 30% (9.4 µGy/rotation) compared to the oCBCT system (12.9 µGy/rotation). One rotational acquisition using the hCBCT and oCBCT system corresponded, respectively, to 12 and 16 minutes of flouroscopy imaging with the 2D c-arm. A wider and thicker lead protection shield provided a reduction in the scatter dose compared to a smaller shield, as expected. Radiation dose measured behind both protective shields, increased as the distance from the shield increased, up to a maximum at approximately 0.6 meter from the shield. This build-up being caused by tertiary scatter from walls and ceiling in the OR. Scatter dose subsequently decreased with further increased distance from the shield and was negligible outside a 3-m radius behind the protective shield.

CLINICAL RELEVANCE/APPLICATION

Occupational radiation is reduced using hCBCT compared to oCBCT. Lead shields achieve the same dose reduction as heavy protective aprons, preventing possible future ergonomic injuries and fatigue.

NR04-B4   Correlation Between Magnetic Susceptibility And Brain Volume In Different Brain Location Might Be Modulated By Apoe4, Age And Gender

Participants
Younghee Yim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to examine relationship between iron accumulation and brain volume and find out possible modulator in this association in subjects with various spectrum of memory symptom.*Methods and Materials Total 103 patients diagnosed with SMI (n=20), MCI (n=57) or AD (n=20) were enrolled retrospectively. QSM data were generated from 3D gradient echo data using QSMnet algorithm. Intracranial volume was measured using automatic segmentation method based on FreeSurfer 6.0 platform. VOI-based analysis with QSM was performed for deep gray matter and six location of cortex. Correlation between brain volume and magnetic susceptibility was calculated and modulating factor was speculated. Also, we divided patients into three groups based on the age to evaluate susceptibility changes in different age and genetic status.*Results Volume of frontal cortex (p = 0.0064) and caudate nucleus (p = 0.0262) are associated with the magnetic susceptibility of the corresponding areas. In subgroup analysis, subjects diagnosed as MCI, whom without APOE4 gene or male gender shows association in frontal cortex while age shows only correlation in caudate nucleus. Magnetic susceptibility of caudate, thalamus, frontal temporal, or insular cortex shows significant difference among three age group. Patients with APOE4 gene show significant different magnetic susceptibility in putamen (p = 0.0176), thalamus (p = 0.0241), insular cortex (p = 0.0017), while those who without APOE4 gene shows significant different magnetic susceptibility in thalamus (p < 0.0001), frontal (p = 0.071), temporal (p = 0.0396), insular cortex (p = 0.0103).*Conclusions Our study demonstrates that volume and magnetic susceptibility of frontal cortex and caudate are probably modulated by genetic factor (APOE4), disease severity, age or gender. It suggests the brain iron accumulation might be associated with brain volume with different regional predilection and modulating factors. Iron accumulation of insular cortex tends to be decreased and that of thalamus tends to be increased as patients getting older regardless of genetic status.*Clinical Relevance/Application We anticipate more accurate and faster diagnosis and regulate correctable modulators to slow down the disease progression and intervene actively before patients hinder their everyday life.

RESULTS

Volume of frontal cortex (p = 0.0064) and caudate nucleus (p = 0.0262) are associated with the magnetic susceptibility of the corresponding areas. In subgroup analysis, subjects diagnosed as MCI, whom without APOE4 gene or male gender shows association in frontal cortex while age shows only correlation in caudate nucleus. Magnetic susceptibility of caudate, thalamus, frontal temporal, or insular cortex shows significant difference among three age group. Patients with APOE4 gene show significant different magnetic susceptibility in putamen (p = 0.0176), thalamus (p = 0.0241), insular cortex (p = 0.0017), while those who without APOE4 gene shows significant different magnetic susceptibility in thalamus (p < 0.0001), frontal (p = 0.071), temporal (p = 0.0396), insular cortex (p = 0.0103).

CLINICAL RELEVANCE/APPLICATION

We anticipate more accurate and faster diagnosis and regulate correctable modulators to slow down the disease progression and intervene actively before patients hinder their everyday life.

NR04-B6   Development And Validation Of An Automatic Classification Algorithm For The Diagnosis Of Alzheimer's Disease Using A High-performance Interpretable Deep Learning Network

Participants
Jinyoung Kim, Chapel Hill, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate an automatic classification algorithm for diagnosing Alzheimer's disease (AD) using a high-performance interpretable deep learning network.*Methods and Materials A deep learning-based classification algorithm was developed using T1-weighted brain MRI. We evaluated two classifier techniques, including TabNet, which is a high-performance interpretable network, and XGBoost for AD prediction. Automatic brain segmentation was performed using an automatic volumetry software (DeepBrain, VUNO Inc.). TabNet and XGBoost were respectively trained on the volumes and radiomics shape features of 104 segmented brain regions for classifying subjects into AD or cognitively normal (CN). Stratified 5-fold cross validation was used for training, while average ensemble value of five models from the stratified 5-fold cross validation was used for prediction. The diagnostic performance of TabNet and XGBoost was compared using areas under the curves (AUCs) for differentiating AD from CN. In addition, deep learning-based, 20 AD signature areas were investigated.*Results Between December 2014 and March 2017, 161 AD patients who were referred to a memory clinic at our tertiary medical center and 306 CN subjects who visited our Health Screening & Promotion Center were consecutively included in the training dataset. In the validation dataset, the other 120 AD and 141 CN were included between March 2017 and June 2018. In differentiating AD from CN, TabNet using volume, shape feature, or both resulted in AUCs of 0.951-0.955, which were similar compared to XGBoost with AUCs of 0.950-0.953. TabNet using both volume and shape features showed a sensitivity of 90% and a specificity of 93%. TabNet using volume, shape feature, or both were not significantly different with XGBoost using volume data in AD detection (P = 0.151-0.477). In comparing deep learning-based AD signature areas, both XGBoost and TabNet using volume data focused on the same 13 regions, including bilateral hippocampus, bilateral inferior

lateral ventricles, left entorhinal, left fusiform, and left accumbens area. For the rest 7 regions, TabNet selected more semantically meaningful regions compared to XGBoost.*Conclusions The automatic classification algorithm using a high-performance interpretable deep learning network helps accurate AD detection using T1-weighted brain MRI and detailed interpretation on the selected regions. This algorithm has the potential to be widely applicable method for AD prediction.*Clinical Relevance/Application Considering the wide availability of T1-weighted MRI in the clinical fields, this automatic classification algorithm for AD could be commonly used as an accurate and interpretable diagnostic method for AD.

RESULTS

Between December 2014 and March 2017, 161 AD patients who were referred to a memory clinic at our tertiary medical center and 306 CN subjects who visited our Health Screening & Promotion Center were consecutively included in the training dataset. In the validation dataset, the other 120 AD and 141 CN were included between March 2017 and June 2018. In differentiating AD from CN, TabNet using volume, shape feature, or both resulted in AUCs of 0.951-0.955, which were similar compared to XGBoost with AUCs of 0.950-0.953. TabNet using both volume and shape features showed a sensitivity of 90% and a specificity of 93%. TabNet using volume, shape feature, or both were not significantly different with XGBoost using volume data in AD detection (P = 0.151-0.477). In comparing deep learning-based AD signature areas, both XGBoost and TabNet using volume data focused on the same 13 regions, including bilateral hippocampus, bilateral inferior lateral ventricles, left entorhinal, left fusiform, and left accumbens area. For the rest 7 regions, TabNet selected more semantically meaningful regions compared to XGBoost.

CLINICAL RELEVANCE/APPLICATION

Considering the wide availability of T1-weighted MRI in the clinical fields, this automatic classification algorithm for AD could be commonly used as an accurate and interpretable diagnostic method for AD.

NR04-B8   Alterations In Vertebrobasilar Arterial System In Migraine And Its Association With Migraine Severity-A Case Control Study

Participants
Aditi Saini, MBBS, Rishikesh, India (*Presenter*) Nothing to Disclose

PURPOSE

Migraine is one of the most prevalent yet least understood neurological disorder, with the medical field still at the crossroads of vascular and neurogenic theories of pathogenesis. Occipital cortex and brainstem have been proposed as the generator areas for migraine headache and aura, thus prompting us to evaluate the association of basilar artery displacement and other alterations in vertebrobasilar arterial system with the severity of migraine.*Methods and Materials A case control study at AIIMS Rishikesh was conducted with 150 migraine (ICHD-3) cases and 153 age-group and sex matched controls over a period of 18 months. Severity of migraine was assessed using the Migraine Disability Assessment (MIDAS) questionnaire. Basilar artery displacement was evaluated on Time of Flight (TOF) sequence of MRI Brain along with basilar and vertebral arteries diameter.*Results Mean displacement of basilar artery was significantly (p<0.001) greater in migraine cases as compared to the controls (5.6±2.3 mm in cases and 3± 2.4 mm in controls); and even more so in migraine with aura (6±2.8 mm, p<0.05). There was significant association between basilar artery displacement and the severity (p<0.001), frequency in last 3 months (p<0.001) and duration (p=0.002) of migraine. A cut off of > 6.6 mm was found to be significant (p<0.001); odd's ratio 132.3) with a specificity of 93.7% to diagnose a case as severe migraine. However, the basilar and vertebral arterial diameters did not show any significant (p>0.05) association with migraine.*Conclusions Basilar artery displacement is significantly associated with migraine with significant correlation with migraine severity. Basilar artery displacement also significantly increases with increase in duration of the disease and frequency.*Clinical Relevance/Application Assessment of vertebrobasilar system in migraine patients, especially the basilar artery and its displacement, can help in severity stratification of the patients, helping the clinicians to provide appropriate medical management.

RESULTS

Mean displacement of basilar artery was significantly (p<0.001) greater in migraine cases as compared to the controls (5.6±2.3 mm in cases and 3± 2.4 mm in controls); and even more so in migraine with aura (6±2.8 mm, p<0.05). There was significant association between basilar artery displacement and the severity (p<0.001), frequency in last 3 months (p<0.001) and duration (p=0.002) of migraine. A cut off of > 6.6 mm was found to be significant (p<0.001); odd's ratio 132.3) with a specificity of 93.7% to diagnose a case as severe migraine. However, the basilar and vertebral arterial diameters did not show any significant (p>0.05) association with migraine.

CLINICAL RELEVANCE/APPLICATION

Assessment of vertebrobasilar system in migraine patients, especially the basilar artery and its displacement, can help in severity stratification of the patients, helping the clinicians to provide appropriate medical management.

NR04-B9   Initial Clinical Experience With Bedside, Point Of Care Non-contrast Brain MRIs

Participants
Brian Yep, MD, Orange, California (*Presenter*) Nothing to Disclose

PURPOSE

While non-contrast computed tomography (CT) imaging of the head represents the first-line imaging choice for a variety of neuro-pathologies due to its acquisition speed and availability, MRI is widely used as a follow-up exam for unrevealing CT examinations due to its superior contrast resolution. The US Food & Drug Administration (FDA) has recently provided 510(k) premarket notification for a bedside, point-of-Care (POC) 0.064T MRI device. Currently, there are less than five of these devices operating clinically in the country, and we present our early institutional clinical experience utilizing POC MRI non-contrast brain exams in the emergency department (ED) and intensive care unit (ICU) patient settings.*Methods and Materials This HIPAA-compliant study was approved by the local institutional review board with informed consent waived. Data were collected on patients in the ED and ICU setting who received POC MRI non-contrast brain exams between January 2021-April 2021. We recorded relevant findings, and how often subsequent fixed 1.5T or 3.0T imaging was required. For those requiring a repeat exam, we recorded whether new findings were appreciated on the follow-up exam.*Results Over a 4-month period, a total of 24 POC MR non-contrast brain exams were performed (9 ED, 15 ICU) with axial DWI/ADC, axial T2, and axial T2/FLAIR images obtained. Clinical indications for these exams included stroke (18) and altered mental status (6). Of POC-MRIs, images provided diagnostic confidence for 75% (18/24) of exams with 25% (6/24) requiring a repeat exam. Of the 6 repeated exams, 3 identified a new finding that was previously not identified on the POC-MRI. This included a 6 mm right thalamic infarct, scattered punctate embolic infarcts, and a lower pontine infarct. Note, the lower pontine infarct was missed on the original POC-MRI due to motion artifact.*Conclusions Preliminary, POC MRI non-contrast brain

exams were diagnostic in the majority of our patients. Findings that were missed thus far include infarcts less than 6 mm. Future studies are needed to determine the resolution to detect subtle neuro-pathologies in order to determine the appropriateness of this new device.*Clinical Relevance/Application POC MRI noncontrast brain exams provide an alternative rapid diagnostic tool to detect recent infarctions, although the study is limited may be limited for smaller infarctions or with significant patient motion.

RESULTS

Over a 4-month period, a total of 24 POC MR non-contrast brain exams were performed (9 ED, 15 ICU) with axial DWI/ADC, axial T2, and axial T2/FLAIR images obtained. Clinical indications for these exams included stroke (18) and altered mental status (6). Of POC-MRIs, images provided diagnostic confidence for 75% (18/24) of exams with 25% (6/24) requiring a repeat exam. Of the 6 repeated exams, 3 identified a new finding that was previously not identified on the POC-MRI. This included a 6 mm right thalamic infarct, scattered punctate embolic infarcts, and a lower pontine infarct. Note, the lower pontine infarct was missed on the original POC-MRI due to motion artifact.

CLINICAL RELEVANCE/APPLICATION

POC MRI noncontrast brain exams provide an alternative rapid diagnostic tool to detect recent infarctions, although the study is limited may be limited for smaller infarctions or with significant patient motion.

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GI04-B

Gastrointestinal Wednesday Poster Discussions

Sub-Events

GI04-B10   Combining Hepatic And Splenic CT Radiomic Features Improves Liver Fibrosis Staging

Participants
Yunchao Yin, MSc, Groningen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning for CT-based liver fibrosis staging uses both hepatic and splenic information. Whether this also holds true for radiomics analysis is currently unknown. The primary aims of this study were to determine whether adding splenic information to hepatic information can improve the performance of liver fibrosis staging by CT-based radiomics analysis. The secondary aim was to compare the performance of radiomics analysis and deep learning in CT-based liver fibrosis staging on the same dataset.*Methods and Materials The radiomics features were extracted from both liver and spleen on contrast-enhanced CT images in the portal venous phase of 252 patients with histologically proven liver fibrosis stage. The radiomic analysis for liver fibrosis staging was done by hepatic and hepatic-splenic features, respectively. The most important radiomic features were analyzed to better understand the contribution of hepatic and splenic features in the models. Results were compared with a previously developed DL based algorithm for liver fibrosis staging using the same dataset.*Results When using both splenic and hepatic features in the CT-based radiomics analysis, the average accuracy rates of significant fibrosis, advanced fibrosis, and cirrhosis were 88%, 82%, and 86%, and area under the receiver operating characteristic curves (AUC's) were 0.92, 0.81, and 0.85. The micro-averaged AUC of hepatic-splenic based radiomic analysis based on ensemble classifier was significantly larger than that of hepatic-based analysis (P<0.05). The micro-averaged AUC of radiomic analysis was only 0.6% lower than deep learning on the same dataset. The top 5 most important features for radiomic analysis included both hepatic and splenic features.*Conclusions Adding CT-based splenic radiomic features to hepatic radiomic features increases radiomic analysis performance for liver fibrosis staging. Radiomic analysis shows promise as a non-inferior alternative to deep learning for liver fibrosis staging. Furthermore, analyzing important features in radiomic analysis make the prediction of the model easier to be understood.*Clinical Relevance/Application Our study analyzed the importance of splenic features in CT-based liver fibrosis staging and suggested radiomic analysis can be a non-inferiority approach compared to deep learning in this setting.

RESULTS

When using both splenic and hepatic features in the CT-based radiomics analysis, the average accuracy rates of significant fibrosis, advanced fibrosis, and cirrhosis were 88%, 82%, and 86%, and area under the receiver operating characteristic curves (AUC's) were 0.92, 0.81, and 0.85. The micro-averaged AUC of hepatic-splenic based radiomic analysis based on ensemble classifier was significantly larger than that of hepatic-based analysis (P<0.05). The micro-averaged AUC of radiomic analysis was only 0.6% lower than deep learning on the same dataset. The top 5 most important features for radiomic analysis included both hepatic and splenic features.

CLINICAL RELEVANCE/APPLICATION

Our study analyzed the importance of splenic features in CT-based liver fibrosis staging and suggested radiomic analysis can be a non-inferiority approach compared to deep learning in this setting.

GI04-B11   Body Diffusion MR Imaging With Compressed Sense Based On Single-shot Echo-planar Imaging: An Intra-individual Comparison.

Participants
Maike Bode, MD, Aachen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To investigate whether combining compressed SENSE (CS) based reconstruction and single-shot echo planar imaging (EPI) is useful in hepatic diffusion weighted imaging (DWI).*Methods and Materials Single-shot EPI-DWI with CS-based reconstruction (CS-DWI) and parallel imaging reconstruction (conv-DWI) in liver MRI was performed in volunteers and patients. In all individuals, conv-DWI was acquired with a spatial resolution of 1.7x1.7x6 mm3, within 3:31 min:sec. In 12 healthy volunteers, signal-to-noise ratio (SNR) and apparent diffusion coefficient (ADC) value were compared for conv-DWI and CS-DWI with the same spatial resolution. For the patient cohort, 75 subjects (60±13 years, 41 men) with 349 focal liver lesions (FLL) were included. In 28 patients (group A), CS was used to reduce acquisition time (3:00 min:sec); in 47 patients (group B), CS was invested to improve spatial resolution (1.48x1.48x6 mm3). Two radiologists independently rated several image quality parameters on a 5-point scale blinded to the applied techniques. The number of FLLs was recorded for both sequences; where FLLs were missed, a side-by-side comparison was added to analyze the reason for non-detectability.*Results In volunteers, higher SNR (19.3±2.8 vs. 9.8±1.6 at b=800) and lower SD of the ADC-values (0.17 vs. 0.20, p<0.05) were found on CS-DWI compared to conv-DWI. Image quality ratings in patients were similar for all parameters in both groups except for "conspicuity of FLLs" which was rated significantly lower on CS-DWI vs. conv-DWI (4.7±0.6 vs. 4.2±0.9; p<0.05) in group A. In 5 patients (1 of group A, 4 of group B), 11/349 FLLs, 3-7 mm in size, were not detectable on CS-DWI, but on conv-DWI.*Conclusions CS-based reconstruction of single-shot EPI-based DWI can accelerate image acquisition or improve spatial resolution in DWI. However, our finding that a small fraction of FLLs was non-detectable on CS-DWI is concerning and warrants further research before using CS-DWI in clinical practice.*Clinical Relevance/Application Although

CS-based reconstruction of single-shot EPI-DWI can be used to accelerate acquisition time and/or improve spatial resolution at comparable image quality, a small fraction of FLLs was not visualized on CS-DWI.

RESULTS

In volunteers, higher SNR (19.3±2.8 vs. 9.8±1.6 at b=800) and lower SD of the ADC-values (0.17 vs. 0.20, p<0.05) were found on CS-DWI compared to conv-DWI. Image quality ratings in patients were similar for all parameters in both groups except for "conspicuity of FLLs" which was rated significantly lower on CS-DWI vs. conv-DWI (4.7±0.6 vs. 4.2±0.9; p<0.05) in group A. In 5 patients (1 of group A, 4 of group B), 11/349 FLLs, 3-7 mm in size, were not detectable on CS-DWI, but on conv-DWI.

CLINICAL RELEVANCE/APPLICATION

Although CS-based reconstruction of single-shot EPI-DWI can be used to accelerate acquisition time and/or improve spatial resolution at comparable image quality, a small fraction of FLLs was not visualized on CS-DWI.

GI04-B4 Replacing Unintentional Weight Loss With CT-Assessed Sarcopenia In Physical Frailty Phenotype Construct For Clinical Use

Participants
Omid Shafaat, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Frailty defined as an aging-related syndrome of physiological decline and is associated with poor post kidney transplant (KT) outcomes. The Physical Frailty Phenotype (PFP) includes weakness, slowness, exhaustion, low physical activity, and unintentional weight loss (shrinking). Compared to the original definition based on subjective self-reported unintentional weight loss, sarcopenia, identified by objective CT measures, may be more appropriate for risk stratification of KT recipients. This study was designed to compare frailty defined by the original PFP (oPFP) using subjective unintentional weight loss vs. frailty defined by new PFP (nPFP) using objective CT-assessed sarcopenia for risk predictions of mortality and graft loss in KT recipients.*Methods and Materials In a prospective cohort of adult KT recipients we measured oPFP at admission (12/2008-2/2020), and skeletal muscle index (SMI) at L3 vertebral level from available CT scans using OsiriX by drawing a closed polygon and using the region of interest (ROI) tool within 1-year pre-KT and ascertained binary sarcopenia status (male SMI<50; female SMI<39 cm2/m2). nPFP score was calculated in the same way as oPFP score, while shrinking was determined by sarcopenia. Frailty by either PFP was defined as a score=3. Hazard ratios (HRs) of all-cause mortality and all-cause graft loss by frailty were estimated using adjusted Cox proportional hazard models for oPFP and nPFP, respectively. The model discriminations of outcomes using oPFP vs. nPFP were quantified using Harrell's C-statistic.*Results Among 1,113 KT recipients with both oPFP and nPFP scores, oPFP identified 16.5% while nPFP identified 15.1% of recipients being frail. After adjustment, frail recipients identified using oPFP had a 1.39-fold risk of mortality (95% CI: 1.03-1.87) and 1.42-fold risk of graft loss (95% CI: 1.11-1.83), compared to their non-frail counterparts; frail recipients identified using nPFP had a 1.45-fold risk of mortality (95% CI: 1.07-1.97) and 1.44-fold risk of graft loss (95% CI: 1.11-1.87), compared to their non-frail counterparts. The C-statistics of mortality and graft models for nPFP and oPFP were similar.*Conclusions Subjective unintentional weight loss used in the PFP construct can be replaced by objective sarcopenia in KT recipients with similar discriminations for post-KT mortality and graft loss risks. Radiologists in transplant centers may consider using sarcopenia identified by CT measures for PFP construct.*Clinical Relevance/Application Frailty is associated with postoperative complications and poor outcomes. Replacing unintentional weight loss with an objective CT-based measure of sarcopenia for the shrinking component in PFP resulted in more appropriate risk stratification.

RESULTS

Among 1,113 KT recipients with both oPFP and nPFP scores, oPFP identified 16.5% while nPFP identified 15.1% of recipients being frail. After adjustment, frail recipients identified using oPFP had a 1.39-fold risk of mortality (95% CI: 1.03-1.87) and 1.42-fold risk of graft loss (95% CI: 1.11-1.83), compared to their non-frail counterparts; frail recipients identified using nPFP had a 1.45-fold risk of mortality (95% CI: 1.07-1.97) and 1.44-fold risk of graft loss (95% CI: 1.11-1.87), compared to their non-frail counterparts. The C-statistics of mortality and graft models for nPFP and oPFP were similar.

CLINICAL RELEVANCE/APPLICATION

Frailty is associated with postoperative complications and poor outcomes. Replacing unintentional weight loss with an objective CT-based measure of sarcopenia for the shrinking component in PFP resulted in more appropriate risk stratification.

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Sub-Events

CH02-B2 **Localizing Peripherally Inserted Central Catheters (PICCs) Tips In Chest Radiographs With A Machine Learning Algorithm Trained Via Transfer Learning.**

Participants
Ravish Patel, Athens, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

Peripherally inserted central catheters (PICCs) are often placed by advanced practitioners (eg, physicians assistants and nurse practitioners) with limited training in chest radiograph interpretation. A system to detect PICC positioning may assist in confirming accurate placement of the line. Our primary objective in this study was to use transfer learning to train a machine learning (ML) algorithm to localize the tip of the PICC in chest radiographs.*Methods and Materials Chest radiographs were obtained from the NIH Chest X-ray Dataset. 677 cases with PICCs were identified, and 743 cases without PICCs, for a total of 1,420 total cases. Training chest radiographs were labeled as left or right PICC, and the tip was manually tagged with a small region of interest (ROI). Images were modified using adaptive histogram equalization to improve image contrast for the purpose of optimizing PICC tip detection. Transfer learning was used to train the YOLOv3 ML architecture on 1,220 images. 100 different images with PICCs were used for testing purposes.*Results The system was 98% accurate at producing a small ROI that contained the PICC tip and labeled each correctly as coming from the left or right side. In almost all cases, the tip was essentially in the exact center of the ROI. Failed cases contained PICC tips in non-standard locations.*Conclusions The YOLOv3 ML architecture trained via transfer learning can accurately localize the tips of PICC lines in chest radiographs. Image modification may assist in incrementally increasing the accuracy of the model.*Clinical Relevance/Application Peripherally inserted central catheters (PICCs) are often placed by advanced practitioners with limited training in chest radiography. A system to detect PICC positioning may assist in placement.

RESULTS

The system was 98% accurate at producing a small ROI that contained the PICC tip and labeled each correctly as coming from the left or right side. In almost all cases, the tip was essentially in the exact center of the ROI. Failed cases contained PICC tips in non-standard locations.

CLINICAL RELEVANCE/APPLICATION

Peripherally inserted central catheters (PICCs) are often placed by advanced practitioners with limited training in chest radiography. A system to detect PICC positioning may assist in placement.

CH02-B3 **Qualitative And Quantitative Characteristics Of Dark-field X-ray Imaging: First Results In Healthy Humans**

Participants
Florian Gassert, MD, Muenchen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To describe the qualitative and quantitative characteristics of X-ray dark-field images in healthy subjects for the first time and thus set a reference for future studies.*Methods and Materials Overall, 40 subjects without history of lung diseases and normal appearance of the lungs in a chest CT scan were included in this study and imaged using the novel clinical X-ray dark-field prototype, recently constructed and commissioned at our institution, simultaneously acquiring both conventional and dark-field thorax radiographs. The subject's total dark-field signal was correlated with the estimated number of alveoli in the lung, and the dark-field coefficient was correlated with the demographic parameters age, sex, weight, and height.*Results The properly ventilated lung tissue gives a strong signal while surrounding osseous structures and soft tissue result in very low or no signal, respectively. The average dark-field signal was 2.53 ± 0.44 per meter of examined lung tissue. There was a highly significant correlation between the total dark-field signal and the number of alveoli ($r = 0.61$; $p < 0.001$). No significant difference was found between males and females ($p = 0.78$). Also, age ($r = -0.18$; $p = 0.26$), weight ($r = 0.24$; $p = 0.13$), and height ($r = 0.01$; $p = 0.96$) did not influence the dark-field signal significantly.*Conclusions The X-ray dark-field signal intensity depends on the lung ventilation while being independent from demographic parameters. Therefore, the quantitative dark-field coefficient may serve as a robust novel imaging biomarker for the diagnostic assessment of lung function. This is the first study to introduce qualitative and quantitative reference values for X-ray dark-field imaging in healthy humans.*Clinical Relevance/Application New imaging techniques are needed to diagnose lung diseases in earlier stages to improve clinical outcome. In that respect, X-ray dark-field imaging may add to the currently existing lung imaging techniques.

RESULTS

The properly ventilated lung tissue gives a strong signal while surrounding osseous structures and soft tissue result in very low or no signal, respectively. The average dark-field signal was 2.53 ± 0.44 per meter of examined lung tissue. There was a highly significant correlation between the total dark-field signal and the number of alveoli ($r = 0.61$; $p < 0.001$). No significant difference was found between males and females ($p = 0.78$). Also, age ($r = -0.18$; $p = 0.26$), weight ($r = 0.24$; $p = 0.13$), and height ($r =

0.01; p = 0.96) did not influence the dark-field signal significantly.

CLINICAL RELEVANCE/APPLICATION

New imaging techniques are needed to diagnose lung diseases in earlier stages to improve clinical outcome. In that respect, X-ray dark-field imaging may add to the currently existing lung imaging techniques.

CH02-B5   **Image Quality Of Thorax On Dual-Energy Spectral CT With And Without The Deep Learning-Based Image Reconstruction: Visual And Quantitative Evaluations Of Virtual Monoenergetic Images**

Participants
Noriko Kikuchi, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To visually and quantitatively evaluate image quality of dual-energy CT in thorax by comparing virtual monoenergetic images reconstructed with filtered back projection (FBP), adaptive statistical iterative reconstruction (ASiR-V), and deep learning-based image reconstruction (DLIR).*Methods and Materials This retrospective study included 30 patients who underwent enhanced dual-energy CT for close examination of esophageal cancer. All images with 0.625-mm slice thickness were reconstructed using FBP, ASiR-V, and DLIR for 50keV and 70keV monochromatic images. ASiR-V degree of 60% was used. Two independent radiologists evaluated FBP-50KeV, ASiR-V-50KeV, DLIR-50KeV, ASiR-V-70KeV, and DLIR-70KeV compared with the conventional 70keV monochromatic images (FBP-70keV) on a 5-point scale (1=worst<2<3=FBP-70KeV<4<5=best) in terms of the visibility of lymph nodes, esophagus, aorta, and overall image quality on mediastinum window setting (width 400 HU; level 60 HU). Regions of interest were placed at the axillary fat (af) and the erector spinae muscle (esm) to measure CT values and standard deviation (SD). The signal-to-noise ratio (SNR=CTesm/SDesm) and the contrast-to-noise ratio (CNR=[CTesm-CTaf]/SDaf) were calculated objectively on the six image sets (FBP-50KeV, ASiR-V-50KeV, DLIR-50KeV, FBP-70KeV, ASiR-V-70KeV, and DLIR-70KeV). Visual evaluation scores were statistically analyzed using Wilcoxson signed-rank test with Bonferroni correction. For quantitative data, statistical analysis was performed using repeated measures analysis of variances followed by post-hoc tests. P values<0.005(0.05/10) were considered significant.*Results DLIR significantly improved visual image quality of lymph nodes, esophagus, aorta, and overall image quality more than ASiR-V-70keV, ASiR-V-50keV, FBP-70keV and FBP-50keV(median scores:3,3,3,and 2, respectively) (all p?0.0003). There was no significant difference between DLIR-70keV and DLIR-50keV. Image quality of DLIR was the best (all median scores:4-5) FBP-50keV was the worst. SNR and CNR of DLIR-70keV(mean±SD,3.96±1.37 and 16.9±5.70) were significantly higher than those of ASiR-V-70keV(2.49±0.66 and 9.44±2.25) and FBP-70keV(1.96±0.49 and 7.63±1.68) (all p<0.005). SNR and CNR of DLIR-50keV(mean±SD,3.68±1.23 and 15.3±5.05) were significantly higher than those of ASiR-V-70keV(2.25±0.60 and 8.41±1.97) and FBP-70keV(1.78±0.45 and 6.69±1.43) (all p<0.005).*Conclusions DLIR can provide the best image quality of thorax on dual-energy spectral CT. Image quality of DLIR-50KeV is visually equivalent to DLIR-70KeV.*Clinical Relevance/Application DLIR on dual-energy CT may be useful for evaluation of contrast effect and reduction of contrast agent by improving image quality.

RESULTS

DLIR significantly improved visual image quality of lymph nodes, esophagus, aorta, and overall image quality more than ASiR-V-70keV, ASiR-V-50keV, FBP-70keV and FBP-50keV(median scores:3,3,3,and 2, respectively) (all p?0.0003). There was no significant difference between DLIR-70keV and DLIR-50keV. Image quality of DLIR was the best (all median scores:4-5) FBP-50keV was the worst. SNR and CNR of DLIR-70keV(mean±SD,3.96±1.37 and 16.9±5.70) were significantly higher than those of ASiR-V-70keV(2.49±0.66 and 9.44±2.25) and FBP-70keV(1.96±0.49 and 7.63±1.68) (all p<0.005). SNR and CNR of DLIR-50keV(mean±SD,3.68±1.23 and 15.3±5.05) were significantly higher than those of ASiR-V-70keV(2.25±0.60 and 8.41±1.97) and FBP-70keV(1.78±0.45 and 6.69±1.43) (all p<0.005).

CLINICAL RELEVANCE/APPLICATION

DLIR on dual-energy CT may be useful for evaluation of contrast effect and reduction of contrast agent by improving image quality.

NR04-D

Neuroradiology Wednesday Poster Discussions

Sub-Events

NR04-D2   **Welcome Pack: A Rapid Brain Screening Protocol Using Deep Learning Reconstruction.**

Participants
Yasutaka Fushimi, MD, PhD, Kyoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Reducing scan time is critical in MRI clinical routine to scan more patients per day to cope with the increasing number of demands and also critical for motion-prone patients or patients with time-sensitive diseases. Various previous reports developed ultrafast brain protocols by using rapid image sequences. In this context, we have optimized 5-minute routine screening protocol that we have called welcome pack (WP) utilizing deep learning reconstruction (DLR). Our main objective is to compare quality and diagnostic capability of WP with the conventional routine protocol.*Methods and Materials We optimized the rapid brain MRI screening protocol (WP) with a scan time of 4 minutes 36 seconds consisting of 2D axial images (T1WI, T2*WI, DWI), 2D coronal T2WI, 3D MR angiography, and 3D-FLAIR image with DLR. Scan time of our routine protocol (control) which included the same sequences as in WP was 11 minutes 47 seconds. A total of 60 patients (32 females, 71 [59-80] years) were enrolled in this study. All patients were explored with the WP and the control protocol during the same session on a Vantage Galan 3T / ZGO (Canon Medical Systems Corporation). Four radiologists separately read the cases of WP and control protocols for diagnosis purpose at 3-week interval in a blind manner. They also evaluated the image quality of each sequence. They classified Deep and Subcortical White Matter Hyperintensity (DSWMH) and Periventricular Hyperintensity (PVH) on 3D FLAIR images in 2 protocols. Statistical comparison for inter-sequence agreement was conducted.*Results Twenty-one lesions were diagnosed in the control protocol (2 patients had 2 lesions). The reading results by the neuroradiologist in control protocol were considered as the reference standard. Inter-sequence agreement of lesion detection for each rater was extremely high (0.971 in neuroradiologist, 0.719 in non-neuroradiologist, 0.928 in resident-1 and 0.917 in resident-2). Reader evaluated 94% sequences in WP as best image quality and 93% as same image quality as control. Concordance of DSWMH and PVH between 2 protocols was high as follows: neuroradiologist, 0.998, 1; non-neuroradiologist, 0.874, 0.873; resident-1, 0.936, 0.941; resident-2, 0.940, 0.929, respectively.*Conclusions Radiologists reached comparable results in lesion detection, image quality assessment, and classification of white matter hyperintensities between WP and control protocol.*Clinical Relevance/Application We have optimized a less than 5 minutes 6 sequences screening brain MR protocol using deep learning reconstruction (DLR) and radiologists reached statistically comparable results between the rapid and the routine control brain protocol, allowing the rapid protocol to be substituted as a clinical routine screening protocol.

RESULTS

Twenty-one lesions were diagnosed in the control protocol (2 patients had 2 lesions). The reading results by the neuroradiologist in control protocol were considered as the reference standard. Inter-sequence agreement of lesion detection for each rater was extremely high (0.971 in neuroradiologist, 0.719 in non-neuroradiologist, 0.928 in resident-1 and 0.917 in resident-2). Reader evaluated 94% sequences in WP as best image quality and 93% as same image quality as control. Concordance of DSWMH and PVH between 2 protocols was high as follows: neuroradiologist, 0.998, 1; non-neuroradiologist, 0.874, 0.873; resident-1, 0.936, 0.941; resident-2, 0.940, 0.929, respectively.

CLINICAL RELEVANCE/APPLICATION

We have optimized a less than 5 minutes 6 sequences screening brain MR protocol using deep learning reconstruction (DLR) and radiologists reached statistically comparable results between the rapid and the routine control brain protocol, allowing the rapid protocol to be substituted as a clinical routine screening protocol.

NR04-D4   **Hypoperfusion Lesion And Target Mismatch Prediction From Baseline Diffusion Imaging Using 3d U-net**

Participants
Yannan Yu, Palo Alto, California (*Presenter*) Nothing to Disclose

PURPOSE

Perfusion imaging is routinely used in acute ischemic stroke to assess target mismatch, but requires contrast agent injection and post-processing software. Clinical diffusion mismatch, such as the criteria used in DAWN trial, was reported to miss candidates that meet DEFUSE 3 criteria and could benefit from thrombectomy. We aim to explore whether neural network can predict hypoperfusion lesion and target mismatch from baseline diffusion-weighted imaging (DWI) and clinical information.*Methods and Materials Acute ischemic stroke cases with baseline MR perfusion and DWI were included from two multi-center trials and one single-center registry. MR perfusion images were post-processed by RAPID software, which automatically segments hypoperfusion lesion (Tmax = 6s) and ischemic core lesion (ADC = 620 ×10-6 mm2/s). All the images were normalized to template space (128 x 128 x 60 px). A 3D U-Net was trained using baseline DWI, Apparent diffusion coefficient, NIH stroke scale (NIHSS) and side of stroke as input, the union of hypoperfusion and ischemic core segmentation as ground truth. The ground truth segmentations were manually cleaned up to remove significant noises. Each training image and its ground truth were slabs extracted from the whole volume (128 x 128 x 16 px). 5-fold cross-validation was performed. Model performance was evaluated by dice score coefficient (DSC), volume difference, and absolute volume difference. DEFUSE 3 target mismatch (1) mismatch ratio = 1.8, 2) ischemic core = 70ml, 3) difference

between hypoperfusion and core lesion = 15 ml) was used as reference, the sensitivity, specificity, PPV, NPV of target mismatch from model and DAWN criteria were compared.*Results 368 patients were included (age 67±15 years, median NIHSS 14, median baseline core 17 ml, median baseline hypoperfusion 77 ml). The 3D U-Net reached a median DSC of 0.58 (interquartile range[IQR] 0.42, 0.69), volume difference 15 ml (IQR -24, 50), and absolute volume difference 40 ml (19, 71). Compared to DAWN criteria, The model reached a sensitivity of 94% vs 51%, a specificity of 61% vs 89%, PPV of 84% vs 91%, and NPV of 82% vs 46%.*Conclusions 3D U-Net can predict hypoperfusion lesion from baseline DWI and clinical information, which identify patients with DEFUSE3 target mismatch more sensitively than DAWN criteria.*Clinical Relevance/Application The model helps identify acute ischemic stroke patients with target mismatch using only baseline DWI and clinical information.

RESULTS

368 patients were included (age 67±15 years, median NIHSS 14, median baseline core 17 ml, median baseline hypoperfusion 77 ml). The 3D U-Net reached a median DSC of 0.58 (interquartile range[IQR] 0.42, 0.69), volume difference 15 ml (IQR -24, 50), and absolute volume difference 40 ml (19, 71). Compared to DAWN criteria, The model reached a sensitivity of 94% vs 51%, a specificity of 61% vs 89%, PPV of 84% vs 91%, and NPV of 82% vs 46%.

CLINICAL RELEVANCE/APPLICATION

The model helps identify acute ischemic stroke patients with target mismatch using only baseline DWI and clinical information.

NR04-D6   Disrupted Default Mode Network Functional Connectivity In Adolescents With Mild Traumatic Brain Injury

Participants
Thomas Johnson, MD,PhD, Rochester, New York (*Presenter*) Nothing to Disclose

PURPOSE

Use resting-state fMRI (rs-fMRI) to determine network connectivity measures in the 'default mode network' (DMN) of patients with mild traumatic brain injury (i.e., concussion - mTBI) with symptoms of post-concussion syndrome (PCS) and compare them to healthy controls.*Methods and Materials Concussion patients (n=142, 75M, 67F, mean age 18.2 yrs, range 9-60) with a history of clinically diagnosed mTBI and PCS and age and sex-matched controls (n=27, 15M, 12F, mean age 20.7 yrs, range 18-28) underwent rs-fMRI. The control group consisted of young athletes with no history of mTBI, as confirmed by a physician. A clinician extracted the number of previous concussions and time between injury and MRI from electronic medical records. Subjects were scanned anywhere between 3 days to 2 years after concussion. 3D MPRAGE sequence: TR/TE = 1200/2.29ms, voxel size = 1.0 x 1.0 x 1.0mm, matrix size = 256 x 256 x 208. Motion-corrected EPI sequence: TR/TE = 2200/30ms, voxel size = 4.0 x 4.0 x 4.0mm, matrix size 64 x 64 x 38 with 220 time points. Patients were instructed to close their eyes during rs-fMRI acquisition. Data analysis was performed using the FSL, and the pipeline and relevant modules are summarized below: 1. Data cleanup [FEAT], including brain extraction, field correction, linear motion correction, and registration to standard space [MNI atlas]. 2. Individual independent component analysis (ICA) [MELODIC], including finding the maximally independent components of the data in both space and time and classifying each as noise vs. signal. 3. Denoising data [FIX] by training a denoiser with hand-labeled components from ICA (10 controls, 20 subjects) and removing noisy components from fMRI data. 4. Group ICA [MELODIC] analysis, concatenating data from all subjects temporally. 5. Mapping group ICA components back to individual subjects [dual_regression] and performing a statistical comparison of groups [randomise].*Results 3-factor ANOVA (Control [CON], 1-2 concussions [C1-2], >=3 concussions [C3]) with posthoc F-test showed significant differences in DMN functional connectivity between C1-2 and C3 as well as CON and C1-2. There was also a trend between CON and C3 groups, p_min=0.055. The disrupted regions include the post-central and supramarginal gyri.*Conclusions DMN functional connectivity is disrupted in mTBI patients experiencing symptoms of PCS, with a significant difference in connectivity between low and high mTBI burden groups. This is congruent with previous data showing disrupted structural connectivity in the same patient group.*Clinical Relevance/Application The fact that disruption of connectivity is most pronounced in chronic mTBI patients suggests that a more severe disease process occurs in subjects with greater mTBI burden.

RESULTS

3-factor ANOVA (Control [CON], 1-2 concussions [C1-2], >=3 concussions [C3]) with posthoc F-test showed significant differences in DMN functional connectivity between C1-2 and C3 as well as CON and C1-2. There was also a trend between CON and C3 groups, p_min=0.055. The disrupted regions include the post-central and supramarginal gyri.

CLINICAL RELEVANCE/APPLICATION

The fact that disruption of connectivity is most pronounced in chronic mTBI patients suggests that a more severe disease process occurs in subjects with greater mTBI burden.

NR04-D8   Utility Of Synthetic MRI And Diffusion Measures In Predicting The Ki-67 Status Of Glioma: A Feasibility Study

Participants
Xin Ge, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the utility of synthetic magnetic resonance imaging (sy-MRI) and diffusion weight imaging (DWI) of glioma in predicting the Ki-67 status.*Methods and Materials From August 2020 to April 2021, forty-six patients with gliomas (including 13 LGGs and 33 HGGs) who underwent DWI and sy-MRI (magnetic resonance image compilation, MAGiC) on a 3.0T MR scanner (Signa Architect, GE, WI), were enrolled in the present study. Sy-MRI data were acquired using a multiple-dynamic, multiple-echo (MDME) sequence, which parameters follow: TR = 4177ms, TE = 20ms, slice thickness/gap = 5/1mm, FOV = 24cm, matrix = 320 × 256. The parameters of DWI sequence were as follows: TR = 3787ms, TE = 78ms, slice thickness/gap = 5/1mm, NEX = 2, FOV = 24cm, matrix = 160 × 166, b values = 0/1000 (sec/mm2). In the synthetic T2 FLAIR images, one radiologist drew the region of interests (ROIs) manually to encompass the largest area of the solid portion lesion, then the ROIs were copied onto T1 relaxometry (T1) / T2 relaxometry (T2) / proton density (PD) maps derived from MAGIC and ADC maps derived from DWI, as well as mean values were recorded. Correlations between the parameters and the label index of Ki-67 (KI-67 LI) were analyzed by using Spearman's correlation analysis.*Results Figure 1 show the representative images and Ki-67 staining of gliomas. Spearman's correlation analysis showed that the values of the tumor Ki-67 LI was correlated with the PD and ADC values (for PD, r = 0.402, P < 0.05; for ADC, r = -0.565, P < 0.001) but not any of the T1 or T2 relaxometry (Table 1).*Conclusions We found a negative correlation between ADC and Ki-67, which is associated with the activity of tumor cells proliferation of tumor cells. Importantly, PD values, were positively correlated with the Ki-67 LI, which may be used as an evaluation index of the cell proliferation state.*Clinical Relevance/Application

The PD represent the inherent properties of matter and the ADC show microstructural differences at the cellular level, which have an omni-directional and omni-depth role in assessing the tumor biological characteristics. Further, as a native parameter of tissue, PD, might be a novel predictor of Ki-67 LI.

RESULTS

Figure 1 show the representative images and Ki-67 staining of gliomas. Spearman's correlation analysis showed that the values of the tumor Ki-67 LI was correlated with the PD and ADC values (for PD, r = 0.402, P < 0.05; for ADC, r = -0.565, P < 0.001) but not any of the T1 or T2 relaxometry (Table 1).

CLINICAL RELEVANCE/APPLICATION

The PD represent the inherent properties of matter and the ADC show microstructural differences at the cellular level, which have an omni-directional and omni-depth role in assessing the tumor biological characteristics. Further, as a native parameter of tissue, PD, might be a novel predictor of Ki-67 LI.

NR04-D9   Validation Of A 3D Convolutional Neural Network For The Detection Of Large Vessel Occlusion In Acute Ischemic Stroke

Participants
Luis Souto Maior Neto, MSc, Calgary, Alberta (*Presenter*) Developer, Circle Cardiovascular Imaging Inc

PURPOSE

CT Angiography (CTA) is the imaging standard for the detection of large vessel occlusion (LVO) in acute ischemic stroke. Early detection of LVO is key for identifying eligible patients for endovascular treatment. StrokeSENS LVO utilizes a 3D convolutional neural network to automatically detect such occlusions on CTA images. The aim of this study was to validate the software's performance in LVO detection.*Methods and Materials 395 studies were used to build the reference dataset. Software performance in predicting LVO was evaluated using sensitivity, specificity and corresponding 95% confidence intervals. Results are reported on the entire reference dataset as well as on multiple subgroups.*Results For the entire reference dataset (184 LVO, 211 non-LVO), we report sensitivity of 0.897 [0.853, 0.941] and specificity of 0.900 [0.853, 0.934]. When testing for internal carotid artery (ICA) occlusion (54 yes vs 211 no), sensitivity of 0.926 [0.824, 0.971] and specificity of 0.900 [0.86, 0.941] was noted. For M1 middle cerebral artery (MCA) occlusion (130 yes vs. 211 no), sensitivity of 0.885 [0.83, 0.94] and specificity of 0.900 [0.86, 0.941] was noted. When testing including subjects with intracranial hemorrhage (62 yes vs. 184 no), sensitivity of 0.897 [0.853, 0.941] and specificity of 1.000 [0.942, 1.0] was noted. When testing for distal or no occlusion (149 yes vs. 184 no), sensitivity of 0.897 [0.853, 0.941] and specificity of 0.859 [0.803, 0.915] was noted. Furthermore, no significant difference in performance was noted when testing for subjects under/above 70 years of age, sex, range of slice thickness (0.5-0.8 mm and 0.9-2 mm), and scanner manufacturer (GE and Siemens).*Conclusions StrokeSENS LVO demonstrates high sensitivity and specificity in the detection of LVO in a large balanced dataset and across multiple subgroups.*Clinical Relevance/Application Patients with acute ischemic stroke due to LVO are candidates to receive lifesaving endovascular treatment. Timely and reliable detection of LVO on CTA is challenging in many centers and therefore automating the process is of great importance.

RESULTS

For the entire reference dataset (184 LVO, 211 non-LVO), we report sensitivity of 0.897 [0.853, 0.941] and specificity of 0.900 [0.853, 0.934]. When testing for internal carotid artery (ICA) occlusion (54 yes vs 211 no), sensitivity of 0.926 [0.824, 0.971] and specificity of 0.900 [0.86, 0.941] was noted. For M1 middle cerebral artery (MCA) occlusion (130 yes vs. 211 no), sensitivity of 0.885 [0.83, 0.94] and specificity of 0.900 [0.86, 0.941] was noted. When testing including subjects with intracranial hemorrhage (62 yes vs. 184 no), sensitivity of 0.897 [0.853, 0.941] and specificity of 1.000 [0.942, 1.0] was noted. When testing for distal or no occlusion (149 yes vs. 184 no), sensitivity of 0.897 [0.853, 0.941] and specificity of 0.859 [0.803, 0.915] was noted. Furthermore, no significant difference in performance was noted when testing for subjects under/above 70 years of age, sex, range of slice thickness (0.5-0.8 mm and 0.9-2 mm), and scanner manufacturer (GE and Siemens).

CLINICAL RELEVANCE/APPLICATION

Patients with acute ischemic stroke due to LVO are candidates to receive lifesaving endovascular treatment. Timely and reliable detection of LVO on CTA is challenging in many centers and therefore automating the process is of great importance.

Abstract Archives of the RSNA, 2021

Sub-Events

MS04-D1 **Improving Radiographic Fracture Detection And Reducing Reading Time Using Artificial Intelligence: A Multi-center Study With Radiologists And Non-radiologists In The United States**

Participants
Daichi Hayashi, MD,PhD, Stony Brook, New York (*Presenter*) Author with royalties, Wolters Kluwer nv

PURPOSE

Missed fractures on radiographs are not an uncommon cause of diagnostic discrepancy between initial interpretation and the final read by board-certified radiologists, leading to delay in care and preventable harm to the patient. The aim of this study was to assess the effect of artificial intelligence (AI) assistance on fracture detection performance of physicians on radiographs.*Methods and Materials Our study is a retrospective diagnostic study that follows the Multiple Readers Multiple Cases methodology. The dataset was composed of 480 exams with at least 60 exams per body region (foot/ankle, knee/leg, hip/pelvis, hand/wrist, elbow/arm, shoulder/clavicle, rib cage, thoracolumbar spine) with a prevalence of fractures set at 50%; 25% obvious and 25% non-obvious. The ground truth was determined by two expert musculoskeletal radiologists, with discrepancies solved by a third. Twenty-four readers of diverse specialties (radiologists, orthopedists, emergency medicine physicians and physician assistants, rheumatologists, family physicians) and level of experience were presented, in random order, the whole validation dataset of 480 cases, with and without AI assistance, with a minimum washout period of one month. The primary analysis had to demonstrate superiority of sensitivity by patient (SEPW) and the non-inferiority of specificity by patient (SPEPW) at -3% margin with AI aid.*Results A total of 480 patients were included (327 women, mean (SD) age 58.3 (17.9) years). The SEPW was 10.4% higher (95% confidence interval (CI): 6.9 to 13.9%, p<.0001 for superiority) with AI aid (75.2%) than without AI (64.8%). The SPEPW with AI aid (95.6%) was non-inferior to that without AI aid (90.6%), with a difference of +5.0% (95%CI: +2.0 to +8.0%, p<.0001 for non-inferiority). The AI shortened the average reading time by 6.3 seconds per examination (95% CI: 0.1 to 12.5, p=.046). The SEPW gain was significant in all regions but shoulder/clavicle and thoracolumbar spine.*Conclusions Radiographic AI assistance improves both sensitivity and specificity of fracture detection by radiologists and non-radiologists of variable expertise involving various anatomical locations. It also slightly reduces the time needed to interpret radiographs.*Clinical Relevance/Application Artificial intelligence assistance with skeletal fracture detection on radiographs improves the sensitivity and specificity of readers and shortens their reading time. We used an external multicenter dataset from the United States including multi-vendor radiographic acquisition systems that were not related to the development set originating from Europe, providing the robust generalization capacity of the model.

RESULTS

A total of 480 patients were included (327 women, mean (SD) age 58.3 (17.9) years). The SEPW was 10.4% higher (95% confidence interval (CI): 6.9 to 13.9%, p<.0001 for superiority) with AI aid (75.2%) than without AI (64.8%). The SPEPW with AI aid (95.6%) was non-inferior to that without AI aid (90.6%), with a difference of +5.0% (95%CI: +2.0 to +8.0%, p<.0001 for non-inferiority). The AI shortened the average reading time by 6.3 seconds per examination (95% CI: 0.1 to 12.5, p=.046). The SEPW gain was significant in all regions but shoulder/clavicle and thoracolumbar spine.

CLINICAL RELEVANCE/APPLICATION

Artificial intelligence assistance with skeletal fracture detection on radiographs improves the sensitivity and specificity of readers and shortens their reading time. We used an external multicenter dataset from the United States including multi-vendor radiographic acquisition systems that were not related to the development set originating from Europe, providing the robust generalization capacity of the model.

PD02-B

Pediatric Monday Poster Discussions

Sub-Events

PD02-B1   Whole Body And Pediatric Imaging With 3D Ultrasound Tomography (UT)

Participants
James Wiskin, PhD, Novato, California (*Presenter*) Employee, QT Imaging, Inc

PURPOSE

There is a clinical need for a body imaging modality that can be used for screening healthy people at high-risk for disease from genetic, environmental or familial factors and for patients who are at risk from complications of radiation, high magnetic fields, heavy metal-based contrast injections or anesthesia if imaged with other modalities. We are particularly thinking of the few options for infants, small children, and screening of healthy, at-risk individuals. Finally, there is need for a low-cost, comprehensive medical imaging modality that can be deployed in low-resource environments (LRE). We desire to show ultrasound tomography could be such a modality.*Methods and Materials The transmission and reflection data are collected on arrays which rotate in a water bath. 2D algorithms create 3D images slice by slice (tomography) in ~30 seconds but have artifacts. 3D algorithms have reported taking 32 hours on a 128 computer cluster. Our 3D algorithm (volography) is ideally suited to run on NIVIDIA GPU's, which enables reconstruction in ~25 minutes. Two 10-12 day old pigs were scanned at TIPS at Texas A&M. Whole body images were acquired using UT and MRI using a 3-T Siemens Magnetom Verio. Following freezing 1 cm thick transverse plane sections of each pig were acquired and photographed. The UT, MR images and gross sections were compared to correlate anatomic structures and volumetric segmentations were carried out to compare quantitative estimates of speed of sound with literature values.*Results Our 3D tomography algorithm is 64X faster (~25 minutes) than published results, using only 2 NVIDIA cards, We validated our speed of sound for the muscle, fat skin, nerve tissue, bone, kidney and liver using constrained segmentation and literature values. Sub-mm resolution is confirmed by detailed comparison of QT volography images with MRI and whole sections of pigs.*Conclusions The quantitative high resolution (sub-mm) estimation of tissue characteristics is shown in the presence of bone and air. These and reconstruction timing results indicate the utility of the QTUS volography in the clinic.*Clinical Relevance/Application The ability to collect and image data in clinically relevant times, the low cost of NVIDIA cards, the safety (lack of ionizing radiation, contrast agents, etc.) and the high resolution and quantitative accuracy make the scanner a potential pediatric clinical tool, especially for historically underserved populations in urban or rural areas. The scanner can easily be loaded into a self-contained mobile unit. It can be used to monitor therapy and biopsies by traversing a partial rotation leaving space for interventional tools. Meso-body imaging is an independent application. The SOS map can be used in ablation therapy.

RESULTS

Our 3D tomography algorithm is 64X faster (~25 minutes) than published results, using only 2 NVIDIA cards, We validated our speed of sound for the muscle, fat skin, nerve tissue, bone, kidney and liver using constrained segmentation and literature values. Sub-mm resolution is confirmed by detailed comparison of QT volography images with MRI and whole sections of pigs.

CLINICAL RELEVANCE/APPLICATION

The ability to collect and image data in clinically relevant times, the low cost of NVIDIA cards, the safety (lack of ionizing radiation, contrast agents, etc.) and the high resolution and quantitative accuracy make the scanner a potential pediatric clinical tool, especially for historically underserved populations in urban or rural areas. The scanner can easily be loaded into a self-contained mobile unit. It can be used to monitor therapy and biopsies by traversing a partial rotation leaving space for interventional tools. Meso-body imaging is an independent application. The SOS map can be used in ablation therapy.

PD02-B2   Ultrasound Guided Core Biopsy For Tissue Diagnosis In Pediatric Oncology - 16-year Experience With 597 Biopsies

Participants
Anat Ilivitzki, MD, Haifa, Israel (*Presenter*) Nothing to Disclose

PURPOSE

Percutaneous imaging guided core needle biopsies (CNB) for diagnosis of cancer in pediatric patients are gaining interest in recent years due to presumed easier availability, less complication rate and proclaimed high diagnostic power, compared to traditional surgical biopsies. Nevertheless, their precise role in the diagnostic algorithm of pediatric oncological subjects is still unsettled. The purpose of the present study is to report our accumulated 16 years' experience and discuss availability, safety and diagnostic accuracy, adequacy of ancillary testing and to compare it to the available literature.*Methods and Materials Pediatric Ultrasound-guided CNB performed in our hospital between November 2003 and December 2019 were retrospectively studied. Data collection included demographics, clinical and procedural parameters, complications and final diagnosis.*Results A total of 597 biopsies were performed on 531 patients: 132 known oncologic patients and 465 to establish diagnosis. The median availability of the procedure was one day. Twelve biopsies out of 432 malignancies (2.8%) were false negative. In 165 cases of benign pathology, all results were true negative. Ancillary testing was adequate in all malignant cases. Overall sensitivity, specificity and accuracy rates were 97.2%, 100% and 98% respectively. Complications were encountered in 5 patients (0.8%), including one major bleeding and another tract seeding.*Conclusions Our experience demonstrates that Ultrasound-guided CNB for suspected malignancy in pediatric patients has a high safety profile, availability and accuracy rate, compared to reported results. Our fast track strategy enables

early initiation of designated therapy and has the potential to become the procedure of choice.*Clinical Relevance/Application Our fast track strategy enables early initiation of designated therapy and has the potential to become the procedure of choice.

RESULTS

A total of 597 biopsies were performed on 531 patients: 132 known oncologic patients and 465 to establish diagnosis. The median availability of the procedure was one day. Twelve biopsies out of 432 malignancies (2.8%) were false negative. In 165 cases of benign pathology, all results were true negative. Ancillary testing was adequate in all malignant cases. Overall sensitivity, specificity and accuracy rates were 97.2%, 100% and 98% respectively. Complications were encountered in 5 patients (0.8%), including one major bleeding and another tract seeding.

CLINICAL RELEVANCE/APPLICATION

Our fast track strategy enables early initiation of designated therapy and has the potential to become the procedure of choice.

Printed on: 06/28/22

CA02-A

Cardiac Monday Poster Discussions

Sub-Events

CA02-A3   **Cardiac Magnetic Resonance Imaging Findings In College Athletes With Recent COVID-19 Infection: Not All Doom And Gloom**

Participants
Neo Poyiadji, MD, Canton, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

COVID-19 cardiac involvement and its implications for college athletes (CA) recovering from recent infection has raised significant concerns regarding return to play (RTP) decisions. Single center early Cardiac Magnetic Resonance (CMR) studies showed varying incidence of myocardial involvement ranging from almost 15 % to as low as 1.4 %. The aim of our study was to evaluate our CMR experience of CA after COVID-19.*Methods and Materials Single center retrospective study of 39 CA after COVID-19 infection (June 2020 -January 2021) undergoing CMR. Demographics and various CMR features were evaluated. Two cardiothoracic radiologists and one cardiologist independently re-reviewed CMRs specifically for certain findings which could have led to higher frequency of abnormal CMR in earlier studies, namely tiny foci of delayed enhancement (DE) at the right ventricle (RV) insertion point. Interobserver agreement analysis was performed.*Results No CA (0/39) had CMR imaging findings suggestive of myocarditis. Two CA(5%) had trace-small pericardial effusions. Mild enlarged left and right ventricular volumes (n = 7/39) as well as tiny foci of DE commonly at the inferior RV insertion site (n = 8/39) were noted. Interobserver agreement between the two most experienced readers for LGE at the RV insertion was good (kappa 0.65) and fair between all three readers (kappa 0.33).*Conclusions Our study reports the lowest incidence of abnormal MRI findings, specifically myocarditis which was 0%. Our study highlights the importance of recognizing normal variant findings sometimes found in athletes, such as mild biventricular enlargement and focal DE at the inferior RV insertion point, on CMR.*Clinical Relevance/Application The prevalence of abnormal CMR findings in CA recovering from COVID-19 is very low. Recognizing physiologic and normal variant findings on CMR, specifically RV insertion DE and mild chamber enlargement in CA, is essential to avoid over diagnosis which has significant negative RTP implications for these individuals.

RESULTS

No CA (0/39) had CMR imaging findings suggestive of myocarditis. Two CA(5%) had trace-small pericardial effusions. Mild enlarged left and right ventricular volumes (n = 7/39) as well as tiny foci of DE commonly at the inferior RV insertion site (n = 8/39) were noted. Interobserver agreement between the two most experienced readers for LGE at the RV insertion was good (kappa 0.65) and fair between all three readers (kappa 0.33).

CLINICAL RELEVANCE/APPLICATION

The prevalence of abnormal CMR findings in CA recovering from COVID-19 is very low. Recognizing physiologic and normal variant findings on CMR, specifically RV insertion DE and mild chamber enlargement in CA, is essential to avoid over diagnosis which has significant negative RTP implications for these individuals.

Printed on: 06/28/22

SDP-HN

Head and Neck Pre-recorded Scientific Posters

Sub-Events

SDP-HN-1   **Comparison Of Imaging And Clinical Findings In Different Pathological Type Of Sinonasal Non-hodgkin Lymphoma**

Participants
Dandan Huang, MD, Xi'An, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the difference of clinical and imaging findings in different pathological type of sinonasal non-Hodgkin lymphoma and to improve the diagnostic accuracy.*Methods and Materials Pathology-proven fifteen patients with NK/T cell lymphoma (NKTCL) and nine patients with diffuse large B-cell lymphoma (DLBCL) were collected in this study. Patient's age, gender distribution, clinical symptoms, mass location, volume, morphology, T1WI and T2WI signal intensity, enhancement degree and homogeneity, surrounding tissue invasion of the two groups were retrospectively analyzed. Difference of measurement data was compared with independent samples t-test or Mann-Whitney U test, calculators information was compared using Fisher's exact test.*Results The mean age at diagnosis for DLBCL was significantly higher than NKTCL(P=0.001). Gender distribution did not have significant difference between the two groups(P=0.351). The most common symptom for patients with NKTCL was nasal congestion (93.3%) whereas ocular signs more often occur in patients with DLBCL (55.5%). The most common region of NKTCL was nasal cavity whereas DLBCL more often located in paranasal sinus(P=0.000). NKTCL was commonly diffuse infiltration growth and DLBCL commonly in mass, but there was no significant difference between the two groups in this study(P=0.099). The lesion of DLBCL was larger than NKTCL(P=0.019). There was no difference in T1WI, T2WI signal intensity and enhancement degree (P values were 0.669, 0.118 and 0.617, respectively). NKTCL was characterized by heterogeneous enhancement and DLBCL was homogeneous enhancement(P=0.009). NKTCL often involved nasal dorsum(70%), and the region invasion of orbital cavity was more often in DLBCL(62.5%). The bone destruction degree was more serious in DLBCL than NKTCL.*Conclusions Nasal obstruction was the most common presenting symptom in NKTCL patients, NKTCL was predominant in nasal cavity, with diffuse infiltration growth, small volume, MR heterogeneous enhancement, and bone destruction mildly. Proptosis and epiphora were the most common presenting symptoms in DLBCL patients, DLBCL often located in paranasal sinus, with mass growth, large volume, MR homogeneous enhancement, and osteolytic bone destruction.*Clinical Relevance/Application There were valuable differentiating clinical and imaging features between sinonasal NKTCL and DLBCL

RESULTS

The mean age at diagnosis for DLBCL was significantly higher than NKTCL(P=0.001). Gender distribution did not have significant difference between the two groups(P=0.351). The most common symptom for patients with NKTCL was nasal congestion (93.3%) whereas ocular signs more often occur in patients with DLBCL (55.5%). The most common region of NKTCL was nasal cavity whereas DLBCL more often located in paranasal sinus(P=0.000). NKTCL was commonly diffuse infiltration growth and DLBCL commonly in mass, but there was no significant difference between the two groups in this study(P=0.099). The lesion of DLBCL was larger than NKTCL(P=0.019). There was no difference in T1WI, T2WI signal intensity and enhancement degree (P values were 0.669, 0.118 and 0.617, respectively). NKTCL was characterized by heterogeneous enhancement and DLBCL was homogeneous enhancement(P=0.009). NKTCL often involved nasal dorsum(70%), and the region invasion of orbital cavity was more often in DLBCL(62.5%). The bone destruction degree was more serious in DLBCL than NKTCL.

CLINICAL RELEVANCE/APPLICATION

There were valuable differentiating clinical and imaging features between sinonasal NKTCL and DLBCL

SDP-HN-10   **Application Of 4d-CT Scanning In Differential Diagnosis Of Arytenoid Subluxation And Vocal Fold Paralysis**

Participants
Yong Wang, MD, Xiamen, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the application of 4D-CT scanning with three-dimensional image reconstruction in the differential diagnosis of arytenoid subluxation and vocal cord paralysis.*Methods and Materials Seventy-six patients were collected who were suspected with vocal cord dyskinesia during January 2019 and December 2020. All patients were examined by larynx CT in our hospital. The CT scan was performed under GE revolution CT Cine mode on the subjects who was ordered to inspire deeply and then make a "Yi" sound continuously, and the scanning time was totally 5.6s. The images of 20 phases were reconstructed using the post-processing workstation. The maximum open phase and minimum closed phase images of glottis were selected from these images, for three-dimensional reconstruction. The following parameters were measured: the length and introversion angle of of vocal cord, the width of glottis, and the anteversion, elevation, valgus, and inversion angles of cricoarytenoid joint. According to the characteristics of shape and position change, the vocal cord was divided into type I, type II and type III. The consistency between CT diagnosis and clinical diagnosis or laryngeal EMG diagnosis was analyzed using Kappa test. And the statistical differences of various parameters between arytenoid subluxation or vocal cord paralysis and normal vocal cord were analyzed with Single-factor analysis of variance (independent sample Kruskal Wallis test).*Results There was high consistency between CT

diagnosis and clinical diagnosis or laryngeal EMG diagnosis (k = 0.731 or 0.783, P<0.05). A significant difference was observed in the opening width of glottis between type I and type III vocal cords, the valgus and inversion angles of cricoarytenoid joint between type I and type II or type III vocal cords, and the convergence angle among three types of vocal cord.*Conclusions 4D-CT scanning combined with three-dimensional image reconstruction can intuitively display the differences among various laryngeal structure changes in vocal cord dyskinesia, and thus can be used for the differential diagnosis of arytenoid subluxation and vocal cord paralysis.*Clinical Relevance/Application CT scanning using 4D imaging mode combined with 3D reconstruction images can directly display the differences of various larynx structures when there is vocal cord dyskinesia, and it there by can be used for the differential diagnosis of arytenoid cartilage subluxation and vocal cord paralysis.

RESULTS

There was high consistency between CT diagnosis and clinical diagnosis or laryngeal EMG diagnosis (k = 0.731 or 0.783, P<0.05). A significant difference was observed in the opening width of glottis between type I and type III vocal cords, the valgus and inversion angles of cricoarytenoid joint between type I and type II or type III vocal cords, and the convergence angle among three types of vocal cord.

CLINICAL RELEVANCE/APPLICATION

CT scanning using 4D imaging mode combined with 3D reconstruction images can directly display the differences of various larynx structures when there is vocal cord dyskinesia, and it there by can be used for the differential diagnosis of arytenoid cartilage subluxation and vocal cord paralysis.

SDP-HN-11 Diffusion Weighted Imaging Of Sellar Region: A Comparison Study Of Turbo Gradient And Spin Echo-blade Dwi With Readout Segmentation Of Long Variable Echo-trains

Participants
Qing Fu, MS,MS, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

Purpose of this study was to compare turbo gradient and spin echo-BLADE DWI (TGSE-BLADE-DWI) with readout segmentation of long variable echo-trains, RESOLVE-DWI (RESOLVE-DWI) on the feasibility of imaging the sellar region and image quality.*Methods and Materials Thirty-eight patients with suspected sellar abnormalities were enrolled to perform RESOLVE-DWI and TGSE-BLADE-DWI at a 3.0T MR scanner, including 32 patients with sellar lesions and 6 patients without any sellar lesions. Two experienced radiologists scored the imaging of two DWI methods for anatomical structures (including internal carotid arteries, optic chiasm, pituitary stalk and pituitary gland), lesion conspicuity, susceptibility artifacts, geometric distortions and overall image quality using a five-point scale. Objective parameters on the two DWIs were compared and analyzed, including lesion size, signal to noise ratio (SNR)and apparent diffusion coefficient (ADC). Paired t-test, Mann-Whitney U test, Kappa statistics and Pearson correlation coefficient were used for statistical evaluation.*Results TGSE-BLADE-DWI performed significantly better than RESOLVE-DWI in depicting anatomical structures, lesion conspicuity, geometric distortions and overall image quality (All p<0.05). There was no significant difference of SNR and ADC between the two DWIs. There was a good agreement between the two radiologists in assessment of the two DWIs (all Kappa values>0.7).The maximum transverse and longitudinal lesion size measured in TGSE-BLADE-DWI were more closely related with those of contrast-enhanced T1WI (r=0.973,r=0.997,respectively)than those of RESOLVE-DWI(r=0.947, r=0.989,respectivley).*Conclusions Compared with RESOLVE-DWI, TGSE-BLADE-DWI performed superior in depicting anatomical structures and lesion sizes, decreased susceptibility artifacts and geometric distortions in sellar region and effectively improved the image quality of diffusion weighted imaging for sellar region, which has great potential and great value in clinical applications.*Clinical Relevance/Application TGSE-BLADE-DWI provides an alternative to RESOLVE-DWI for depicting sellar region with minimized geometric distortions and susceptibility artifacts and superior image quality, which is of great importance for clinical applications of DWI.

RESULTS

TGSE-BLADE-DWI performed significantly better than RESOLVE-DWI in depicting anatomical structures, lesion conspicuity, geometric distortions and overall image quality (All p<0.05). There was no significant difference of SNR and ADC between the two DWIs. There was a good agreement between the two radiologists in assessment of the two DWIs (all Kappa values>0.7).The maximum transverse and longitudinal lesion size measured in TGSE-BLADE-DWI were more closely related with those of contrast-enhanced T1WI (r=0.973,r=0.997,respectively)than those of RESOLVE-DWI(r=0.947, r=0.989,respectivley).

CLINICAL RELEVANCE/APPLICATION

TGSE-BLADE-DWI provides an alternative to RESOLVE-DWI for depicting sellar region with minimized geometric distortions and susceptibility artifacts and superior image quality, which is of great importance for clinical applications of DWI.

SDP-HN-12 The Value Of Spectral CT In Differentiating Between Benign And Malignant Thyroid Lesions

Participants
Li Li, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the value of spectral CT in the differential diagnosis of thyroid lesions.*Methods and Materials Patients with thyroid lesions underwent neck spectral CT scan. The monochromatic images were used for the morphological features and iodine-based material decomposition (MD) images were used to measure the iodine concentration (IC) of lesions, and normal thyroid. The normalized iodine concentration to carotid artery (NICA), the normalized iodine concentration to normal thyroid (NICT) and slope of spectral curve (?HU) were calculated. The statistical analysis was performed and receiver operating characteristic (ROC) curve was used to determine the diagnostic capability of the lesion.*Results A total of 230 lesions were found in 225 patients (57 benign, 173 malignant). There were significant differences between benign and malignant lesions in the border, microcalcifications and lymph node metastasis (P<0.05). The accuracy was 73.0%, 43.0% and 75.2%, respectively using these parameters alone and 82.6% combined. There was no difference in the parameters between the three benign groups except the IC values. There was no significant difference in IC between nodular goiter and adenoma, nodular goiter and thyroiditis, while the IC value of adenoma was significantly higher than that of thyroiditis (P=0.006). The differences of IC, NICT and ?HU were significant between nodular goiter and malignant tumor, adenoma and malignant tumor, while there were no statistical differences between the thyroiditis and malignant tumors in all the parameters. The threshold of IC <3.16mg/ml was the predictor of malignancy demonstrating 71.1%, 68.4% and 70.4% in sensitivity, specificity and accuracy, respectively. The diagnostic parameters of IC, NICT, ?HU combined with morphological features were higher in the diagnosis of malignancy with 86.1% in sensitivity, 86.0% in specificity and 83.9%

accuracy.*Conclusions Spectral CT quantitatively evaluates the iodine concentration of thyroid lesions, which is valuable for benign and malignant identification. Combining spectral parameters with the morphological features is helpful for differentiating the thyroid lesions.*Clinical Relevance/Application Spectral CT imaging is helpful to differentiate malignant and benign thyroid lesions.

RESULTS

A total of 230 lesions were found in 225 patients (57 benign, 173 malignant). There were significant differences between benign and malignant lesions in the border, microcalcifications and lymph node metastasis (P<0.05). The accuracy was 73.0%, 43.0% and 75.2%, respectively using these parameters alone and 82.6% combined. There was no difference in the parameters between the three benign groups except the IC values. There was no significant difference in IC between nodular goiter and adenoma, nodular goiter and thyroiditis, while the IC value of adenoma was significantly higher than that of thyroiditis (P=0.006). The differences of IC, NICT and ?HU were significant between nodular goiter and malignant tumor, adenoma and malignant tumor, while there were no statistical differences between the thyroiditis and malignant tumors in all the parameters. The threshold of IC <3.16mg/ml was the predictor of malignancy demonstrating 71.1%, 68.4% and 70.4% in sensitivity, specificity and accuracy, respectively. The diagnostic parameters of IC, NICT, ?HU combined with morphological features were higher in the diagnosis of malignancy with 86.1% in sensitivity, 86.0% in specificity and 83.9% accuracy.

CLINICAL RELEVANCE/APPLICATION

Spectral CT imaging is helpful to differentiate malignant and benign thyroid lesions.

SDP-HN-13 Facial Injury Patterns In Intimate Partner Violence

Participants
Anji Tang, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Intimate partner violence (IPV) is a highly prevalent and critical public health issue in which radiologists play an increasingly pivotal role due to their ability to objectively assess injuries on imaging. Understanding facial injury patterns is critical for detection because the face is thought to be the most common target organ. The purpose of our study was therefore to evaluate imaging patterns of facial injuries in survivors of intimate partner violence.*Methods and Materials A retrospective review of all available radiological studies of 668 patients reporting IPV to our institution's violence prevention support program identified 96 patients with 152 facial injuries. Demographics, imaging findings, and clinical data obtained from a review of the electronic medical records were analyzed to categorize injury patterns. Sites of facial injuries were categorized into thirds—upper (frontal and supraorbital), mid (orbit, maxilla, zygoma), and lower face (mandibular and temporomandibular joint) fractures and soft tissue injuries.*Results The study cohort consisted of 93 women and 3 men with mean age 35 years (19-76 years; median 32). At the time of presentation, only 57 (59%) patients reported IPV as the mechanism of injury, with fall being the most common reported mechanism among patients who did not disclose IPV (16%). Facial fractures represented 61% of all facial injuries while isolated soft tissue swelling or hematoma was seen in 39%. The most frequent site of injury was the midface (68%) for both fractures and soft tissue injury, with left sided injuries slightly more common (59%). The most common fracture location was the nasal bone (45/152, 30%), followed by the mandible (17/152, 11%), and orbit (16/152, 11%). Most fractures (95%) showed no or minimal displacement (<2 mm). Associated injuries were seen most frequently in the upper extremity, occurring synchronously in 11 (11%) patients and preceding the index injury in 20 (21%) patients. Recurrent facial injuries were seen in 8/96 (8%) patients.*Conclusions The midface was the most frequent location of injury in IPV victims, with the nasal bone being the most commonly fractured facial bone. These were frequently either preceded by or occurred synchronously with upper extremity injuries. Both features, in the presence of an unclear presentation history, should prompt the radiologist to consider IPV in the differential.*Clinical Relevance/Application Recognizing facial injury patterns can help radiologists suspect IPV and prompt clinical providers to discuss the possibility of IPV with the patient. Early identification can facilitate early intervention, thereby preventing severe life-threatening injuries.

RESULTS

The study cohort consisted of 93 women and 3 men with mean age 35 years (19-76 years; median 32). At the time of presentation, only 57 (59%) patients reported IPV as the mechanism of injury, with fall being the most common reported mechanism among patients who did not disclose IPV (16%). Facial fractures represented 61% of all facial injuries while isolated soft tissue swelling or hematoma was seen in 39%. The most frequent site of injury was the midface (68%) for both fractures and soft tissue injury, with left sided injuries slightly more common (59%). The most common fracture location was the nasal bone (45/152, 30%), followed by the mandible (17/152, 11%), and orbit (16/152, 11%). Most fractures (95%) showed no or minimal displacement (<2 mm). Associated injuries were seen most frequently in the upper extremity, occurring synchronously in 11 (11%) patients and preceding the index injury in 20 (21%) patients. Recurrent facial injuries were seen in 8/96 (8%) patients.

CLINICAL RELEVANCE/APPLICATION

Recognizing facial injury patterns can help radiologists suspect IPV and prompt clinical providers to discuss the possibility of IPV with the patient. Early identification can facilitate early intervention, thereby preventing severe life-threatening injuries.

SDP-HN-14 Prognostic Value Of Whole-tumor Adc Histogram Analysis In Patients With Tongue Squamous Cell Carcinoma And Cervical Lymph Node Metastases

Participants
Yingwei Wu, MD, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

Objectives: To determine the prognostic value of whole-tumor apparent diffusion coefficient (ADC) histogram with histological heterogeneity and cervical lymph node metastases in patients with tongue squamous cell carcinoma (SCC)CONCLUSION*Methods and Materials Patients with SCC completed preoperative MRI were included. Volumetric MRI parameters including tumor volume, ADC histograms (mean ADC, standard deviation [SD], 10th, 25th, 50th, 75th, and 90th percentiles, variance, skewness and kurtosis) were measured. Surgical resection was performed on all patients. Uneven histological grade such as grade I-II or grade II-III were defined as hetero-group. The histological heterogeneity index (HHI) was calculated using the percentage of the larger sub-fraction*100% (range from 0.5-1). Follow-up biopsy, imaging, and clinical examinations were used to determine the cervical lymph node metastasis (CNM) status.*Results Forty-five patients with a mean follow-up period of 15.6 months were included. The histological heterogeneity accounted for 53.3% (24/45) patients. Whole-lesion ADC histogram metrics lower in hetero-group than homo-group were mean ADC, percentiles from 10th to 90th, SD and variance. Whole-lesion ADC histogram metrics lower in CNM+ group were mean ADC, percentiles from 10th to 90th and kurtosis. Higher incidence of CNM was observed in histological hetero-

group than that in homo-group. Larger tumor volume, kurtosis and lower HHI were independent prognostic factors for CNM status.*Conclusions Whole-tumor ADC histogram metrics may serve as non-invasive biomarkers of tumoral heterogeneity of SCC. ADC histogram metrics kurtosis on preoperative imaging is an independent predictor for CNM status.*Clinical Relevance/Application Tumor histological heterogeneity occurred frequently in patients with SCC and associated poor prognosis. Compared to clinic TNM stage or the histological grade, the histological heterogeneity has not been well addressed yet. Whole-tumor ADC histogram offered an approach for detecting intra-tumoral heterogeneity and complexity.

RESULTS

Forty-five patients with a mean follow-up period of 15.6 months were included. The histological heterogeneity accounted for 53.3% (24/45) patients. Whole-lesion ADC histogram metrics lower in hetero-group than homo-group were mean ADC, percentiles from 10th to 90th, SD and variance. Whole-lesion ADC histogram metrics lower in CNM+ group were mean ADC, percentiles from 10th to 90th and kurtosis. Higher incidence of CNM was observed in histological hetero-group than that in homo-group. Larger tumor volume, kurtosis and lower HHI were independent prognostic factors for CNM status.

CLINICAL RELEVANCE/APPLICATION

Tumor histological heterogeneity occurred frequently in patients with SCC and associated poor prognosis. Compared to clinic TNM stage or the histological grade, the histological heterogeneity has not been well addressed yet. Whole-tumor ADC histogram offered an approach for detecting intra-tumoral heterogeneity and complexity.

SDP-HN-15 Intraindividual Comparison Between Contrast-enhanced Golden-angle Radial Sparse Parallel Sequence And Conventional Fat-suppressed Contrast-enhanced T1-weighted Spin-echo Sequence For Head And Neck MRI

Participants
Yangsean Choi, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The golden-angle radial sparse parallel-volumetric interpolated breath-hold (GRASP-VIBE) sequence is a recently introduced imaging technique with high resolution. This study compared the image quality between conventional fat-suppressed T1-weighted TSE (T1-TSE) and GRASP-VIBE after gadolinium enhancement in the head and neck region.*Methods and Materials Data from 65 patients with clinical indications for head and neck MRI between September 2020 and January 2021 were retrospectively reviewed. Two radiologists assessed the overall image quality, overall artifacts, and image conspicuities in the oropharynx, hypopharynx, and cervical lymph nodes according to five-point scores (best score: 5). Interobserver agreement was assessed using weighted kappa statistics. SNR and contrast-to-noise ratio (CNR) were calculated and compared between the two sequences using a paired Wilcoxon signed-rank test.*Results The analysis included 52 patients (mean age, 60±14 years; male, 71.2% [37/52]) who were mostly diagnosed with head and neck malignancies (94.3% [50/52]). Kappa statistics ranged from slight agreement in cervical lymph node conspicuity (kappa=0.18) to substantial agreement in oropharyngeal mucosal conspicuity (kappa=0.80) (kappa range, 0.18-0.80). Moreover, GRASP-VIBE demonstrated significantly higher mean scores in overall image qualities (4.68±0.41 vs. 3.66±0.73), artifacts (4.47±0.48 vs. 3.58±0.71), oropharyngeal mucosal conspicuity (4.85±0.41 vs. 4.11±0.79), hypopharyngeal mucosal conspicuity (4.84±0.34 vs. 3.58±0.81), and cervical lymph node conspicuity (4.79±0.32 vs. 4.08±0.64) than T1-TSE (all, P<0.001). Furthermore, GRASP-VIBE demonstrated a higher SNR (22.8±11.5 vs. 11.3±5.6, P<0.001) and CNR (4.7±5.4 vs. 2.3±2.7, P=0.059) than T1-TSE.*Conclusions GRASP-VIBE provided better image quality with fewer artifacts than conventional T1-TSE for the head and neck regions.*Clinical Relevance/Application Compared to the conventional spin-echo contrast-enhanced T1-weighted imaging, GRASP-VIBE provides improved and motion-robust images of head and neck regions.

RESULTS

The analysis included 52 patients (mean age, 60±14 years; male, 71.2% [37/52]) who were mostly diagnosed with head and neck malignancies (94.3% [50/52]). Kappa statistics ranged from slight agreement in cervical lymph node conspicuity (kappa=0.18) to substantial agreement in oropharyngeal mucosal conspicuity (kappa=0.80) (kappa range, 0.18-0.80). Moreover, GRASP-VIBE demonstrated significantly higher mean scores in overall image qualities (4.68±0.41 vs. 3.66±0.73), artifacts (4.47±0.48 vs. 3.58±0.71), oropharyngeal mucosal conspicuity (4.85±0.41 vs. 4.11±0.79), hypopharyngeal mucosal conspicuity (4.84±0.34 vs. 3.58±0.81), and cervical lymph node conspicuity (4.79±0.32 vs. 4.08±0.64) than T1-TSE (all, P<0.001). Furthermore, GRASP-VIBE demonstrated a higher SNR (22.8±11.5 vs. 11.3±5.6, P<0.001) and CNR (4.7±5.4 vs. 2.3±2.7, P=0.059) than T1-TSE.

CLINICAL RELEVANCE/APPLICATION

Compared to the conventional spin-echo contrast-enhanced T1-weighted imaging, GRASP-VIBE provides improved and motion-robust images of head and neck regions.

SDP-HN-16 The Distinction Of Brain Network Topology And Structural-functional Connectivity Coupling In Tinnitus Patients With Different Outcomes After Sound Therapy

Participants
Qian Chen, MD,PhD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

As a first-line treatment, previous studies have shown that patients with effective and ineffective outcomes after the sound therapy have distinct reorganization patterns in brain structural changes and functional activations. This study was conducted to investigate whether the effective group (EG) and ineffective group (IG) after the treatment have different topological alterations of structural connectivity (SC), functional connectivity (FC), and the SC-FC coupling correlation with the tinnitus symptoms improvement.*Methods and Materials Resting-state functional magnetic resonance imaging (rs-fMRI) and diffusion tensor imaging (DTI) were prospectively acquired in 60 patients with idiopathic tinnitus (28 as EG and 32 as IG) and 57 healthy controls (HCs). Graph theoretical network analyses of SC and FC were performed. Associations between the symptom's improvement and graph-theoretical features were also studied.*Results For the FC, there were no differences in graph-theoretical features between the tinnitus patients (whether EG or IG) and HCs, whereas the EG showed higher local efficiency (Eloc) than the IG. For the SC, both the EG and IG displayed lower normalized characteristic path length (?), Lp, and global efficiency (Eg) than the HCs, whereas no significant differences existed between the EG and IG. Importantly, the IG had a higher coupling than the HCs, whereas there was no difference in coupling between the EG and HCs. In addition, significant associations existed between the SC graph-theoretical features and clinical performance in EG patients.*Conclusions The EG and IG tinnitus patients show distinct network-level

reorganization patterns, especially in SC and FC-SC coupling. Our findings help to better understand the anatomical-functional interaction mechanisms underlying tinnitus patients' different prognoses.*Clinical Relevance/Application Our study may provide useful information for individualized therapeutic strategies for tinnitus patients.

RESULTS

For the FC, there were no differences in graph-theoretical features between the tinnitus patients (whether EG or IG) and HCs, whereas the EG showed higher local efficiency (Eloc) than the IG. For the SC, both the EG and IG displayed lower normalized characteristic path length (?), Lp, and global efficiency (Eg) than the HCs, whereas no significant differences existed between the EG and IG. Importantly, the IG had a higher coupling than the HCs, whereas there was no difference in coupling between the EG and HCs. In addition, significant associations existed between the SC graph-theoretical features and clinical performance in EG patients.

CLINICAL RELEVANCE/APPLICATION

Our study may provide useful information for individualized therapeutic strategies for tinnitus patients.

SDP-HN-18 Rate Of Malignancy In Thyroid Nodules Classified As Highly Suspicious Using The TI-RADS System

Participants
Douglas Katz, MD, Mineola, New York (*Presenter*) Nothing to Disclose

PURPOSE

The TI-RADS classification of TR5 carries the highest risk of malignancy for the sonographic characterization of thyroid nodules, with studies having found varying wide rates of malignancy, ranging from 21-73%. The purpose of our study was to retrospectively analyze our own institutional rate of malignancy in biopsied TR5 nodules. We also aimed to determine if any particular features carry a higher risk.*Methods and Materials We evaluated 450 thyroid nodules which were classified as TR5 & which subsequently underwent fine-needle aspiration from September 2018 to December 2019. Final TR5 categorization and nodule description was based on the official sonographic reports; nodules were not included in this analysis if there was no specific mention of TR5 categorization in the reports. Overall demographic & nodule characteristics were summarized using median (Interquartile range) & frequency (percentages) as appropriate. Logistic regression models were used to find factors associated with malignancy versus benignity. Diagnostic accuracy was assessed by computing sensitivity, specificity, PPV, & NPV for various sonographic characteristics, using the fine-needle aspiration pathology results as the reference standard.*Results Of the 450 thyroid nodules evaluated, 96 (21.3%) were malignant. Mean patient age was 56.5 years, & 350 of the nodules occurred in women. Mean nodule size was 13 mm (10 to 20 mm, interquartile range). Individual sonographic features which were most strongly associated with malignancy were 'very hypoechoic' (2.93 unadjusted odds ratio (1.35 - 6.38 95% CI, p value 0.007)), & 'lobulated or irregular' (2.08 unadjusted odds ratio (1.24 - 3.50 95% CI, p value 0.006)). The sensitivity, specificity, PPV, & NPV value for individual sonographic thyroid features were: hypoechoic - 90.6%, 19.8%, 23.5%, & 88.6%; very hypoechoic - 13.5%, 95.5%, 44.8%, & 80.3%; taller than wide - 40.6%, 68.6%, 26.0%, 81.0%; microcalcifications - 67.7%, 28.0%, 20.3%, & 76.2%; & lobulated margin - 61.5%, 55.0%, 27.1%, & 84.0%.*Conclusions Our institutional malignancy rate was lower than expected, in our retrospective study of 450 individual thyroid nodules categorized as TR5 according to TI-RADS, & was on the lower end of the spectrum reported to date to our knowledge in the literature for nodules in this category. The nodule feature with the highest positive predictive value in our study was "very hypoechoic."*Clinical Relevance/Application The TR5 category should be viewed as a spectrum of risk, & not necessarily strongly indicative of malignancy. Clinicians should further consider malignancy risk & predicative sonographic thyroid nodule features when evaluating patients with TR5 nodules. Further analysis should consider combinations of sonographic features.

RESULTS

Of the 450 thyroid nodules evaluated, 96 (21.3%) were malignant. Mean patient age was 56.5 years, & 350 of the nodules occurred in women. Mean nodule size was 13 mm (10 to 20 mm, interquartile range). Individual sonographic features which were most strongly associated with malignancy were 'very hypoechoic' (2.93 unadjusted odds ratio (1.35 - 6.38 95% CI, p value 0.007)), & 'lobulated or irregular' (2.08 unadjusted odds ratio (1.24 - 3.50 95% CI, p value 0.006)). The sensitivity, specificity, PPV, & NPV value for individual sonographic thyroid features were: hypoechoic - 90.6%, 19.8%, 23.5%, & 88.6%; very hypoechoic - 13.5%, 95.5%, 44.8%, & 80.3%; taller than wide - 40.6%, 68.6%, 26.0%, 81.0%; microcalcifications - 67.7%, 28.0%, 20.3%, & 76.2%; & lobulated margin - 61.5%, 55.0%, 27.1%, & 84.0%.

CLINICAL RELEVANCE/APPLICATION

The TR5 category should be viewed as a spectrum of risk, & not necessarily strongly indicative of malignancy. Clinicians should further consider malignancy risk & predicative sonographic thyroid nodule features when evaluating patients with TR5 nodules. Further analysis should consider combinations of sonographic features.

SDP-HN-4 MRI Findings In Trigeminal Neuralgia Without Neurovascular Compression: Acute Angulation Of The Petrous Ridge And The Trigeminal Nerve

Participants
Yifan Bie, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

To provide anatomical characteristics of the petrous ridge and the trigeminal nerve in trigeminal neuralgia (TN) without neurovascular compression (NVC) in MR imaging. *Methods and Materials From May 2017 to March 2021, 66 TN patients without NVC and 57 controls were enrolled and measured the angle of the petrous ridge(APR) and the angle of the trigeminal nerve(ATN) in MRI with the high-resolution three-dimensional T2 sequence. Data of the symptomatic side were compared with the asymptomatic side in patients and with the mean of bilateral sides in controls. Receiver operating characteristic (ROC) analysis was performed to examine the diagnostic performances of APR and ATN. The Youden index, sensitivity, specificity, positive and negative predictive values, and accuracy were calculated respectively. *Results In patients, the mean APR of the symptomatic side was 98.40±19.75°, significantly sharper than that of the asymptomatic side (105.59±22.45°, P=0.019) and controls(108.44±15.98°, P=0.003). The mean ATN of the symptomatic side was 144.4±8.92°, significantly sharper than that of the asymptomatic side (149.67±8.09°, P=0.003) and controls(150.45±8.48°, P<0.001). Areas under the ROC curve (AUC) and 95% Cis for APR and ATN were 0.673(0.574-0.772) and 0.700(0.605-0.795). Regarding the diagnostic performance for differentiating between TN patients and controls, the highest Youden index was 0.321 with the APR cutoff score of 94.40° (sensitivity, 82.10%; specificity, 50.00%; positive predictive value, 74.40%; negative predictive value, 57.50%; accuracy, 63.41%) and 0.333 with the ATN cutoff score of 148.26° (sensitivity, 66.10%; specificity, 67.20%; positive predictive value, 67.20%; negative predictive value, 66.10%; accuracy,

61.79%)*Conclusions In TN without NVC, the angulation of the petrous ridge and the trigeminal nerve was sharper compared with controls, which would provide additional information contributing to the diagnosis. *Clinical Relevance/Application The excessively acute petrous ridge may lead to an underlying entrapment of the trigeminal nerve. APR and ATN were recommended to be taken into consideration to make a comprehensive diagnosis pre- or post-operatively for TN patients without specific duty vessels.

RESULTS

In patients, the mean APR of the symptomatic side was 98.40±19.75°, significantly sharper than that of the asymptomatic side (105.59±22.45°, P=0.019) and controls(108.44±15.98°, P=0.003). The mean ATN of the symptomatic side was 144.4±8.92°, significantly sharper than that of the asymptomatic side (149.67±8.09°, P=0.003) and controls(150.45±8.48°, P<0.001). Areas under the ROC curve (AUC) and 95% Cis for APR and ATN were 0.673(0.574-0.772) and 0.700(0.605-0.795). Regarding the diagnostic performance for differentiating between TN patients and controls, the highest Youden index was 0.321 with the APR cutoff score of 94.40° (sensitivity, 82.10%; specificity, 50.00%; positive predictive value, 74.40%; negative predictive value, 57.50%; accuracy, 63.41%) and 0.333 with the ATN cutoff score of 148.26° (sensitivity, 66.10%; specificity, 67.20%; positive predictive value, 67.20%; negative predictive value, 66.10%; accuracy, 61.79%)

CLINICAL RELEVANCE/APPLICATION

The excessively acute petrous ridge may lead to an underlying entrapment of the trigeminal nerve. APR and ATN were recommended to be taken into consideration to make a comprehensive diagnosis pre- or post-operatively for TN patients without specific duty vessels.

SDP-HN-5   The Effect Of Facemasks For COVID-19 Prevention On Image Quality In Head And Face Computed Tomography Scans

Participants
Ji Ye Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Infectious disease caused by the novel coronavirus (SARS-CoV-2) are currently pandemic in the world. When it is appropriate for a patient to wear a facemask during the CT exam to prevent the spread of respiratory droplets, there is a concern of beam hardening artifacts and noise associated with the metallic nose piece of the facemask. To this end, no study have focused on how facemasks influence the image quality in face CT examinations and currently there is no clear consensus whether to guide patients to wear facemasks during their face CT examinations. Therefore, we aimed to compare the image quality of face CT images before and after applying facemasks.*Methods and Materials We retrospectively enrolled a total of 609 consecutive patients who underwent non-contrast face CT scans in our institution from two periods; before, and during the pandemic of SARS-CoV-2 (between Oct to Dec 2019 without facemasks and between Oct to Dec 2020 with face masks). Quantitative image quality measurements of image noise, signal-to-noise ratio (SNR), and contrast-to-noise ratio (CNR) were compared between patients groups with and without facemasks. For subjective evaluation, two radiologists independently assessed noise, spatial resolution, presence of artifacts, and overall image quality.*Results The average measured noise for examinations with facemasks were 60.0 ± 13.4 and 47.7 ± 14.8 in the nasal dorsum and malar areas, respectively. Scans with facemasks showed significantly higher noise in the nasal dorsum (P < .001), with lower SNR (P = 0.007) and CNR (P = 0.004) than scans without facemasks. There was no significant difference in the noise in the malar area (P = 0.882). Upon subjective evaluation, images with facemasks showed overall poorer image quality (P < .001). However, there was no significant difference in the proportions of images sets which resulted in diagnostic limitation (P = 0.128).*Conclusions Facemasks resulted in overall image quality reduction in face CT examinations. However, CT scans with facemasks provided sufficient image quality to achieve its diagnostic purpose upon visual assessment. Therefore, it would be appropriate to fit all patients with facemasks including metallic nosepieces to prevent the spread of the disease in the era of SARS-CoV-2.*Clinical Relevance/Application Face CT scans with facemasks showed overall reduced image quality but provided sufficient image quality to achieve its diagnostic purpose. Therefore, all patients should wear facemasks when undergoing CT examinations in the face to prevent the spread of disease. Our results might provide a practical guide to various positions of medical personnels and might be a basis for a future clinical practice guideline for CT examinations

RESULTS

The average measured noise for examinations with facemasks were 60.0 ± 13.4 and 47.7 ± 14.8 in the nasal dorsum and malar areas, respectively. Scans with facemasks showed significantly higher noise in the nasal dorsum (P < .001), with lower SNR (P = 0.007) and CNR (P = 0.004) than scans without facemasks. There was no significant difference in the noise in the malar area (P = 0.882). Upon subjective evaluation, images with facemasks showed overall poorer image quality (P < .001). However, there was no significant difference in the proportions of images sets which resulted in diagnostic limitation (P = 0.128).

CLINICAL RELEVANCE/APPLICATION

Face CT scans with facemasks showed overall reduced image quality but provided sufficient image quality to achieve its diagnostic purpose. Therefore, all patients should wear facemasks when undergoing CT examinations in the face to prevent the spread of disease. Our results might provide a practical guide to various positions of medical personnels and might be a basis for a future clinical practice guideline for CT examinations

SDP-HN-6   Baseline MRI-based Radiomics Model Assisted Predicting Disease Progression In Nasopharyngeal Carcinoma Patients With Complete Response After Treatment.

Participants
Bao Dan, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Our aim was to evaluate the value of baseline MRI-based radiomics machine-learning models in predicting the disease progression in nasopharyngeal carcinoma patients who achieved complete response after treatment.*Methods and Materials Radiomic features were extracted with the least absolute shrinkage and selection operator method based on baseline fat suppression T2WI and contrast-enhanced T1WI of 171 patients in this retrospective study. After Pearson's correlation analysis of selected radiomic features, multivariate logistic regression analysis was applied to radiomic and clinical characteristics selection. Logistic regression analysis and support vector machine classifier were utilized to build the predictive model respectively. The predictive accuracy of the model was evaluated by ROC analysis along with sensitivity, specificity and AUC calculated.*Results In total, 13 radiomic features were selected. A prediction of disease progression MRI-based (PDPM) model (Model L4) using logistic regression analysis comprising 4 radiomics features (HGLZE_T2H, HGLZE_T1, LDLGLE_T1, and GLNU_T1) and 5 clinical features (histology, T stage, N

stage, smoking history, and age) showed the best performance with an AUC of 0.75 in the training cohort (95% CI: 0.66-0.83) and 0.77 in the validation cohort (95% CI: 0.64-0.90). The nine independent impact factors of Model L4 were entered into the nomogram. The calibration curves for probability of 3-year disease progression showed good agreement between nomogram-based predictions and actual observations. The features of Model L4 showed satisfactory clinical utility with decision curve analysis, and the predictive value of PDPM model was increased by incorporating both clinical variables and radiomic features.*Conclusions Radiomics models based on baseline MRI can be used as a reliable prognostic tool for predicting disease progression in nasopharyngeal carcinoma patients.*Clinical Relevance/Application The results of this study add to the growing evidence of using radiomics-based machine learning model in the assessment of disease progression for NPC patients. The addition of radiomics to clinical characteristics can improve the prediction of disease progression. Based on our nomogram, clinicians were able to stratify high-risk patients and accordingly facilitate the treatment decision-making process in individual cases.

RESULTS

In total, 13 radiomic features were selected. A prediction of disease progression MRI-based (PDPM) model (Model L4) using logistic regression analysis comprising 4 radiomics features (HGLZE_T2H, HGLZE_T1, LDLGLE_T1, and GLNU_T1) and 5 clinical features (histology, T stage, N stage, smoking history, and age) showed the best performance with an AUC of 0.75 in the training cohort (95% CI: 0.66-0.83) and 0.77 in the validation cohort (95% CI: 0.64-0.90). The nine independent impact factors of Model L4 were entered into the nomogram. The calibration curves for probability of 3-year disease progression showed good agreement between nomogram-based predictions and actual observations. The features of Model L4 showed satisfactory clinical utility with decision curve analysis, and the predictive value of PDPM model was increased by incorporating both clinical variables and radiomic features.

CLINICAL RELEVANCE/APPLICATION

The results of this study add to the growing evidence of using radiomics-based machine learning model in the assessment of disease progression for NPC patients. The addition of radiomics to clinical characteristics can improve the prediction of disease progression. Based on our nomogram, clinicians were able to stratify high-risk patients and accordingly facilitate the treatment decision-making process in individual cases.

SDP-HN-7 Comparison Of Image Quality And Diagnostic Performance On DWI Between FASE And EPI Sequences With And Without Deep Learning Reconstruction In Suspected Head And Neck Tumor

Participants
Hirotaka Ikeda, MD, Toyoake, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To compare the capability of DWI obtained by Fast Advanced Spin-Echo (FASE) and Echo-Planar Imaging (EPI) sequences with and without deep learning reconstruction (DLR) for image quality and diagnostic performance on DWI in patients suspected head and neck tumors.*Methods and Materials This study included with in vitro and in vivo studies. As in vitro study, a QIBA DWI phantom was scanned at a 3T scanner by DWIs with FASE and EPI sequences, and each data was reconstructed with and without DLR. On all DWIs, ADCs of each phantom was evaluated by ROI measurement. As in vivo study, 41 patients suspected head and neck tumors (malignant vs. benign: 17 vs. 24) obtained T2WI and both DWIs. Then, each DWI was also reconstructed with and without DLR. SNR and ADC of each lesion were assessed by ROI measurements. To compare deformation difference between all DWIs, the margin of lesion was traced by free hand ROI on each sequence to assess each lesion deformation. Then, deformation ratio (DR) was defined as free hand ROI area difference between each DWI and T2WI divided by ROI area on T2WI. On in vitro study, Pearson's correlations were performed for correlation analysis of ADC between each DWI and standard reference. On in vivo study, DR and SNR were compared among all DWIs by Student t-test. Feasible threshold values of each DWI for diagnosis was determined by ROC-based positive test. Finally, sensitivity, specificity and accuracy were compared among all DWIs by McNemar's test.*Results Correlation coefficient of ADC between each DWI and standard reference was excellent on in vitro study (0.95<r<0.99, p<0.0001). On in vivo study, DRs of FASE with and without DLR were significantly smaller than those of EPI with and without DLR (p<0.001). SNR of FASE with DLR was significantly better than that without DLR (p<0.05). When applied each threshold value, FASE with and without DLR were significantly more specific and accurate than EPI with and without DLR (p<0.05).*Conclusions FASE has a better capability than EPI for less deformation and better diagnostic performance on DWI in patients suspected with head and neck tumor. Moreover, DLR can improve image quality with accurate ADC measurement in routine clinical practice.*Clinical Relevance/Application FASE has a better capability than EPI for less deformation and better diagnostic performance on DWI in patients suspected with head and neck tumor.

RESULTS

Correlation coefficient of ADC between each DWI and standard reference was excellent on in vitro study (0.95<r<0.99, p<0.0001). On in vivo study, DRs of FASE with and without DLR were significantly smaller than those of EPI with and without DLR (p<0.001). SNR of FASE with DLR was significantly better than that without DLR (p<0.05). When applied each threshold value, FASE with and without DLR were significantly more specific and accurate than EPI with and without DLR (p<0.05).

CLINICAL RELEVANCE/APPLICATION

FASE has a better capability than EPI for less deformation and better diagnostic performance on DWI in patients suspected with head and neck tumor.

SDP-HN-8 A MRI Mp2rage And SMS-Rs-fMRI Study In Vestibular Migraine Patients

Participants
Ya Guo, MD, Xining, China (*Presenter*) Nothing to Disclose

PURPOSE

To apply Resting-state fMRI(Rs-fMRI) to explore the gray matter volume (GMV), brain function, and brain default in patients with vestibular migraine (VM).The unique change characteristics of the functional connection (FC) of the default mode network(DMN).*Methods and Materials 30 VM patients (VM group) who met the International Headache Association (3rd edition) diagnostic criteria for VM and 34 normal volunteers (control group) were enrolled in this study. All the scanning was performed on a 3T MR scanner(Magnetom Prisma, Siemens Healthineer, Germany) with a 64-channel head-neck coil. Brain structure image was acquired using magnetization-prepared two rapid acquisition gradient echoes sequence (MP2RAGE). The Rs-fMRI sequence was performed with a simultaneous multi-slice(SMS) technique for getting better SNR about the raw data.The related FC analysis method of posterior cingulate cortex (PCC) seed point was used to extract the brain areas changed by DMN in the resting state.*Results Compared with the control group, GMV was decreased in bilateral talus fissure cortex, bilateral lingual gyrus, bilateral

precuneus, bilateral cuneus, bilateral posterior cingulate gyrus, bilateral parahippocampal gyrus, left insula, and the bean-shaped putamen about the VM group (p<0.05, AlphaSim correction). The ALFF values about the VM group were increased in the bilateral precuneus, bilateral supplementary motor areas, bilateral medial and lateral cingulate gyrus, bilateral posterior cingulate gyrus, left posterior cingulate gyrus, right middle frontal gyrus, right middle temporal gyrus, right middle occipital gyrus, and right superior marginal gyrus. The ALFF values were decreased in the left postcentral gyrus and left superior temporal gyrus (p<0.05). The brain areas in the VM group with enhanced FC between DMN and PCC were bilateral cerebellar area IX, bilateral parahippocampal gyrus, bilateral hippocampus, left fusiform gyrus. The brain areas with weakened connections are bilateral supplementary motor areas, bilateral superior marginal gyrus, bilateral superior temporal gyrus, left cerebellar area VI, right dorsolateral superior frontal gyrus, right middle frontal gyrus, right triangular inferior frontal gyrus, right insular tegmental inferior frontal gyrus, right temporal pole, right middle temporal gyrus and left parietal-inferior marginal angular gyrus (p<0.05).*Conclusions Compared with the control group, patients with VM had abnormal GMV and ALFF values in multiple brain areas and had changes in the brain default network function connection in the Resting-state.*Clinical Relevance/Application The differences in brain structure, function, and FC provide theoretical support for the timely treatment of VM in clinical practice.

RESULTS

Compared with the control group, GMV was decreased in bilateral talus fissure cortex, bilateral lingual gyrus, bilateral precuneus, bilateral cuneus, bilateral posterior cingulate gyrus, bilateral parahippocampal gyrus, left insula, and the bean-shaped putamen about the VM group (p<0.05, AlphaSim correction). The ALFF values about the VM group were increased in the bilateral precuneus, bilateral supplementary motor areas, bilateral medial and lateral cingulate gyrus, bilateral posterior cingulate gyrus, left posterior cingulate gyrus, right middle frontal gyrus, right middle temporal gyrus, right middle occipital gyrus, and right superior marginal gyrus. The ALFF values were decreased in the left postcentral gyrus and left superior temporal gyrus (p<0.05). The brain areas in the VM group with enhanced FC between DMN and PCC were bilateral cerebellar area IX, bilateral parahippocampal gyrus, bilateral hippocampus, left fusiform gyrus. The brain areas with weakened connections are bilateral supplementary motor areas, bilateral superior marginal gyrus, bilateral superior temporal gyrus, left cerebellar area VI, right dorsolateral superior frontal gyrus, right middle frontal gyrus, right triangular inferior frontal gyrus, right insular tegmental inferior frontal gyrus, right temporal pole, right middle temporal gyrus and left parietal-inferior marginal angular gyrus (p<0.05).

CLINICAL RELEVANCE/APPLICATION

The differences in brain structure, function, and FC provide theoretical support for the timely treatment of VM in clinical practice.

SDP-HN-9   Automatic Segmentation Of Thyroid Cartilage Using Deep Learning

Participants
Farhad Maleki, PhD, Montreal, Quebec (*Presenter*) Nothing to Disclose

PURPOSE

Accurate evaluation of the thyroid cartilage (TC) is essential for staging and optimal treatment planning for laryngeal and hypopharyngeal squamous cell carcinomas. Automatic segmentation can be fundamental for downstream applications such as anomaly detection and autostaging of cartilage invasion. Threshold-based TC segmentation works poorly due to the extensive variations in Hounsfield unit attenuation related to variable ossification. Also, TC comprises a small fraction of a head and neck CT volume (about 0.0005%) making segmentation using standard deep learning pipelines challenging. To the best of our knowledge, there is no auto-segmentation of TC, and we aim to fill this gap.*Methods and Materials After obtaining institutional review board approval, 301 CTs at our institution were selected. Manual contouring was performed by a senior diagnostic radiology resident and then reviewed/edited by a head and neck radiologist with over 10 years of experience. Figure 1 illustrates the details of our modified UNet architecture and our model building procedure. We randomly selected 15% of CTs as an independent test set. The remaining CTs were partitioned to 5 groups to build 5 training/validation CT datasets. For each of these datasets an OTC (only including axial CT slices with TC) and BTC (including equal number of axial CT slices with and without TC) datasets were generated. Each model was first trained using OTC for 200 epochs; the model with the highest F1 score on the validation set was then retrained using a BTC dataset for 100 epochs, and the model with the highest F1 score was selected. Using the 5 CT datasets, we trained 5 models. For each CT in the test set, the predictions of these models were aggregated using a vote of majority to make the final segmentation.*Results Our ensemble model generated high-quality segmentations (Dice score: 86%) on the test set. In comparison, a standard UNet trained using all slices converged to a local optimum predicting no TC, which could be attributed to TC being a negligible fraction of a CT volume.*Conclusions The proposed ensemble model can serve as a building block for clinical applications involving thyroid cartilage. Also, our methodology can be used for developing auto-segmentation models for other small volume organs.*Clinical Relevance/Application Auto-segmentation of thyroid cartilage can represent the first and fundamental step for future detection of anomalies and computer-assisted staging of cartilage invasion.

RESULTS

Our ensemble model generated high-quality segmentations (Dice score: 86%) on the test set. In comparison, a standard UNet trained using all slices converged to a local optimum predicting no TC, which could be attributed to TC being a negligible fraction of a CT volume.

CLINICAL RELEVANCE/APPLICATION

Auto-segmentation of thyroid cartilage can represent the first and fundamental step for future detection of anomalies and computer-assisted staging of cartilage invasion.

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Abstract Archives of the RSNA, 2021

Sub-Events

GU05-B1   **Detection Rate Of Clinically Significant Prostate Cancer Using A Novel High Resolution Transrectal Ultrasound And Scoring System (PRIMUS V1.0). A Pilot Study.**

Participants
Matías Callejas, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

To determine the detection rate of clinically significant prostate cancer using a second-generation high resolution transrectal micro-ultrasound, ExactVuTM (MicroUS) applying PRIMUS (Prostate Risk Identification using Micro Ultrasound) score v1.0.*Methods and Materials MicroUS has two main differences with conventional transrectal ultrasound (TRUS): Frequency of 29 MHz (vs 9-12 MHZ for conventional TRUS); and fabrication techniques allowing 4-fold higher crystal density along the transducer (512 vs 128 crystals). The resolution of MicroUS is 70 microns, which is the diameter of a typical prostatic duct, as opposed to 200 microns or more of TRUS (300% higher resolution compared to conventional frequency TRUS). Second generation MicroUS has upgrades in electronics and image processing to further improve image quality.25 men who went to radical prostatectomy following MicroUS evaluation and biopsy were included in the study. Dynamic cine loops obtained with MicroUS for each of these patients were reviewed by an experienced radiologist. The radiologist was aware that these men went to radical prostatectomy but was blinded to pathological data, including cancer location, volume, grade and stage. Suspicious sites were assigned a prostate cancer risk score using the previously published PRIMUS v1.0. All patients had subsequent radical prostatectomy that were examined with quarter mount technique. Detection rate of clinically significant index lesion (ISUP =2) by MicroUS was assessed at a patient level.*Results MicroUS visualized 87% of the clinically significant index lesions (20/23). All these lesions where categorized PRIMUS score 4 or 5. The 3 missed index lesions where localized in the anterior transition zone of the prostate gland.*Conclusions MicroUS showed a high sensitivity, particularly in detecting index lesions in the peripheral zone using PRIMUS v1.0 (100%). This reflects further improvement in comparison to previously published data and may be explained by application of PRIMUS risk score in assessing suspicious sites for cancer in the prostate gland. PRIMUS V2.0 iterations are required for improvements in the detection of transition zone lesions.*Clinical Relevance/Application High resolution transrectal micro-ultrasound is a promising imaging modality for detection of clinically significant prostate cancer with the additional benefit of simultaneous guided biopsy.

RESULTS

MicroUS visualized 87% of the clinically significant index lesions (20/23). All these lesions where categorized PRIMUS score 4 or 5. The 3 missed index lesions where localized in the anterior transition zone of the prostate gland.

CLINICAL RELEVANCE/APPLICATION

High resolution transrectal micro-ultrasound is a promising imaging modality for detection of clinically significant prostate cancer with the additional benefit of simultaneous guided biopsy.

GU05-B2   **Multi-parametric Magnetic Resonance Imaging-based Radiomics Analysis Of Cervical Cancer For Preoperative Prediction Of Lymphovascular Space Invasion**

Participants
yaqiong cui, Lanzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To train and validate a mpMRI-based radiomics model to detect LVSI in patients with CC and investigate its potential as a complementary tool to enhance the efficiency of risk assessment strategies.*Methods and Materials The model was developed from the tumor volume of interest (VOI) of 125 patients with CC, with 1037 radiomics features obtained from conventional magnetic resonance imaging (MRI), including small field of view (sFOV) high-resolution (HR) T2-weighted MRI (T2WI), apparent diffusion coefficient (ADC), T2WI, and contrast-enhanced T1-weighted MRI (T1c). We conducted a radiomics-based characterization of each tumor region using pretreatment image data. Feature selection was performed using a LASSO (least absolute shrinkage and selection operator) method on the training set. A non-invasive radiological classifier capable of discriminating between CC with and without LVSI was proposed. The predictive performance was compared with that of single variates (clinical data and single-layer radiomics signatures) analyzed using a receiver operating characteristic (ROC) curve. Twenty times 3-fold cross-validation was used to evaluate the accuracy of the trained classifiers and the stability of the selected features. These radiomics models were validated using a validation set (n = 25).*Results Feature selection extracted the six most important features (3 from sFOV HR-T2WI, 2 from routine T2WI, and 1 from T1c) for model construction. The multi-parametric combined radiomics model (area under the curve [AUC], 0.940) reached a significantly higher performance (better than the clinical parameters [AUC, 0.730]), including any single-layer model using sFOV HR-T2WI (AUC, 0.840), conventional T2WI (AUC, 0.770, 0.710), ADC maps (AUC, 0.650), and T1c (AUC, 0.710, 0.680) in the validation set.*Conclusions Biomarkers using multi-parametric radiomics features derived from preoperative MR images could predict LVSI in CC.*Clinical Relevance/Application It is challenging to detect lymphovascular space invasion (LVSI) in early cervical cancer (CC). Thus far, no standard clinical markers or screening tests have been used to detect LVSI preoperatively; therefore, noninvasive risk stratification tools are highly desirable. We trained and tested an integrated radiomics model for LVSI prediction in women with CC using preoperative multi-parametric magnetic resonance imaging (mpMRI).

RESULTS

Feature selection extracted the six most important features (3 from sFOV HR-T2WI, 2 from routine T2WI, and 1 from T1c) for model construction. The multi-parametric combined radiomics model (area under the curve [AUC], 0.940) reached a significantly higher performance (better than the clinical parameters [AUC, 0.730]), including any single-layer model using sFOV HR-T2WI (AUC, 0.840), conventional T2WI (AUC, 0.770, 0.710), ADC maps (AUC, 0.650), and T1c (AUC, 0.710, 0.680) in the validation set.

CLINICAL RELEVANCE/APPLICATION

It is challenging to detect lymphovascular space invasion (LVSI) in early cervical cancer (CC). Thus far, no standard clinical markers or screening tests have been used to detect LVSI preoperatively; therefore, noninvasive risk stratification tools are highly desirable. We trained and tested an integrated radiomics model for LVSI prediction in women with CC using preoperative multi-parametric magnetic resonance imaging (mpMRI).

Abstract Archives of the RSNA, 2021

MS04-C

Multisystem Wednesday Poster Discussions

Abstract Archives of the RSNA, 2021

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CA03-C

Cardiac Tuesday Poster Discussions

Sub-Events

CA03-C3 **Reproducibility Of Radiomics Features Extracted From Late Gadolinium Enhancement Imaging In Patients With Acute Myocarditis**

Participants
Caterina Monti, MD, Milan, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To review the inter-reader reproducibility of various radiomics features extracted from late gadolinium enhancement (LGE) sequences at cardiac magnetic resonance (CMR) in patients with acute myocarditis.*Methods and Materials we retrospectively included all patients with acute myocarditis who underwent CMR at our institution between March 2014 and December 2020. From each CMR examination two readers segmented the epicardium and endocardium of the left ventricle on all short-axis slices from LGE sequences. Afterwards we performed a radiomics extraction from 5 individual classes using 7 image filters, totalling 1320 individual features. Features were deemed reproducible when their inter-reader intra-class correlation coefficient (ICC) was =0.8. Data were reported as median and interquartile range (IQR).*Results our final study population counted 66 patients with acute myocarditis, with a median age of 28 years (IQR 20-44 years), 56 (85%) of whom were males. Patients' median left ventricular ejection fraction was 67% (IQR 37-67%). Out of 1320 features, 820 appeared reproducible, with an ICC=0.8. The most reproducible features were the minimums of the original image and the logarithm and square root filtered image (all ICC=0.99), whereas the least reproducible features were the grey level non uniformity of the exponential and gradient filtered image (both ICC=0.00). Overall, features extracted from the original image showed the highest ICC, with a median of 0.91 (IQR 0.86-0.95), whereas features extracted from the exponential filtered image yielded the lowest ICC with a median of 0.82 (IQR 0.74-0.89).*Conclusions a considerable number of radiomics feature extracted from LGE sequences in patients with acute myocarditis could be used for further clinical models, as they present with a satisfactory reproducibility.*Clinical Relevance/Application Radiomics analyses on LGE imaging may offer a potential source of novel insight for the assessment of patients with acute myocarditis.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Radiomics analyses on LGE imaging may offer a potential source of novel insight for the assessment of patients with acute myocarditis.

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Abstract Archives of the RSNA, 2021

Nuclear Medicine/Molecular Imaging Thursday Poster Discussions

Sub-Events

NMMI05-B1 Anti-CD20 Radioimmunotherapy With 177Lu-ofatumumab Cures NHL In A Pre-clinical Model System

Participants
Kyuhwan Shim, PhD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

PURPOSE

Ofatumumab (Ofa) is a fully human anti-CD20 antibody approved for use by the FDA. Despite greater potential for redosing than chimeric or mouse anti-CD20 antibodies, Ofa has not been investigated previously for lymphoma radioimmunotherapy. Here, we determine if Ofa radiolabeled with the beta-particle emitting radioisotope, lutetium 177 (177Lu), has therapeutic potential.*Methods and Materials Ofa and human IgG1 were conjugated to CHX-A"-DTPA and 177Lu chelated. Radiochemical purity and stability in serum were analyzed by thin-layer chromatography and immunoreactivity by binding to CD20-positive Raji cells expressing luciferase (Raji-luc). 177Lu-Ofa biodistribution was determined as % injected activity/gram (% IA/g) 7 days post injection into R2G2 mice with subcutaneous tumors. R2G2 mice were injected intravenously with Raji-luc cells and 4 days later with vehicle only, cold Ofa, 20 or 230 µCi/mouse 177Lu-IgG1 or 20 or 230 µCi/mouse 177Lu-Ofa (n=10 mice/group, 6 groups). Tumor-cell growth was followed by bioluminescence imaging (BLI) and survival was tracked.*Results Typical radiochemical yields were >85% with >98% radiochemical purity and specific activities of 458 ± 31 MBq/mg (n=3). 177Lu-Ofa retained 52 ± 5 % (n=3) immunoreactivity and 74 ± 5% (n=3) chelation in serum after 7 days. Biodistribution indicated 17 ± 5% IA/g in tumor and 7 ± 3, 5 ± 1 and 11 ± 4% IA/g in blood, liver and spleen, respectively. Median survivals for groups after 60 days for vehicle, cold Ofa, 20 µCi and 230 µCi 177Lu-IgG1 and 20 µCi 177Lu-Ofa groups were 15, 41.5, 31.5, 20 and 57.5 days, respectively, with no deaths in the 230 µCi 177Lu-Ofa group and no other group with over 3 surviving mice. BLI results corresponded well with survival. Log-rank Mantel-Cox tests of Kaplan-Meier curves show p values of <0.001 when comparing the 230 µCi 177Lu-Ofa group with each of the 5 other groups.*Conclusions 177Lu-ofatumumab was obtained with high specific activity, radiochemical yield, radiochemical purity and retention of immunoreactivity. 230 µCi 177Lu-Ofa showed apparent curative therapeutic efficacy for disseminated lymphoma in a mouse model.*Clinical Relevance/Application 177Lu-ofatumumab may be a candidate for radioimmunotherapy in patients with B-cell lymphoma and has the potential to improve patient outcomes.

RESULTS

Typical radiochemical yields were >85% with >98% radiochemical purity and specific activities of 458 ± 31 MBq/mg (n=3). 177Lu-Ofa retained 52 ± 5 % (n=3) immunoreactivity and 74 ± 5% (n=3) chelation in serum after 7 days. Biodistribution indicated 17 ± 5% IA/g in tumor and 7 ± 3, 5 ± 1 and 11 ± 4% IA/g in blood, liver and spleen, respectively. Median survivals for groups after 60 days for vehicle, cold Ofa, 20 µCi and 230 µCi 177Lu-IgG1 and 20 µCi 177Lu-Ofa groups were 15, 41.5, 31.5, 20 and 57.5 days, respectively, with no deaths in the 230 µCi 177Lu-Ofa group and no other group with over 3 surviving mice. BLI results corresponded well with survival. Log-rank Mantel-Cox tests of Kaplan-Meier curves show p values of <0.001 when comparing the 230 µCi 177Lu-Ofa group with each of the 5 other groups.

CLINICAL RELEVANCE/APPLICATION

177Lu-ofatumumab may be a candidate for radioimmunotherapy in patients with B-cell lymphoma and has the potential to improve patient outcomes.

PD04-B

Pediatric Wednesday Poster Discussions

Sub-Events

PD04-B2   **Pre-operative Brain Network Architecture And Surgical Outcome In A Pediatric Cohort With Focal Epilepsy**

Participants
Michael Paldino, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Converging evidence points to the role of large-scale cortical and subcortical neural networks in the genesis and expression of pediatric focal epilepsy. Neuroimaging assessments of network abnormalities are not currently used in the pre-surgical evaluation of epilepsy. However, a rapidly growing number of studies suggest that they may have clinical utility. The goal of this study was to measure the test characteristics of surgical outcome prediction using individualized network biomarkers derived from resting state functional MRI (rs-fMRI).*Methods and Materials Thirty-three pediatric patients (mean [SD] age: 11.8 [4.96] yrs) selected for surgical management of FE who had undergone pre-operative rs-fMRI were included. Outcomes were defined by the International League Against Epilepsy (ILAE) classification of post-operative outcome. Network nodes were defined by anatomic parcellation of whole-brain gray matter. Weighted graphs were constructed for each patient consisting of the pair-wise correlation of BOLD signal times series over all network nodes. Network metrics (path length, global efficiency, modularity, and clustering coefficient) were then computed for each graph. The relationship of network metrics to ILAE outcome was assessed by ordinal regression. Finally, a machine learning approach (logistic regression classifier) was used to predict surgical outcome (seizure-free [SF] versus non seizure-free [NSF]) based on pre-operative network metrics.*Results Clustering coefficient (p: 0.001), efficiency (p: 0.012) and path length (p:0.018) were significantly associated with ILAE outcome class. These metrics also demonstrated area under curve and test characteristics for outcome prediction greater than clinical predictors (Figure 1). The best prediction model, however, consisted of both clinical and network variables.*Conclusions Pre-operative brain network architecture improved the prediction of seizure-free outcome.*Clinical Relevance/Application Network biomarkers derived from rs-fMRI have the potential to add value to clinical prognostication in pediatric epilepsy surgery.

RESULTS

Clustering coefficient (p: 0.001), efficiency (p: 0.012) and path length (p:0.018) were significantly associated with ILAE outcome class. These metrics also demonstrated area under curve and test characteristics for outcome prediction greater than clinical predictors (Figure 1). The best prediction model, however, consisted of both clinical and network variables.

CLINICAL RELEVANCE/APPLICATION

Network biomarkers derived from rs-fMRI have the potential to add value to clinical prognostication in pediatric epilepsy surgery.

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Abstract Archives of the RSNA, 2021

Sub-Events

CH04-A2 Ultra-Low-Dose Computed Tomography Of The Chest Compared To Chest X-Ray In An Unfiltered Emergency Department Patient Cohort - A Prospective Interventional Cohort Study

Participants
Christian Wassipaul, MD, Vienna, Austria (*Presenter*) Institution has grants / grants pending from Siemens Healthineers.

PURPOSE

To conduct a prospective intra-patient comparison of Chest-X-Ray (CXR) and Ultra-Low-Dose CT (ULDCT) of the chest with regard to detected findings and their clinical relevance in an unfiltered non-traumatic patient cohort of an emergency department.*Methods and Materials 294 consecutive non-traumatic ED-patients with a clinically indicated CXR were included. Additional inclusion criteria were an age above 18 years and informed consent. For women under the age of 55 pregnancy was ruled out by ß-HCG testing. All participants received both, a CXR and an unenhanced ULDCT of the chest and were randomized into two arms. In arm A, radiologists first filed the report for the CXR followed by the report for the ULDCT by the same radiologist, in arm B the reporting order was inverted. CXRs were performed with standard imaging parameters. ULDCTs were acquired on a 3rd generation 256-row Multi-Detector Dual-Source CT System at 50 ref. mAs, a tube voltage of 100 kV, tin filtration and tube current modulation enabled. All prospectively detected findings were checked against the radiological reference standard built by an expert radiologist from all available imaging and clinical data. All elements of the reference standard were labelled regarding their clinical relevance by expert emergency physicians.*Results The mean total dose length product (DLP) for ULDCTs was 12.7 mGy*cm (range 5.2 - 34.3), equivalent to a mean effective dose of 0.21 mSv (range 0.09 - 0.58). This corresponds to about twice the reference dose of a CXR in two views. CXR was reported as first imaging modality in 147 patients (arm A), detecting 40 essential clinical findings in these reports. In the other 147 patients (arm B) ULDCT was reported as first imaging modality, showing 63 essential clinical findings. In arm A, the second examination (ULDCT) revealed another 24 additional essential clinical findings, whereas in arm B the second examination (CXR) did not provide any additional essential clinical findings (p < 0.01).*Conclusions In this study, Ultra-Low-Dose CT of the chest (about twice the reference dose of a CXR in two views) detected significantly more essential clinical findings than CXR in a non-traumatic patient cohort of an emergency department, irrespective of indication.*Clinical Relevance/Application ULDCT of the chest emerges as a superior alternative to CXR in non-traumatic ED patients at comparable radiation dose.

RESULTS

The mean total dose length product (DLP) for ULDCTs was 12.7 mGy*cm (range 5.2 - 34.3), equivalent to a mean effective dose of 0.21 mSv (range 0.09 - 0.58). This corresponds to about twice the reference dose of a CXR in two views. CXR was reported as first imaging modality in 147 patients (arm A), detecting 40 essential clinical findings in these reports. In the other 147 patients (arm B) ULDCT was reported as first imaging modality, showing 63 essential clinical findings. In arm A, the second examination (ULDCT) revealed another 24 additional essential clinical findings, whereas in arm B the second examination (CXR) did not provide any additional essential clinical findings (p < 0.01).

CLINICAL RELEVANCE/APPLICATION

ULDCT of the chest emerges as a superior alternative to CXR in non-traumatic ED patients at comparable radiation dose.

CH04-A3 In Vivo MRI Assessment Of Tumor Oxygenation In Non-small Cell Lung Cancer Patients Receiving Stereotactic Body Radiation Therapy

Participants
Xiangyu Yang, PhD, Columbus, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Use Blood Oxygen Level Dependent (BOLD) MRI to assess tumor oxygenation in vivo in patients with non-small cell lung cancer (NSCLC) and to study its response to Stereotactic Body Radiation Therapy (SBRT) and correlation with tumor permeability, perfusion, and diffusion.*Methods and Materials Fifteen patients with pre- and post-treatment BOLD MRI of unresectable Stage I-III NSCLC treated with SBRT to the primary tumor were identified from two prospective trials for this analysis. All BOLD MRIs were acquired on a Philips Ingenia CX 3T scanner using a dynamic T2* mapping sequence and a dStream WholeBody coil. Tumor oxygenation was quantified by the BOLD response (the relative change in R2*) induced by an oxygen challenge delivered through a nasal cannula (15 L/min). Treatment response was measured within 30 hours after the first fraction of SBRT and correlated with Apparent Diffusion Coefficient (ADC) and pharmacokinetic rate constant kep (modified Brix's model) derived from Diffusion Weighted Imaging (DWI, b=0/600) and Dynamic Contrast Enhanced MRI (DCE-MRI) data acquired with the BOLD MRI.*Results Sixteen lesions were identified for analysis. Their mean T2* was 13 ± 5 ms prior to and 13 ± 6 ms post treatment. Their mean BOLD response was 3.56 ± 0.07% prior to and -2.31 ± 0.06% post treatment. SBRT induced a statistically significant decrease in BOLD response in NSCLC lesions (-5.9 ± 0.1%, P = 0.03) but not in contralateral skeletal muscle (-0.44 ± 0.03%, P = 0.6). The treatment-induced change in tumor oxygenation was strongly correlated with the pre-treatment BOLD response level (r = -0.74) but was not correlated with ADC (r = -0.1) or kep (r = 0.12). No significant change in tumor ADC (1.2 ± 0.3 to 1.3 ± 0.3 x 10-3 mm2/s, P = 0.6) or kep (2 ± 1 to 2 ± 1 min-1, P = 0.9) was observed at the post-treatment scan.*Conclusions In this study, BOLD MRI detected an

acute increase in tumor oxygenation after SBRT treatment of NSCLC. This response is tumor-specific and is more profound in lesions with higher levels of hypoxia prior to the therapy. It also precedes the occurrence of radiation-induced edema and any substantial changes in tumor perfusion or permeability.*Clinical Relevance/Application Our results demonstrated the feasibility of using BOLD MRI to monitor early responses to radiation therapy in patients with NSCLC, and suggested that it might be more sensitive than DWI and DCE-MRI.

RESULTS

Sixteen lesions were identified for analysis. Their mean T2* was 13 ± 5 ms prior to and 13 ± 6 ms post treatment. Their mean BOLD response was 3.56 ± 0.07% prior to and -2.31 ± 0.06% post treatment. SBRT induced a statistically significant decrease in BOLD response in NSCLC lesions (-5.9 ± 0.1%, P = 0.03) but not in contralateral skeletal muscle (-0.44 ± 0.03%, P = 0.6). The treatment-induced change in tumor oxygenation was strongly correlated with the pre-treatment BOLD response level (r = -0.74) but was not correlated with ADC (r = -0.1) or kep (r = 0.12). No significant change in tumor ADC (1.2 ± 0.3 to 1.3 ± 0.3 x 10-3 mm2/s, P = 0.6) or kep (2 ± 1 to 2 ± 1 min-1, P = 0.9) was observed at the post-treatment scan.

CLINICAL RELEVANCE/APPLICATION

Our results demonstrated the feasibility of using BOLD MRI to monitor early responses to radiation therapy in patients with NSCLC, and suggested that it might be more sensitive than DWI and DCE-MRI.

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Abstract Archives of the RSNA, 2021

Sub-Events

BR03-C1 Diagnostic Performance Of Diffusion-weighted Imaging For Detecting Breast Cancer In Asymptomatic Women With Dense Breasts

Participants
Hee Jeong Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Mammography has low sensitivity in dense breasts, and needs to be supplemented with another screening method for women with dense breasts. The purpose of our study is to assess the diagnostic performance of diffusion-weighted imaging (DWI) for breast cancer detection in asymptomatic women with dense breast tissue on mammography and to compare the diagnostic performance of mammography, dynamic contrast-enhanced MRI (DCE-MRI), and DWI.*Methods and Materials From August 2018 to January 2019, consecutive asymptomatic women with dense breast on mammography who underwent breast MRI including DWI and DCE protocols and mammography were retrospectively reviewed. Three readers independently reviewed the lesion visibility and level of suspicion on each modality. Diagnostic performance was assessed by using areas under the receiver operating characteristic curves (AUCs). The tumor histopathologic features on surgical specimen served as the standard of reference.*Results Among a total of 297 women (mean age, 51.2 years ± 9.4 [standard deviation]) there were 233 breast cancers in 230, benign lesions in 11, and normal breast in 56 women. Of the 233 cancers, there were ductal carcinoma in situ in 35 (15.0%), microinvasive ductal carcinoma in 28 (12.0%), and invasive carcinoma in 170 (73.0%). The overall sensitivity was 61.4% in mammography, 79.4% in DWI, 86.3% in DCE-MRI, and 91.8% in the combination of mammography and DWI. The sensitivities for noninvasive cancer in mammography, DWI, DCE-MRI, and the combination of mammography and DWI were 73.0%, 68.3%, 74.6%, and 92.1%, whereas those for invasive cancer smaller than 20 mm were 51.9%, 81.5%, 88.9% and 89.6%, and those for invasive cancer larger than 20 mm were 77.1%, 91.4%, 97.1%, and 100%, respectively. In the comparison of AUCs, DWI was superior to mammography (P < .001) and comparable to DCE-MRI when combined with mammography (P = .05).*Conclusions DWI was a sensitive and effective screening method for breast cancer detection in asymptomatic women with dense breast tissues.*Clinical Relevance/Application The present study suggests that DWI may be useful as a safe and effective screening tool for the supplementation of mammography in women with dense breast tissues.

RESULTS

Among a total of 297 women (mean age, 51.2 years ± 9.4 [standard deviation]) there were 233 breast cancers in 230, benign lesions in 11, and normal breast in 56 women. Of the 233 cancers, there were ductal carcinoma in situ in 35 (15.0%), microinvasive ductal carcinoma in 28 (12.0%), and invasive carcinoma in 170 (73.0%). The overall sensitivity was 61.4% in mammography, 79.4% in DWI, 86.3% in DCE-MRI, and 91.8% in the combination of mammography and DWI. The sensitivities for noninvasive cancer in mammography, DWI, DCE-MRI, and the combination of mammography and DWI were 73.0%, 68.3%, 74.6%, and 92.1%, whereas those for invasive cancer smaller than 20 mm were 51.9%, 81.5%, 88.9% and 89.6%, and those for invasive cancer larger than 20 mm were 77.1%, 91.4%, 97.1%, and 100%, respectively. In the comparison of AUCs, DWI was superior to mammography (P < .001) and comparable to DCE-MRI when combined with mammography (P = .05).

CLINICAL RELEVANCE/APPLICATION

The present study suggests that DWI may be useful as a safe and effective screening tool for the supplementation of mammography in women with dense breast tissues.

BR03-C2 Variability In Clinical And Imaging Follow Up Of Pediatric Breast Masses

Participants
Courtney Cave, MD, Detroit, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

Pediatric breast masses are almost always benign with approximately 95% of them representing fibroadenomas. On ultrasound, these are classically described as circumscribed, oval, hypoechoic solid masses. The current proposed recommendations in the pediatric literature for managing these masses include follow up ultrasound for a mass <3 cm, core biopsy for a mass 3-5 cm, and surgical excision for a mass >5 cm. We sought to determine how often these guidelines were appropriately applied and if the interpreting radiologist subspecialty (ie. pediatric, breast, or general radiologist) had a significant impact on the type of follow up recommended.*Methods and Materials Following IRB approval, pediatric patients who received a breast ultrasound for a solid mass between 2017-2020 were identified by retrospective query of the electronic medical record. This yielded 370 patients ranging in age from 9 to 18 years. 169 patients had a mass consistent with a fibroadenoma. The follow-up for these patients was categorized into clinical follow-up, ultrasound follow-up, core biopsy, or surgical excision.*Results Of the 169 patients included in the study, 26.03% underwent 6-12 month imaging follow up, 40.2% received core biopsy, and 18.3% underwent excisional biopsy. 6.5% had clinical follow up without either further imaging or biopsy. The remainder of the patients were lost to follow up. Data was further stratified by mass size and interpreting radiologist subspecialty. This demonstrated variability in management among radiologist subspecialist. Additionally, the data showed that masses <3 cm are the most frequently mismanaged with 53% of these masses undergoing biopsy rather than ultrasound follow-up as per the guidelines (p<0.00001).*Conclusions This data demonstrates variable follow up for pediatric breast masses within our institution. While multiple factors influence the decision to biopsy or surgically

excise a mass, published literature shows that follow up sonography is a safe, non-invasive management strategy for masses with specific sonographic characteristics and size in this patient population. Despite this, only 26.03% of the pediatric breast masses in this study were managed with follow up sonography regardless of the interpreting radiologist subspecialty, with the majority undergoing core biopsy. Better familiarity with the published guidelines among radiologists may help to avoid unnecessary procedures for pediatric patients.*Clinical Relevance/Application Increased familiarity with the published management guidelines of pediatric solid breast masses would decrease the number of unnecessary procedures and improve consistency in follow up recommendations by radiologists.

RESULTS

Of the 169 patients included in the study, 26.03% underwent 6-12 month imaging follow up, 40.2% received core biopsy, and 18.3% underwent excisional biopsy. 6.5% had clinical follow up without either further imaging or biopsy. The remainder of the patients were lost to follow up. Data was further stratified by mass size and interpreting radiologist subspecialty. This demonstrated variability in management among radiologist subspecialist. Additionally, the data showed that masses <3 cm are the most frequently mismanaged with 53% of these masses undergoing biopsy rather than ultrasound follow-up as per the guidelines (p<0.00001).

CLINICAL RELEVANCE/APPLICATION

Increased familiarity with the published management guidelines of pediatric solid breast masses would decrease the number of unnecessary procedures and improve consistency in follow up recommendations by radiologists.

BR03-C3   Discordance In Breast Biopsies: An Analysis Of Contributing Variables

Participants
Bill Zhou, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

Image-guided core needle biopsy is a less invasive method than excisional biopsy. However, sampling error can occur. In discordant cases where there is concern for missed malignancy, additional evaluation such as imaging, repeat biopsy, or excisional biopsy is performed. These additional steps cause patient anxiety and financial burden. Our objective is to determine factors that contribute to discordant results.*Methods and Materials Our institutional database was searched for discordant biopsies performed between 2016-2021. Patient demographics, imaging features, biopsy method, needle gauge, and pathology findings were recorded.Discordant rates were calculated. True discordance was defined as additional evaluation that resulted in a final malignant pathology. False discordance was defined as additional evaluation that resulted in a final benign pathology. Statistical significance between the true and false discordance groups was assessed using IBM SPSS, with Pearson's chi-squared test used for categorical variables and independent-samples t test for numerical variables.*Results A total of 7635 biopsies, of which 71 discordant lesions were identified (0.9%). Of the 60 patients who underwent additional evaluation, 13 were true discordant (21.6%) and 47 were false discordant (78.4%). BI-RADS score (p = 0.02), axillary lymphadenopathy (p = 0.03), and lesion size (p = 0.005) were associated with true discordance. Age, breast atypia, family history, IBIS score, prior breast procedure, breast density, lesion type, and method of biopsy were non-significant variables.US-guided biopsies had a higher rate of true discordance compared to stereotactic-guided biopsies (33.3% versus 12.5%). Most discordances with calcifications was caused by lack calcifications on the initial pathology (90.9%). Common final pathologies in false discordance cases were stromal fibrosis, fat necrosis, and radial scar. Total of 17 (36.2%) of the false discordant cases demonstrated high risk lesions on final pathology. Four patients who obtained post-procedure MR breast had the BI-RADS score downgraded, which obviated the need for additional biopsy.*Conclusions Our institutional discordance rate (0.9%) was relatively low, with a true discordance rate of 21.6%. Important predictive factors for a true discordant lesion are BI-RADS score, axillary lymphadenopathy, and lesion size. US-guided biopsies are more prone to false discordance, likely due to technical challenges and smaller needle size. Additional evaluation with MR breast can help prevent patients from invasive excisional biopsy.*Clinical Relevance/Application This study emphasizes the need for careful radiological-pathologic review to help guide the radiologist in the setting of discordance.

RESULTS

A total of 7635 biopsies, of which 71 discordant lesions were identified (0.9%). Of the 60 patients who underwent additional evaluation, 13 were true discordant (21.6%) and 47 were false discordant (78.4%). BI-RADS score (p = 0.02), axillary lymphadenopathy (p = 0.03), and lesion size (p = 0.005) were associated with true discordance. Age, breast atypia, family history, IBIS score, prior breast procedure, breast density, lesion type, and method of biopsy were non-significant variables.US-guided biopsies had a higher rate of true discordance compared to stereotactic-guided biopsies (33.3% versus 12.5%). Most discordances with calcifications was caused by lack calcifications on the initial pathology (90.9%). Common final pathologies in false discordance cases were stromal fibrosis, fat necrosis, and radial scar. Total of 17 (36.2%) of the false discordant cases demonstrated high risk lesions on final pathology. Four patients who obtained post-procedure MR breast had the BI-RADS score downgraded, which obviated the need for additional biopsy.

CLINICAL RELEVANCE/APPLICATION

This study emphasizes the need for careful radiological-pathologic review to help guide the radiologist in the setting of discordance.

BR03-C5   Does Lateral Arm Technique Decrease The Rate Of Clip Migration In Stereotactic And Tomosynthesis-guided Biopsies?

Participants
Olena Weaver, MD, Houston, Texas (*Presenter*) Consultant, General Electric Company;Research Grant, General Electric Company

PURPOSE

Mammography-guided vacuum-assisted biopsies (MGVAB) can be done with stereotaxis or digital breast tomosynthesis (DBT)-guidance, and are used for sampling mammography-only detected findings. Both methods can be performed with a conventional biopsy approach (CBA) (needle perpendicular to the compression paddle) or with a lateral arm biopsy approach (LABA) (needle parallel to the compression paddle). Marker clip placement is required for biopsy site identification in both procedures. Clip migration is relatively frequent (up to 44%), which in cases requiring surgery carries a risk of positive margins or re-excision. Some proposed mechanisms of clip migration suggest that LABA may decrease clip migration rate. Meanwhile, the long needle travel in the plane of stretched breast tissues in LABA raises theoretical concern about increased hematoma formation. We aimed to compare the rates of clip migration and hematoma formation between the CBA and LABA techniques of prone MGVAB.*Methods and Materials Our HIPAA compliant retrospective study included all consecutive prone MGVAB performed in a single institution over a 20 month period. The LABA approach was used with DBT guidance; CBA utilized DBT or stereotactic guidance. The tissue sampling techniques were

otherwise identical.*Results After exclusion, 389 biopsies on 356 patients were analyzed. LABA was done in 97 (25%), and CBA in 292 (75%) cases. There was no statistical difference in clip migration rate with either 1 cm or 2 cm distance cut-off (15% for CBA and 10% for LABA for 1 cm threshold (p=0.31); 5.8% or CBA and 3.1% or LABA for 2 cm threshold (p=0.43)). There was no difference in the rate of hematoma formation (57.5% in CDB and 50.5% in LABA, p=0.24). The rates of technical failure were similar for both techniques (1.7% for CBA and 3% for LABA) with a combined failure rate of 1%.*Conclusions LABA and CBA had no statistical difference in clip migration or hematoma formation rates. Both techniques had similar success rates and may be helpful in different clinical situations.*Clinical Relevance/Application LABA cannot reliably decrease the rate of clip migration, but it is complementary to CBA for some clinical applications. Utilizing both techniques increases the overall technical success rate of biopsies to 99%.

RESULTS

After exclusion, 389 biopsies on 356 patients were analyzed. LABA was done in 97 (25%), and CBA in 292 (75%) cases. There was no statistical difference in clip migration rate with either 1 cm or 2 cm distance cut-off (15% for CBA and 10% for LABA for 1 cm threshold (p=0.31); 5.8% or CBA and 3.1% or LABA for 2 cm threshold (p=0.43)). There was no difference in the rate of hematoma formation (57.5% in CDB and 50.5% in LABA, p=0.24). The rates of technical failure were similar for both techniques (1.7% for CBA and 3% for LABA) with a combined failure rate of 1%.

CLINICAL RELEVANCE/APPLICATION

LABA cannot reliably decrease the rate of clip migration, but it is complementary to CBA for some clinical applications. Utilizing both techniques increases the overall technical success rate of biopsies to 99%.

BR03-C6   Cryoablation As Substitute For Surgery In Elderly Patients With Non Resected Breast Cancer: Pilot Study With Medium-term Outcomes

Participants
Jose Maria Oliver-Goldaracena, Madrid, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To review the tolerance and medium-term efficacy of ultrasound-guided cryoablation (USCr) as a replacement treatment for surgery in elderly patients (pts) with inoperable breast carcinoma (BC) due to associated comorbidity or rejection of surgical treatment.*Methods and Materials A retrospective study of the 29 BC (ranged 5-60mm, mean 22mm) treated with CrUS between March 2019 and December 2020, was carried out in 27 patients who were not candidates for surgery with ages ranged 80 and 94 years (mean 86). The histology was : 19 Invasive ductal carcinomas (IDC), 4 Invasive lobular carcinomas, 4 Mucinous carcinomas , 2 Papillary carcinomas. All BC were HER-2 negatives. All patients were treated with hormonal therapy (HT).Primary treatment with USCr was performed in 6 pts (6 BC) with negative axillary US , and adjuvant HT : a) 3 pts with BC ranged 5-10mm ; b) 3 pts with low hormone receptor expression BC.The treatment was started with HT and was completed later with USCr in 21 patientes (23 BC) with negative axillary US: a) Resistance to Primary Endocrine Therapy, between 8 years and 6 months , 7 pts. b) Neoadjuvant HT for 6-12 months reduced the size of the BC and later USCr was performed , 14 pts. procedures were outpatient and performed under local anesthesia.The follow-up protocol was to perform US and Large Needle Biopsy (LNB) of the treated bed in 2-3 months and subsequently US every 6 months. If suspicious findings of residual or recurrent BC were detected, a new rescue USCr was considered. Tolerance to the procedure and associated complications were collected.*Results In 23 patients (25 BC, between 5-60mm, mean 19mm), no residual lesion was detected in the first US control , nor local recurrence in the following US , between 6-22 months (mean 16 months). In 2 pts (BC 22, 18 mm) local recurrence was detected (1) in the cryoablation bed at 16 months , (1) multifocal recurrence separated from the cryoablation bed at 18 months . They were managed with a new USCr. In 2 patients, 2 CaMs of 40 and 45mm, residual lesions were detected in the first US control, which were treated with 1 and 2 successive CrR, respectively. Despite local BC control , 2 patients died from distant metastases and 1 patient from COVID at 13, 8 and 9 months after the CrUS, respectively. All patients tolerated the procedure well and there were no complications.*Conclusions Ultrasound-guided cryoablation of BC is a very well tolerated technique, without serious complication and effective in the medium term. Larger tumors may require more than one procedure to achieve complete ablation and local or regional recurrences can be managed with new rescue USCr.*Clinical Relevance/Application Ultrasound-guided cryoablacion can replace surgery in the management of breast cancer in elderly patients

RESULTS

In 23 patients (25 BC, between 5-60mm, mean 19mm), no residual lesion was detected in the first US control , nor local recurrence in the following US , between 6-22 months (mean 16 months). In 2 pts (BC 22, 18 mm) local recurrence was detected (1) in the cryoablation bed at 16 months , (1) multifocal recurrence separated from the cryoablation bed at 18 months . They were managed with a new USCr. In 2 patients, 2 CaMs of 40 and 45mm, residual lesions were detected in the first US control, which were treated with 1 and 2 successive CrR, respectively. Despite local BC control , 2 patients died from distant metastases and 1 patient from COVID at 13, 8 and 9 months after the CrUS, respectively. All patients tolerated the procedure well and there were no complications.

CLINICAL RELEVANCE/APPLICATION

Ultrasound-guided cryoablacion can replace surgery in the management of breast cancer in elderly patients

BR03-C7   Phase 0 Clinical Trial Using An Ultrasound-detectable Twinkling Marker For Preoperative Localization Of Positive Axillary Nodes In Patients With Breast Cancer: Initial Results

Participants
Benjamin Wood, BS, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Positive axillary lymph nodes in breast cancer (cN+) which radiographically normalize following neoadjuvant chemotherapy are challenging to localize preoperatively with an I-125 seed for targeted surgical removal. The purpose of this study is to evaluate ultrasound color Doppler twinkling conspicuity of a proprietary marker in cN+ converted to cN0- with neoadjuvant chemotherapy in patients with breast cancer.*Methods and Materials In this ongoing study anticipated to complete by September 2021, six of ten patients with cN+ breast cancer have been recruited into this single arm, prospective study. During I-125 seed localization of the previously biopsy-confirmed positive axillary lymph node, we placed a proprietary marker and an I-125 seed using standard percutaneous techniques. After the post-localization mammogram, we performed ultrasound (GE Logiq E9, Wauwatosa, WI, USA) using a broad band linear (2-8 MHz, 9L) transducer to assess for twinkling conspicuity of the marker. Two board-certified

radiologists evaluated ultrasound conspicuity of the marker and the clip. The ease for detecting the clip or marker was categorized from 1 (&lt30 sec) to 5 (not detectable). At the time of surgery less than 5 days after localization, the previously placed biopsy clip and the proprietary marker were resected along with the specimen to assess pathologic response.*Results Diagnostic axillary ultrasound after neoadjuvant chemotherapy could not depict the clip associated with the positive node in 4 of the 6 (67%) patients. Three of these 4 sonographically occult clips were later identified by ultrasound at the time of localization, and 5 of the 6 patients underwent successful ultrasound-guided localization with the I-125 seed and our proprietary marker. One patient underwent CT-guided seed and marker localization. The average categorical ease for detecting the marker by ultrasound was 2.75 for the marker and 3.08 for the clip. Doppler ultrasound preliminarily demonstrates improvement in depicting the proprietary marker compared to standard B-mode imaging alone.*Conclusions Initial results for ultrasound detection of a proprietary marker in lymph nodes previously biopsy proven cN+ and normalized with neoadjuvant chemotherapy of patients with breast cancer are promising.*Clinical Relevance/Application Preliminary data from our ongoing clinical trial show promise using ultrasound color Doppler twinkling to detect a proprietary soft tissue marker in biopsy-positive axillary nodes that have normalized in patients with breast cancer.

RESULTS

Diagnostic axillary ultrasound after neoadjuvant chemotherapy could not depict the clip associated with the positive node in 4 of the 6 (67%) patients. Three of these 4 sonographically occult clips were later identified by ultrasound at the time of localization, and 5 of the 6 patients underwent successful ultrasound-guided localization with the I-125 seed and our proprietary marker. One patient underwent CT-guided seed and marker localization. The average categorical ease for detecting the marker by ultrasound was 2.75 for the marker and 3.08 for the clip. Doppler ultrasound preliminarily demonstrates improvement in depicting the proprietary marker compared to standard B-mode imaging alone.

CLINICAL RELEVANCE/APPLICATION

Preliminary data from our ongoing clinical trial show promise using ultrasound color Doppler twinkling to detect a proprietary soft tissue marker in biopsy-positive axillary nodes that have normalized in patients with breast cancer.

Printed on: 06/28/22

NPM02-A

Noninterpretative Monday Poster Discussions

Sub-Events

NPM02-A1   **RadDiscord: The Creation Of A Successful Online Community**

Participants
Grace Zhu, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

PURPOSE

RadDiscord, a novel pandemic-era open access digital educational platform available to the global radiology community, has an impact on clinical radiology through transforming the education of radiology residents around the world and improving access to knowledge to radiologists. The goal is to showcase the perceived and tangible benefits of this type of educational platform.*Methods and Materials RadDiscord is hosted on the Discord platform (a web-based application that hosts communities for people to interact in real time online). To assess the impact of RadDiscord's efforts, the examinees in the community were anonymously surveyed after the February 2021 CORE exam to assess performance and overall RadDiscord usage and perception.*Results As of April 2021, 1,135 radiologists from 280+ institutions across 30+ countries have joined the community. The community has hosted 97 resident group study sessions and 84 faculty led case based reviews and didactics. 50 examinees (out of 270, 18%) responded to the survey. The average CORE exam score was 488.1 (stdev 84.9), higher in comparison to national mean of 457 (stdev 90.2, p=0.0189). RadDiscord faculty led board reviews were given an average rating of 4.29 (on a 5 point scale), compared to internal residency formal didactics of 2.86 (p=<0.0001). In terms of usage, 80% of respondents report using RadDiscord 1-5 hours per week, 14% 6-10 hours, and 6% 11-15 hours. Overall, the majority of survey responses were positive, with a majority reporting decreased isolation, more motivation, and expansion of knowledge. 92% of respondents would recommend the community to others.*Conclusions RadDiscord is a successful online community and has positively impacted clinical radiology as evidenced by the community's performance and overall positive survey responses.*Clinical Relevance/Application Knowledge empowers radiologists. RadDiscord impacts clinical radiology by democratizing knowledge through improving education and training, to improve global patient care.

RESULTS

As of April 2021, 1,135 radiologists from 280+ institutions across 30+ countries have joined the community. The community has hosted 97 resident group study sessions and 84 faculty led case based reviews and didactics. 50 examinees (out of 270, 18%) responded to the survey. The average CORE exam score was 488.1 (stdev 84.9), higher in comparison to national mean of 457 (stdev 90.2, p=0.0189). RadDiscord faculty led board reviews were given an average rating of 4.29 (on a 5 point scale), compared to internal residency formal didactics of 2.86 (p=<0.0001). In terms of usage, 80% of respondents report using RadDiscord 1-5 hours per week, 14% 6-10 hours, and 6% 11-15 hours. Overall, the majority of survey responses were positive, with a majority reporting decreased isolation, more motivation, and expansion of knowledge. 92% of respondents would recommend the community to others.

CLINICAL RELEVANCE/APPLICATION

Knowledge empowers radiologists. RadDiscord impacts clinical radiology by democratizing knowledge through improving education and training, to improve global patient care.

NPM02-A3   **Global Health Radiology Planning Using Geographic Information Systems To Identify Populations With Decreased Access To Care**

Participants
Shan Sivanushanthan, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose

PURPOSE

A novel approach for improving access to radiology services for underserved populations is through use of a medical hybrid airship, which requires careful planning to identify regions with poor infrastructure. Through use of geographic information systems (GIS), we aimed to identify (1) high risk and medically underserved patient populations in northern Canada and (2) potential landing sites for a medical airship to allow for mobile delivery of radiology services.*Methods and Materials The northern region of Canada extending from the Rocky Mountains to the Atlantic Ocean was analyzed using multi-variable, multi-weighted GIS modeling. Based on population distance from hospitals (50% weight), health centers (e.g. clinic; 30% weight), remote communities (not connected to electric grid; 10% weight), and roads (10% weight), individuals were stratified into one of five health access severity index (HASI) categories (ranging from very low to very high severity). Topographic and land cover data were used to identify suitable landing sites for the medical airship. A coordinate data set was made from georeferenced healthcare facilities, and infrastructure data was obtained from OpenStreetMap.*Results GIS analyzed 815,772 Canadians. Of this population, 522,094 (64%) were found to live =60 km from a hospital, 326,309 (40%) were =45 km from the nearest health center, 65,262 (8%) were within 30 km of a remote community, and 57,104 (7%) lived =1 kilometer from the nearest road. Combined, the HASI identified 44% of the population as having decreased access to care (high or very high severity). Lastly, 27.5% of land analyzed was found to be suitable for airship operations.*Conclusions GIS identified medically underserved populations in northern Canada who may benefit from mobile radiology services. These techniques may help to guide future global health radiology outreach efforts.*Clinical Relevance/Application This study demonstrates the role of geographic information systems in quantifying healthcare disparities faced by residents in northern

Canada and identifying locations suitable for global health radiology outreach.

RESULTS

GIS analyzed 815,772 Canadians. Of this population, 522,094 (64%) were found to live =60 km from a hospital, 326,309 (40%) were =45 km from the nearest health center, 65,262 (8%) were within 30 km of a remote community, and 57,104 (7%) lived =1 kilometer from the nearest road. Combined, the HASI identified 44% of the population as having decreased access to care (high or very high severity). Lastly, 27.5% of land analyzed was found to be suitable for airship operations.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates the role of geographic information systems in quantifying healthcare disparities faced by residents in northern Canada and identifying locations suitable for global health radiology outreach.

NPM02-A4 **Optimizing Practice Management In Emergency Radiology: Lessons In Efficiency From A Large Emergency Radiology Division**

Participants
Scott Steenburg, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

TEACHING POINTS

Emergency Radiology is known for its high speed, high acuity, and high-volume environment.To succeed, emergency radiology practices must optimize the key practice management domains of recruitment, staffing, infrastructure development and support, and integrated use of data analytics.Workload and workflow are not synonymous. Workload is a measure of exams or RVUs per unit time. Workflow is the defined steps and processes that are performed to accomplish a specific task.Emergency radiology practices that focus on workload balancing and efficient workflow are most likely to be successful and sustainable.Creative scheduling to allow for sufficient recovery time is necessary to promote career longevity and radiologist retention.

TABLE OF CONTENTS/OUTLINE

Discuss how to recruit, retain, and staff for success in emergency radiology.Define and provide examples of workflow vs workload in an efficient emergency radiology practice.Delve into workflow considerations and optimization strategies.Provide case examples of workload and workflow balancing using historical data from our practice to create efficient and effective radiologist scheduling.Describe creative solutions to reduce distractions and interruptions in the reading room.

Abstract Archives of the RSNA, 2021

HN03-D

Head and Neck Tuesday Poster Discussions

Abstract Archives of the RSNA, 2021

Sub-Events

MK02-B1   Kypho-scoliosis In Neurofibromatosis Type 1 On Whole Body Mri: Frequency And Association With Intraspinal And Paraspinal Lesions And Tumors.

Participants
Shamrez Haider, BS, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Scoliosis is a common orthopedic problem in patients with Neurofibromatosis 1 (NF1). Spinal deformities have been reported to be found in 77% of all NF1 cases and 2% of all pediatric scoliosis cases have been attributed to NF1. A proposed etiology of scoliosis in NF1 patients states that paraspinal or intraspinal neurofibromas disrupt the normal orderly development of the spine. This study aimed to use whole-body MR imaging (WBMRI) to screen patients with NF1 for scoliosis and determine its association with locoregional spinal tumors.*Methods and Materials It was an Institutional Review Board (IRB) approved retrospective review of 122 NF1 patients with WBMRIs isolated from the electronic medical record (EMR). 97 cases that met inclusion criteria were identified. All patients underwent 3-Tesla MR imaging with automated software fusion of the three sets of inversion recovery and 3D T1W coronal images. Frequency of scoliosis and intra-spinal and paraspinal tumors was recorded. Patients with severe-dystrophic type scoliosis were separately identified, and Cobb angles were measured for all such cases. Association analysis was performed. P-value less than 0.05 was considered statistically significant.*Results 97 patients with NF1 were evaluated. Two had prior spinal surgery and were excluded. The final sample of 95 patients included 33 (35%) males and 62 (65%) females with a mean BMI of 25.82 (+/- 4.96). 43/95 (45.3%) patients had scoliosis and 13/43 (30.2%) of which were severely angled. ICC for Cobb's angles measured 0.99 (CI 0.98,1.0). Fisher's exact test determined no association between scoliosis and presence of either paraspinal or intraspinal tumors (p= 0.485). There was also no association between the tumors and severe dystrophic scoliosis (p =1).*Conclusions Understanding the etiology of scoliosis in NF1 patients has potential implication for treatment planning, imaging requirements, timely surgical correction, and interventions to prevent deformity at young age. This study contradicts the hypothesized association of the presence of locoregional spinal tumors and scoliosis in NF1 patients. The work adds to the body of knowledge of NF1 literature and infers that the presence of scoliosis in an NF1 patient should not require searching for causative locoregional spinal tumors.*Clinical Relevance/Application Scoliosis is a common issue in patients with Neurofibromatosis 1 and according to our results, its presence should not mandate an immediate search for intra or paraspinal tumors.

RESULTS

97 patients with NF1 were evaluated. Two had prior spinal surgery and were excluded. The final sample of 95 patients included 33 (35%) males and 62 (65%) females with a mean BMI of 25.82 (+/- 4.96). 43/95 (45.3%) patients had scoliosis and 13/43 (30.2%) of which were severely angled. ICC for Cobb's angles measured 0.99 (CI 0.98,1.0). Fisher's exact test determined no association between scoliosis and presence of either paraspinal or intraspinal tumors (p= 0.485). There was also no association between the tumors and severe dystrophic scoliosis (p =1).

CLINICAL RELEVANCE/APPLICATION

Scoliosis is a common issue in patients with Neurofibromatosis 1 and according to our results, its presence should not mandate an immediate search for intra or paraspinal tumors.

MK02-B2   Comparison Of Muscle Fat Fraction Measurements In The Lower Spine Musculature With Non-Contrast-Enhanced CT And Different MR Imaging Sequences (Two-Point Dixon, TRUFI) Using Multi-Point Dixon MR As Standard Of Reference

Participants
Jonas Getzmann, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To assess whether two-point Dixon (TPD) MRI, true fast imaging with steady-state free precession (TRUFI) MRI and non-contrast-enhanced CT (NECT) can accurately measure the muscle fat fraction (FF) in the autochthonous back muscles (AM) and the psoas muscle (PM) compared to the standard of reference multi-point Dixon (MPD) MRI.*Methods and Materials A total of 29 oncological patients who received MPD, TPD and NECT images in a period of three months were retrospectively analyzed. A sub-cohort of 16 patients also received a TRUFI MRI for radio-oncology planning and were included in a sub-analysis. The AM and the PM of all individuals were bilaterally analyzed at the height of L3. Region of interest (ROI) measurements for each muscle compartment of the AM and the PM were conducted independently by two examiners on respective FF maps. For CT, linear formulas were calculated to convert Hounsfield unit (HU) measurements into FF percentages. Additionally, the Goutallier classification was used to quantify the amount of fatty infiltration of each muscle by eye. Standard statistical tests were used to compare imaging sequences and modalities. Interreader agreement was assessed using the Pearson correlation coefficient (r) and Cohen's kappa coefficient (?) for Goutallier grades.*Results Good correlations with MPD were found for NECT (r = 0.969), TPD (r = 0.942) and TRUFI (r = 0.904, all P < 0.001) when assessing the FF in the AM. Intermodality correlations were slightly lower when measuring the FF in the PM and with generally higher muscle FF. Interreader agreement between readers showed good correlations and low median deviations (1.1 - 4.1 percentage points, depending on the modality). The Goutallier classification of the AM showed substantial overlap between FF

values especially in grades 2 and 3 but with substantial overall interreader agreement (? = 0.688, P < 0.005).*Conclusions ROI measurements of the AM in NECT highly correlate with muscle FF measurements in the standard of reference MPD MRI. TPD and TRUFI MRI show reliable values in patients only with a low muscle FF.*Clinical Relevance/Application High fat fraction (FF) of the lower spine muscles is associated with higher morbidity in oncological conditions. Our research suggests that the widely available NECT delivers reliable FF measurements.

RESULTS

Good correlations with MPD were found for NECT (r = 0.969), TPD (r = 0.942) and TRUFI (r = 0.904, all P < 0.001) when assessing the FF in the AM. Intermodality correlations were slightly lower when measuring the FF in the PM and with generally higher muscle FF. Interreader agreement between readers showed good correlations and low median deviations (1.1 - 4.1 percentage points, depending on the modality). The Goutallier classification of the AM showed substantial overlap between FF values especially in grades 2 and 3 but with substantial overall interreader agreement (? = 0.688, P < 0.005).

CLINICAL RELEVANCE/APPLICATION

High fat fraction (FF) of the lower spine muscles is associated with higher morbidity in oncological conditions. Our research suggests that the widely available NECT delivers reliable FF measurements.

SDP-CA

Cardiac Pre-recorded Scientific Posters

Sub-Events

SDP-CA-1   **Clinical Usability Of Free Breathing Three-dimensional Late Gadolinium Enhancement Cardiovascular Magnetic Resonance Using Compressed Sensing**

Participants
Masashi Nakamura, Toon, Japan (*Presenter*) Nothing to Disclose

PURPOSE

In Cardiovascular Magnetic Resonance (CMR), late gadolinium enhancement (LGE) is an important tool in the assessment of Myocardial scar and fibrosis. A two-dimensional (2D) LGE sequence acquired in multiple breath-holds may suffer from slice misregistration and artifacts due to respiratory motion. Alternatively, a three-dimensional (3D) LGE sequence has been proposed with the potential advantage of isotropic resolution and extended myocardial coverage. However, 3D LGE sequences suffered from long breath-hold duration. Recently, the mathematical theory of compressed sensing (CS) has also been applied in CMR, and it has been known to enable 3D imaging under free breathing. The purpose of this study was to evaluate the diagnostic performance of free-breathing 3D LGE using CS (CS 3D LGE) comparing with conventional breath hold 2D LGE (2D LGE).*Methods and Materials 91 consecutive patients of clinically suspected cardiovascular disease underwent both 2D LGE and CS 3D LGE on a clinical 3T MRI scanner (MAGNETOM Skyra, Siemens Healthcare). The slice thickness of CS 3D LGE protocol is 1.4 mm, conventional 2D LGE protocol is 6mm. We respectively assessed acquisition times, scores of image quality on a 4-point scale (1-4) and scar volume percentage (percentage of enhanced mass in total left ventricular mass). An enhanced mass and left ventricular mass were calculated by full-width at half-maximum method using a dedicated software (CMR42, Circle Cardiovascular Imaging).*Results The mean effective scan time was 388 ± 114 sec for CS 3D LGE and 411 ± 130 sec for 2D LGE (p=0.39). Image quality scores were significantly lower for CS 3D LGE than for 2D LGE (3.1 ± 0.7 for 3D vs. 3.5 ± 0.6 for 2D; p < 0.001). However, both scores were above the 3 points that does not interfere for diagnosis. Of all cases, 51 patients had visualized LGE. In these 51 patients, the scar volume percentage were 19.2 ± 16.2 % (3D) and 18.0 ± 14.2 % (2D) (p=0.473, R2=0.72).*Conclusions CS 3D LGE method allows complete whole heart coverage in a scan time of approximately 6 min while maintaining diagnostic performance.*Clinical Relevance/Application Free-breathing CS 3D LGE might be a suitable alternative to conventional breath hold 2D LGE for assessment of LGE for patients who cannot tolerate breath hold.

RESULTS

The mean effective scan time was 388 ± 114 sec for CS 3D LGE and 411 ± 130 sec for 2D LGE (p=0.39). Image quality scores were significantly lower for CS 3D LGE than for 2D LGE (3.1 ± 0.7 for 3D vs. 3.5 ± 0.6 for 2D; p < 0.001). However, both scores were above the 3 points that does not interfere for diagnosis. Of all cases, 51 patients had visualized LGE. In these 51 patients, the scar volume percentage were 19.2 ± 16.2 % (3D) and 18.0 ± 14.2 % (2D) (p=0.473, R2=0.72).

CLINICAL RELEVANCE/APPLICATION

Free-breathing CS 3D LGE might be a suitable alternative to conventional breath hold 2D LGE for assessment of LGE for patients who cannot tolerate breath hold.

SDP-CA-10   **Direct Comparison Of Motion Artifact Reduction Between The First And Second Generation Motion Correction Algorithms In Coronary Computed Tomography Angiography Using A 256-row CT**

Participants
Yuji Matsuzaki, RT, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

In coronary CTA (CCTA), motion correction algorithms contribute to improved image quality but have limited correcting only the area around the pre-segmented coronary arteries. We expected that the new generation of the algorithm correcting for the entire scanning area without any segmentation of coronary trees, lead to further improvement of the image quality. The aim was to visually evaluate the image quality of proximal and distal coronary arteries for each generation of the motion correction algorithm.*Methods and Materials We retrospectively reviewed 42 patients (11 women, median age 68 years) who underwent CCTA using 256-row CT from November 2020 to February 2021. We used automatic optimal cardiac phase reconstruction in the systolic and diastolic phases to minimize bias during phase selection. We adapted each motion correction algorithm (SSF and SSF2) with workstations. For image evaluation, two independent CT technologists divided proximal and distal in the three branches of the coronary artery into a total of six segments and performed a visual assessment of the degree of artifacts due to coronary artery motion on a five-point scale (0: artifacts are severe and inferior to 4: excellent). The lower score of the two observers was adopted; the score = 3 was defined as sufficient quality for investigation by radiologists. We used the sum of the scores as the overall coronary artery score. We used the Wilcoxon test to evaluate the difference between the two algorithms.*Results The median heart rate was 60.5 (41-145) bpm, and arrhythmia cases were 23.8%. SSF2 showed a significant improvement in image quality in the segmental evaluation compared to SSF in both diastolic and systolic images (P<.001 for each). As a result, 99.6% of the segments achieved readable image quality with SSF2, and 87.6% received an excellent rating. On a per-patient basis, SSF2 scored 24 [IQR 23-24] and significantly increased from the SSF (23 [IQR 22-24])(P<.001). Further, SSF2 showed an image quality improvement on the peripheral side in the diastole (P=.004) and on the proximal and distal sides in the systole (P<.001 for

each).*Conclusions The new motion correction algorithm, which can correct the entire heart, is more effective in reducing motion artifacts than the previous generation and showed a 99.6% test achievement rate for image quality.*Clinical Relevance/Application The new generation motion correction algorithm that corrects the motion for the entire scanning area can improve image quality, compared with previous algorithms, which only collect the area around the pre-segmented coronary arteries.

RESULTS

The median heart rate was 60.5 (41-145) bpm, and arrhythmia cases were 23.8%. SSF2 showed a significant improvement in image quality in the segmental evaluation compared to SSF in both diastolic and systolic images (P<.001 for each). As a result, 99.6% of the segments achieved readable image quality with SSF2, and 87.6% received an excellent rating. On a per-patient basis, SSF2 scored 24 [IQR 23-24] and significantly increased from the SSF (23 [IQR 22-24])(P<.001). Further, SSF2 showed an image quality improvement on the peripheral side in the diastole (P=.004) and on the proximal and distal sides in the systole (P<.001 for each).

CLINICAL RELEVANCE/APPLICATION

The new generation motion correction algorithm that corrects the motion for the entire scanning area can improve image quality, compared with previous algorithms, which only collect the area around the pre-segmented coronary arteries.

SDP-CA-11   Image Quality And Diagnosis Performance Of Myocardial Delayed Enhancement CT Improved By The Artificial Intelligence-based Denoising Method

Participants
Hironori Tanaka, RT, Suita, Japan (Presenter) Nothing to Disclose

PURPOSE

To improve the myocardial delayed enhancement (MDE) CT, we have developed an AI-based denoising method using a pair of images by adding three acquisitions and the original single acquisition as a teacher. The purpose is to evaluate the quantitative image quality of this AI denoised image and evaluate its diagnostic performance using reference cardiac MRI.*Methods and Materials We retrospectively reviewed 156 patients who underwent MDE CT (70-80kV, quality reference mAs, 580 mAs/80kVp; ECG triggered at 250ms after R wave) using 192-row dual-source CT from July 2020 to March 2021. We obtained the late phase image 5 minutes after injected the contrast material (median 415 mgI/kg). After developing a model that learned denoising using 100 cases as supervised data, we generated AI denoised images of the remaining fold outed 56 cases as tests. We used the pre-average images as inputs for a residual dense network and the average images as ground-truth images. Image analysis was performed on the original single-shot image, the average additive image, and the AI denoised image, respectively. In the first 40 cases, we placed ROIs in the left ventricular cavity, and septal myocardium and CT values and SD were measured to obtain contrast-to-noise ratio (CNR) of the myocardium and myocardial cavity. Sixteen patients who had cardiac MRI within two months were evaluated segmentally for the presence or absence of MDE; a radiologist evaluated the CTs using the serial confidence method to assess the sensitivity, specificity, and accuracy using the MRI diagnosis a reference, and AUC was measured.*Results The AI denoising method showed a 3.5-fold higher CNR (5.77 [IQR 4.94-6.76] from 1.66 [IQR 1.89-1.42], P<.001) compared to the input single acquisition image. Furthermore, the CNR was significantly higher (P<.001) than that of the averaged image (3.19 [IQR 2.63-3.65]). For the 250 segments diagnosable by MRI (113 segments of positive), the sensitivity, specificity, accuracy, and AUC of AI denoise images were 98.3%, 81.6%, 89.2%, and 0.954, respectively. The accuracy and AUC were significantly improved from 75.2% and 0.827 for the original image (P<.001); and were identical to the averaged image (92.4% and 0.959, respectively).*Conclusions AI-based denoising process learned from average additive images could significantly improve the CNR and diagnostic performance of the MDE CT.*Clinical Relevance/Application The AI denoising method, which learns noise reduction by additive averaging using MDE CT, can achieve high noise reduction and improved diagnostic performance, thus optimizing radiation exposure.

RESULTS

The AI denoising method showed a 3.5-fold higher CNR (5.77 [IQR 4.94-6.76] from 1.66 [IQR 1.89-1.42], P<.001) compared to the input single acquisition image. Furthermore, the CNR was significantly higher (P<.001) than that of the averaged image (3.19 [IQR 2.63-3.65]). For the 250 segments diagnosable by MRI (113 segments of positive), the sensitivity, specificity, accuracy, and AUC of AI denoise images were 98.3%, 81.6%, 89.2%, and 0.954, respectively. The accuracy and AUC were significantly improved from 75.2% and 0.827 for the original image (P<.001); and were identical to the averaged image (92.4% and 0.959, respectively).

CLINICAL RELEVANCE/APPLICATION

The AI denoising method, which learns noise reduction by additive averaging using MDE CT, can achieve high noise reduction and improved diagnostic performance, thus optimizing radiation exposure.

SDP-CA-12   Prognostic Value Of Cardiac Magnetic Resonance Assessed Myocardial Strain Among Ischaemic And Non-ischaemic Dilated Cardiomyopathy Patients

Participants
Hok Shing Tang, Hong Kong, Hong Kong (Presenter) Nothing to Disclose

PURPOSE

Studies comparing the cardiac magnetic resonance (CMR) strain parameters for predicting major adverse cardiovascular events in dilated cardiomyopathy (DCM) patients are lacking. Studies available are generally small with few outcomes and contradictory results. In this study, we aim to acquire a larger number of patients with longer term follow-up and significantly more major adverse cardiovascular events. The purpose is to determine which myocardial strain has the best prognostic value in patients with ischaemic and non-ischaemic DCM using CMR.*Methods and Materials 300 patients with ejection fraction (EF) <50% and ischaemic or non-ischaemic dilated cardiomyopathy underwent CMR at 4 different centres were included in this study. Feature tracking was used to assess the left ventricular (LV) and right ventricular (RV) global radial, global circumferential and global longitudinal strain. Outcomes include heart failure (HF) hospitalisation and all-cause mortality. Cox regression modelling was used to determine the association between myocardial strain and the outcomes.*Results 78.3% were male and mean age is 61.3±13.1. Outcomes occurred in 134 patients (74 all-cause deaths and 97 heart failure hospitalisations) during a median follow-up time period of 1095 days. Kaplan-Meier analysis and log-rank test showed statistical significance for all strain parameters while LV global longitudinal strain (GLS) had the largest area under curve (AUC). LV GLS is significantly better than other strain parameters (p<0.05) except for RV GLS. Multivariable Cox regression modelling with age, myocardial infarction (MI), late gadolinium enhancement (LGE) quantification and one strain parameter showed that all strain parameters were significant independent predictors of outcomes in DCM patients (p<0.01), while the extent of LGE and incidence of MI were not statistically significant. This indicates that myocardial strain is better in predicting the overall outcome.*Conclusions LV GLS was the best CMR parameter for predicting outcome in DCM

patients.*Clinical Relevance/Application LV GLS shows promise in predicting cardiovascular outcomes in DCM patients.

RESULTS

78.3% were male and mean age is 61.3±13.1. Outcomes occurred in 134 patients (74 all-cause deaths and 97 heart failure hospitalisations) during a median follow-up time period of 1095 days. Kaplan-Meier analysis and log-rank test showed statistical significance for all strain parameters while LV global longitudinal strain (GLS) had the largest area under curve (AUC). LV GLS is significantly better than other strain parameters (p<0.05) except for RV GLS. Multivariable Cox regression modelling with age, myocardial infarction (MI), late gadolinium enhancement (LGE) quantification and one strain parameter showed that all strain parameters were significant independent predictors of outcomes in DCM patients (p<0.01), while the extent of LGE and incidence of MI were not statistically significant. This indicates that myocardial strain is better in predicting the overall outcome.

CLINICAL RELEVANCE/APPLICATION

LV GLS shows promise in predicting cardiovascular outcomes in DCM patients.

SDP-CA-13   Feasibility Of Cardiac Imaging Using A Breast Coil For Cardiotoxicity Evaluation In Breast Cancer Patients: From The Carebest Study

Participants
Yoo Jin Hong, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to investigate whether the addition of cardiac imaging to breast MRI is feasible for routine surveillance of cardiotoxicity in patients with breast cancer who underwent chemotherapy.*Methods and Materials A preliminary study was conducted on 13 healthy controls without any history and 30 breast cancer patients who underwent chemotherapy. Cardiac imaging, including cine, pre-T1 map mapping using a cardiac coil in the supine position and cardiac imaging, including cine, pre-, and post-T1 mapping using a breast coil in the prone position was continuously performed in the healthy group. For 30 patients with breast cancer in the post-chemotherapy state, cardiac cine imaging using a breast coil with standard segmented cine imaging was performed, followed by two repeated low-resolution cine scans with a shorter scan time. For T1 mapping values, the reproducibility of native T1 values and the repeatability of native T1 and extracellular volume fraction (ECV) between the images using breast or cardiac coils was assessed with the intraclass correlation coefficient (ICC). For the interscan variability of cine imaging, standardized mean differences between sequences for the left ventricular ejection fraction (LVEF), LV mass, and right ventricular ejection fraction (RVEF) were measured.*Results For T1 mapping values, the mean global native T1 and ECV of the LV myocardium acquired using the breast coil were 1186.9 ± 33.6 ms and 28.6 ± 1.3%, respectively, and the native T1 with the cardiac coil was 1182.4 ± 36.4 ms. The repeatability of the native T1 value between two repeated scans using the breast coil was 0.774, while the reproducibility of the native T1 between images using the breast and cardiac coils was 0.809, which was higher on the septal wall. For functional parameters, the standardized mean difference of LVEF, LV mass, RVEF between standard and low-resolution cine imaging were very low (0.09, 0.01, and 0.02, respectively). Those between two repeated low-resolution cine scan were 0.03, 0.02, and 0.05, respectively). The additional scan time for cardiac imaging was an average of 50 seconds for cine imaging and 10-15 seconds for native T1, post T1 mapping, totaling approximately 3 minutes.*Conclusions Cardiac imaging protocol added to the breast MRI examination is a feasible routine surveillance imaging tool for cardiotoxicity evaluation in patients with breast cancer.*Clinical Relevance/Application The acquired cardiac imaging parameters using a breast coil showed low interscan variability for the functional assessment and high interscan reproducibility for tissue characterization of the left ventricle. This may have an important role in diagnosis and monitoring of cancer therapy related cardiac dysfunction in patents with breast cancer

RESULTS

For T1 mapping values, the mean global native T1 and ECV of the LV myocardium acquired using the breast coil were 1186.9 ± 33.6 ms and 28.6 ± 1.3%, respectively, and the native T1 with the cardiac coil was 1182.4 ± 36.4 ms. The repeatability of the native T1 value between two repeated scans using the breast coil was 0.774, while the reproducibility of the native T1 between images using the breast and cardiac coils was 0.809, which was higher on the septal wall. For functional parameters, the standardized mean difference of LVEF, LV mass, RVEF between standard and low-resolution cine imaging were very low (0.09, 0.01, and 0.02, respectively). Those between two repeated low-resolution cine scan were 0.03, 0.02, and 0.05, respectively). The additional scan time for cardiac imaging was an average of 50 seconds for cine imaging and 10-15 seconds for native T1, post T1 mapping, totaling approximately 3 minutes.

CLINICAL RELEVANCE/APPLICATION

The acquired cardiac imaging parameters using a breast coil showed low interscan variability for the functional assessment and high interscan reproducibility for tissue characterization of the left ventricle. This may have an important role in diagnosis and monitoring of cancer therapy related cardiac dysfunction in patents with breast cancer

SDP-CA-14   The Image Quality Of Sub-millimeter High-spatial-resolution 2D Late Gadolinium Enhancement Images In Cardiac MRI: A Feasibility Study

Participants
Yasutoshi Ohta, MD, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To examine the image quality of high-resolution 2D late gadolinium enhancement (LGE) cardiovascular magnetic resonance (CMR) by head-to-head comparison against conventional normal-resolution 2D LGE*Methods and Materials Sixty patients (53±19 years) referred for CMR examination were included in this study. Both normal resolution (NR, 1.5x1.5x6mm) and high resolution (HR, 0.6x0.6x6mm) 2D-LGE sequences of inversion recovery (IR) and phase-sensitive inversion recovery (PSIR) sequences were performed at 3T. The magnitude image obtained from the PSIR (PSIR-MAG) was also included in the evaluation. The resolution of the total cardiac anatomical structures (TCR), anterior interventricular groove (AIS), lateral wall-epicardial fat border (LWB), inferior interventricular groove (IIS), right ventricle wall, papillary muscle and trabeculae (PT), blurring of RV, septum, lateral wall, and total image quality (TIQ) were evaluated qualitatively in 5-point scale. Edge sharpness measurements, contrast-to-noise ratio (CNR) between scar and remote myocardium were compared among scan protocols. CNR was measured for LGE-positive cases in all sequences. Qualitative scores were evaluated in heart rate groups (low, middle, high, total). These parameters were compared with NR-IR images as reference.*Results In the resolution analysis, TCR, AIS, LWB, and IIS were improved in HR groups compared with NR groups (all, p<0.001). TIQ did not change significantly between the HR and NR groups, except for HR-PSIR in total heart rate groups(all, p<0.01). Both HR and NR images showed degradation of image resolution and blurring in the high heart rate group, but

the degradation was more noticeable in the HR group. LGE was observed in 32 patients, of whom 2 were false negative on HR-IR, both in the high heart rate group. The sharpness showed a significant reduction in the HR groups compared to the NR groups (all, p<0.001). The sharpness of HR-IR, HR-PSIR-MAG, HR-PSIR, NR-IR, NR-PSIR-MAG, and NR-PSIR were 1.43±0.52, 1.44±0.57, 1.42±0.53, 2.14±0.94 2.05±0.98, and 2.02±0.88, respectively.For CNR of LGE, no significant change was observed in IR images and PSIR-MAG compared to the reference (p<0.001).*Conclusions The high-resolution LGE images improved image resolution without loss of image quality or CNR.*Clinical Relevance/Application Since high-resolution LGE protocol improves cardiac structure resolution without compromising CNR, there is a possibility to observe the distribution and morphology of LGE precisely.

RESULTS

In the resolution analysis, TCR, AIS, LWB, and IIS were improved in HR groups compared with NR groups (all, p<0.001). TIQ did not change significantly between the HR and NR groups, except for HR-PSIR in total heart rate groups(all, p<0.01). Both HR and NR images showed degradation of image resolution and blurring in the high heart rate group, but the degradation was more noticeable in the HR group. LGE was observed in 32 patients, of whom 2 were false negative on HR-IR, both in the high heart rate group. The sharpness showed a significant reduction in the HR groups compared to the NR groups (all, p<0.001). The sharpness of HR-IR, HR-PSIR-MAG, HR-PSIR, NR-IR, NR-PSIR-MAG, and NR-PSIR were 1.43±0.52, 1.44±0.57, 1.42±0.53, 2.14±0.94 2.05±0.98, and 2.02±0.88, respectively.For CNR of LGE, no significant change was observed in IR images and PSIR-MAG compared to the reference (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Since high-resolution LGE protocol improves cardiac structure resolution without compromising CNR, there is a possibility to observe the distribution and morphology of LGE precisely.

SDP-CA-15 Ca-scoring When The Subject Is Moving By Using TPVE And Ring ROI Method In X-ray CT

Participants
Katsumi Tsujioka, PhD, Toyota-city, Japan (*Presenter*) Scientist, Canon Medical Systems Corporation

PURPOSE

The Volumetric score has been assessed the progression of coronary artery disease. The score has been calculated by using the threshold and the basic of the isotropic interpolation. The threshold has been used to differentiate noncalcified and calcified artery lesion. We developed a new calcification method using the temporal partial volume effect (TPVE) and the ring region of interest (ROI) method without the threshold.*Methods and Materials To investigate useful for measurement of the calcification volume by using the TPVE and the Ring ROI method. We compared the measurement accuracy of the TPVE and the Ring ROI method with that of the conventional method.*Results When the subject moved, in the conventional method, the volume measurement of hydroxyapatite was not accurate. However, in the new method, even if the CT image had a motion artifact, we were able to measure the volume of hydroxyapatite with high acuuracy.*Conclusions When the subject moved, temporal partial volume effect occurs. However, the conventional method could not taking into account temporal partial volume effect. The new method was able to measure the volume of hydroxyapatite with high acuuracy by taking into account temporal partial volume effect.*Clinical Relevance/Application The motion arch fact is an important problem to reduce measurement accuracy in calcium scoring. TPVE and the ring ROI method that we developed are techniques to solve this problem. Our new method is effective for volume measurement of the moving objects.

RESULTS

When the subject moved, in the conventional method, the volume measurement of hydroxyapatite was not accurate. However, in the new method, even if the CT image had a motion artifact, we were able to measure the volume of hydroxyapatite with high acuuracy.

CLINICAL RELEVANCE/APPLICATION

The motion arch fact is an important problem to reduce measurement accuracy in calcium scoring. TPVE and the ring ROI method that we developed are techniques to solve this problem. Our new method is effective for volume measurement of the moving objects.

SDP-CA-16 Sex-specific Differences In Disease Progression And Treatment Response In Fabry Disease Assessed By Multiparametric Cardiac MRI

Participants
Victor Chan, FRCR, MBBS, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

Fabry disease is an X-linked storage disorder leading to glycosphingolipid accumulation. The purpose of this study was to assess longitudinal changes in myocardial glycosphingolipid accumulation, hypertrophy and fibrosis in relation to sex and treatment.*Methods and Materials All gene-positive Fabry patients at our center with two sequential cardiac MRIs with native T1 mapping (MOLLI) and late gadolinium enhancement (LGE) imaging were included. For analysis across different scanners (1.5T and 3T), T1 values were converted to a z-score using scanner-specific local reference values (patient value - reference mean)/(reference SD), indicating how many SD each patient's T1 values are above/below the reference mean. Low T1 was defined as a z-score <-2. Interval change in MRI biomarkers was evaluated with respect to sex and enzyme replacement therapy (ERT).*Results 47 patients were included (44±16 years, 66% female, 30% on ERT) with mean inter-scan interval of 2.3±0.7 years. At baseline, 21% had left ventricular hypertrophy (LVH), 50% had LGE reflecting fibrosis, and 23% had low T1 reflecting glycosphingolipid accumulation. Two patients (4%) developed LGE at follow-up (both untreated, one male and one female). Increase in indexed left ventricular mass between baseline and follow-up was significantly higher in men than women (9±18 g/m2 vs. 1±8 g/m2, p=0.032) and did not differ by treatment group (p=0.65). Treatment naïve men and women both had a significant decrease in T1 over follow-up (z-score change -0.9±0.9, p=0.012 and -0.9+0.7, p<0.001, respectively) in keeping with progressive glycosphingolipid accumulation. However, treatment response differed by sex. Women on ERT had a significant increase in T1 (z-score change 0.5±0.4, p=0.011) while T1 did not change significantly in treated men (0.02±0.7, p=0.29). Study conclusions remained unchanged when restricted to patients who had undergone both MRIs on the same 3T scanner (n=28).*Conclusions There are sex-specific differences in myocardial response in Fabry disease. Men had a greater rate of LVH progression than women. ERT improves glycosphingolipid storage in women, however the response is less pronounced in men.*Clinical Relevance/Application Judicious use of serial cardiac MRI in Fabry patients can provide valuable information. Further research is needed to evaluate the prognostic significance of sex-specific differences in disease progression and treatment response.

RESULTS

47 patients were included (44±16 years, 66% female, 30% on ERT) with mean inter-scan interval of 2.3±0.7 years. At baseline, 21% had left ventricular hypertrophy (LVH), 50% had LGE reflecting fibrosis, and 23% had low T1 reflecting glycosphingolipid accumulation. Two patients (4%) developed LGE at follow-up (both untreated, one male and one female). Increase in indexed left ventricular mass between baseline and follow-up was significantly higher in men than women (9±18 g/m2 vs. 1±8 g/m2, p=0.032) and did not differ by treatment group (p=0.65). Treatment naïve men and women both had a significant decrease in T1 over follow-up (z-score change -0.9±0.9, p=0.012 and -0.9+0.7, p<0.001, respectively) in keeping with progressive glycosphingolipid accumulation. However, treatment response differed by sex. Women on ERT had a significant increase in T1 (z-score change 0.5±0.4, p=0.011) while T1 did not change significantly in treated men (0.02±0.7, p=0.29). Study conclusions remained unchanged when restricted to patients who had undergone both MRIs on the same 3T scanner (n=28).

CLINICAL RELEVANCE/APPLICATION

Judicious use of serial cardiac MRI in Fabry patients can provide valuable information. Further research is needed to evaluate the prognostic significance of sex-specific differences in disease progression and treatment response.

SDP-CA-17   Extracellular Volume Fraction As A Quantitative Disease-biomarker In Cardiac Amyloidosis: Influence Of Non-specific Myocardial Edema

Participants
Seitaro Oda, MD, Kumamoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Amyloid fibril deposition and non-specific myocardial edema coexist in the myocardium of cardiac amyloidosis (CA). This non-specific myocardial edema can affect the quantitative values of various disease-biomarkers of CA including extracellular volume fraction (ECV). This study aimed to assess the influence of non-specific myocardial edema on ECV as a quantitative disease-biomarker in CA.*Methods and Materials Seventy-four patients with wild-type transthyretin CA who underwent cardiovascular magnetic resonance (CMR), 99mTc-labeled pyrophosphate (99mTc-PYP) scintigraphy, and echocardiography were evaluated. We assessed the quantitative disease-biomarkers, e.g. global longitudinal strain (GLS) by echocardiography, native T1, ECV, and T2 value by CMR, heart to contralateral ratio (H/CL) by 99mTc-PYP, and high-sensitive cardiac troponin T (hs-cTnT). Myocardial T2 value = 50 ms was defined as myocardial edema. The ECV was compared with other biomarkers in CA patients with/without myocardial edema.*Results Myocardial T2 values showed a moderate correlation with native T1 (r=0.41), and a weak correlation with ECV and hs-cTnT (r=0.30-0.32). In patients with myocardial edema, ECV showed a moderate correlation with native T1, hs-cTnT and H/CL (r=0.45-0.55), and a weak correlation with T2 value (r=0.22). In patients without myocardial edema, ECV showed a strong correlation with GLS and hs-cTnT (r=0.73-0.82), and a moderate correlation with H/CL (r=0.50).*Conclusions Myocardial edema affected the ECV value in CA. When myocardial edema was excluded, ECV showed a significant correlation with various quantitative disease-biomarker and can be a disease-monitoring marker in patients with CA.*Clinical Relevance/Application The presence or absence of myocardial edema should be considered when conducting disease-monitoring with myocardial ECV in patients with CA.

RESULTS

Myocardial T2 values showed a moderate correlation with native T1 (r=0.41), and a weak correlation with ECV and hs-cTnT (r=0.30-0.32). In patients with myocardial edema, ECV showed a moderate correlation with native T1, hs-cTnT and H/CL (r=0.45-0.55), and a weak correlation with T2 value (r=0.22). In patients without myocardial edema, ECV showed a strong correlation with GLS and hs-cTnT (r=0.73-0.82), and a moderate correlation with H/CL (r=0.50).

CLINICAL RELEVANCE/APPLICATION

The presence or absence of myocardial edema should be considered when conducting disease-monitoring with myocardial ECV in patients with CA.

SDP-CA-18   Multiparametric Cardiac MRI Differentiation Of Antimalarial Induced Cardiomyopathy And Myocarditis In Patients With Systemic Lupus Erythematosus

Participants
Kate Hanneman, MD, FRCPC, Toronto, Ontario (*Presenter*) Speaker, sanofi-aventis Group;Speaker, Amicus Therapeutics, Inc

PURPOSE

Patients with systemic lupus erythematosus (SLE) are at risk of myocarditis and antimalarial (AM)-induced cardiomyopathy (AMIC). Differentiating between these disease processes can very challenging due to overlapping clinical features. The purpose of this study was to evaluate cardiac MRI findings in patients with SLE.*Methods and Materials Patients with SLE who had undergone cardiac MRI with native T1/T2 mapping (MOLLI/FLASH) and late gadolinium enhancement (LGE) imaging were compared with 30 healthy controls (39±15 years, 60% female). T1/T2 values were converted to a z-score using scanner-specific local reference values (patient value - reference mean)/(reference SD), indicating how many SD each patient's T1/T2 values are above/below the reference mean. Patients were classified into three groups blinded to MRI findings: AMIC, myocarditis, and no AMIC or myocarditis (other SLE). One-way ANOVA was used to compare findings between groups with Bonferroni post-hoc analysis.*Results 45 SLE patients were included (47±17 years, 80% female, 84% treated with AMs): 8 (11%) with AMIC and 7 (9%) with myocarditis. T1 and T2 were significantly higher in myocarditis compared to AMIC (z-score 3.7±1.6 vs. 1.2±1.3, p<0.001 and 4.0±2.0 vs. 1.3±0.8, p<0.001, respectively), other SLE (0.4±0.9, p<0.001 and 0.2±1.0, p<0.001, respectively), and controls (0±0.6, p<0.001 and 0±1.0, p<0.001, respectively). LGE presence and extent did not differ significantly between SLE groups (p>0.05 for both). However, in myocarditis the pattern of LGE was subepicardial or mid-wall often at the interventricular septum, while in AMIC LGE was most frequently mid-wall located at the basal inferolateral segment. Native T1 correlated negatively with AM treatment duration in other SLE (r=-0.43, p=0.012). However, there was a strong positive correlation between T1 and AM treatment duration in AMIC (r=0.95, p=0.001). AM treatment duration did not correlate significantly with T1 in myocarditis or with T2 in any group.*Conclusions Myocardial native T1 and T2 are significantly higher in patients wtih myocarditis compared to AMIC. Native T1 decreases with AM treatment duration in SLE patients without AMIC or myocarditis. This raises the possibility of glycosphingolipid accumulation concordant with the hypothesis that AMIC is caused by inhibition of myocyte lysosomal activity. Increasing T1 with longer AM treatment in AMIC could reflect progressive myocardial fibrosis.*Clinical Relevance/Application Multiparametric cardiac MRI differentiates between AMIC and myocarditis in patients with SLE. Further longitudinal evaluation is needed to establish whether T1 mapping is useful in detecting pre-clinical AMIC.

RESULTS

45 SLE patients were included (47±17 years, 80% female, 84% treated with AMs): 8 (11%) with AMIC and 7 (9%) with myocarditis. T1 and T2 were significantly higher in myocarditis compared to AMIC (z-score 3.7±1.6 vs. 1.2±1.3, p<0.001 and 4.0±2.0 vs. 1.3±0.8, p<0.001, respectively), other SLE (0.4±0.9, p<0.001 and 0.2±1.0, p<0.001, respectively), and controls (0±0.6, p<0.001 and 0±1.0, p<0.001, respectively). LGE presence and extent did not differ significantly between SLE groups (p>0.05 for both). However, in myocarditis the pattern of LGE was subepicardial or mid-wall often at the interventricular septum, while in AMIC LGE was most frequently mid-wall located at the basal inferolateral segment. Native T1 correlated negatively with AM treatment duration in other SLE (r=-0.43, p=0.012). However, there was a strong positive correlation between T1 and AM treatment duration in AMIC (r=0.95, p=0.001). AM treatment duration did not correlate significantly with T1 in myocarditis or with T2 in any group.

CLINICAL RELEVANCE/APPLICATION

Multiparametric cardiac MRI differentiates between AMIC and myocarditis in patients with SLE. Further longitudinal evaluation is needed to establish whether T1 mapping is useful in detecting pre-clinical AMIC.

SDP-CA-20   Myocardial Extracellular Volume Fraction Quantification In Patients With Heart Failure Using Late Iodine Enhancement From Dual-energy Computed Tomography:Comparison With MRI T1 Mapping

Participants
Jie Deng, Kunming, China (*Presenter*) Nothing to Disclose

PURPOSE

To validate the quantification of myocardial extracellular volume fraction (ECV) by using late iodine enhancement (LIE) derived from dual-energy computed tomography (DECT), with the ECV based on cardiac MR (CMR) as the reference standard.*Methods and Materials 22 patients with suspected heart failure (49±11years, 15 men) underwent both DECT and CMR . 9 subjects (56±9 years, 4 men), who underwent DECT for chest pain and were found to have no coronary abnormalities with negative electrocardiogram and myocardial enzyme testing, were serve as a control group. CCTA was performed by intravenous injection of 0.9ml/kg of iopamidol to assess coronary arteries. LIE was acquired 7 minutes after iodine administration. Iodine images were reconstructed at 8mm slice thickness and 6 mm slice gap to the short-axis plane of the left ventricular (LV) myocardium and then the basal, mid and apical slices were extracted. CMR T1maps were obtained in short-axis consistent with the LIE images before and 10 minutes after intravenous administration of 0.1mmol/kg of Gadobutrol by using the modified Look-Locker inversion recovery sequence. ROIs were manually drawn on myocardium using the AHA's 16-segment model of the LV and the LV blood pool (Fig.A). CT-ECV and CMR-ECV were calculated, respectively (Fig.B, C, D, E, F). Correlation between groups were evaluated with Pearson correlation analysis. Differences between groups were determined with test. The bias and the 95% limits of agreement was assessed with Bland-Altman analysis.*Results Among the 22 patients, 17 were diagnosed as nonischemic heart failure (NIHF) according to the results of CCTA and CMR, were enrolled in this study. The mean radiation dose of the DECT in NIHF and HCs has no statistic difference (10.35 ± 1.67 mSv vs 10.78 ± 3.01 mSv, P=0.699). In patients with NIHF, CT-ECV correlated with CMR-ECV (r= 0.856, P<0.001) and there was no significant difference between the mean values of CT-ECV and CMR-ECV (33.57 ± 2.96% vs 33.16 ± 3.17% , P=0.322). Bland-Altman analysis showed CT-ECV was comparable to CMR-ECV with small bias (95%CI: -11.2% to 8.6%, bias = -1.3%). The CT-ECV in patients with NIHF was significantly higher than that in HCs (33.57 ± 2.96% vs 27.06 ± 2.59%, P<0.001).*Conclusions CT-ECV derived from LIE can serve as an excellent alternative to CMR-ECV in noninvasively quantifying diffused myocardial fibrosis (DMF). Furthermore, CT-ECV have the potential to be used for risk stratification in patients with heart failure.*Clinical Relevance/Application CCTA combined with LIE has relatively low radiation and is highly useful not only in assessments of coronary arteries and cardiac structure, but also meriting in quantifying DMF. in one stop examination, as CT-ECV derived from LIE can serve as an excellent alternative to CMR-ECV.

RESULTS

Among the 22 patients, 17 were diagnosed as nonischemic heart failure (NIHF) according to the results of CCTA and CMR, were enrolled in this study. The mean radiation dose of the DECT in NIHF and HCs has no statistic difference (10.35 ± 1.67 mSv vs 10.78 ± 3.01 mSv, P=0.699). In patients with NIHF, CT-ECV correlated with CMR-ECV (r= 0.856, P<0.001) and there was no significant difference between the mean values of CT-ECV and CMR-ECV (33.57 ± 2.96% vs 33.16 ± 3.17% , P=0.322). Bland-Altman analysis showed CT-ECV was comparable to CMR-ECV with small bias (95%CI: -11.2% to 8.6%, bias = -1.3%). The CT-ECV in patients with NIHF was significantly higher than that in HCs (33.57 ± 2.96% vs 27.06 ± 2.59%, P<0.001).

CLINICAL RELEVANCE/APPLICATION

CCTA combined with LIE has relatively low radiation and is highly useful not only in assessments of coronary arteries and cardiac structure, but also meriting in quantifying DMF. in one stop examination, as CT-ECV derived from LIE can serve as an excellent alternative to CMR-ECV.

SDP-CA-21   Dual Energy Cardiac Computed Tomography For Evaluating Late Iodine Enhancement: Usefulness Of Electron Density Map And Mixed Image

Participants
Takeshi Nakaura, MD, Kumamoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Previous studies have demonstrated that low keV images or iodine maps using dual energy computed tomography (CT) are more suitable than single energy CT to evaluate late iodine enhancement (LIE) in cardiac CT. However, no previous report has evaluated the usefulness of other quantitative maps and mixed images to evaluate LIE in cardiac CT.The purpose of this study was to establish optimal virtual monochromatic energy images, optimal quantitative maps, and mixed images to depict LIE in dual energy cardiac CT.*Methods and Materials We retrospectively enrolled 15 patients with obsolete myocardial infarction (OMI) who underwent dual energy cardiac CT. We generated virtual monochromatic energy image (VMI) sets at 10-keV intervals from 40 to 200 keV and quantitative maps (iodine concentration, effective Z, and electric density). We calculated the contrast-to-noise ratio (CNR) between the OMI area and normal myocardium as well as the OMI area and left intraventricular space. We selected the VMI with the highest average CNR as the optimal keV image. We compared CT values of the optimal keV image and quantitative values of iodine concentration, effective Z, and electric density of the OMI area, normal myocardium, and left intraventricular space. Two radiologists evaluated overall image quality in mixed images of optimal keV images and quantitative maps.*Results Average CNR increased as energy level decreased; we defined 40-keV images as the optimized energy level. The CT value of 40 keV and all quantitative values were significantly higher in the OMI area than in the normal myocardium (p < 0.01). The electron density of the OMI was significantly higher in the OMI area than in the normal myocardium (p < 0.01); however, no significant differences were observed in CT value, iodine concentration, or effective Z (p > 0.05). In qualitative analysis of mixed images, the overall image

quality score of mixed images with the electron density map was significantly higher than those of other mixed images.*Conclusions Compared with low keV images or the iodine map, the electron density map provides better contrast between the LIE area and left intraventricular space in cardiac dual energy CT. A mixed image of low keV image and electron density map offers better image quality than other mixed images.*Clinical Relevance/Application The mixed image of low keV image and electron density map has the capability to offer additional information for LIE analysis in cardiac dual energy CT.

RESULTS

Average CNR increased as energy level decreased; we defined 40-keV images as the optimized energy level. The CT value of 40 keV and all quantitative values were significantly higher in the OMI area than in the normal myocardium (p < 0.01). The electron density of the OMI was significantly higher in the OMI area than in the normal myocardium (p < 0.01); however, no significant differences were observed in CT value, iodine concentration, or effective Z (p > 0.05). In qualitative analysis of mixed images, the overall image quality score of mixed images with the electron density map was significantly higher than those of other mixed images.

CLINICAL RELEVANCE/APPLICATION

The mixed image of low keV image and electron density map has the capability to offer additional information for LIE analysis in cardiac dual energy CT.

SDP-CA-22   A Comparative Study On The Detection Efficiency For Different Types Of Coronary Plaque Based On Deep Learning (dl) Algorithm

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore differences in the detection efficiency using deep learning (DL) based artificial intelligence (AI) diagnostic system for calcified plaque, noncalcified plaque and mixed plaques.*Methods and Materials In this retrospective study, a total of 50 patients with acute chest pain underwent coronary CT angiography using a 256-detector row CT (Revolution CT, GE healthcare) were collected. CCTA AI-assisted Diagnostic System (CoronaryDoc, Shukun Technology) was used to detect the presence of coronary plaque. The reference standard for the presence of coronary plaque was finally annotated by two radiologists with more than 15 years of experience based on the review of AI results. Coronary plaques were classified into three groups, calcified plaque, noncalcified plaque and mixed plaques. The detection number of different types of coronary plaque by the system was recorded and the sensitivity of different types of fractures compared using chi-square test.*Results A total of 330 plaque including 149 calcified plaque, 109 noncalcified plaque and 72 mixed plaque were established as the gold standard. Based on the results obtained using AI system, we detected a total of coronary plaque,140 were marked as calcified plaque, along with 82 noncalcified plaque and 67 mixed plaques. Therefore, the sensitivity of AI for coronary plaque detection was 87.58%. The detection rate for calcified plaque, noncalcified plaque and mixed plaques was 93.96%, 75.23% and 93.06%, respectively. There was a statistically significant differences in sensitivity among three types of coronary plaque detected by AI (P=0.000). Particularly, the diagnostic rate in the detection of calcified plaque and mixed plaques was found to be significantly greater than that of noncalcified plaque.*Conclusions The diagnostic efficiency using AI in the detection of coronary plaque was found to be correlated with the plaque type. Particularly, calcified plaque and mixed plaques was found to be best identified by the AI system compared to noncalcified plaque.*Clinical Relevance/Application AI system demonstrated different performances in the detection of different types of plaque, and the effectiveness of calcified plaque and mixed plaques examination is found to be better than noncalcified plaque.

RESULTS

A total of 330 plaque including 149 calcified plaque, 109 noncalcified plaque and 72 mixed plaque were established as the gold standard. Based on the results obtained using AI system, we detected a total of coronary plaque,140 were marked as calcified plaque, along with 82 noncalcified plaque and 67 mixed plaques. Therefore, the sensitivity of AI for coronary plaque detection was 87.58%. The detection rate for calcified plaque, noncalcified plaque and mixed plaques was 93.96%, 75.23% and 93.06%, respectively. There was a statistically significant differences in sensitivity among three types of coronary plaque detected by AI (P=0.000). Particularly, the diagnostic rate in the detection of calcified plaque and mixed plaques was found to be significantly greater than that of noncalcified plaque.

CLINICAL RELEVANCE/APPLICATION

AI system demonstrated different performances in the detection of different types of plaque, and the effectiveness of calcified plaque and mixed plaques examination is found to be better than noncalcified plaque.

SDP-CA-23   Improvement Of Spatial Resolution By Using Super-resolution Deep Learning Reconstruction At Coronary CT Angiography

Participants
Fuminari Tatsugami, Hiroshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Coronary CT angiography (CTA) is a robust noninvasive imaging modality that can yield an accurate diagnosis and exclude coronary artery disease (CAD). At coronary CTA, higher spatial resolution is desirable for the precise assessment of CAD. Recently developed deep learning-based reconstruction (DLR) reduces image noise and improves the image quality of CT scans, but it does not improve spatial resolution. We developed a super-resolution DLR (SR-DLR) for conventional CT images, that convert conventional resolution-to high-resolution CT images. The purpose of this study was to compare the image noise and spatial resolution on SR-DLR images and conventional hybrid iterative reconstruction (IR) images.*Methods and Materials The SR-DLR was implemented using super-resolution deep convolutional neural network (SR-DCNN). Firstly, we trained the SR-DCNN with pairs of high-resolution- and conventional resolution images. The high-resolution images were acquired using an actual ultra-high-resolution CT scanner (Aquilion Precision, Canon), and reconstructed with advanced reconstruction technique. The conventional resolution images were generated using a sinogram-based normal resolution (NR) simulation technique. The clinical study included 10 patients who underwent coronary CTA on a 320-slice CT scanner. The images were reconstructed with hybrid IR and with SR-DLR. We measured the image noise in the ascending aorta on the two reconstruction images. The modulation transfer function (MTF) was the index for spatial resolution; it was measured on edge of the left ventricle and septum using the circular edge method. Two radiologists visually evaluated the image quality based on the noise-related blurring, margin sharpness, and blooming artifacts using a 4-point scale (1 = poor, 4 = excellent).*Results The mean image noise on the SR-DLR images was significantly lower than hybrid IR images (17.5±1.5

vs. 23.1±4.8 [HU]; p < 0.05), while there was no change in the CT attenuation of the coronary arteries. Based on the 10% MTF, spatial resolution was higher on SR-DLR image than hybrid IR image (0.94±0.14 vs. 0.58±0.04 [cy/mm]; p < 0.01). The mean image quality score was also improved with SR-DLR images (3.8 vs. 2.6; p < 0.05).*Conclusions The use of SR-DLR reduces image noise and improves spatial resolution at cardiac CT compared to conventional hybrid IR.*Clinical Relevance/Application A super-resolution deep learning reconstruction for conventional coronary CT images reduces image noise and improves spatial resolution.

RESULTS

The mean image noise on the SR-DLR images was significantly lower than hybrid IR images (17.5±1.5 vs. 23.1±4.8 [HU]; p < 0.05), while there was no change in the CT attenuation of the coronary arteries. Based on the 10% MTF, spatial resolution was higher on SR-DLR image than hybrid IR image (0.94±0.14 vs. 0.58±0.04 [cy/mm]; p < 0.01). The mean image quality score was also improved with SR-DLR images (3.8 vs. 2.6; p < 0.05).

CLINICAL RELEVANCE/APPLICATION

A super-resolution deep learning reconstruction for conventional coronary CT images reduces image noise and improves spatial resolution.

SDP-CA-24   Photon Counting CT Based Virtual Non-contrast Reconstructions: Feasibility Of Coronary Artery Calcium Scoring On CTA Series.

Participants
Katharina Rippel, Augsburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of using virtual non-contrast-enhanced (VNC) series derived from coronary CT-angiography scans on a photon counting CT for coronary artery calcium quantification.*Methods and Materials Here, we present the interim analysis of an ongoing study which will include 100 patients. This study was institutional review board approved and all patients provided written informed consent. All patients underwent noncontrast CT of the heart followed by CT angiography of the heart, aorta and iliac arteries on a novel photon counting dual-source CT (NAEOTOM Alpha, Siemens Healthineers, Erlangen, Germany) prior to transcatheter aortic valve replacement (TAVR). Two readers evaluated noise and efficiency of virtual iodine removal for different VNC reconstruction algorithms. Furthermore, they independently quantified calcium on VNC images and true non contrast-enhanced (TNC) calcium score series. Calcium scores and volumes were correlated both on a per patient and on a per vessel level.*Results Correlation between VNC and TNC series regarding calcium volumes as well as calcium scores was excellent on a per-patient level (r = 0.91 and r = 0.90, p<0.05). On a per-vessel level, correlation of calcium volumes and calcium scores between VNC and TNC series was excellent for the left circumflex artery (r = 0,97, r = 0,99) and left anterior descending artery (r = 0,94, r = 0,95). Very good correlation was observed for the left main coronary artery (r = 0,85, r = 0,83) and the right coronary artery (r = 0,84, r = 0,81).*Conclusions PCD-based VNC series provide excellent correlations of coronary artery calcium scores compared with TNC series and are highly likely interchangeable. This might replace dedicated TNC calcium scoring studies in the immediate future.*Clinical Relevance/Application Radiation exposure from cardiac CT remains a concern - particularly with the expected rapid rise in cardiac CT scans worldwide. Coronary artery calcium scoring using PCD-based VNC series will likely be able to replace dedicated TNC studies thereby reducing total radiation dose.

RESULTS

Correlation between VNC and TNC series regarding calcium volumes as well as calcium scores was excellent on a per-patient level (r = 0.91 and r = 0.90, p<0.05). On a per-vessel level, correlation of calcium volumes and calcium scores between VNC and TNC series was excellent for the left circumflex artery (r = 0,97, r = 0,99) and left anterior descending artery (r = 0,94, r = 0,95). Very good correlation was observed for the left main coronary artery (r = 0,85, r = 0,83) and the right coronary artery (r = 0,84, r = 0,81).

CLINICAL RELEVANCE/APPLICATION

Radiation exposure from cardiac CT remains a concern - particularly with the expected rapid rise in cardiac CT scans worldwide. Coronary artery calcium scoring using PCD-based VNC series will likely be able to replace dedicated TNC studies thereby reducing total radiation dose.

SDP-CA-3   Effect Of Low Tube Voltage On Image Quality And Radiationdose Of Cta:: A Phantom Study

Participants
Qi Hao, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the effect of image quality and radiation dose of CTA on spectral CT at low tube voltage state.*Methods and Materials A polypropylene cylindrical phantom (QSP Phantom) with nine tubes containing varying concentrations of iodine (20 mgl/ml) was scanned with both Conventional CT .Group A,B and C were divided according to different CT tube voltage , the group A ,B and C were set to 120kV,100kV and 80kV,respectively. Group A,B and C with conventional spiral CT scan mode by spectral CT scanner was defined as follows: tube current was set to 480mA; the detector width was 8cm;pitch value in helical mode was 0.992:1; the noise index (NI) was set to 10, the slice thickness and slice increment were 1.25mm.The CDTI ,CT values and SD values the three groups were recorded separately, and the signal-to-noise ratio (SNR) of within each group was calculated. All statistical tests were performed using SPSS version 26.0 (SPSS, Chicago, IL), the independent t-test was used to compare the difference of CDTI and SNR between different tube voltage. For all tests, the level of statistical significance was set at P<0.05.*Results The radiation doses of energy spectrum CT were 6.2 mGy, 12.15 mGy, and 19.58 mGy in different groups ranging from 80 kVp to140 kVp, respectively.The differences in radiation doses between different groups were statistically significant (P < 0.05), and the differences in SD values (F = 350.328,P = 0.000) and SNR (F = 7.271,P = 0.000) for each group were statistically significant (P < 0.05). The SD values were 19.72±1.535 and 13.069±0.647, and the CNR values were 52.314±3.256 and 58.614±3.443 for the low-tube voltage 80 kVp and 100 kVp groups, respectively, and the SD and CNR values were 9.878±0.733 and 60.344±3.259 respectively for the conventional voltage 120 kVp group.The differences in radiation dose and SNR between the low-tube voltage 80 kV group and the conventional tube voltage 120 kV group were statistically significant (P < 0.05), and the radiation dose in the low-voltage 80kV group was 68.34% lower than that in the conventional 120kV group.The differences in radiation dose between the two groups were statistically significant (P < 0.05), and the radiation dose in the low tube voltage 100kV group is reduced by 37.95% compared to the conventional tube voltage 120kV group., but there was no significant difference in the noise ratio between the two groups (P > 0.05).*Conclusions In conventional spiral CT , low-tube voltage 100 kV scanning can obtain the same

image quality (CNR) as conventional 120 kV scanning, and its radiation dose is lower and the SD is higher significantly.*Clinical Relevance/Application In CT angiography, the application of the spiral CT low tube voltage 100kV scanning can replace the conventional tube voltage 120kv image.

RESULTS

The radiation doses of energy spectrum CT were 6.2 mGy, 12.15 mGy, and 19.58 mGy in different groups ranging from 80 kVp to 140 kVp, respectively.The differences in radiation doses between different groups were statistically significant (P < 0.05), and the differences in SD values (F = 350.328,P = 0.000) and SNR (F = 7.271,P = 0.000) for each group were statistically significant (P < 0.05). The SD values were 19.72±1.535 and 13.069±0.647, and the CNR values were 52.314±3.256 and 58.614±3.443 for the low-tube voltage 80 kVp and 100 kVp groups, respectively, and the SD and CNR values were 9.878±0.733 and 60.344±3.259 respectively for the conventional voltage 120 kVp group.The differences in radiation dose and SNR between the low-tube voltage 80 kV group and the conventional tube voltage 120 kV group were statistically significant (P < 0.05), and the radiation dose in the low-voltage 80kV group was 68.34% lower than that in the conventional 120kV group.The differences in radiation dose between the two groups were statistically significant (P < 0.05), and the radiation dose in the low tube voltage 100kV group is reduced by 37.95% compared to the conventional tube voltage 120kV group., but there was no significant difference in the noise ratio between the two groups (P > 0.05).

CLINICAL RELEVANCE/APPLICATION

In CT angiography, the application of the spiral CT low tube voltage 100kV scanning can replace the conventional tube voltage 120kv image.

SDP-CA-4   The Value Of Coronary Computed Tomography Angiography Derived Plaque Features In Diagnosis Of Vulnerable Plaques Defined By Optical Coherence Tomography

Participants
Liu Xiaojing, Kaifeng, China (*Presenter*) Nothing to Disclose

PURPOSE

Identification of vulnerable plaque is essential to pre-estimate the risk of cardiovascular disease (CVD) and stratify major adverse cardiac events (MACEs) risks. This study aims to evaluating the diagnosis ability of coronary computed tomography angiography (CCTA) derived qualitative and quantitative plaque features on detecting optical coherence tomography (OCT) defined vulnerable plaques.*Methods and Materials 31 Patients who underwent both CCTA and OCT were retrospectively included in this study. Results of OCT and CCTA were blindly analysis on a segment-to-segment comparison. The qualitative and quantitative plaque parameters derived by CCTA were recorded. Univariate analysis and multivariate logistic regression analysis were performed to reveal the independent predictors. The diagnostic efficacy of quantitative parameters was evaluated by receiver operating characteristic (ROC) curve and area under curve (AUC).*Results 76 plaques in 31 patients were included for analysis, of which 19.7% (15/76 plaques, 10 patients) was vulnerable plaques. Low-density plaques, punctate calcification, positive remodeling, number of high-risk plaque signs, non-calcified fraction and lipid fraction were shown significant differences between vulnerable and non-vulnerable plaques (p < 0.05). The lipid fraction (odd ratio (OR) = 1.148, 95% CI 0.993 ~ 1.327), punctate calcification (OR = 4.521, 95% CI 1.022 ~ 20.008) and low-density plaques (OR = 8.012, 95% CI 2.024 ~ 31.718) were independent predictors of vulnerable plaques. Compared with qualitative and quantitative models, the mixed model integrating all significant CCTA derived plaque characteristics own the highest AUC and accuracy (mixed model AUC = 0.869, 95% CI: 0.808 to 0.979; qualitative model AUC = 0.798, 95% CI: 0.654 to 0.941; quantitative Model AUC = 0.638, 95% CI: 0.528~0.866).*Conclusions The CCTA derived plaque characteristics were able to detect the OCT-defined vulnerable plaques and the diagnosis performance was enhanced by integrating significant qualitative and quantitative plaque parameters.*Clinical Relevance/Application CCTA derived plaque parameters show great potentials as a non-invasive biomarker for early diagnosis and treatment of coronary vulnerable plaques.

RESULTS

76 plaques in 31 patients were included for analysis, of which 19.7% (15/76 plaques, 10 patients) was vulnerable plaques. Low-density plaques, punctate calcification, positive remodeling, number of high-risk plaque signs, non-calcified fraction and lipid fraction were shown significant differences between vulnerable and non-vulnerable plaques (p < 0.05). The lipid fraction (odd ratio (OR) = 1.148, 95% CI 0.993 ~ 1.327), punctate calcification (OR = 4.521, 95% CI 1.022 ~ 20.008) and low-density plaques (OR = 8.012, 95% CI 2.024 ~ 31.718) were independent predictors of vulnerable plaques. Compared with qualitative and quantitative models, the mixed model integrating all significant CCTA derived plaque characteristics own the highest AUC and accuracy (mixed model AUC = 0.869, 95% CI: 0.808 to 0.979; qualitative model AUC = 0.798, 95% CI: 0.654 to 0.941; quantitative Model AUC = 0.638, 95% CI: 0.528~0.866).

CLINICAL RELEVANCE/APPLICATION

CCTA derived plaque parameters show great potentials as a non-invasive biomarker for early diagnosis and treatment of coronary vulnerable plaques.

SDP-CA-5   Proof-of-principle Demonstration Of Left Atrial Hemodynamics In Patients With Atrial Fibrillation Before And After Left Atrial Appendage Occlusion: A Study With 3D-printed Model Using 4d Flow MRI

Participants
Min Jae Cha, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Percutaneous left atrial appendage occlusion (LAAO) is currently performed to reduce thromboembolic event in patients with atrial fibrillation (AF). However, little is known about the actual flow dynamic changes within the left atrium (LA) before and after LAAO. The aim of this study is to visualize LA hemodynamic changes after LAAO by use of 4D flow magnetic resonance imaging (MRI) using a 3D-printed phantom model.*Methods and Materials This proof-of-concept study was approved by institutional review board, and performed based on the CT images of 86-year-old male patient with chronic AF and history of cerebral infarction and subdural hemorrhage. Three life-sized LA phantoms, including pre-occluded, correctly-occluded, and mal-occluded models, were constructed based on CT images of pre-LAAO ECG-gated cardiac CT and 3D-pinted models (Fig.1). Pulsatile pulmonary venous flow obtained from transesophageal echocardiography were entered through four inlets (pulmonary veins) from output-adjustable pump. 4D flow MRI of three phantom models with flow simulation were acquired using 3T scanner (Fig.2) and data were extracted and analyzed using a MATLAB-based software.*Results 4D flow MRI visualized the internal flow with virtual particles tracing during the cardiac cycle. The particles inside the appendage of the pre-occluded model remained almost in place despite pulsatile flow, which may

lead to thrombus formation. We defined an area that satisfies |V | < 2 cm/s as a "stagnant zone", and cross-sectional view demonstrated that the stagnant zone is formed in the 'unintended space' near the LAA ostium of the mal-occluded model for a longer time than the correctly-occluded model (Fig. 3).*Conclusions 4D flow MRI directly visualized different flow dynamics of LA before and after LAAO in the phantom study. We demonstrated sparse flow within the LAA before LAAO and maloccluded LAA could adversely lead to thrombus formation adjacent to the LAA ostium.*Clinical Relevance/Application 4D flow MRI visualize little flow within LAA in patient with AF, which may result in thrombus formation. Mal-occluded LAA can also lead to adverse thrombus formation.

RESULTS

4D flow MRI visualized the internal flow with virtual particles tracing during the cardiac cycle. The particles inside the appendage of the pre-occluded model remained almost in place despite pulsatile flow, which may lead to thrombus formation. We defined an area that satisfies |V | < 2 cm/s as a "stagnant zone", and cross-sectional view demonstrated that the stagnant zone is formed in the 'unintended space' near the LAA ostium of the mal-occluded model for a longer time than the correctly-occluded model (Fig. 3).

CLINICAL RELEVANCE/APPLICATION

4D flow MRI visualize little flow within LAA in patient with AF, which may result in thrombus formation. Mal-occluded LAA can also lead to adverse thrombus formation.

SDP-CA-6   Comparison Of Cardiovascular Magnetic Resonance Characteristics And Clinical Prognosis In Left Ventricular Non-compaction Patients With And Without Arrhythmia

Participants
Ziqi Zhou, MD,BMBCh, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

Left ventricular non-compaction (LVNC) is a rare cardiomyopathy whose main clinical manifestations include arrhythmia. Although cardiovascular magnetic resonance (CMR) is increasingly used in the diagnosis and prognosis of LVNC, there are still insufficient studies of CMR on LVNC patients with arrhythmia.This study was performed to characterize and compare CMR features and prognosis in LVNC patients with and without arrhythmias.*Methods and Materials 84 LVNC patients diagnosed by CMR were collected retrospectively. Clinical data, arrhythmia characteristics and CMR parameters were collected. Patients were divided into different groups according to their arrhythmia characteristics and CMR manifestations for statistical analysis and comparison. One-way ANOVA and Kaplan-Meier survival curves were used for statistical comparison. The outcome events defined as a composition event of cardiac death, rehospitalization of heart failure, heart transplantation and pacemaker implantation.*Results Sixty-seven LVNC patients (79.76%) mainly presented with arrhythmia, including premature ventricular beat (33, 27.73%), bundle branch block (14, 11.77%), ECG waveform changes (18, 15.13%), ventricular tachycardia (11, 9.24%). The cardiac function and structure parameters had no significant difference among non-arrhythmia group, benign arrhythmia group and malignant arrhythmia group, but the LGE presence was higher in the malignant arrhythmia group than other two groups (p=0.023). At a mean follow-up of 46 ± 27 months, cardiac events occurred in 23 patients (46.94%). Kaplan-Meier analysis showed no statistically significant difference in prognosis among the non-arrhythmia, benign and malignant arrhythmia groups,but the arrhythmia patients with LGE+ or LVEF <30% had higher risk than patients with LGE- or LVEF>30%(p=0.003, HR=4.035, 95%CI:1.475-11.035; p=0.003, HR=8.131, 95%CI:1.805-36.636).*Conclusions In LVNC patients, the types of arrhythmia are numerous and unrepresentative, and arrhythmia is not the prognostic factors. Arrhythmia combined with imaging indicators may more useful for risk stratification. Arrhythmia LVNC patients with combined LGE positive or LVEF <30% patients are at higher risk.*Clinical Relevance/Application Arrhythmia is one of the most common clinical features in LVNC patients, with many types and no specificity. LGE is more common in LVNC patients with malignant arrhythmia, and patients with LGE have a higher incidence of adverse cardiovascular events and a lower survival rate than arrhythmic patients without LGE. In addition, in LVNC patients with arrhythmia, the more the LVEF decreased, the worse the prognosis. The combination of imaging indicators may be more useful for risk stratification in LVNC patients.

RESULTS

Sixty-seven LVNC patients (79.76%) mainly presented with arrhythmia, including premature ventricular beat (33, 27.73%), bundle branch block (14, 11.77%), ECG waveform changes (18, 15.13%), ventricular tachycardia (11, 9.24%). The cardiac function and structure parameters had no significant difference among non-arrhythmia group, benign arrhythmia group and malignant arrhythmia group, but the LGE presence was higher in the malignant arrhythmia group than other two groups (p=0.023). At a mean follow-up of 46 ± 27 months, cardiac events occurred in 23 patients (46.94%). Kaplan-Meier analysis showed no statistically significant difference in prognosis among the non-arrhythmia, benign and malignant arrhythmia groups,but the arrhythmia patients with LGE+ or LVEF <30% had higher risk than patients with LGE- or LVEF>30%(p=0.003, HR=4.035, 95%CI:1.475-11.035; p=0.003, HR=8.131, 95%CI:1.805-36.636).

CLINICAL RELEVANCE/APPLICATION

Arrhythmia is one of the most common clinical features in LVNC patients, with many types and no specificity. LGE is more common in LVNC patients with malignant arrhythmia, and patients with LGE have a higher incidence of adverse cardiovascular events and a lower survival rate than arrhythmic patients without LGE. In addition, in LVNC patients with arrhythmia, the more the LVEF decreased, the worse the prognosis. The combination of imaging indicators may be more useful for risk stratification in LVNC patients.

SDP-CA-7   Endogenous Contrast T1 Rho Mapping For Myocardial Fibrosis In Non-ischemic Cardiomyopathy: Comparison With Extracellular Volume Fraction Using T1 Mapping

Participants
Yoshiaki Morita, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

T1 rho mapping with endogenous MRI contrast, which is sensitive to macromolecular interaction and differs from conventional T1- and T2-based MRI contrast, has been used to assess the tissue damage of articular cartilage, brain and liver, but less in heart. The aim was to evaluate the feasibility of T1 rho mapping for the detection of myocardial fibrosis in patients with non-ischemic cardiomyopathy, by comparison with pre- and post-contrast T1 maps derived extracellular volume (ECV) fraction as indicator of extracellular space expansion including diffuse interstitial fibrosis that is difficult to detect in late gadolinium enhancement (LGE).*Methods and Materials Thirty-five patients with non-ischemic cardiomyopathy and 5 patients with normal myocardium (mild arrhythmia without organic cardiac disease) underwent cardiac MRI with 3T machine. T1 rho mapping was performed at short-axial

slice in basal, mid-ventricular and apical level. T1 rho map was reconstructed using three source images with different spin-lock preparation times (1, 20 and 40msec). T1 mapping using MOLLI method and LGE were also performed. Using pre- and post-contrast T1 maps, ECV map was reconstructed. We measured the T1 rho, pre-contrast T1 (=native T1) and ECV at septum in each level. The presence of LGE was also decided visually.*Results The meanT1 rho value in patients with non-ischemic cardiomyopathy showed significantly higher than that in normal patients (62.1and 53.1msec, p<0.001). Further, not only LGE positive but apparently LGE negative segments also showed higher ECV and T1 rho values than normal myocardium (p<0.01 for all). T1 rho values was well correlated with ECV (r=0.63). Whereas, native T1 values showed weak correlation with ECV (r=0.19). The cut-off value for T1 rho values to differentiate between higher ECV (>30%), suggesting interstitial space expansion due to fibrosis, and normal ECV was 58.5msec (sensitivity 81 %, specificity 76%, area under the curve 0.85).*Conclusions Myocardial T1 rho mapping showed good association with ECV in non-ischemic cardiomyopathy and enabled the detection of abnormal ECV with high diagnostic accuracy. Further, T1 rho of apparently LGE-negative segments, as well as of LGE-positive, was significantly higher than normal myocardium in the same way as ECV.*Clinical Relevance/Application T1 rho mapping permit the detection of myocardial fibrosis, including diffuse interstitial involvement that is difficult to evaluate by conventional LGE, without the need for gadolinium, which would be useful particularly in patients with a higher risk of contrast administration. This novel endogenous mapping could be a useful and practical biomarker for evaluation of the early cardiac involvement, disease severity and prognostic information.

RESULTS

The meanT1 rho value in patients with non-ischemic cardiomyopathy showed significantly higher than that in normal patients (62.1and 53.1msec, p<0.001). Further, not only LGE positive but apparently LGE negative segments also showed higher ECV and T1 rho values than normal myocardium (p<0.01 for all). T1 rho values was well correlated with ECV (r=0.63). Whereas, native T1 values showed weak correlation with ECV (r=0.19). The cut-off value for T1 rho values to differentiate between higher ECV (>30%), suggesting interstitial space expansion due to fibrosis, and normal ECV was 58.5msec (sensitivity 81 %, specificity 76%, area under the curve 0.85).

CLINICAL RELEVANCE/APPLICATION

T1 rho mapping permit the detection of myocardial fibrosis, including diffuse interstitial involvement that is difficult to evaluate by conventional LGE, without the need for gadolinium, which would be useful particularly in patients with a higher risk of contrast administration. This novel endogenous mapping could be a useful and practical biomarker for evaluation of the early cardiac involvement, disease severity and prognostic information.

SDP-CA-8　Usefulness Of Compressed Sensing Cine For Feature Tracking Strain Analysis On Left Ventricle Compared To Conventional Cine Imaging

Participants
Yasuhiro Nagai, Osaka, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Myocardial strain analysis has been used to assess the detailed regional cardiac function. The feature tracking method, which allows direct derivation of myocardial strain from conventional cine MRI sequences, was introduced as novel technique. Recently, compressed sensing (CS) technique with incoherent sampling and iterative reconstruction has been applied to cine MRI, which has reduced acquisition time. However, the effects of CS imaging for feature tracking strain analysis is still unclear. We investigated the impact of acceleration factor and ECG-gating technique of CS cine for feature tracking strain analysis compared to conventional cine imaging.*Methods and Materials We obtained CS cine and conventional cine images at short-axis and 4-chamber plane in 26 healthy volunteers (44.3±18.8 years, man: woman = 21:5). CS cine with comparable temporal and spatial resolution to conventional method were performed with acceleration factor (factor) of 4, 6, 8 and with two different ECG-gating technique: retrospective trigger and prospective trigger (=Real time cine). We measured peak strain [%] in the Radial, Circumferential and Longitudinal direction according to the AHA16segment model using dedicated feature tracking software (Circle cardiovascular Imaging Inc, cvi42). The mean peak strain values and variability in CS cine were compared with conventional cine. Significant differences were determined by the Welch test.*Results Peak Radial Strain in retrospective CS cine (factor of 6,8) and real-time CS cine (factor of 4,6,8) were underestimated. Peak Circumferential Strain in retrospective CS cine (factor of 6,8) and real-time CS cine (factor of 4,6,8) were also underestimated, with especially lower in the mid inferior to mid inferoseptal wall. Peak Longitudinal Strain in retrospective CS cine (factor of 6,8) and real-time CS cine (factor of 4,6,8) were underestimated, with especially lower in the basal anterolateral wall. Peak Radial Strain showed the larger variation than other strain in all cine imaging technique. There were no significant differences in Peak Strain of three directions between conventional and retrospective CS cine (factor of 4).*Conclusions CS cine using retrospective ECG triggering and acceleration factor of 4 could be used for feature tracking strain analysis as well as conventional cine imaging.*Clinical Relevance/Application The acceleration factor and ECG triggering method in CS cine influence the peak strain values. CS cine using our proposed adequate parameter setting enable the accurate and reproducible strain analysis, thus reducing the cine scan time and improving the patient compliance, especially in patients who have difficulties in the repeated breath-hold and the constant holding position during scan.

RESULTS

Peak Radial Strain in retrospective CS cine (factor of 6,8) and real-time CS cine (factor of 4,6,8) were underestimated. Peak Circumferential Strain in retrospective CS cine (factor of 6,8) and real-time CS cine (factor of 4,6,8) were also underestimated, with especially lower in the mid inferior to mid inferoseptal wall. Peak Longitudinal Strain in retrospective CS cine (factor of 6,8) and real-time CS cine (factor of 4,6,8) were underestimated, with especially lower in the basal anterolateral wall. Peak Radial Strain showed the larger variation than other strain in all cine imaging technique. There were no significant differences in Peak Strain of three directions between conventional and retrospective CS cine (factor of 4).

CLINICAL RELEVANCE/APPLICATION

The acceleration factor and ECG triggering method in CS cine influence the peak strain values. CS cine using our proposed adequate parameter setting enable the accurate and reproducible strain analysis, thus reducing the cine scan time and improving the patient compliance, especially in patients who have difficulties in the repeated breath-hold and the constant holding position during scan.

SDP-CA-9　Feasibility Of Whole Heart 3D Cine MRI With Highly-accelerated Technique Using Hyperkat Method: Evaluation By Automatic Left And Right Ventricular Volumetry Based On Deep Learning In Comparison With Conventional 2D Cine Imaging.

Participants

Tatsuhiro Yamamoto, Osaka, Japan (*Presenter*) Nothing to Disclose

PURPOSE

3D cine imaging using HyperKat method which is parallel imaging with k-t space data under-sampling enable to obtain the whole heart volume images with the reduction of acquisition time and to reconstruct any cardiac-axis as post-processing. Recently, automatically identified ventricular segmentation and volumetric cine MRI analysis based on deep learning architectures has become as accurate and reproducible method. This study aims to investigate the feasibility of our proposed 3D cine imaging for automatic biventricular analysis compared with conventional 2D cine imaging.*Methods and Materials We obtained 3D cine and conventional 2D cine images in 10 healthy volunteers using a 3T-MRI. Highly-accelerated 3D cine imaging using HyperKat technique of acceleration factor=8 were performed covering whole heart in transverse plane with two or three breath-hold. 3D cine were obtained with same spatial and temporal resolution as 2D cine images which need the 10 or more breath-holds including determination of cardiac axis. The obtained 3D volume data was reconstructed in short-axis and 4 chamber plane from original transverse images. We measured the volumetric parameters (EDV, ESV and EF) of left and right ventricle (LV and RV) using automatic ventricular function module programmed based on deep learning (Circle cardiovascular Imaging Inc, cvi42). Then, these parameters between 3D and 2D cine images were compared. The visual assessment score using a 4-point scale and contrast ratio between myocardium and lumen were also assessed.*Results Despite slight degradation in image quality and contrast ratio for 3D cine imaging, automatic ventricular segmentation and volumetric analysis of both ventricles were successful with some manual correction in all 3D cine images equivalent to 2D images. The good correlations between 3D and 2D cine were shown for the functional parameters (LV: EDV r=0.961, ESV r=0.960, EF r=0.899, RV: EDV r=0.986, ESV r=0.986, EF r=0.848). The Bland-Altman plot showed a good agreement between both methods.*Conclusions The highly-accelerated whole heart 3D cine imaging using HyperKat methods permit the accurate assessment of cardiac volume and function using automatically identified volumetry method based on deep learning, equivalent to conventional 2D cine imaging.*Clinical Relevance/Application The highly-accelerated 3D cine imaging using HyperKat methods can be implemented with a simple scan plan and evaluate the accurate ventricular function with equivalent to conventional 2D cine images. Our proposed method is useful and practical approach for the reduction of acquisition time and the reconstruction of any cardiac-axis as post-processing without complicated determination of cardiac axis during scan.

RESULTS

Despite slight degradation in image quality and contrast ratio for 3D cine imaging, automatic ventricular segmentation and volumetric analysis of both ventricles were successful with some manual correction in all 3D cine images equivalent to 2D images. The good correlations between 3D and 2D cine were shown for the functional parameters (LV: EDV r=0.961, ESV r=0.960, EF r=0.899, RV: EDV r=0.986, ESV r=0.986, EF r=0.848). The Bland-Altman plot showed a good agreement between both methods.

CLINICAL RELEVANCE/APPLICATION

The highly-accelerated 3D cine imaging using HyperKat methods can be implemented with a simple scan plan and evaluate the accurate ventricular function with equivalent to conventional 2D cine images. Our proposed method is useful and practical approach for the reduction of acquisition time and the reconstruction of any cardiac-axis as post-processing without complicated determination of cardiac axis during scan.

NPM04-D

Noninterpretative Wednesday Poster Discussions

Sub-Events

NPM04-D1   **Where Is The Zoom Link? Impact Of Remote Learning On Radiology Residents During COVID-19**

Participants
Michael Jin, MD, Coram, New York (*Presenter*) Nothing to Disclose

PURPOSE

The COVID-19 pandemic had tremendous impact on residency programs throughout the country. With novel tools to facilitate distant learning, radiology residencies were quick to implement remote education curriculums. The purpose of this study is to investigate the impact of remote learning on radiology residents' education and wellness.*Methods and Materials A 26-item questionnaire was distributed to radiology residency programs throughout the United States with targeted audience of PGY2 to PGY 5 radiology residents. The survey was open for 10 days between the month of March and April of 2021 and asked participants to rank the impact of remote learning on various aspects of radiology residency on a 1 to 5 scale (1: significantly negatively affected, 5: significantly positively affected). Survey results were analyzed using normal distribution and was considered significant when 95% confidence interval did not include 3 (neutral). Two-sample t-test was used to compare our results with results from prior studies (P = 0.05).*Results The survey respondents breakdown includes 28.57% PGY 2, 26.19% PGY 3, 21.42% PGY 4, and 23.82% PGY 5 radiology residents. Out of 42 survey responses, 67% of respondents reported rotations with supervision by faculty who work remotely >50% of the time. Residents reported decreased quality of faculty interactions (x =2.4; 95% CI 2.2-2.7), preparedness for independent call (2.5; 2.2-2.9), professional relationships with attendings (2.3; 2.0-2.6), and education in diagnostic radiology (2.5; 2.3-2.8), ultrasound (2.3; 2.1-2.6), and procedural studies (2.4; 2.1-2.6). Compared with prior studies, residents reported higher support from co-residents (p=0.04), lower support from administrative staff (p=0.004), and decreased satisfaction with educational experience (p=0.0003), particularly with faculty's commitment to resident education (p=.02). No differences were detected between preference for in-person vs virtual conference, research involvement, or amount of attending feedback.*Conclusions Our survey results show the COVID-19 had significant impact on radiology residents and suggests factors that can contribute to successful radiology residency experiences. While COVID 19 may have been perceived to unanimously negatively impact resident education, our survey poses a different perspective.*Clinical Relevance/Application While COVID has universally impacted resident education in other specialties negatively, its effect on radiology highlights a unique set of challenges and potential opportunities in training the next generation of radiologists.

RESULTS

The survey respondents breakdown includes 28.57% PGY 2, 26.19% PGY 3, 21.42% PGY 4, and 23.82% PGY 5 radiology residents. Out of 42 survey responses, 67% of respondents reported rotations with supervision by faculty who work remotely >50% of the time. Residents reported decreased quality of faculty interactions (x =2.4; 95% CI 2.2-2.7), preparedness for independent call (2.5; 2.2-2.9), professional relationships with attendings (2.3; 2.0-2.6), and education in diagnostic radiology (2.5; 2.3-2.8), ultrasound (2.3; 2.1-2.6), and procedural studies (2.4; 2.1-2.6). Compared with prior studies, residents reported higher support from co-residents (p=0.04), lower support from administrative staff (p=0.004), and decreased satisfaction with educational experience (p=0.0003), particularly with faculty's commitment to resident education (p=.02). No differences were detected between preference for in-person vs virtual conference, research involvement, or amount of attending feedback.

CLINICAL RELEVANCE/APPLICATION

While COVID has universally impacted resident education in other specialties negatively, its effect on radiology highlights a unique set of challenges and potential opportunities in training the next generation of radiologists.

Abstract Archives of the RSNA, 2021

Sub-Events

PH02-B4   Performance Evaluation Of A Dual Source CT With Two Photon Counting Detectors

Participants
Thomas G. Flohr, PhD, Forchheim, Germany (*Presenter*) Employee, Siemens AG

PURPOSE

To evaluate image quality parameters of a new clinical dual source CT (DSCT) with two photon counting detectors (PCD).*Methods and Materials The DSCT is equipped with two PCDs with pixel apertures of 0.151x0.176 mm2 (UHR) and 0.302x0.352 mm2 (standard, combining 2x2 UHR pixels) at the isocenter. Detector collimation is 144x0.4 mm (standard) and 120x0.2 mm (UHR). Each PCD is read-out with 4 energy thresholds. The minimum gantry rotation time is 0.25 s, the field of view is 50 cm for PCD A and 35.6 cm for PCD B. We evaluated in-plane spatial resolution with the QRM D100 HCR bar pattern phantom and minimum spiral slice width with a gold plate phantom (both standard and UHR). We measured iodine contrast-noise ratios (CNR) in pseudo-monoenergetic images at 40, 50, 60 and 70 keV derived from a 120 kVp acquisition and compared it to the CNR in lowest energy threshold images both at 120 kVp and at 90 kVp. We evaluated the accuracy of iodine quantification in iodine base material images using iodine inserts with 2.0, 5.0, 10.0 and 15.0 mg/ml concentration in the GammexTM multi-energy CT phantom (40 cm x 30 cm).*Results Maximum spatial resolution was 20 lp/cm (standard) and 40 lp/cm (UHR). Minimum spiral slice width (full width at half maximum FWHM) was 0.53 mm (standard) and 0.33 mm (UHR) at isocenter. Pseudo-monoenergetic images of the GammexTM phantom had iodine CNRs in the 15 mg/ml insert of 35.7, 29.8, 23.4, and 19.8 at 40, 50, 60, and 70 keV, respectively, compared to 21.1 and 26.5 in the lowest threshold images at 120 kVp and at 90 kVp, all at CTDIvol = 9.7mGy. Measured iodine concentrations were 2.3, 5.6, 10.5 and 15.5 mg/ml for the 2, 5, 10 and 15 mg/ml inserts.*Conclusions Dual source photon counting CT provides in-plane and through-plane spatial resolution moderately better (standard) and significantly better (UHR) than conventional CT. Pseudo-monoenergetic images at low keV demonstrate increased iodine CNR comparable to low kVp data acquisition. Iodine quantification is accurate down to low concentrations of 2 mg/ml.*Clinical Relevance/Application Image quality characterization of a clinical photon counting dual source CT. Results indicate very high spatial resolution combined with spectral imaging capabilities.

RESULTS

Maximum spatial resolution was 20 lp/cm (standard) and 40 lp/cm (UHR). Minimum spiral slice width (full width at half maximum FWHM) was 0.53 mm (standard) and 0.33 mm (UHR) at isocenter. Pseudo-monoenergetic images of the GammexTM phantom had iodine CNRs in the 15 mg/ml insert of 35.7, 29.8, 23.4, and 19.8 at 40, 50, 60, and 70 keV, respectively, compared to 21.1 and 26.5 in the lowest threshold images at 120 kVp and at 90 kVp, all at CTDIvol = 9.7mGy. Measured iodine concentrations were 2.3, 5.6, 10.5 and 15.5 mg/ml for the 2, 5, 10 and 15 mg/ml inserts.

CLINICAL RELEVANCE/APPLICATION

Image quality characterization of a clinical photon counting dual source CT. Results indicate very high spatial resolution combined with spectral imaging capabilities.

PH02-B5   Comparison of Two Versions of The Deep Learning Image Reconstruction Algorithm Aice on CT Image Quality and Dose Reduction: A Phantom Study

Participants
Joel Greffier, PhD, Nimes, France (*Presenter*) Nothing to Disclose

PURPOSE

To compare the impact on image quality and dose reduction of two versions of the Deep Learning Image Reconstruction algorithm Advanced intelligent Clear-IQ Engine (AiCE).*Methods and Materials Acquisitions were performed at five dose levels (CTDIvol: 10/7.5/5/2.5/1 mGy) using an image quality phantom. Raw data were reconstructed using the three levels of AiCE (Mild, Standard and Strong) for the two versions (AiCE V8 vs AiCE V10). The noise power spectrum (NPS) and task-based transfer function (TTF) for bone and acrylic were computed. The detectability index (d') was computed to model the detectability of either a large mass in the liver or lung or a small calcification or high contrast tissue boundaries.*Results The noise magnitude was lower with AiCE V10 than with AiCE V8 (-4±6% for Mild, -14±3% for Standard, and -48±1% for Strong levels). The average NPS spatial frequencies shifted towards higher frequencies with AiCE V10 as compared with AiCE V8 (45 ±4%, 36±4%, and 5±4% for all levels, respectively). The TTF50% values shifted towards higher frequencies with AiCE V10 as compared with AiCE V8 for both inserts, except for the Strong level for the acrylic insert. Whatever the dose and AiCE levels, d' values were on average 10±3% higher with AiCE V10 than with AiCE V8 for the small object/calcification and by 11±5% for the large object/lesion.*Conclusions As compared to AiCE V8, AiCE V10 reduced noise and improved spatial resolution and detectability without changing the noise texture, except for the Strong level. AiCE V10 seemed to have a greater potential for dose reduction than AiCE V8*Clinical Relevance/Application The new version of AiCE demonstrated an improvement in image quality and lesion detectability, thus showing great potential for dose reduction in patients

RESULTS

The noise magnitude was lower with AiCE V10 than with AiCE V8 (-4±6% for Mild, -14±3% for Standard, and -48±1% for Strong

levels). The average NPS spatial frequencies shifted towards higher frequencies with AiCE V10 as compared with AiCE V8 (45 ±4%, 36±4%, and 5±4% for all levels, respectively). The TTF50% values shifted towards higher frequencies with AiCE V10 as compared with AiCE V8 for both inserts, except for the Strong level for the acrylic insert. Whatever the dose and AiCE levels, d' values were on average 10±3% higher with AiCE V10 than with AiCE V8 for the small object/calcification and by 11±5% for the large object/lesion.

CLINICAL RELEVANCE/APPLICATION

The new version of AiCE demonstrated an improvement in image quality and lesion detectability, thus showing great potential for dose reduction in patients

PH02-B6   From The Phantom To The Patient: Can We Use Simple Geometric Phantoms For Image Quality Evaluation Of CT With Anatomical Model- Based Reconstructions?

Participants
Oleksandra Ivashchenko, PhD, Leiden, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning (DL) and iterative (IR) model-based reconstructions can facilitate significant artifact and radiation dose reduction in CT. Many DL/IR algorithms are trained using patient data, whereas quality control programs are designed and performed using simplified geometric phantoms. The question posed in this work is, if these phantoms are able to realistically evaluate image quality (IQ) performance of CT systems with model-based image reconstruction.*Methods and Materials IQ performance of CT (Prism, Canon) was evaluated using three objects of increasing complexity: Catphan (simple geometry), CTU41 anthropomorphic phantom (KyotoKagaku), and, retrospectively, a single patient scan. Each phantom was scanned 5 times with a clinical abdominal protocol (approx. CTDIvol=3.7mGy, 120kVp, SD=12.5) and reconstructed with 1 mm slices, using FBP, IR (AIDR3De, clin. standard with FC18 filter) and two DL-based methods (AiCE-Body-std and BodySharp-std). The same CT protocol was used for the patient (IR and Body-Sharp DL reconstruction). The materials attenuation (HU), CNR (Catphan CTP515 insert, CTU41- liver vessel-to-parenchyma contrast, patient - hypodense liver lesion), as well as 2D NPS trends for both phantoms were analyzed.*Results Catphan inserts did not reveal any significant HU variation for all reconstructions, while CNR improved by 0.8 to 1 point (1% supra-slice) for DL-based methods. For anthropomorphic phantom and patient data, no significant difference was found in most tissues (fat, liver parenchyma, muscle/fat), yet an increase in HU was observed for high attenuation areas (bone, calcifications ~40HU). Liver CNR (anthropomorphic phantom) was the best for Body-DL-based reconstruction (2.6/2.4/1.7/0.8 for Body/BodyS/IR/FBP). Patient CNR for a hypodense liver lesion improved by 33% in the DL images (3.2 to 4.8), even when comparing 0.5 mm DL- to 1mm IR-slices. NPS peak in the phantoms shifted by 20/30/35% to lower frequencies for IR and DL-based methods, respectfully, while noise levels were consistent for all test objects and reconstructions.*Conclusions Simplified geometric phantoms allow for basic CT reconstruction IQ assessment. However, clinically important performance parameters (CNR of low contrast detail) in these objects do not reveal the same IQ-trend as those calculated on anthropomorphic phantom or clinical images. Our results highlight the importance of new IQ metrics and phantoms (with realistic anatomical representation) for evaluation of reconstructions developed using patient data.*Clinical Relevance/Application widely accepted IQ metrics/phantoms may deviate from actual quality of patient images for DL/IR model-based reconstructions.

RESULTS

Catphan inserts did not reveal any significant HU variation for all reconstructions, while CNR improved by 0.8 to 1 point (1% supra-slice) for DL-based methods. For anthropomorphic phantom and patient data, no significant difference was found in most tissues (fat, liver parenchyma, muscle/fat), yet an increase in HU was observed for high attenuation areas (bone, calcifications ~40HU). Liver CNR (anthropomorphic phantom) was the best for Body-DL-based reconstruction (2.6/2.4/1.7/0.8 for Body/BodyS/IR/FBP). Patient CNR for a hypodense liver lesion improved by 33% in the DL images (3.2 to 4.8), even when comparing 0.5 mm DL- to 1mm IR-slices. NPS peak in the phantoms shifted by 20/30/35% to lower frequencies for IR and DL-based methods, respectfully, while noise levels were consistent for all test objects and reconstructions.

CLINICAL RELEVANCE/APPLICATION

widely accepted IQ metrics/phantoms may deviate from actual quality of patient images for DL/IR model-based reconstructions.

PH02-B8   Convolutional Neural Network Based Ultra-low Kev Virtual Monoenergetic Imaging For Maximizing Soft-tissue Contrast In Neuro CT

Participants
Hao Gong, PhD, Rochester,, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

CT is limited in its ability to resolve small contrast differences, e.g., gray/white matter. Although low energy (e.g. 50 keV) virtual monoenergetic imaging (VMI) derived from dual energy CT (DECT) can improve iodine contrast, it is not optimized for differentiating non-iodinated soft tissue. Commercial VMI amplifies image noise / artifacts at low energy levels, therefore limiting VMI to typically 40 keV or higher. We aim to maximize low contrast resolution of soft tissue by using ultra-low energy VMI (e.g. 18 keV) created from a deep learning based direct VMI synthesis.*Methods and Materials A convolutional neural network (CNN) was developed to model the mapping between dual- / multi-energy CT images and VMI. The CNN used customized structure and loss function to suppress noise / artifact and enforce CT number accuracy, structural consistency, and texture validity. The training used image data from phantom materials with varying densities that mimic x-ray attenuation of human tissues (i.e. hydroxyapatite, blood, adipose, etc.). DECT image patches were used as inputs, and the corresponding theoretical monoenergetic CT numbers were used as labels. Random-shaped numerical phantom materials were generated to boost training sample diversity. The trained CNN was used to process testing phantom materials (mass densities unseen in training) at two low dose levels (12.7 & 6.4 mGy) and routine patient images. For demonstration purposes, the CNN was implemented for clinical head CT images from a clinical DECT system and evaluated at 18 keV, which approximately maximized gray / white matter contrast. Visual inspection was used to compare CNN results with commercial 40 / 50 keV VMI and clinical mix images. The bias and variance of CT number was gauged by normalized mean absolute error (NMAE). Contrast noise ratio (CNR) of soft tissue was also compared.*Results In phantom study, CNN 18 keV VMI demonstrated high CT number accuracy at both lower dose levels: NMAE ranged from 0.87% (Calcium 300mg/cc: un-normalized MAE 45HU) to 8.3% (blood: un-normalized MAE 3HU) in target materials with varying densities (e.g. calcium to lung tissue). Commercial 40 / 50 keV VMI had obvious image artifacts and did not provide better brain tissue CNR than clinical mixed images. The CNN-synthesized 18 keV images improved gray / white matter contrast (up to 100%) and provided the best brain tissue CNR (e.g. ~75% improvement over clinical mixed images).*Conclusions The CNN-based ultra-low energy VMI has the potential of boosting

soft tissue differentiation in neurological CT exams.*Clinical Relevance/Application Compared to commercial CT systems, the presented method enables better differentiation in non-iodinated brain tissue and may improve the visualization of normal brain anatomy and pathology.

RESULTS

In phantom study, CNN 18 keV VMI demonstrated high CT number accuracy at both lower dose levels: NMAE ranged from 0.87% (Calcium 300mg/cc: un-normalized MAE 45HU) to 8.3% (blood: un-normalized MAE 3HU) in target materials with varying densities (e.g. calcium to lung tissue). Commercial 40 / 50 keV VMI had obvious image artifacts and did not provide better brain tissue CNR than clinical mixed images. The CNN-synthesized 18 keV images improved gray / white matter contrast (up to 100%) and provided the best brain tissue CNR (e.g. ~75% improvement over clinical mixed images).

CLINICAL RELEVANCE/APPLICATION

Compared to commercial CT systems, the presented method enables better differentiation in non-iodinated brain tissue and may improve the visualization of normal brain anatomy and pathology.

PH02-B9   Evaluation Of Low Dose Urinary Stone CT Scanning Protocols Using Two Torso Phantom Sizes And Human Calcium Oxalate Stone Samples - With A Focus On The Impact Of Reconstruction Method And Spectral Analysis On Stone Detectability

Participants
Michael Abel, Zionsville, Indiana (*Presenter*) Manager, Cardinal Health, Inc

PURPOSE

The objective of this study is to establish urinary stone detectability benchmarks in low dose CT using phantoms implanted with human kidney stones. A robust quantitative method was implemented as a complement to human observational review to determine optimal acquisition and reconstruction parameters for patient size dependent, low dose renal stone CT protocols.*Methods and Materials A tissue equivalent torso phantom (30x20 cm) was implanted with 12 test tubes, each containing water and a single human calcium oxalate urinary stone. Stone diameters ranged from 1.8 to 11.9 mm. The phantom was scanned on an iQon Spectral CT scanner (Philips Healthcare, Best, The Netherlands) at 120 kVp and the following mAs: 10, 20, 30, 40, and 120. Multiple recons were performed for comparison, including statistical iterative (iDose4), model based iterative (IMR3), and spectral (40-keV MonoE SPR4). The process was replicated after wrapping the phantom in 4 cm of bolus material to simulate a larger patient. Stone CNR was calculated in each case using a VOI encompassing each stone. One radiologist and two physicists evaluated stone detectability.*Results In the normal sized phantom, 10 mAs acquisitions demonstrated adequate detectability for stones as small as 1.8 mm with all recon techniques. In the bolus wrapped phantom, the smallest 1.8 mm stone was visible at 20 mAs with iDose4 but not with IMR3, likely due to the impact of increased smoothing at the threshold of detectability. Conversely, relative to iDose4 recon, stones less than 3 mm in diameter yielded an aggregate CNR about 10X greater in the smaller phantom when reconstructed using IMR3 at a minimal CTDIvol of 0.9 mGy (10 mAs).*Conclusions Radiation doses for renal stone detectability may be decreased significantly by combining very low mAs acquisitions with iterative reconstruction techniques and novel spectral capabilities. Radiation doses as low as 10 mAs (CTDIvol 0.9 mGy) may be adequate for renal CT in average sized patients. This needs further validation in clinical studies. Protocols may be optimized by correlating observational studies with novel image quality metrics. With model based iterative techniques, CNR is not entirely indicative of stone detectability suggesting the need for more comprehensive image quality indices which incorporate MTF and NPS.*Clinical Relevance/Application CT has higher sensitivity for renal stone detection than plain radiography and ultrasound, but these modalities are commonly favored in renal stone follow up due to concern of increased radiation exposure. As a result, low dose CT protocols are increasingly utilized. This study demonstrates the feasibility of further reducing radiation doses for renal stone CT, potentially in the range of plain radiographs.

RESULTS

In the normal sized phantom, 10 mAs acquisitions demonstrated adequate detectability for stones as small as 1.8 mm with all recon techniques. In the bolus wrapped phantom, the smallest 1.8 mm stone was visible at 20 mAs with iDose4 but not with IMR3, likely due to the impact of increased smoothing at the threshold of detectability. Conversely, relative to iDose4 recon, stones less than 3 mm in diameter yielded an aggregate CNR about 10X greater in the smaller phantom when reconstructed using IMR3 at a minimal CTDIvol of 0.9 mGy (10 mAs).

CLINICAL RELEVANCE/APPLICATION

CT has higher sensitivity for renal stone detection than plain radiography and ultrasound, but these modalities are commonly favored in renal stone follow up due to concern of increased radiation exposure. As a result, low dose CT protocols are increasingly utilized. This study demonstrates the feasibility of further reducing radiation doses for renal stone CT, potentially in the range of plain radiographs.

Abstract Archives of the RSNA, 2021

Sub-Events

SDP-NR-10 Development And Validation Of A Deep Machine Learning Tool For Automated Intraventricular Hemorrhage Segmentation And Volume Measurement Using 3d Convolutional Neural Networks

Participants
Alexander Wong, BSC, MPH, Richmond, British Columbia (*Presenter*) Nothing to Disclose

PURPOSE

Development of new intraventricular hemorrhage (IVH) within 24 hours of presentation or expansion of 1mL or more independently predicts poor outcome. Current methods for IVH volume estimation lack sufficient precision to detect this level of change. The gold-standard method of quantification with manual/semi-automated segmentation remain impractical in the clinical setting. We aimed to train and validate a convolutional neural network (CNN) to autonomously segment and quantify IVH volume in acute intracerebral hemorrhage (ICH) patients.*Methods and Materials Imaging data for training and validation was obtained from 3 international multicenter studies. IVH volumes were assessed using CNN, IVH Score (IVHS), Original Graeb Score (oGS), Modified Graeb Score (mGS), and manual segmentation using ITK-SNAP. Agreement between CNN volume and IVHS estimated volume compared to manual segmentation was assessed using intraclass correlation coefficient (ICC) and Bland-Altman charts. Accuracy of CNN segmentation was compared to manual segmentation with Dice similarity coefficient (DSC). Accuracy of hematoma expansion detection was assessed using receiver operating characteristic curves.*Results 172 patients and 311 CT scans were included. Intra-rater reliability was significantly greater for CNN versus IVHS method (ICC 0.99 [95%CI 0.99 - 1.00] vs 0.76 [95%CI 0.66 - 0.83]). Accuracy of CNN segmentation compared to manual segmentation was satisfactory (DSC 0.76 [95%CI 0.75 - 0.78]). Accuracy of hematoma expansion detection was substantially greater in CNN (AUC 0.91 [95%CI 0.85 - 0.97]) versus IVHS, oGS and mGS when compared to reference standard of manual segmentation.*Conclusions Our results demonstrate that a fully automated CNN algorithm is capable of segmenting IVH volumes on multi-center data with higher-intra-rater reliability and satisfactory accuracy over the current methods of IVH volume measurement tools. The algorithm has proven to be capable of detecting hematoma expansion with substantially greater accuracy over existing methods of IVH measurement.*Clinical Relevance/Application Classification and measurement of IVH is a rapidly developing field, and there is currently a great need for a tool that can accomplish this with great accuracy, reliability, and without the highly labour and time intensive processes required in current methods; both in the clinical and research environment. The results of this project will yield a clinically applicable tool that will greatly inform radiologists, clinicians, patients, and their family members in prognostication of ICH, improve clinical workflow, and patient care. We also see this tool being highly relevant for use in research and development of experimental ICH and IVH therapies.

RESULTS

172 patients and 311 CT scans were included. Intra-rater reliability was significantly greater for CNN versus IVHS method (ICC 0.99 [95%CI 0.99 - 1.00] vs 0.76 [95%CI 0.66 - 0.83]). Accuracy of CNN segmentation compared to manual segmentation was satisfactory (DSC 0.76 [95%CI 0.75 - 0.78]). Accuracy of hematoma expansion detection was substantially greater in CNN (AUC 0.91 [95%CI 0.85 - 0.97]) versus IVHS, oGS and mGS when compared to reference standard of manual segmentation.

CLINICAL RELEVANCE/APPLICATION

Classification and measurement of IVH is a rapidly developing field, and there is currently a great need for a tool that can accomplish this with great accuracy, reliability, and without the highly labour and time intensive processes required in current methods; both in the clinical and research environment. The results of this project will yield a clinically applicable tool that will greatly inform radiologists, clinicians, patients, and their family members in prognostication of ICH, improve clinical workflow, and patient care. We also see this tool being highly relevant for use in research and development of experimental ICH and IVH therapies.

SDP-NR-11 Favorable Cortical Vein Opacification Was Associated With Favorable Collateral And Perfusion

Participants
Dongshan Han, Bei Jing, China (*Presenter*) Nothing to Disclose

PURPOSE

The study aimed to explore the relationship between cortical vein opacification and collateral and perfusion in patients with symptomatic non-acute intracranial artery severe stenosis/occlusion. We hypothesized that favourable cortical vein opacification was associated with favourable collateral and perfusion.*Methods and Materials Patients with symptomatic non-acute ICA/MCA severe stenosis/occlusion were enrolled retrospectively. The hypoperfusion volume of Tmax>4s on the lesion side was obtained by auto-quantitative software. Simulated mCTA were reconstructed from CTP data and collateral score were assessed on mCTA (range, 0-5). Enhancement of the vein of Labbé, sphenoparietal sinus, and superficial middle cerebral vein was graded on vein phase CTP source images (VCTP-SI), as follows: 0, not visible; 1, moderate opacification; and 2, full opacification. The sum for the affected hemisphere was calculated, resulting in the cortical vein opacification score (COVES) (range, 0-6). The association between COVES and collateral score and the hypoperfusion volume were analyzed. The ability of COVES to predict poor collateral circulation (collateral score<4) was assessed using receiver operating characteristic curve.*Results A total of 191 patients with

ICA/MCA severe stenosis/occlusion were enrolled in this study. The COVES were positively correlated with collateral score (r=0.725, p<0.001). 74 patients showed collateral score<4 and 117 patients showed collateral score=3. The COVES were lower in poor collateral group[2(0~3)vs 5(4~6),p<0.001]. After univariate analysis, the results with significant differences were included in multivariate Logistic regression analysis, which showed that the COVES were independently related to collateral score (R=2.550, 95% CI: 4.070-12.887, p<0.001). A COVES=3 best predicted the collateral score<4 (sensitivity, 85.41%; specificity, 77.03%),and an area under the receiver operating characteristics curve was 0.883. The COVES were negatively correlated with hypoperfusion volume (r=-0.735, p<0.001). After multivariate linear regression, there was a significant relationship between COVES and hypoperfusion volume(ß=-0.687, p<0.001).*Conclusions In this study, patients with non-acute symptomatic intracranial arterial severe stenosis/occlusion with higher COVES showed favourable collateral and perfusion. COVES=3 predicted the poor collateral circulation.*Clinical Relevance/Application COVES may be useful imaging biomarkers to assess collateral circulation and cerebral perfusion in patients with symptomatic non-acute intracranial artery severe stenosis/occlusion and play a role in screening for high-risk patients.

RESULTS

A total of 191 patients with ICA/MCA severe stenosis/occlusion were enrolled in this study. The COVES were positively correlated with collateral score (r=0.725, p<0.001). 74 patients showed collateral score<4 and 117 patients showed collateral score=3. The COVES were lower in poor collateral group[2(0~3)vs 5(4~6),p<0.001]. After univariate analysis, the results with significant differences were included in multivariate Logistic regression analysis, which showed that the COVES were independently related to collateral score (R=2.550, 95% CI: 4.070-12.887, p<0.001). A COVES=3 best predicted the collateral score<4 (sensitivity, 85.41%; specificity, 77.03%),and an area under the receiver operating characteristics curve was 0.883. The COVES were negatively correlated with hypoperfusion volume (r=-0.735, p<0.001). After multivariate linear regression, there was a significant relationship between COVES and hypoperfusion volume(ß=-0.687, p<0.001).

CLINICAL RELEVANCE/APPLICATION

COVES may be useful imaging biomarkers to assess collateral circulation and cerebral perfusion in patients with symptomatic non-acute intracranial artery severe stenosis/occlusion and play a role in screening for high-risk patients.

SDP-NR-12 Predicting Middle Cerebral Artery Aneurysms Rupture With A Machine Learning-based, Radiomics-morphological Model: A Multicentral Study

Participants
Yunjun Yang, Wenzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To determine robust radiomics feature related to middle cerebral artery (MCA) aneurysms rupture and evaluate the additional value of combining morphological and radiomics features in MCA aneurysms rupture prediction.*Methods and Materials A total of 668 MCA aneurysms from five hospitals were included. Radiomics and morphological features of aneurysms were extracted on computed tomography angiography images. The support vector machine method was applied for model construction. Optimal radiomics and morphological features were used to develop the radiomics model (R model), morphological model (M model), and radiomics-morphological model (RM model), respectively. A comprehensive nomogram integrating clinical, morphological, and radiomics predictors was generated.*Results Seven radiomics features and four morphological predictors of MCA aneurysms rupture were found. The R model obtained an AUC of 0.822 (95% CI, 0.776, 0.867), 0.817 (95% CI, 0.744, 0.890), and 0.691 (95% CI, 0.567, 0.816) in the training, temporal validation, and external validation cohort, respectively. The RM model showed an AUC of 0.909 (95% CI, 0.874, 0.943), 0.861 (95% CI, 0.806, 0.917) and 0.758 (95% CI, 0.645, 0.871) in the training, temporal validation, and external validation cohort, respectively. The RM model outperformed the single R model and M model. Decision curve analysis further confirmed the clinical usefulness of the RM model.*Conclusions Robust radiomics features were determined related to MCA aneurysm rupture. The RM model exhibited excellent ability in predicting MCA aneurysm rupture. The combination of radiomics and morphological features could improve the predictive performance.*Clinical Relevance/Application Middle cerebral artery aneurysm is the most common subtype of unruptured aneurysms. As the rupture of aneurysms could cause catastrophic consequences, it is vital to screen rupture-prone aneurysms.

RESULTS

Seven radiomics features and four morphological predictors of MCA aneurysms rupture were found. The R model obtained an AUC of 0.822 (95% CI, 0.776, 0.867), 0.817 (95% CI, 0.744, 0.890), and 0.691 (95% CI, 0.567, 0.816) in the training, temporal validation, and external validation cohort, respectively. The RM model showed an AUC of 0.909 (95% CI, 0.874, 0.943), 0.861 (95% CI, 0.806, 0.917) and 0.758 (95% CI, 0.645, 0.871) in the training, temporal validation, and external validation cohort, respectively. The RM model outperformed the single R model and M model. Decision curve analysis further confirmed the clinical usefulness of the RM model.

CLINICAL RELEVANCE/APPLICATION

Middle cerebral artery aneurysm is the most common subtype of unruptured aneurysms. As the rupture of aneurysms could cause catastrophic consequences, it is vital to screen rupture-prone aneurysms.

SDP-NR-13 Automated Classification Of Alzheimer'S Disease By Graph Convolutional Network In Multimodal MR Images

Participants
Aonan Wang, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

A graph convolutional network(GCN) was used for automated identification of Alzheimer's Disease from the healthy and mild cognition impairment*Methods and Materials 149 Alzheimer's disease (AD) cases and 95 mild cognition impairment (MCI) cases and 102 healthy controls (HCs) were investigated. Diffuse tensor imaging (DTI) and high-resolution 3D T1WI images were acquired on a SIEMENS Trio 3T scanner. The acquisition parameters were: TR/TE = 2530/3.44 ms, voxel size = 1 × 1 × 1 mm3. The DTI data were first processed using the FMRIB's Diffusion Toolbox and Brain Extraction Tool in the FSL toolkit [1]. The inverse transformations were used to transform the anatomical automatic labeling (AAL) [2] atlas into the DTI space, which was used to define the region of interest (ROI) for each person. Voxel-based morphometry (VBM) method was used and the same normalized T1 gray matter data were statistically analyzed on Statistical Parametric Mapping 8(SPM8). The volume feature and diffusion features including the average fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AxD) and radial diffusivity (RD) of each ROIs

were calculated. Graph convolutional network (GCN) was used the as the classifier. The diffusion features of each person were used as features of the vertices of the graph. The connectivity between the vertices were represented using each person's gender, age and mini-mental state examination (MMSE) score*Results 1. The diffusion features extracted from DTI have the best effect on the identification between AD and HC (accuracy 0.824), followed by AD and MCI (accuracy 0.741), and the identification effect between MCI and HC (accuracy 0.700) is slightly lower. 2. After considering the volume changes of each ROI, there is a great improvement in the identification between AD and MCI (accuracy improved from 0.741 to 0.811), while the other two have little effect.*Conclusions 1. Our results revealed high classification accuracy for AD diagnosis by using Graph convolutional network. 2. We can infer that during the transition from MCI to AD, the patients' brain volume begins to shrink significantly. The volume feature becomes one of the important features to distinguish MCI from AD. That is why we can improve the effect of identification between AD and MCI while adding the volume feature.*Clinical Relevance/Application Graph convolutional network is an effective computer-aided method to help clinician to identify AD from MCI and the healthy. Our findings also demonstrated correlation between brain volume and transition from MCI to AD, which provides a novel perspective for understanding the pathophysiological mechanisms underlying AD

RESULTS

1. The diffusion features extracted from DTI have the best effect on the identification between AD and HC (accuracy 0.824), followed by AD and MCI (accuracy 0.741), and the identification effect between MCI and HC (accuracy 0.700) is slightly lower. 2. After considering the volume changes of each ROI, there is a great improvement in the identification between AD and MCI (accuracy improved from 0.741 to 0.811), while the other two have little effect.

CLINICAL RELEVANCE/APPLICATION

Graph convolutional network is an effective computer-aided method to help clinician to identify AD from MCI and the healthy. Our findings also demonstrated correlation between brain volume and transition from MCI to AD, which provides a novel perspective for understanding the pathophysiological mechanisms underlying AD

SDP-NR-14 Prognostic Value Of Diffusion-weighted Imaging In Patients With Newly Diagnosed Sporadic Creutzfeldt-jakob Disease

Participants
Ho Young Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate clinico-radiologic markers that predict poor overall survival in sporadic Creutzfeldt-Jakob disease (sCJD).*Methods and Materials Patients with newly diagnosed sCJD were included who underwent diffusion-weighted imaging (DWI) from February 2000 to July 2020. The impact of 9 clinico-radiologic features on overall survival was analyzed using univariable Cox proportional hazards regression model. The DWI prognostic score model was generated and the adjusted effect of the model on overall survival was evaluated. The weighted kappa was calculated for interobserver agreement.*Results Sixty patients (mean age ± SD, 61.0 ± 9.7 years, 32 women) were included. Univariable analysis showed positive associations between poor overall survival and patient age (P = 0.003), extent of involved cortical lobes (P = 0.11), involvement of caudate nucleus (P = 0.07), and putamen (P = 0.04). Based on these features, the DWI prognostic score model was generated (0-4 points). Three risk groups were classified into group A (0 point), B (1-2 points) and C (3-4 points). Multivariable analysis demonstrated two independent prognostic factors: Group C (hazard ratio [HR], 4.84 [95% CI, 1.12-1.20.97], P = 0.04), and age (HR, 1.08 [95% CI, 1.04-1.11], P < 0.001). Interobserver agreements were excellent (? = 0.91-0.92).*Conclusions High risk group based on the DWI prognostic score model as well as patient age at diagnosis was associated with poorer overall survival. Our model may be useful in clinical settings for disease stratification.*Clinical Relevance/Application The proposed DWI prognostic score model may be useful in clinical settings for disease stratification in sporadic Creutzfeldt-Jakob disease.

RESULTS

Sixty patients (mean age ± SD, 61.0 ± 9.7 years, 32 women) were included. Univariable analysis showed positive associations between poor overall survival and patient age (P = 0.003), extent of involved cortical lobes (P = 0.11), involvement of caudate nucleus (P = 0.07), and putamen (P = 0.04). Based on these features, the DWI prognostic score model was generated (0-4 points). Three risk groups were classified into group A (0 point), B (1-2 points) and C (3-4 points). Multivariable analysis demonstrated two independent prognostic factors: Group C (hazard ratio [HR], 4.84 [95% CI, 1.12-1.20.97], P = 0.04), and age (HR, 1.08 [95% CI, 1.04-1.11], P < 0.001). Interobserver agreements were excellent (? = 0.91-0.92).

CLINICAL RELEVANCE/APPLICATION

The proposed DWI prognostic score model may be useful in clinical settings for disease stratification in sporadic Creutzfeldt-Jakob disease.

SDP-NR-15 Microstructural White Matter Alterations In Media Multitasking; A Gender-based Diffusion Magnetic Resonance Imaging Study

Participants
Mohammad Mehrabinejad, Istanbul, Iran, Islamic Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Media multitasking (MMT) is defined as the simultaneous use of different forms of media. Herein, we implemented diffusion MRI (dMRI) connectometry to identify the microstructural alterations in individuals with MMT.*Methods and Materials A total of 120 healthy adults (67 (55.8%) male, mean age = 36.83 ± 18.86 years), who were assessed for MMT were enrolled in the current study. Multimedia Multitasking Index (MMI) questionnaire was used for assessing participant's MMT behavior. Images were analyzed for diffusion connectometry metrics (spin distribution function). A multiple regression model was adopted to consider MMI scores among both sexes, separately.*Results dMRI connectometry findings showed a direct correlation of MMI scores with the quantitative anisotropy (QA) value of both fornices, corpus callosum (CC), bilateral cingulum, middle cerebellar peduncle (MCP), left corticothalamic pathway, and left parieto-pontine tract in females (FDR=0.049). The CC, right cerebellum, right parieto-pontine tract, right corticospinal tract (CST), and left cingulum had a negative correlation with MMI scores in females (FDR=0.037). Finally, the CC, bilateral cerebellar hemispheres, left arcuate fasciculus, and MCP showed the same inverse correlation in males (FDR<0.001).*Conclusions Our findings suggested that microstructures with functional connection to the limbic or motor system may play a critical role in MMT. Furthermore, neurobiological differences were observed between males and females regarding MMT.*Clinical Relevance/Application MMT is relatively a new concept and, although there have been some functional MRI (fMRI)

studies of dual-tasking, there is no evidence regarding the microstructural correlates of MMT in the normal population. Our results provided a preliminary meanwhile novel insight into the WM microstructural correlates of MMT in gender subgroups.

RESULTS

dMRI connectometry findings showed a direct correlation of MMI scores with the quantitative anisotropy (QA) value of both fornices, corpus callosum (CC), bilateral cingulum, middle cerebellar peduncle (MCP), left corticothalamic pathway, and left parieto-pontine tract in females (FDR=0.049). The CC, right cerebellum, right parieto-pontine tract, right corticospinal tract (CST), and left cingulum had a negative correlation with MMI scores in females (FDR=0.037). Finally, the CC, bilateral cerebellar hemispheres, left arcuate fasciculus, and MCP showed the same inverse correlation in males (FDR<0.001).

CLINICAL RELEVANCE/APPLICATION

MMT is relatively a new concept and, although there have been some functional MRI (fMRI) studies of dual-tasking, there is no evidence regarding the microstructural correlates of MMT in the normal population. Our results provided a preliminary meanwhile novel insight into the WM microstructural correlates of MMT in gender subgroups.

SDP-NR-16 Explainable And Fully Automated Clinical Referral Suggestion For Mass Like Lesions In The Brain Using Multi-contrast MRI

Participants
Ji Eun Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning of multi-contrast MRI with explainable algorithm holds potential to decide tumorous condition and suggest clinical referral for patients with intraaxial mass like lesion (IMLL) in brain. The purpose of this study was to apply a deep learning algorithm to learn multi-contrast MRI for clinical referral suggestion of IMLL and validate the AI system and to explore clinical value in the setting of nontraumatic emergency neuroradiology.*Methods and Materials In this population-based cohort study, AI system was developed in 690 patients across 30 diseases between January 2015 and November 2019. Pre-and post-contrast T1 weighted (CE-T1w), FLAIR, diffusion-weighted imaging (DWI), and apparent diffusion coefficient map were obtained. A fully automated AI system combines detection, segmentation, and classification to clinical referral of surgery, systematic work-up, medical treatment, or conservative treatment using multi-contrast MRI. The model was validated using 130 consecutive cases who manifested with IMLL in emergency room between December 2019 and November 2020, and performance for clinical referral suggestion and tumor prediction was compared with radiology residents and neuroradiologists by accuracy and using area-under-the curve (AUC) of the receiver operating characteristic curve analysis. Explainability was quantified with layer-wise relevance propagation (LRP) by calculating Dice coefficient of high relevance regions between CE-T1w and DWI imaging.*Results The AI system correctly placed the referral suggestion to given patients in 93 of 130 (71.5%) of validation set and performed comparably to the human readers (mean accuracy 71.5%, McNemar test; P >.05). For distinguishing tumor from non-tumorous condition, the AI system (AUC 0.877) performed similarly to neuroradiologists (AUC 0.835-0.878) and better than radiology residents (AUC 0.75-0.796, largest P =.043). On LRP, tumors showed matched relevance between contrast-enhancement and diffusion restriction on solid portion while non-tumors showed matched relevance between contrast-enhancement and diffusion restriction on solid portion while non-tumors did not (Dice coefficient 0.636 vs. 0.385, P <.001), demonstrating AI's decision basis.*Conclusions Our work verifies AI system learns and explains decision among from multi-contrast MRI and suggests patients' referrals, thereby provides clinical value in a real-world setting.*Clinical Relevance/Application Our AI system can triage patients with raw multi-modal MRI images to clinical referral pathway and the clinicians can be aided in challenging cases of brain IMLL in nontraumatic neurological emergencies where expert neuroradiologists are not attended. AI's decision bases were quantitatively calculated and improved explainability.

RESULTS

The AI system correctly placed the referral suggestion to given patients in 93 of 130 (71.5%) of validation set and performed comparably to the human readers (mean accuracy 71.5%, McNemar test; P >.05). For distinguishing tumor from non-tumorous condition, the AI system (AUC 0.877) performed similarly to neuroradiologists (AUC 0.835-0.878) and better than radiology residents (AUC 0.75-0.796, largest P =.043). On LRP, tumors showed matched relevance between contrast-enhancement and diffusion restriction on solid portion while non-tumors did not (Dice coefficient 0.636 vs. 0.385, P <.001), demonstrating AI's decision basis.

CLINICAL RELEVANCE/APPLICATION

Our AI system can triage patients with raw multi-modal MRI images to clinical referral pathway and the clinicians can be aided in challenging cases of brain IMLL in nontraumatic neurological emergencies where expert neuroradiologists are not attended. AI's decision bases were quantitatively calculated and improved explainability.

SDP-NR-17 D-dimer And Ferritin As Biomarkers Of Acute Stroke Risk In Patients With Severe COVID-19: A Case Series

Participants
Adam Holmes, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

Previous studies have shown that patients with COVID-19 are predisposed to a hypercoagulable state and consequently are at an increased risk of thromboembolic events, including ischemic stroke. Herein, we sought to identify biomarkers that are associated with symptomatic ischemic stroke in patients hospitalized with COVID-19.*Methods and Materials A single institution retrospective chart review was conducted on patients hospitalized with COVID-19 between March 2020 and April 2021 who concurrently suffered an ischemic stroke as documented on head CT or brain MRI. Laboratory data was collected and recorded according to blood draws most immediately prior to the time of imaging.*Results A total of 13 patients were identified with findings of acute ischemia on either head CT or brain MRI while hospitalized with COVID-19. Among these patients, median international normalized ratio, prothrombin time, activated partial thromboplastin time, and fibrinogen were within normal limits. Median (IQR) level of D-dimer was 2.60 (2.15) mcg/mL, a 4.4-fold increase from the upper limit of normal (ULN). Additionally, median (IQR) level of ferritin, an acute phase reactant, was 1219 (455) mcg/L, a 3.8-fold increase from the ULN.*Conclusions Analysis of biomarkers in patients hospitalized with severe COVID-19 complicated by ischemic stroke displays that D-dimer and ferritin levels were the most aberrantly increased from normal range. This suggests that tracking levels of D-dimer and ferritin may be a useful way to stratify risk of ischemic stroke in patients with severe COVID-19.*Clinical Relevance/Application D-dimer and ferritin may be useful biomarkers to guide initiation of thromboprophylaxis for ischemic stroke prevention in patients with severe COVID-19 infection.

RESULTS

A total of 13 patients were identified with findings of acute ischemia on either head CT or brain MRI while hospitalized with COVID-19. Among these patients, median international normalized ratio, prothrombin time, activated partial thromboplastin time, and fibrinogen were within normal limits. Median (IQR) level of D-dimer was 2.60 (2.15) mcg/mL, a 4.4-fold increase from the upper limit of normal (ULN). Additionally, median (IQR) level of ferritin, an acute phase reactant, was 1219 (455) mcg/L, a 3.8-fold increase from the ULN.

CLINICAL RELEVANCE/APPLICATION

D-dimer and ferritin may be useful biomarkers to guide initiation of thromboprophylaxis for ischemic stroke prevention in patients with severe COVID-19 infection.

SDP-NR-18 The Relationship Between Perfusion Reduction On Arterial Spin Labeling And The Occurrence Of Cerebrovascular Events In Patients With Bilateral Moyamoya Angiography

Participants
Maoxue Wang, Nanjing, China (Presenter) Nothing to Disclose

PURPOSE

To investigate the correlation between decreased cerebral perfusion on arterial spin labeling and cerebrovascular events in patients with bilateral moyamoya angiography (MMA).*Methods and Materials 27 patients with bilateral MMA, who had stroke or hemorrhage in the unilateral hemisphere, hospitalized in the neurosurgery department of Nanjing Drum Tower Hospital were recruited from April to November 2020. There were 10 male and 17 female, aged 35-66 (54.5±8.8) years. The arterial transit artifact (ATA) of bilateral cerebral hemispheres were qualitative analyzed using Wilcoxon paired signed rank test. The mean gray value, kurtosis and skewness of gray distribution of bilateral cerebral hemispheres on cerebral blood flow (CBF) images with post labeling delay (PLD) is 1.5s and 2.5s were quantitative analyzed using paired sample T test. The relationship between ASL and cerebrovascular event was determined using binary logistics regression analysis.*Results No significant difference was found in ATA between bilateral hemispheres on CBF images with PLDs of 1.5s and 2.5s (P>0.05). The mean value in cerebral hemispheres with lesions (17.50±5.88) was lower than that in the contralateral side (20.80±5.51) on CBF images with the PLD of 1.5s (P<0.001). The kurtosis and skewness of gray distribution were also significantly different between bilateral cerebral hemispheres (P<0.05). The mean value and skewness of gray distribution were significantly different between bilateral cerebral hemispheres on CBF images with the PLD of 2.5s (P<0.05). However, the kurtosis of gray distribution was not significantly different (P>0.05). Multivariate regression analysis showed that the reduction of gray value on the side of the lesion was independently associated to the occurrence of the cerebrovascular events (OR=0.192, 95% CI: 0.047~0.783;OR=0.175, 95% CI: 0.05~0.615) (Table 1, Fig 1).*Conclusions The decreased perfusion detected by ASL was independently associated with cerebrovascular events in patients with MMA.*Clinical Relevance/Application It is suggested that bilateral moyamoya vasculopathy patients with severe cerebral hemisphere perfusion reduction on ASL should have the priority of surgery.

RESULTS

No significant difference was found in ATA between bilateral hemispheres on CBF images with PLDs of 1.5s and 2.5s (P>0.05). The mean value in cerebral hemispheres with lesions (17.50±5.88) was lower than that in the contralateral side (20.80±5.51) on CBF images with the PLD of 1.5s (P<0.001). The kurtosis and skewness of gray distribution were also significantly different between bilateral cerebral hemispheres (P<0.05). The mean value and skewness of gray distribution were significantly different between bilateral cerebral hemispheres on CBF images with the PLD of 2.5s (P<0.05). However, the kurtosis of gray distribution was not significantly different (P>0.05). Multivariate regression analysis showed that the reduction of gray value on the side of the lesion was independently associated to the occurrence of the cerebrovascular events (OR=0.192, 95% CI: 0.047~0.783;OR=0.175, 95% CI: 0.05~0.615) (Table 1, Fig 1).

CLINICAL RELEVANCE/APPLICATION

It is suggested that bilateral moyamoya vasculopathy patients with severe cerebral hemisphere perfusion reduction on ASL should have the priority of surgery.

SDP-NR-19 Association Between The Drd3 Ser9gly Polymorphism And Striatum Volumes In Parkinsonprimes Disease: Voxel-based Morphometry Analysis

Participants
Kenji Ohira, MD, Chiba, Japan (Presenter) Nothing to Disclose

PURPOSE

Recent studies have shown that the dopamine receptor D3 gene (DRD3) plays an important role in the clinical manifestations and treatment of Parkinson's disease (PD). DRD3 Ser9Gly polymorphism is the most frequently studied variant point among DRD3 variants. Since DRD3 is well expressed in the striatum, DRD3 Ser9Gly polymorphism is expected to affect volume changes in this area. However, morphological changes in PD regarding this polymorphism remain unclear. The purpose of our study was to estimate volume changes in the striatum, including the caudate and putamen, in relation to this polymorphism.*Methods and Materials We recruited 59 PD patients from our institute. According to their DRD3 Ser9Gly polymorphism, they were divided into 2 groups: Ser/Ser (S/S) carriers and Ser/Gly (S/G) carriers. All patients fulfilled the criteria of PD defined by Movement Disorder Society (MDS) Clinical Diagnostic Criteria for Parkinson's disease. We also recruited 54 age-matched healthy subjects (HS) without any mental or neurological disorders. Total brain volume (TBV) and the volumes of the caudate nucleus and putamen were calculated via 3D volume analysis by MR imaging.*Results There were no significant differences among the groups with regard to the distribution of gender, age, and total GM volume. The results of analysis of covariance (ANCOVA) using the covariates of age and TBV showed that the volume of the bilateral caudate was significantly smaller for PD patients with S/G than for HS (P < .05).*Conclusions We suggest that the interaction between PD and DRD3 Ser9Gly polymorphism may have an effect on brain morphology in the caudate nucleus.*Clinical Relevance/Application Voxel based morphometry (VBM) allows for investigation of focal differences in brain morphology due to SNPs, which leads to the procession of precision medicine for PD categorized by SNPs

RESULTS

There were no significant differences among the groups with regard to the distribution of gender, age, and total GM volume. The results of analysis of covariance (ANCOVA) using the covariates of age and TBV showed that the volume of the bilateral caudate was significantly smaller for PD patients with S/G than for HS (P < .05).

CLINICAL RELEVANCE/APPLICATION

Voxel based morphometry (VBM) allows for investigation of focal differences in brain morphology due to SNPs, which leads to the procession of precision medicine for PD categorized by SNPs

SDP-NR-2 Altered Spontaneous Brain Activity In Subjects With Different Cognitive States Of Biologically Defined Alzheimer's Disease: A Surface-based Functional Brain Imaging Study

Participants
Yunjun Yang, Wenzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

As previous studies investigating local brain activity may suffer from the problem of cortical signal aliasing during volume-based analysis, we aim to investigate cortical functional alterations in the AD continuum using a surface-based approach.*Methods and Materials Based on biomarker profile "A/T", we included 11 healthy controls (HC, A-T-), 22 preclinical AD (CU, A+T+), 33 prodromal AD (MCI, A+T+), and 20 AD with dementia (d-AD, A+T+) from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database. The amplitude of low frequency fluctuation (ALFF) method was used to evaluate the changes of spontaneous brain activity, which was performed in classic frequency band (0.01-0.08Hz), slow-4 (0.027-0.073 Hz) band and slow-5 (0.01-0.027 Hz) band.*Results Under classic frequency band and slow-4 band, analysis of covariance (ANCOVA) showed that there were significant differences of standardized ALFF (zALFF) in the left posterior cingulate cortex (PCC) among the four groups. Post-hoc analyses showed that under the classic frequency band, AD group had significantly decreased zALFF compared with the other three groups, and CU group had decreased zALFF compared with HC group. Under the slow-4 band, more group differences were detected (HC > CU/MCI > d-AD). The accuracy of classifying CU, MCI and AD from HC by left PCC activity under slow-4 band were 0.774, 0.744 and 0.920, respectively. Moreover, the zALFF values of the left PCC had significant correlations with cerebrospinal fluid (CSF) biomarkers and neuropsychological tests.*Conclusions Spontaneous brain activity in the left PCC may decrease in preclinical AD when cognitive functions were relatively normal. The combination of surfaced-based approach and specific frequency band analysis may increase sensitivity for the identification of preclinical AD subjects.*Clinical Relevance/Application Before apparent cognitive decline, subjects on the course to Alzheimer's disease (AD) can have significantly altered spontaneous brain activity, which could be potentially used for early diagnosis.

RESULTS

Under classic frequency band and slow-4 band, analysis of covariance (ANCOVA) showed that there were significant differences of standardized ALFF (zALFF) in the left posterior cingulate cortex (PCC) among the four groups. Post-hoc analyses showed that under the classic frequency band, AD group had significantly decreased zALFF compared with the other three groups, and CU group had decreased zALFF compared with HC group. Under the slow-4 band, more group differences were detected (HC > CU/MCI > d-AD). The accuracy of classifying CU, MCI and AD from HC by left PCC activity under slow-4 band were 0.774, 0.744 and 0.920, respectively. Moreover, the zALFF values of the left PCC had significant correlations with cerebrospinal fluid (CSF) biomarkers and neuropsychological tests.

CLINICAL RELEVANCE/APPLICATION

Before apparent cognitive decline, subjects on the course to Alzheimer's disease (AD) can have significantly altered spontaneous brain activity, which could be potentially used for early diagnosis.

SDP-NR-20 Is It Possible To Evaluate Morphological Carotid Artery Stenosis Information Using NASCET Criteria?

Participants
Naoki Maeda, Tokushima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To assess flow analysis parameters derived from four-dimensional flow magnetic resonance imaging (4D-flow MRI) for the morphological classification of carotid artery stenosis.*Methods and Materials In this study, we investigated cervical MR imaging for 26 patients with cervical vascular stenosis (mean age, 75±7.1 years). Firstly, on a 3 Tesla MR scanner (GE Healthcare), MRI data was obtained using phase contrast (PC) imaging for 4D-flow MRI and time of flight MR angiography (TOF-MRA) sequences. These imaging parameters were as follows; PC imaging: repetition time (TR), 5.3 ms; echo time (TE), 2.0 ms; velocity encoding, 100 cm/sec; flip angle (FA), 8 degrees; TOF-MRA: TR, 19 ms; TE, 5.2 ms; FA, 20 degrees. Next, 4D-flow analysis was performed using cardiovascular imaging software. Parameters for blood flow and wall shear stress were calculated. Then, a region of interest was set on the most stenotic area of the short axis of the artery. For the calculation method of percent stenosis, we used the criteria set by North American Symptomatic Carotid Endarterectomy Trial (NASCET) for each patient using TOF-MRA; here based on the original study of NASCET and classified as six narrow morphological patterns (A to F). Finally, we compared results for the 4D-flow parameters and the percent stenosis.*Results For all patients, there were negative correlations between percent stenosis of NASCET and some 4D-flow parameters: total volume (R = -0.44), average wall shear stress (R = -0.31), and maximum wall shear stress (R = -0.38). There was no significant correlation between the percent stenosis and other flow parameters, e.g., maximum pressure gradient and peak velocity. On the other hand, the relationships between the percent stenosis and the other parameters (maximum pressure gradient and peak velocity) in narrow pattern B (n = 9) were shown with negative correlation (R = -0.50 and R = -0.48, respectively).*Conclusions Hemodynamic analysis using 4D-flow MRI enabled quantitative evaluation with more detailed information of morphological stenosis patterns. This information may indicate implicit risk factor (e.g., plaque rapture) which is inapplicable to NASCET criteria.*Clinical Relevance/Application 4D-flow MRI analysis may be useful to determine treatment approaches such as carotid endarterectomy, carotid artery stenting and clinical follow-up.

RESULTS

For all patients, there were negative correlations between percent stenosis of NASCET and some 4D-flow parameters: total volume (R = -0.44), average wall shear stress (R = -0.31), and maximum wall shear stress (R = -0.38). There was no significant correlation between the percent stenosis and other flow parameters, e.g., maximum pressure gradient and peak velocity. On the other hand, the relationships between the percent stenosis and the other parameters (maximum pressure gradient and peak velocity) in narrow pattern B (n = 9) were shown with negative correlation (R = -0.50 and R = -0.48, respectively).

CLINICAL RELEVANCE/APPLICATION

4D-flow MRI analysis may be useful to determine treatment approaches such as carotid endarterectomy, carotid artery stenting and clinical follow-up.

SDP-NR-21 International MAGNIMS-CMSC-NAIMS Consensus Recommendations On The Use Of Standardized

MRI In Multiple Sclerosis

Participants

David K. Li, MD, Vancouver, British Columbia (*Presenter*) Speaker, Biogen Idec Inc;Speaker, sanofi-aventis Group;;

PURPOSE

To harmonize and update previous guidelines and recommendations from the European MAGNetic resonance Imaging in MS (MAGNIMS) group and the Consortium of MS Centers (CMSC) and North American Imaging in MS (NAIMS) cooperative, on the use of standardized magnetic resonance imaging (MRI) in multiple sclerosis (MS), .*Methods and Materials Two panels were convened to update existing guidelines for a standardized MRI protocol, one in Graz, Austria in April 2019 to update the 2015 MAGNIMS guidelines and a second, which in addition to MS neurologists and radiologists also included MR technologists, imaging scientists, MS patient advocacy groups and MRI vendors, meeting separately and independently in Newark, NJ, USA in October 2019 to update the 2016 CMSC guidelines and to discuss advocacy efforts. Subsequently, the leadership of the MAGNIMS, NAIMS, and CMSC working groups combined their efforts to produce these international consensus guidelines.*Results Topics discussed included advances in using MRI to establish an earlier diagnosis of MS, including the 2017 revisions of the McDonald diagnostic criteria; safety concerns regarding gadolinium-based contrast agents (GBCA); the value of spinal cord MRI for diagnosis, prognosis and monitoring and the changing role of MRI for MS patient management and care. 3D acquisitions were emphasized over 2D as they allow for more optimum comparison. Core brain sequences include a 3D-T2weighted FLuid Attenuated Inversion Recovery (FLAIR) for lesion identification and treatment monitoring. GBCA is helpful for identifying lesion dissemination in time for diagnosis and for unexpected clinical worsening but not necessary for routine monitoring. Diffusion-weighted sequences are recommended for progressive multifocal leukoencephalopathy safety monitoring. Optional sequences that could be incorporated into future recommendations include high resolution 3D-T1weighted gradient echo for brain volume monitoring; double and phase-sensitive inversion recovery for identifying cortical lesions; and susceptibility weighted imaging for central vein and paramagnetic rim lesion evaluation.*Conclusions The 2021 evidence-based MAGNIMS-CMSC-NAIMS international consensus recommendations on the use of standardized MRI in MS unify recommendations from European and North American expert groups and address major issues concerning the use of MRI in clinical practice that have arisen in the past few years.*Clinical Relevance/Application Use of a standardized MRI will improve the quality of care for patients with MS by improving diagnostic accuracy and reducing the need and the additional cost for repeat studies because scans cannot be adequately compared.

RESULTS

Topics discussed included advances in using MRI to establish an earlier diagnosis of MS, including the 2017 revisions of the McDonald diagnostic criteria; safety concerns regarding gadolinium-based contrast agents (GBCA); the value of spinal cord MRI for diagnosis, prognosis and monitoring and the changing role of MRI for MS patient management and care. 3D acquisitions were emphasized over 2D as they allow for more optimum comparison. Core brain sequences include a 3D-T2weighted FLuid Attenuated Inversion Recovery (FLAIR) for lesion identification and treatment monitoring. GBCA is helpful for identifying lesion dissemination in time for diagnosis and for unexpected clinical worsening but not necessary for routine monitoring. Diffusion-weighted sequences are recommended for progressive multifocal leukoencephalopathy safety monitoring. Optional sequences that could be incorporated into future recommendations include high resolution 3D-T1weighted gradient echo for brain volume monitoring; double and phase-sensitive inversion recovery for identifying cortical lesions; and susceptibility weighted imaging for central vein and paramagnetic rim lesion evaluation.

CLINICAL RELEVANCE/APPLICATION

Use of a standardized MRI will improve the quality of care for patients with MS by improving diagnostic accuracy and reducing the need and the additional cost for repeat studies because scans cannot be adequately compared.

SDP-NR-22 An Interpretable Multiparametric Radiomics Model For The Diagnosis Of Schizophrenia From Corpus Callosum

Participants

Yaewon Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to investigate the robustness of the diagnostic model for schizophrenia using radiomic features from diffusion tensor imaging and T1-weighted images (T1) of the corpus callosum (CC).*Methods and Materials A total of 165 participants [86 with schizophrenia and 79 healthy controls (HCs)] were allocated to training (N = 115) and test (N = 50) sets. Radiomic features of the CC subregions were extracted from T1, apparent diffusion coefficient, and fractional anisotropy maps (N = 1,605). Following feature selection, various combinations of classifiers were trained, and Bayesian optimization was adopted in the best performing classifier. Discrimination, calibration, and clinical utility of the model were assessed. An online calculator was constructed to offer the probability of schizophrenia to clinicians. SHapley Additive exPlanations (SHAP) was applied to explore the interpretability of the model.*Results We identified 30 first- and second-order radiomic features to differentiate participants with schizophrenia from HCs. The Bayesian optimized model achieved the highest performance, with an area under the curve, accuracy, sensitivity, and specificity of 0.89 (95% confidence interval: 0.81-0.98), 80.0%, 83.3%, and 76.9%, respectively, in the test set. The final model offers clinical probability in an online calculator (https://nhimc.shinyapps.io/sirano-schizoml/). The model explanation by SHAP suggested that second-order features from the posterior CC were highly associated with the risk of schizophrenia.*Conclusions The multiparametric radiomics model focusing on the CC shows its robustness for the diagnosis of schizophrenia. Radiomic features could be a potential source of biomarkers that support the objective diagnosis of schizophrenia and improve the understanding of its neurobiology.*Clinical Relevance/Application Radiomic features extracted from neuroimaging data could be a potential source of biomarkers that support the objective diagnosis of schizophrenia and improve the understanding of its neurobiology.

RESULTS

We identified 30 first- and second-order radiomic features to differentiate participants with schizophrenia from HCs. The Bayesian optimized model achieved the highest performance, with an area under the curve, accuracy, sensitivity, and specificity of 0.89 (95% confidence interval: 0.81-0.98), 80.0%, 83.3%, and 76.9%, respectively, in the test set. The final model offers clinical probability in an online calculator (https://nhimc.shinyapps.io/sirano-schizoml/). The model explanation by SHAP suggested that second-order features from the posterior CC were highly associated with the risk of schizophrenia.

CLINICAL RELEVANCE/APPLICATION

Radiomic features extracted from neuroimaging data could be a potential source of biomarkers that support the objective diagnosis

of schizophrenia and improve the understanding of its neurobiology.

SDP-NR-23 A Magnetic Resonance Imaging-based Radiomic Model For The Noninvasive Preoperative Differentiation Between Transitional And Atypical Meningiomas

Participants
Jing Zhang, Zhuhai, China (*Presenter*) Nothing to Disclose

PURPOSE

Preoperative distinction between transitional meningioma and atypical meningioma would aid the selection of appropriate surgical techniques, as well as the prognosis prediction. Here, we aimed to differentiate between these two tumors using radiomic signatures based on preoperative, contrast-enhanced T1-weighted and T2-weighted magnetic resonance imaging.*Methods and Materials A total of 141 transitional meningioma and 101 atypical meningioma cases between January 2014 and December 2018 with a histopathologically confirmed diagnosis were retrospectively reviewed. All patients underwent magnetic resonance imaging before surgery. For each patient, 1227 radiomic features were extracted from contrast-enhanced T1-weighted and T2-weighted images each. Least absolute shrinkage and selection operator regression analysis was performed to select the most informative features of different modalities. Subsequently, multivariate logistic regression was chosen to build classification models that can distinguish transitional from atypical meningioma. The diagnostic abilities were evaluated by receiver operating characteristic analysis. Furthermore, a nomogram was built by incorporating clinical characteristics, radiological features, and radiomic signatures, and decision curve analysis was used to validate the clinical usefulness of the nomogram.*Results Sex, tumor shape, brain invasion, and four radiomic features differed significantly between transitional meningioma and atypical meningioma. The clinicoradiomic model derived by fusing the above features resulted in the best discrimination ability, with areas under the curves of 0.809 (95% confidence interval, 0.743-0.874) and 0.795 (95% confidence interval, 0.692-0.899) and sensitivity values of 74.0% and 71.4% in the training and validation cohorts, respectively.*Conclusions The clinicoradiomic model demonstrated good performance for the differentiation between transitional and atypical meningioma. It is a quantitative tool that can potentially aid the selection of surgical techniques and the prognosis prediction.*Clinical Relevance/Application The clinicoradiomic model showed good discrimination ability and can thus be applied in patients with these two meningioma subtypes.

RESULTS

Sex, tumor shape, brain invasion, and four radiomic features differed significantly between transitional meningioma and atypical meningioma. The clinicoradiomic model derived by fusing the above features resulted in the best discrimination ability, with areas under the curves of 0.809 (95% confidence interval, 0.743-0.874) and 0.795 (95% confidence interval, 0.692-0.899) and sensitivity values of 74.0% and 71.4% in the training and validation cohorts, respectively.

CLINICAL RELEVANCE/APPLICATION

The clinicoradiomic model showed good discrimination ability and can thus be applied in patients with these two meningioma subtypes.

SDP-NR-24 Changes In Apparent Diffusion Coefficient During Cardiac Cycle In Cerebrospinal Fluid Tap Test Response In Possible Idiopathic Normal Pressure Hydrocephalus

Participants
Ryo Yagawa, Kanazawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

We previously reported that the apparent diffusion coefficient (ADC) obtained from diffusion magnetic resonance imaging (MRI) in the cerebral white matter significantly changed during the cardiac cycle, and this change (?ADC) aided in the diagnosis of idiopathic normal pressure hydrocephalus (iNPH). Although one of the most important criteria for iNPH is the cerebrospinal fluid (CSF) tap test, it is unclear how ?ADC is associated with this test response in "possible iNPH," defined by ventricular dilation and clinical triad (more than one symptom: gait disturbance, cognitive impairment, and urinary incontinence) and not caused by other neurological or non-neurological disease. Therefore, we assessed ?ADC of the brain between positive and negative CSF tap test groups in possible iNPH.*Methods and Materials This study assessed 22 patients with possible iNPH who either showed symptomatic improvements (positive group, n = 17) and those without improvement (negative group, n = 5) after the CSF tap test. On a 1.5-T MRI, electrocardiogram-triggered single-shot diffusion echo planar imaging (b = 0 and 1000 s/mm2) of the brain was used with parallel imaging and half-scan techniques to minimize the sampling window. The ?ADC image was calculated from the maximum-minus-minimum ADC value of all cardiac phase images on a pixel-by-pixel basis. Then, the ?ADC, the mean ADC during the cardiac cycle (ADCmean), and the rates of change before and after CSF tap test of the white matter were determined and compared between positive and negative groups in possible iNPH.*Results Before the CSF tap test, the ?ADC in the positive group was significantly higher than that in the negative group (P < .05), but there was no significant difference in the ?ADC between positive and negative groups after the CSF tap test. No significant difference was observed in the ADCmean between positive and negative groups both before and after the CSF tap test. The ?ADC change rate before and after CSF tap test in the positive group was significantly higher than that in the negative group (P < .05), but there was no significant difference in the ADCmean change rate before and after CSF tap test between positive and negative groups.*Conclusions The ?ADC follows the CSF tap test response in possible iNPH. Therefore, ?ADC analysis makes it possible to predict the CSF tap test response in possible iNPH.*Clinical Relevance/Application Analysis of changes in the apparent diffusion coefficient during the cardiac cycle makes it possible to predict the cerebrospinal fluid tap test response in possible idiopathic normal pressure hydrocephalus.

RESULTS

Before the CSF tap test, the ?ADC in the positive group was significantly higher than that in the negative group (P < .05), but there was no significant difference in the ?ADC between positive and negative groups after the CSF tap test. No significant difference was observed in the ADCmean between positive and negative groups both before and after the CSF tap test. The ?ADC change rate before and after CSF tap test in the positive group was significantly higher than that in the negative group (P < .05), but there was no significant difference in the ADCmean change rate before and after CSF tap test between positive and negative groups.

CLINICAL RELEVANCE/APPLICATION

Analysis of changes in the apparent diffusion coefficient during the cardiac cycle makes it possible to predict the cerebrospinal fluid tap test response in possible idiopathic normal pressure hydrocephalus.

SDP-NR-25 Amplified Flow To Assess Wall Motion Of Intracranial Aneurysms: A Comparative Analysis Between Unstable Vs. Stable Aneurysms

Participants
Kambiz Nael, MD, Los Angeles, California (*Presenter*) Consultant, Canon Medical Systems Corporation;Consultant, Brainomix Limited

PURPOSE

Intracranial aneurysm (IA) wall motion has been suggested as a potential biomarker of instability (Vanrossomme A.E. et al. AJNR. PMID: 25929878). Detection and accurate assessment of wall motion however are challenging considering the small size of IA. Recently, a new image processing algorithm called amplified Flow (aFlow) has been used to successfully track IA wall by combining the amplification of cine and 4D flow MRI (Abderezaei J et al. IEEE Trans Med Imaging. PMID: 32746150). We sought to apply aFlow to assess wall motion as a potential marker of instability in a paired-wise analysis of patients with unstable vs. stable aneurysms.*Methods and Materials In this prospective study, patients with IA underwent MRI including MRA and 4D flow at baseline, and were followed up to 5 years. After a cross-sectional analysis at the end of the 5th year from initial imaging, 10 patients were identified with growing IA. These were matched with a cohort of patients with similar size and location of IA, whose aneurysms remained stable in size. 4D flow imaging parameters: (3D phase-contrast peripherally-gated sequence, TR/TE: 5.5/2.8 ms; FOV: 160 x 112 mm, matrix: 224 x 224 mm2, 40 x 0.8 mm slices, 3D-velocity encoding value: 80 cm/s). The aFlow algorithm was applied to the 4D flow MRI data to visualize and quantify the 3D displacement of the IA wall at selected frequency ranges. The associations of aFlow parameters with commonly used risk factors and morphometric features were assessed using paired-wise univariate and multivariate analyses.*Results The age, sex, race, IA-size, aspect-ratio, and PHASES scores were not significantly different between the two groups. 90th percentile IA wall displacement acquired from the aFlow was 68% higher in unstable IAs (P<0.05). Unstable IAs also showed higher variability of deformation across their geometry evident by dispersion variables including standard deviation (SD) and interquartile range (IQR) with values being 153% and 164% higher in unstable vs. stable IA, respectively (p<0.01). ROC analysis showed AUC/sensitivity/specificity of 0.91/90%/90% for SD and 0.85/100%/70% for 90th% wall motion in differentiating unstable from stable IAs.*Conclusions aFlow MRI-derived wall motion variables including 90th percentile wall displacement and dispersion variables including SD and IQR at baseline may be able to identify unstable from stable IAs.*Clinical Relevance/Application Given that aFlow is a post-processing algorithm carried out on standard 4D flow MRI data, it holds great promise to identify unstable aneurysms with potential value in treatment decision making of IAs.

RESULTS

The age, sex, race, IA-size, aspect-ratio, and PHASES scores were not significantly different between the two groups. 90th percentile IA wall displacement acquired from the aFlow was 68% higher in unstable IAs (P<0.05). Unstable IAs also showed higher variability of deformation across their geometry evident by dispersion variables including standard deviation (SD) and interquartile range (IQR) with values being 153% and 164% higher in unstable vs. stable IA, respectively (p<0.01). ROC analysis showed AUC/sensitivity/specificity of 0.91/90%/90% for SD and 0.85/100%/70% for 90th% wall motion in differentiating unstable from stable IAs.

CLINICAL RELEVANCE/APPLICATION

Given that aFlow is a post-processing algorithm carried out on standard 4D flow MRI data, it holds great promise to identify unstable aneurysms with potential value in treatment decision making of IAs.

SDP-NR-26 Automated Detection Of Descending Transtentorial Hernia On Computed Tomography Images Using A Convolutional Neural Network

Participants
Meng-Hsuan Chiang, Kaohsiung, Taiwan (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study is to investigate the possibility of automated detection of transtentorial hernia (DTH) using an automated shape-detection orientation convolutional neural network (CNN) technique for prompt diagnosis on computed tomography (CT) images.*Methods and Materials IRB approved retrospective study with the requirement for informed consent waived. Included cases were identified through a keyword search of our radiological information system (RIS) for head CT (HCT) with DTH and normal HCT between 1/1/2000-1/1/2020. A total of 402 DTH cases and 260 normal HCT cases were included. Ground truth labeling structure focused on the cerebellar tentorium level, about 4-5 sequent DICOM files (slice thickness: 5mm), were labeled with slice-level bounding boxes and approved by a board-certified radiologist. The total number of positive DTH images is 1831 and the number of normal images is 1328. The DTH image and normal image are each divided into training data, verification data, and testing data in sequence at a ratio of 7:2:1. In our research, based on shape-detection orientation, we used You Only Look Once version 3 (YOLOv3) to train our well-prepared dataset. The evaluation of our inference result is the Intersection over Union (IOU) index and the threshold is 0.5. The positive result for each image slice was defined as 1 when the number of percentages is larger than 0.5, and negative is zero. Once the result we identified, we use sensitivity, specificity, accuracy rate?to evaluate our model.*Results The 402 patients with DTH (mean age, 59 years +/- 19[standard deviation]; 246 men) and 260 normal HCT cases (mean age, 55 years +/- 18[standard deviation]; 133 men) were involved. The testing data including 182 positive DTH images and 133 negative images, shows sensitivity 0.887, specificity 0.862, PPV 0.878, NPV 0.854 and accuracy rate 0.824 for DTH detection (classified testing data number of true positive: 180, false positive: 2; true negative:127, false negative:6).*Conclusions We successfully proposed a shape-detection model to detect DTH well on HCT examinations with general ground truth, which is not necessary to be annotated with bounding box "very precisely" by radiologists. With good accuracy, making a prompt diagnosis by the model is promising for the patient's safety.*Clinical Relevance/Application DTH is a life-threatening condition that requires prompt accurate image diagnosis and treatment in emergency. CT is the imaging modality of choice used for establishing a correct diagnosis and guiding therapeutic decisions. We developed the inference model with one of the deep learning algorithm, YOLO, that will be a promising approach to solve delayed and missed diagnosis of DTH.

RESULTS

The 402 patients with DTH (mean age, 59 years +/- 19[standard deviation]; 246 men) and 260 normal HCT cases (mean age, 55 years +/- 18[standard deviation]; 133 men) were involved. The testing data including 182 positive DTH images and 133 negative images, shows sensitivity 0.887, specificity 0.862, PPV 0.878, NPV 0.854 and accuracy rate 0.824 for DTH detection (classified testing data number of true positive: 180, false positive: 2; true negative:127, false negative:6).

CLINICAL RELEVANCE/APPLICATION

DTH is a life-threatening condition that requires prompt accurate image diagnosis and treatment in emergency. CT is the imaging

modality of choice used for establishing a correct diagnosis and guiding therapeutic decisions. We developed the inference model with one of the deep learning algorithm, YOLO, that will be a promising approach to solve delayed and missed diagnosis of DTH.

SDP-NR-27 A Novel Habitat Co-localization Descriptor For Predicting Survival In Glioblastoma

Participants
Xuan Xu, Centereach, New York (*Presenter*) Nothing to Disclose

PURPOSE

Glioblastoma Multiforme (GBM) is a highly aggressive primary brain tumor with a median survival of 12 months. Tumor shape and texture have been proposed as prognostic markers. Intra-tumor heterogeneity has been linked to uncontrolled cellular proliferation and angiogenesis leading to poor prognosis. Spatial heterogeneity in GBM, as manifested on multi-protocol MRI (mp-MRI), can be categorized into physiologically similar sub-regions called "habitats". Studies have correlated survival rate with radiomic analysis on global habitats; however, interactions within the local habitats or "microhabitats" have been unexplored. We quantify the spatial diversity of global and microhabitats on mp-MRI by constructing region adjacency graphs (RAGs) using a novel 3D spatial co-localization descriptor. We hypothesize that the adjacency of such habitats contributes to intralesional heterogeneity and overall survival (OS).*Methods and Materials We used leveraged GBM cases with corresponding OS information from TCIA. Global habitats are identified by ground truth tumor sub-compartment segmentations including enhancing tumor (ET), peritumoral edema (ED), and necrotic and non-enhancing tumor core (NET). Microhabitats are obtained via resegmentation of the tumor into 20 supervoxels based on their intensity distribution. Connected components (CCs) are calculated within the global and microhabitats independently. Two voxels are connected if they are adjacent and share the same label. A RAG is constructed based on CCs. All the CCs with neighbors are denoted as graph nodes and an edge is built between two nodes if these components are adjacent. We extracted general graph measurements including nodes, edges, and degree. Graph embedding is computed for each graph with GL2Vec. Principal component analysis (PCA) is leveraged to extract 10 PCs of the embedded representation. The computed features including general graph information and graph embedding information are used as inputs to a Cox model to predict personalized survival risk.*Results Compared to the baseline model with clinical features, incorporation of global and microhabitat graph features improved C-index from 0.64 to 0.66 and HR from 1.73 to 2.19 . This integrated model also outperformed a textural radiomic model (C-index = 0.63, HR=1.91).*Conclusions Intra-tumoral phenotypic diversity, quantified by graph-based analysis of radiologically defined global and microhabitats, can provide valuable prognostic information at early stages of GBM to direct patient-specific management.*Clinical Relevance/Application Our model demonstrates the significance of radiologically defined features in providing early personalized risk prediction and characterizing overall survival rates in GBM.

RESULTS

Compared to the baseline model with clinical features, incorporation of global and microhabitat graph features improved C-index from 0.64 to 0.66 and HR from 1.73 to 2.19 . This integrated model also outperformed a textural radiomic model (C-index = 0.63, HR=1.91).

CLINICAL RELEVANCE/APPLICATION

Our model demonstrates the significance of radiologically defined features in providing early personalized risk prediction and characterizing overall survival rates in GBM.

SDP-NR-28 Deep Learning-based Reconstruction Of Accelerated 2d T2 Flair: A Clinical Feasibility Study

Participants
Jeongmin Yim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

We compared a prototype DL based reconstruction algorithm in accelerated 2D T2 FLAIR images (P4) with standard images (P2), and conventionally reconstructed images.*Methods and Materials 56 subjects who underwent brain MRI with 2D T2 FLAIR images were included in this study. We obtained two separate scans for each subject, GRAPPA factors, 2 and 4. Other parameters were the same for two scans; TR/TI/TE = 8000/2370/131 msec, FA 150', 0.7 x 0.7 x 4 mm3, turbo factor 25. Scan time was 288 sec for P2 and 240 sec for P4. From them, we obtained three different MR images, P2 (standard, factor 2), P4 (factor4), and P4-DL (factor 4 with DL reconstruction).The prototype DL reconstruction comprised a variational network that alternates data consistency based on a parallel imaging signal model and regularization based on convolution neural networks. The network receives undersampled k-space data, pre-calculated coil sensitivity maps and a bias field as input and delivers a coil-combined reconstructed image as output. For training more than 10000 slices covering a broad range of image contrasts and body regions were acquired and the training performed in a supervised manner performing retrospective undersampling for the data input.We compared the subjective image quality, presence of artifacts, and lesion clarity for three sets of images, P2, P4 and P4-DL. Subjective analysis was done by two reviewers independently. We also measured SNR of each images and compared.*Results While most P4 images suffered from low image quality (bad or poor image quality 45/56 for reviewer 1, 53/56 for reviewer 2), which might be associated to under-sampling, P4-DL shows similar or sometimes higher image quality (51/56 good or above for reviewer, 39/56 for reviewer 2), as compared to P2 images (54/56 good for reviewer 1, 55/56 for reviewer 2). This was closely related to the successful suppression of grappa artifacts (P4-DL acceptable or better 43/56 for both reviewers, P4 mild or severe 55/56 for both reviewers), especially at the central portion of the images. In 30 cases of the brain lesions, P4-DL showed similar lesion clarity to P2. Interestingly, measured SNR was not different in P4 (195 ± 43) and P4-DL (193± 43) images.*Conclusions DL reconstructed 2D TSE T2 FLAIR images had suppressed artifacts from highly undersampled data, preserving image quality and reducing scan time.*Clinical Relevance/Application Using deep learning, we can reduce acquisition time of 2D TSE FLAIR images, preserving image quality, which is useful in patients with acute ischemic stroke or other acutely ill patients.

RESULTS

While most P4 images suffered from low image quality (bad or poor image quality 45/56 for reviewer 1, 53/56 for reviewer 2), which might be associated to under-sampling, P4-DL shows similar or sometimes higher image quality (51/56 good or above for reviewer, 39/56 for reviewer 2), as compared to P2 images (54/56 good for reviewer 1, 55/56 for reviewer 2). This was closely related to the successful suppression of grappa artifacts (P4-DL acceptable or better 43/56 for both reviewers, P4 mild or severe 55/56 for both reviewers), especially at the central portion of the images. In 30 cases of the brain lesions, P4-DL showed similar lesion clarity to P2. Interestingly, measured SNR was not different in P4 (195 ± 43) and P4-DL (193± 43) images.

CLINICAL RELEVANCE/APPLICATION

Using deep learning, we can reduce acquisition time of 2D TSE FLAIR images, preserving image quality, which is useful in patients

with acute ischemic stroke or other acutely ill patients.

SDP-NR-29   Association Of Signal Intensity Ratio On Fluid-attenuated Inversion Recovery-MRI With Time From Stroke Onset And Clinical Outcomes In Acute Anterior Circulation Ischemic Stroke

Participants
Kehui Nie, MSc, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to explore the relationship between signal intensity ratio (SIR) of ischemic lesions on FLAIR and time from stroke onset (TSO) in patients, and revealed the correlation of volumes of different SIR values in specific TSO with clinical outcome.*Methods and Materials Tissue at-risk regions of ischemic infarction on DWI were segmented and co-registered on the corresponding FLAIR to locate target lesions. The FLAIR signal intensity of the target lesions and of the mirror regions on the side of normal (contralateral) brain tissue was obtained, with cerebrospinal fluid and extracerebral space excluded. The SIR value was calculated as a ratio of mean signal intensity of voxels in the target lesions relative to those in the contralateral brain regions. The volumes of SIR>1.05, SIR>1.10, SIR>1.15 and SIR>1.2 were used for the correlation with primary clinical outcome, mRS at 90 days after stroke.*Results A total of 99 acute anterior circulation stroke patients with clear TSO were included in this multi-center retrospective study. Eighty-six patients underwent DWI and FLAIR examinations immediately after the thrombolysis and 13 underwent MRI at admission before treatments. The median TSO of all patients was 194 minutes (IQR:120-334.5), with the mean age of 70.4±12.2 years and male-to-female ratio of 1.8:1. The median NIHSS at admission was 10 (IQR:4.75-17), and 90-day mRs was 2 (IQR:1-4). A higher SIR was significantly associated with a longer elapsed TSO (P=0.002). The volumes of SIR>1.05, SIR>1.10, SIR>1.15 and SIR>1.2 were all significantly associated with a higher (worse) 90-day mRs (P=0.001) as well as a higher admission NIHSS (P<0.001), elucidating evolution of the lesion size measured on our quantitative FLAIR in terms of stroke severity and outcome within certain TSO period.*Conclusions The evolution of ischemic stroke could be measured quantitatively as SIR on FLAIR within 9 hours of TSO in our study, and the larger lesion volume at SIR>1.05 may be predictive of a worse clinical outcome.*Clinical Relevance/Application The quantitative signal intensity ratio of positive DWI-FLAIR stroke lesions can help elucidate evolution after stroke onset and possibly predict clinical outcome.

RESULTS

A total of 99 acute anterior circulation stroke patients with clear TSO were included in this multi-center retrospective study. Eighty-six patients underwent DWI and FLAIR examinations immediately after the thrombolysis and 13 underwent MRI at admission before treatments. The median TSO of all patients was 194 minutes (IQR:120-334.5), with the mean age of 70.4±12.2 years and male-to-female ratio of 1.8:1. The median NIHSS at admission was 10 (IQR:4.75-17), and 90-day mRs was 2 (IQR:1-4). A higher SIR was significantly associated with a longer elapsed TSO (P=0.002). The volumes of SIR>1.05, SIR>1.10, SIR>1.15 and SIR>1.2 were all significantly associated with a higher (worse) 90-day mRs (P=0.001) as well as a higher admission NIHSS (P<0.001), elucidating evolution of the lesion size measured on our quantitative FLAIR in terms of stroke severity and outcome within certain TSO period.

CLINICAL RELEVANCE/APPLICATION

The quantitative signal intensity ratio of positive DWI-FLAIR stroke lesions can help elucidate evolution after stroke onset and possibly predict clinical outcome.

SDP-NR-3   Assessment Of Intracranial Culprit Plaque Vulnerability After Stroke Within Three Months: A 3-dimensional High-resolution Magnetic Resonance Imaging Study

Participants
Zelan Ma, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to assess HRMRI-detected plaque features after stroke within three months, and compare intracranial plaque vulnerability in the acute phase after stroke with that of in the subacute phase.*Methods and Materials Seventy-eight patients with ischemic stroke due to middle cerebral artery or basilar artery stenosis underwent HRMRI within 90 days of symptom onset. The relationship between features of vulnerability (intraplaque hemorrhage, surface irregularity, positive remodeling and plaque enhancement) in plaques and degree of stenosis was analyzed. And in the low- and high-grade stenotic arteries, the difference of vulnerability features in plaques between the acute phase group and the subacute phase group was analyzed respectively.*Results Fifty-four patients with acute stroke (range, 1-28 days after onset) and twenty four patients with subacute stroke (range, 32-88 days after onset) underwent HRMRI. The incidence of positive remodeling was significantly higher in the high-grade stenosis group than in the low-grade stenosis group (P=0.023). There were no statistical differences in vulnerability features of culprit plaques between the acute group and the subacute group, both in patients with low-grade stenosis and high-grade stenosis.*Conclusions HRMRI-detected features of vulnerability have no statistical differences in the acute phase and the subacute phase after stroke, which providing important insight into the secondary prevention of ischemic stroke.*Clinical Relevance/Application Knowledge of plaque vulnerability in the acute (within one month) and subacute (between 1 and 3 months) phase after stroke would be helpful to assist decision-making in the secondary prevention of ischemic stroke.

RESULTS

Fifty-four patients with acute stroke (range, 1-28 days after onset) and twenty four patients with subacute stroke (range, 32-88 days after onset) underwent HRMRI. The incidence of positive remodeling was significantly higher in the high-grade stenosis group than in the low-grade stenosis group (P=0.023). There were no statistical differences in vulnerability features of culprit plaques between the acute group and the subacute group, both in patients with low-grade stenosis and high-grade stenosis.

CLINICAL RELEVANCE/APPLICATION

Knowledge of plaque vulnerability in the acute (within one month) and subacute (between 1 and 3 months) phase after stroke would be helpful to assist decision-making in the secondary prevention of ischemic stroke.

SDP-NR-30   Deep Learning Reconstruction For Unenhanced Brain CT: Assessment Of Image Quality And Dose Optimization Potential

Participants
Yasunori Nagayama, MD, Kumamoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to evaluate the subjective and objective image quality of the deep-learning reconstruction (DLR) algorithm for reduced-dose unenhanced brain CT and compare it with those of standard-dose hybrid iterative reconstruction (HIR) images.*Methods and Materials This retrospective study included 74 patients who underwent unenhanced brain CT with standard-dose (STD group, n = 37) or low-dose (LD group, n = 37) protocol on a 320-row multidetector CT. The STD images were reconstructed with HIR (AIDR-3D), whereas LD images were reconstructed with HIR (LD-HIR) and DLR (AiCE brain LCD; LD-DLR). The section thickness of all images was 2 mm. The image noise, grey-white matter (GM-WM) contrast, and contrast-to-noise ratio (CNR) at section levels of the centrum semiovale, basal ganglia, and posterior fossa were quantified and compared among three images series. The noise magnitude, noise texture, GM-WM contrast, margin sharpness of cerebrospinal fluid space, and overall image quality were subjectively scored on a four-point scale (1 = worst, 4 = best).*Results The radiation dose in the LD group was 25% lower than that in the STD group (p < 0.01). In quantitative assessment, the LD-DLR images yielded significantly lower image noise, higher GM-WM contrast, and higher CNR at all section levels than STD and LD-HIR images (all p < 0.01). In all subjective criteria, the scores assigned for LD-DLR images were significantly higher than those assigned to STD and LD-HIR images (all p < 0.01).*Conclusions For unenhanced brain CT obtained at 75% radiation dose, DLR yielded superior subjective and objective image quality compared with standard-dose HIR images.*Clinical Relevance/Application DLR allows for 25% radiation dose reduction in unenhanced brain CT while reducing image noise and improving GM-WM contrast without degrading sharpness and noise texture relative to the current standard-of-care HIR algorithm.

RESULTS

The radiation dose in the LD group was 25% lower than that in the STD group (p < 0.01). In quantitative assessment, the LD-DLR images yielded significantly lower image noise, higher GM-WM contrast, and higher CNR at all section levels than STD and LD-HIR images (all p < 0.01). In all subjective criteria, the scores assigned for LD-DLR images were significantly higher than those assigned to STD and LD-HIR images (all p < 0.01).

CLINICAL RELEVANCE/APPLICATION

DLR allows for 25% radiation dose reduction in unenhanced brain CT while reducing image noise and improving GM-WM contrast without degrading sharpness and noise texture relative to the current standard-of-care HIR algorithm.

SDP-NR-31 ASSESSMENT OF BAYESIAN VERSUS SINGULAR VALUE DECONVOLUTION CT PERFUSION MODELS TO PREDICT INFARCT VOLUME FROM ACUTE ISCHEMIC STROKE FROM M2 OR DISTAL BRANCHES

Participants
Ivano Chiarotti, Siena, Italy (*Presenter*) Nothing to Disclose

PURPOSE

In Patients with acute ischemic stroke (AIS), cerebral computed tomography-perfusion (CTP) poses various technical issues including different models used by automated softwares processing hemodynamic parameters. Few data exist in AIS from M2 or smaller branches of medium cerebral artery. In this clinical scenario, we retrospectively evaluated two CTP models measuring infarct volume.*Methods and Materials Patients with AIS, NIHSS score at admission, complete multimodal CT protocol including unenhanced brain CT (NCCT), cervico-cranial arteries CT-angiography and brain CTP, isolated unilateral occlusion of M2 or distal branch(es), and 1 to 7 days follow-up brain NCCT or MRI were included. A commercial software (Olea Sphere 3.0, Olea Medical, La Ciotat, France) processed CTP images for "core" and "penumbra" estimation by blockcirculant singular value deconvolution (cSVD) Tmax/CBF-based (vSP16) and bayesian TTP/CBF-based (vSP22) models. Estimates were compared with infarct lesion volumes manually assessed at follow-up.*Results From July 2015 to February 2021, 75 patients (40 females, 35 males) met inclusion criteria. They had been treated by intravenous thrombolysis with (n:12) or without (n:17) mechanical thrombectomy, mechanical thrombectomy alone (n:28), or conservative medical management (n:18). Mean "core" estimates were 5,8 mL and 16,1 mL by SP16 and SP22, respectively; mean ischemic "penumbra" estimates were 49,8 mL 39,9 mL. Mean infarct volume at follow-up was 14,0 mL. At correlation analysis, infarct volume was predicted by SP22 (?=0,506) significantly better than SP16 (?=0,472; p<4e-12).*Conclusions In our Patients' population with M2 or distal branches AIS, a bayesian TTP/CBF-based model was superior to a sCVD Tmax/CBF-based one in assessing the evolution of infarct volume.*Clinical Relevance/Application The algorithm model of softwares evaluating CT perfusion data in AIS patients is one of the major factors affecting their results and predictive value in assessing "core" and "penumbra", and thus their use in clinical practice.

RESULTS

From July 2015 to February 2021, 75 patients (40 females, 35 males) met inclusion criteria. They had been treated by intravenous thrombolysis with (n:12) or without (n:17) mechanical thrombectomy, mechanical thrombectomy alone (n:28), or conservative medical management (n:18). Mean "core" estimates were 5,8 mL and 16,1 mL by SP16 and SP22, respectively; mean ischemic "penumbra" estimates were 49,8 mL 39,9 mL. Mean infarct volume at follow-up was 14,0 mL. At correlation analysis, infarct volume was predicted by SP22 (?=0,506) significantly better than SP16 (?=0,472; p<4e-12).

CLINICAL RELEVANCE/APPLICATION

The algorithm model of softwares evaluating CT perfusion data in AIS patients is one of the major factors affecting their results and predictive value in assessing "core" and "penumbra", and thus their use in clinical practice.

SDP-NR-32 Effect Of Small Vessel Disease Burden On Collateral Perfusion In Symptomatic Large Vessel Stenosis Or Occlusion

Participants
Liu-Xian Wang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

The effect of small vessel disease (SVD) burden on collateral circulation in acute ischemic stroke reached different conclusions. We sought to identify whether the SVD burden could also impact collateral circulation in symptomatic ICA/MCA severe stenosis or occlusion patients.*Methods and Materials All included patients underwent pseudo-continuous arterial spin labeling (pCASL) with post-labeling delay (PLD) of 1.5s and 2.5s. The total SVD burden were assessed by four separate features: white matter hyperintensity, perivascular space (PVS), lacunes and cerebral microbleed. Cerebral blood flow (CBF) of MCA territory was calculated by manually drawing region of interest. Collateral perfusion was defined as (CBF 2.5s minus CBF 1.5s) at lesion side minus

(CBF 2.5s minus CBF 1.5s) at normal side.*Results A total of 91 patients with symptomatic ICA/MCA severe stenosis/occlusion met the inclusion criteria. Compared with patients with no SVD burden (N = 24), those with any SVD (N = 67) were older (p = 0.01), and showed higher incidence of diabetes mellitus (p = 0.001). Furthermore, the mean CBF at PLD 2.5s in patients with any SVD was lower than those without SVD (p = 0.003). Collateral perfusion was significantly correlated with total SVD score in univariate linear regression (b = -1.29, p = 0.04). However, such correlation disappeared after adjusted for age and interval from symptom onset to imaging (b = -1.03, p = 0.14). In the subgroup analysis, PVS could still significantly impact collateral circulation (F = 3.21, p = 0.02) after adjusted for age, sex and interval from symptom onset to imaging.*Conclusions Our results suggested that collateral circulation may not be affected by total SVD burden in chronic symptomatic large vessel stenosis or occlusion. However, PVS may affect the collateral perfusion after a relatively long time from symptom onset. Our results suggested that PVS could be one of the possible therapeutic targets for improvement of collateral circulation.*Clinical Relevance/Application The effect of SVD burden on collaterals in acute stroke reached different conclusions. In patients with relatively chronic ICA/MCA severe stenosis or occlusion, our results suggested that the total SVD burden showed no obvious impact on collateral perfusion. However, the collateral perfusion showed significant difference among different PVS grades. PVS may be considered as one possible therapeutic target in patients with ICA/MCA severe stenosis or occlusion.

RESULTS

A total of 91 patients with symptomatic ICA/MCA severe stenosis/occlusion met the inclusion criteria. Compared with patients with no SVD burden (N = 24), those with any SVD (N = 67) were older (p = 0.01), and showed higher incidence of diabetes mellitus (p = 0.001). Furthermore, the mean CBF at PLD 2.5s in patients with any SVD was lower than those without SVD (p = 0.003). Collateral perfusion was significantly correlated with total SVD score in univariate linear regression (b = -1.29, p = 0.04). However, such correlation disappeared after adjusted for age and interval from symptom onset to imaging (b = -1.03, p = 0.14). In the subgroup analysis, PVS could still significantly impact collateral circulation (F = 3.21, p = 0.02) after adjusted for age, sex and interval from symptom onset to imaging.

CLINICAL RELEVANCE/APPLICATION

The effect of SVD burden on collaterals in acute stroke reached different conclusions. In patients with relatively chronic ICA/MCA severe stenosis or occlusion, our results suggested that the total SVD burden showed no obvious impact on collateral perfusion. However, the collateral perfusion showed significant difference among different PVS grades. PVS may be considered as one possible therapeutic target in patients with ICA/MCA severe stenosis or occlusion.

SDP-NR-33   Neuroradiology Protocol Selection By Natural Language Processing

Participants
Daniel J. Blezek, PhD, Mantorville, Minnesota (*Presenter*) Founder, FLOWSIGMA Inc;Shareholder, FLOWSIGMA Inc

PURPOSE

High quality care requires radiologists to specifically craft an MR imaging study to best answer the clinical question posed by the referring physician. Neuroadiologists must balance often competing concerns when selecting an imaging protocol e.g. scan time, patient tolerance, department throughput, scanner capabilities, technologist expertise, series selection, etc. This protocoling process has been shown to require significant non-image-interpretive time. In this study, we construct a natural language processing (NLP) algorithm to provide protocol suggestions and evaluate the system's performance.*Methods and Materials Our IRB approved a waiver of HIPPA authorization for this retrospective study. Data were collected between 1/1/2019 and 3/24/2021 for 19 MR scanners primarily used for outpatient neuroradiology imaging including: age, gender, ordered procedure, protocol, indication, most recent applicable clinical notes, and ordering department. Non neuro protocols were removed from the dataset. The remaining protocols were grouped into standard protocols and custom protocols, and all protocols were ranked. An algorithm was constructed to classify an input string into the corresponding protocol. Data from 2019 and 2020 were used for training and validation, with 2021 data held out for testing. Multi-class accuracy, kappa, F1, recall, precision, and Matthews correlation coefficient(MCC) metrics were calculated.*Results After removing non-neuro protocols from 99,503 total protocols, 54,329 standard protocols were divided into training (N=19,839), validation (N=4,730) and test (N=7,038). The system was trained to classify the top 12 protocols and an "other" class representing all remaining protocols. The top protocols were chosen by taking any standard protocol representing > 2% of the data. The system achieved an overall accuracy of 86%, kappa of 0.83, F1 (micro) of 0.86, recall of 0.86, precision of 0.86, and MCC of 0.83.*Conclusions We have demonstrated a system that is able to predict neuroradiology protocols with high accuracy. This inital model was trained using a very restricted set of data available in the EHR suggesting room for accuracy improvement. Significant further study is required to evaluate performance relative to MR technologists, residents, fellows and experienced radiologists.*Clinical Relevance/Application Large institutions face many challenges in efficiently imaging patients to best diagnose clinical unknowns. Determining the most helpful and customized imaging protocols requires time and expertise. Automation removes this time and energy consuming process off the shoulders of radiologists who can then better use these precious resources to improve their interpretations and overall care of patients.

RESULTS

After removing non-neuro protocols from 99,503 total protocols, 54,329 standard protocols were divided into training (N=19,839), validation (N=4,730) and test (N=7,038). The system was trained to classify the top 12 protocols and an "other" class representing all remaining protocols. The top protocols were chosen by taking any standard protocol representing > 2% of the data. The system achieved an overall accuracy of 86%, kappa of 0.83, F1 (micro) of 0.86, recall of 0.86, precision of 0.86, and MCC of 0.83.

CLINICAL RELEVANCE/APPLICATION

Large institutions face many challenges in efficiently imaging patients to best diagnose clinical unknowns. Determining the most helpful and customized imaging protocols requires time and expertise. Automation removes this time and energy consuming process off the shoulders of radiologists who can then better use these precious resources to improve their interpretations and overall care of patients.

SDP-NR-34   Increased Confidence Of Radiomics Facilitating Pretherapeutic Differentiation Of BRAF-altered Pediatric Low-grade Glioma

Participants
Kareem Kudus, Toronto, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

Pediatric low-grade glioma (pLGG) is the most common pediatric brain tumor and affected children suffer from multiple recurrences.

Radiomics-based prediction of molecular markers (BRAF V600E mutation vs. BRAF fusion) has recently demonstrated improved diagnosis and prognosis. In this work, we evaluate the predictive value of a radiomics model combined with clinical data. We also introduce a confidence measure for radiomics results enabling the radiomics model to achieve a desired level of accuracy by identifying patients for whom the model is confident enough to produce reliable results.*Methods and Materials In this REB approved retrospective study, we included pretherapeutic data from two independent hospitals consisting of 213 (internal/training cohort) and 31 patients (external/test cohort). Clinical data was comprised of age, gender, and tumour location. Radiologic data consisted of FLAIR MR images with manual segmentation of the tumour volume. This was used to extract 851 (Py-)radiomic features. A Random Forest model was trained on the internal dataset, and the external dataset was reserved for testing. In training where hyperparameters were fine-tuned, we added a new hyperparameter to determine the model's confidence for the produced results so the model refrains from making a prediction, when it is not confident. This threshold was chosen based on the accuracy deemed necessary for the model.*Results Adding a confidence hyperparameter resulted in a more precise determination of BRAF status. Higher confidence thresholds resulted in more accurate predictions for a subset of test dataset, while the results for the remaining patients were flagged by the model as unreliable. On the external dataset, the mean accuracy of the model with a specific confidence threshold (95%, set during the training) was 88.7%, 95% confidence interval (CI) [82.1%, 95.4%], while making a prediction for 67.5% of patients, compared to mean accuracy of 76.2%, 95% CI [72.5%, 80.0%] for the model without the threshold, making a prediction for all patients. For internal 5-fold cross validation, the mean accuracy for the model with the confidence threshold was 93.4%, 95% CI [82.3%, 100%], while making a prediction for 66.6% of the patients, compared to 83.9%, 95% CI [72.6%, 95.1%] for all patients.*Conclusions BRAF status can be classified using a machine learning model trained on radiomic and clinical data. Precision can be improved by tuning the model to only make predictions where it has a high level of confidence.*Clinical Relevance/Application BRAF status of pLGG is assessed through biopsy, which is invasive and has significant side effects. Prediction of the molecular marker via MRI-based radiomics provides increased reliability and confidence for clinical deployment.

RESULTS

Adding a confidence hyperparameter resulted in a more precise determination of BRAF status. Higher confidence thresholds resulted in more accurate predictions for a subset of test dataset, while the results for the remaining patients were flagged by the model as unreliable. On the external dataset, the mean accuracy of the model with a specific confidence threshold (95%, set during the training) was 88.7%, 95% confidence interval (CI) [82.1%, 95.4%], while making a prediction for 67.5% of patients, compared to mean accuracy of 76.2%, 95% CI [72.5%, 80.0%] for the model without the threshold, making a prediction for all patients. For internal 5-fold cross validation, the mean accuracy for the model with the confidence threshold was 93.4%, 95% CI [82.3%, 100%], while making a prediction for 66.6% of the patients, compared to 83.9%, 95% CI [72.6%, 95.1%] for all patients.

CLINICAL RELEVANCE/APPLICATION

BRAF status of pLGG is assessed through biopsy, which is invasive and has significant side effects. Prediction of the molecular marker via MRI-based radiomics provides increased reliability and confidence for clinical deployment.

SDP-NR-35   Brain Atrophy Significantly Modulates The Association Betwwen Infarct Volume And National Institutes Of Health Stroke Scale In Acute Ischemic Stroke

Participants
Jia-Ying Zhou, Nanjing, China (*Presenter*) Nothing to Disclose

PURPOSE

The National Institutes of Health Stroke Scale (NIHSS) provides a reliable, quantitative measure of ischemic stroke severity and is predicted by the infarct core volume. We aim to determine whether brain atrophy assessed quantitatively could have an impact on the association between NIHSS and the infarct core volume.*Methods and Materials We retrospectively studied consecutive patients with supratentorial, ischemic strokes between Aug 2016 to Sep 2020. We evaluated their severity of brain frailty quantitatively on baseline non-contrast-enhanced CT using CTseg algorithm (https://github.com/WCHN/CTseg) in SPM12. The ratio of brain parenchymal volume to total intracerebral volumes (brain parenchymal fraction [BPF]) was assessed. Infarct volume was assessed on diffusion-weighted images 24 hours after admission. Multivariable linear regression models were used to test the interaction of atrophy with infarct volume, and assess whether the association of brain atrophy and infarct volume on NIHSS was independent of other clinically relevant covariates.*Results A total consecutive 224 patients (mean age 71±12years; 53% men) were enrolled for the final analysis. Overall, there was a significant correlation between the infarct volume and NIHSS (r=0.52, P<0.001), and between BPF and NIHSS (r=-0.61, P<0.001). Multivariable adjusted leaner regression model disclosed that BPF (OR, 0.11 [95%CI 0.04-0.18], P=0.016) and infarct core volume (OR, 1.36, [95%CI 1.31-1.42], P<0.001) were independently associated with a greater NIHSS deficit, and that there is a significant interaction between BPF and infarct volume (OR, 1.017 [95%CI, 1.013-1.019], P=0.026) in determining a higher NIHSS score.*Conclusions Preexisting brain atrophy significantly modulates the association between infarct core and NIHSS at baseline. This finding may be relevant to mitigate outcome differences in stroke patients by aiding treatment decisions that rely on the NIHSS, and have significant implications to improve selection for acute stroke therapies.*Clinical Relevance/Application Preexisting brain atrophy significantly modulates the association between infarct core and NIHSS at baseline. This may explain outcome differences in stroke patients by aiding treatment decisions that rely on the NIHSS, and have a significant implication to improve selection for acute stroke therapies.

RESULTS

A total consecutive 224 patients (mean age 71±12years; 53% men) were enrolled for the final analysis. Overall, there was a significant correlation between the infarct volume and NIHSS (r=0.52, P<0.001), and between BPF and NIHSS (r=-0.61, P<0.001). Multivariable adjusted leaner regression model disclosed that BPF (OR, 0.11 [95%CI 0.04-0.18], P=0.016) and infarct core volume (OR, 1.36, [95%CI 1.31-1.42], P<0.001) were independently associated with a greater NIHSS deficit, and that there is a significant interaction between BPF and infarct volume (OR, 1.017 [95%CI, 1.013-1.019], P=0.026) in determining a higher NIHSS score.

CLINICAL RELEVANCE/APPLICATION

Preexisting brain atrophy significantly modulates the association between infarct core and NIHSS at baseline. This may explain outcome differences in stroke patients by aiding treatment decisions that rely on the NIHSS, and have a significant implication to improve selection for acute stroke therapies.

SDP-NR-36   Noninvasive Prediction Of Molecular Subtypes In WHO Iii~iv Grade Gliomas Using Multiparametric MR Radiomic Features

Participants

Jian Jiang, MS, Lan Zhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Noninvasive detection of isocitrate dehydrogenase 1 mutation (IDH1(+)), Telomerase reverse transcriptase (TERT), O6-methylguanine (O6-MeG)-DNA methyltransferase (MGMT) promoter methylation status are clinically meaningful for molecular stratification in WHO III~IV gliomas. To study a radiomic approach based on multiparametric MR for noninvasively determining molecular subtypes in patients with WHO III~IV gliomas.*Methods and Materials POPULATION: 114 patients with pathologically confirmed gliomas were divided into 3 molecular subtypes: IDH1(+), MGMT(+), TERT(+) (n?=?32); IDH1(-), MGMT(-), TERT(+) (n?=? 45); IDH1(-), TERT(+), MGMT(+) (n?=?37).FIELD STRENGTH/SEQUENCE: 3.0T MRI, containing contrast-enhanced T 1 -weighted (CET 1 WI), axial T 2 -weighted (T 2 WI), T2/fluid-attenuated inversion recovery (T2FLAIR), and apparent diffusion coefficient (ADC) sequences.ASSESSMENT: In all, 205 high-throughput radiomic features were extracted on each tumor volume of interest from T 2 FLAIR and the other three multiparametric MR. Optimal feature subsets were selected as using the support vector machine with a recursive feature elimination algorithm (SVM-RFE). Receiver operating characteristic curve (ROC) analysis was employed to assess the efficiency for identifying the 3 molecular subtypes.STATISTICAL TESTS: Correlations between the radiomics features and molecular pathology were revealed by partial correlation analysis, and multivariate models were built to identify the best predictive models.*Results Optimal SVM predictive models of 3 molecular subtypes were established using 17 features from T 2 Flair, ADC, CET 1 WI. In differentiating among 3 molecular subtypes, the best AUC was 0.884 for IDH1(+), MGMT(+), TERT(+) , 0.876 for IDH1(-), MGMT(-), TERT(+) , and 0.861 for IDH1(-), TERT(+), MGMT(+).*Conclusions Using the optimal texture features extracted from multiple MR sequences, a promising stratifying strategy was acquired for predicting molecular subtypes of IDH1, TERT and MGMT in WHO III~IV gliomas.*Clinical Relevance/Application The establishment of the prediction model will be able to predict the molecular subtypes and other genetic characteristics of high-grade glioma through non-invasive imaging examination, so as to provide a scientific basis for the formulation of individualized treatment of glioma.

RESULTS

Optimal SVM predictive models of 3 molecular subtypes were established using 17 features from T 2 Flair, ADC, CET 1 WI. In differentiating among 3 molecular subtypes, the best AUC was 0.884 for IDH1(+), MGMT(+), TERT(+) , 0.876 for IDH1(-), MGMT(-), TERT(+) , and 0.861 for IDH1(-), TERT(+), MGMT(+).

CLINICAL RELEVANCE/APPLICATION

The establishment of the prediction model will be able to predict the molecular subtypes and other genetic characteristics of high-grade glioma through non-invasive imaging examination, so as to provide a scientific basis for the formulation of individualized treatment of glioma.

SDP-NR-37 Branch-like Enhancement, A Specific Enhancement Pattern In Cerebellar Malignant Lymphoma.

Participants
Kota Yokoyama, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Recently, A contrast enhanced magnetic resonance imaging (CE-MRI) finding, branch-like enhancement (BLE) was reported to be useful in differentiating primary central nervous system lymphoma (PCNSL) from high grade glioma (HGG) in cerebellum (Sci Rep. 2020 Jun 19;10(1):10007). Whether it could be applied to secondary CNSL or other cerebellar lesions is unknown. Herein, we attempted to investigate the frequency and utility of BLE in differentiating cerebellar lymphoma (CL) including both primary and secondary from other cerebellar lesions.*Methods and Materials We retrospectively reviewed our radiology information system and searched for suspected CL lesions in CE-MRI. Patients without CE-MRI data at the time of diagnosis, only with small nodular lesions in known cancer patients, patients without any lesion in cerebellum, and patients without certain final diagnosis were excluded. For the included patients, clinical data and MRI findings were recorded. We qualitatively evaluated CE-T1 weighted images for presence and degree of BLE and if multiple views were available, BLE was evaluated for each of the view, and the view in which the findings were most visible was determined. As a secondary analysis, we qualitatively evaluated the the presence of restricted diffusion and streak-like edema. In addition, CT hyperdensity and high Fluorodeoxyglucose (FDG) uptake were recorded if images were available.*Results A total of 75 patients (mean age 55.8, range 3-88 years; 28 women) were included in the study. We identified 17 CNSL, 30 metastasis, 12 hemangioblastoma, 9 HGG and 3 pilocytic astrocytoma, 2 medulloblastoma, 1 ependymoma, and 1 radiation necrosis (RN). The median age in CL was 64.1 years (range 9-79 years) and 4 were women (23.5%). Twelve were PCNSL and five were SCNSL. Within the 17 CL cases, 15 (88%) showed BLE, while three cases out 58 cases (5%) in non-CL group showed BLE; Two HGG cases and one RN case which had a history of gamma knife surgery for lung cancer metastasis to cerebellum showed BLE. In CL group, all the patients were assessed by multiple views and, sagittal image was the most visible for detecting BLE followed by coronal image. Diffusion restriction (81%), streak-like edema (82%), CT hyperdensity (93%), and high FDG uptake (93%) were frequently observed however not that specific to CL compared with BLE.*Conclusions The present study revealed that BLE observed in CE-MRI is a highly specific finding for CL both in primary and secondary CNSL which is useful to distinguish from the other pathologies in cerebellum and sagittal view is valuable to evaluate the finding.*Clinical Relevance/Application It is useful for evaluating undiagnosed cerebellar lesions.

RESULTS

A total of 75 patients (mean age 55.8, range 3-88 years; 28 women) were included in the study. We identified 17 CNSL, 30 metastasis, 12 hemangioblastoma, 9 HGG and 3 pilocytic astrocytoma, 2 medulloblastoma, 1 ependymoma, and 1 radiation necrosis (RN). The median age in CL was 64.1 years (range 9-79 years) and 4 were women (23.5%). Twelve were PCNSL and five were SCNSL. Within the 17 CL cases, 15 (88%) showed BLE, while three cases out 58 cases (5%) in non-CL group showed BLE; Two HGG cases and one RN case which had a history of gamma knife surgery for lung cancer metastasis to cerebellum showed BLE. In CL group, all the patients were assessed by multiple views and, sagittal image was the most visible for detecting BLE followed by coronal image. Diffusion restriction (81%), streak-like edema (82%), CT hyperdensity (93%), and high FDG uptake (93%) were frequently observed however not that specific to CL compared with BLE.

CLINICAL RELEVANCE/APPLICATION

It is useful for evaluating undiagnosed cerebellar lesions.

SDP-NR-38 Fast 3D Wheel (Fast 3Dw) On Cerebral MR Angiography: Capability For Examination Time Reduction Without Degradation Of Image Quality And Aneurysm Evaluation In Candidates With Cerebral Aneurysm Treatment

Participants
Satomu Hanamatsu, Toyoake, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To compare the capability of wheel encoding order (Fast 3D wheel: i.e. Fast 3Dw) method for examination time reduction with no degradation of image quality and aneurysm evaluation on MR angiography (MRA) with parallel imaging (PI) in candidates for cerebral aneurysm treatment.*Methods and Materials 50 consecutive candidates with unruptured cerebral aneurysm underwent conventional MRA by PI and two types of Fast 3Dw methods at a 3T scanner. On PI and Fast 3Dw-A methods, same scan parameters were applied. On MRA by Fast 3Dw-B, matrix, section thickness and slice number were slightly reduced for further examination time reduction. To compare examination time, all examination times were recorded in each patient. For comparison of image quality improvement, SNRs at internal carotid artery (ICA), middle cerebral artery (MCA) and white matter and CNRs between white matter and ICA or MCA were assessed by ROI measurements. Moreover, diameters of each aneurysm, ICA and MCA on each MRA data were semi-automatically measured. For qualitative comparison among three methods, overall image quality and aneurysm depiction level were assessed by 5-point scales by consensus of two readers in each patient. Then, mean examination time, SNR, CNR and diameters of aneurysm, ICA and MCA were compared among three methods by Tukey's HSD test. Moreover, mean scores of image quality and lesion depiction were compared among all methods by Steel-Dwass test.*Results Each Fast 3Dw showed significantly shorter examination time than PI (p<0.05). SNR of Fast 3Dw-B was significantly higher than that of PI (p<0.05), although other quantitative indexes showed no significant differences among three methods. Overall image quality of PI was significantly higher than that of Fast 3Dw-B (p<0.05), although there were no significant difference of aneurysm depiction level among three methods.*Conclusions Fast 3Dw is considered more useful than PI for reducing examination time without any degradation of image quality and aneurysm evaluation on cerebral MRA. If further reduction of examination time is warranted, Fast 3Dw can reduce examination time without degradation of aneurysm evaluation in routine clinical practice.*Clinical Relevance/Application Fast 3Dw is considered more useful than PI for reducing examination time without any image quality degradation and aneurysm evaluation on cerebral MRA.

RESULTS

Each Fast 3Dw showed significantly shorter examination time than PI (p<0.05). SNR of Fast 3Dw-B was significantly higher than that of PI (p<0.05), although other quantitative indexes showed no significant differences among three methods. Overall image quality of PI was significantly higher than that of Fast 3Dw-B (p<0.05), although there were no significant difference of aneurysm depiction level among three methods.

CLINICAL RELEVANCE/APPLICATION

Fast 3Dw is considered more useful than PI for reducing examination time without any image quality degradation and aneurysm evaluation on cerebral MRA.

SDP-NR-39   **Noninvasive Assessment Of The Cerebrospinal Fluid Composition By MRI: Does Electric Properties Tomography Have A Role?**

Participants
Khin Khin Tha, MBBS, PhD, Sapporo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Lumbar puncture is a standard test to diagnose altered cerebrospinal fluid (CSF) composition in various diseases, including meningitis and malignancy. However, this procedure is invasive and can lead to serious side effects. This study aimed to evaluate if electric properties tomography (EPT), an MRI technique that noninvasively estimates tissue electrical conductivity (s), be sensitive to alterations in CSF composition.*Methods and Materials This study was conducted as ex vivo and in vivo examinations. As ex vivo examinations, cadaveric CSF samples (6-15 ml per sample) were collected over 6 months. EPT was performed using a 3D steady-state free precession (3D-SSFP) sequence (TR/TE = 3.5/1.7 ms, FA = 25°, voxel size = 1 x 1 x 1 mm3, non-selective RF pulse), at 3T. Routine CSF laboratory investigation was also done in all samples. For in vivo examinations, EPT scans of the brain acquired in 4 years and under the same scan conditions as ex vivo examinations were reviewed. The exclusion criteria were a lack of CSF laboratory investigation results and motion artifacts. For both ex vivo and in vivo image data, s maps were reconstructed from the phase of 3D-SSFP using the formula s = ?2 f+ / µ0?, where f+ = the phase of H+ [the positive circularized of the magnetic field H+ = (Hx + iHy)/2], µ0 = magnetic vacuum permeability, and ? = Larmor frequency. The s histogram metrics were measured for each CSF sample and CSF within the lateral ventricles. These metrics were then tested for correlation with the CSF laboratory investigation results (i.e., specific gravity, pH, protein concentration, and cell count). Pearson's product-moment correlation analyses were used to determine statistical significance at P<0.05.*Results Altogether 38 cadaveric CSF samples and 13 patients were included. Tests of correlation revealed significant weak to moderate positive correlation between the mean (r=0.387, P=0.018), median (r=0.366, P=0.026), and maximum (r=0.466, P=0.004) s of cadaveric CSF samples with polymorph count. As for in vivo examinations, significant strong positive correlation was observed between the mean (r=0.750, P=0.020), mode (r=0.743, P=0.022), median (r=0.743, P=0.022), minimum (r=0.749, P=0.020), and maximum (r=0.731, P=0.025) s and albumin concentration, as well as between the minimum s (r=0.607, P=0.036) and total cell count.*Conclusions Our observations suggest that s by EPT is sensitive to alterations in CSF composition. s measurable by EPT can become a noninvasive imaging biomarker that quantifies the CSF biochemical composition.*Clinical Relevance/Application 1. s measured noninvasively by MRI can become an imaging biomarker that quantifies the CSF biochemical composition. 2. This is the first report on its correlation with CSF biochemical composition.

RESULTS

Altogether 38 cadaveric CSF samples and 13 patients were included. Tests of correlation revealed significant weak to moderate positive correlation between the mean (r=0.387, P=0.018), median (r=0.366, P=0.026), and maximum (r=0.466, P=0.004) s of cadaveric CSF samples with polymorph count. As for in vivo examinations, significant strong positive correlation was observed between the mean (r=0.750, P=0.020), mode (r=0.743, P=0.022), median (r=0.743, P=0.022), minimum (r=0.749, P=0.020), and maximum (r=0.731, P=0.025) s and albumin concentration, as well as between the minimum s (r=0.607, P=0.036) and total cell count.

CLINICAL RELEVANCE/APPLICATION

1. s measured noninvasively by MRI can become an imaging biomarker that quantifies the CSF biochemical composition. 2. This is the first report on its correlation with CSF biochemical composition.

SDP-NR-4   **Additional Use Of A Deep Learning Algorithm In Detecting Intracranial Hemorrhages On Emergency Computed Tomographies Of A Radiology And Neuroradiology Department With Teleradiology**

Participants
Leonie Goelz, PhD, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

As teleradiology continues to be on the rise, diagnostic imaging of varying quality is increasingly bundled at big centers during any time of the day. This trend demands for prioritization and speediness of reporting in radiology1. Deep learning algorithms could support radiologist in meeting these challenges2-6. This study analyzes the number of additionally detectable intracranial hemorrhages (ICH) by a commercially available artificial intelligence (AI) analysis software and evaluates reasons for false results at a (neuro-)radiology department of a level 1 trauma center with teleradiology.*Methods and Materials Retrospective cohort-study (1) Analysis of consecutive emergency non-contrast head computed tomographies (hCT) by the AI. (2) Review of hCT with deviating results between the AI analysis and the initial radiology report (RR) by a blinded neuroradiologist (NR). (3) Evaluation of the number of additionally detected ICH using the AI and of reasons for false results.*Results 4946 hCT were included between 05/2020 and 09/2020 from 19 different CT scanners. 205 reports (4.1%) were classified by both the RR and the AI as bleedings. 162 (3.3%) diverging reports were identified, 62 of these were confirmed as bleedings by a NR. The RR identified 33 ICH and analysis by the AI detected 29 additional ICH. 88 (1.8%) hCT flagged by the AI as bleedings and 10 (0.2%) positive RR were evaluated as incorrect findings by the NR. ICH missed by the AI were often located in the subarachnoid space (41.2%) and immediately underneath the calvaria (47.1%). 85% of ICH missed by the RR but detected by AI occurred beyond regular working hours. Calcifications (39.3%), beam hardening artifacts (18%), tumors (15.7%), and vessels (7.9%) were the most common reasons for incorrectly positive flagged hCT. There was no significant association between size of the ICH or image quality and probability of incorrect AI results.*Conclusions The disagreement rate between AI analysis and primary RR was 3.3 %. 12.2 % ICH were identified additionally by the AI. 1.8 % hCT were falsely flagged by the AI often caused by calcifications, whereas ICH missed by the AI were mainly located in the subarachnoid space or underneath the calvaria.*Clinical Relevance/Application Combining radiological experience and an AI algorithm is a promising strategy for maximizing detection of ICH in high-volume radiology departments with teleradiology especially during on-call duty.

RESULTS

4946 hCT were included between 05/2020 and 09/2020 from 19 different CT scanners. 205 reports (4.1%) were classified by both the RR and the AI as bleedings. 162 (3.3%) diverging reports were identified, 62 of these were confirmed as bleedings by a NR. The RR identified 33 ICH and analysis by the AI detected 29 additional ICH. 88 (1.8%) hCT flagged by the AI as bleedings and 10 (0.2%) positive RR were evaluated as incorrect findings by the NR. ICH missed by the AI were often located in the subarachnoid space (41.2%) and immediately underneath the calvaria (47.1%). 85% of ICH missed by the RR but detected by AI occurred beyond regular working hours. Calcifications (39.3%), beam hardening artifacts (18%), tumors (15.7%), and vessels (7.9%) were the most common reasons for incorrectly positive flagged hCT. There was no significant association between size of the ICH or image quality and probability of incorrect AI results.

CLINICAL RELEVANCE/APPLICATION

Combining radiological experience and an AI algorithm is a promising strategy for maximizing detection of ICH in high-volume radiology departments with teleradiology especially during on-call duty.

SDP-NR-40   **Difference In Topological Organization Of White Matter Structural Connectome Between Methamphetamine And Heroin Use Disorder**

Participants
Wei Li, Xian, China (*Presenter*) Nothing to Disclose

PURPOSE

Both methamphetamine use disorder (MAUD) and heroin use disorder (HUD) were related to the activation of the dopamine transmission, while the psychological symptoms caused by HUD and MAUD were significantly different. The purpose of this study is to explore the difference in the topological organization of white matter structural between MAUD and HUD, and identify the relationship between structural alteration and psychological symptoms.*Methods and Materials Demographic matched 23 male MAUD patients, 20 HUD patients, and 21 healthy controls (HC) participated in the analysis. Diffusion tensor imaging and probabilistic tractography were used for white matter network construction. Psychological symptoms were evaluated by the Symptom Checklist-90. Schizophrenia nuclear symptoms dimension was used to identify the core symptoms. Differences of global-level and nodal-level properties among groups, and the network Hubs distribution were explored by FSL6.0. Partial correlation analysis was used for identifying the relationship between the network alteration and psychological status.*Results MAUD demonstrated significantly increased scores in anxiety, hostility, and schizophrenia nuclear symptoms. Higher hostility score was found in MAUD compared with HUD. HUD showed significantly increased global efficiency and network strength than HC, and increased network strength than MAUD. Compared with the HUD, MAUD showed significantly decreased Nodal Strength and efficiency distributed in the temporal, parietal and occipital regions. We also found the network Hubs were decreased in MAUD but increased in HUD. Nodal Strength in right superior temporal gyrus was positively correlated with depression, anxiety, hostile, paranoid, and psychoticism score in MAUD.*Conclusions These findings reflect the significant differences in topological structural connection between HUD and MAUD patients. Significantly increased global/nodal strength and efficiency in HUD indicate the imbalance between the efficiency and cost of the information transmission within the network. Decreased Nodal Strength and efficiency in the limbic system, parietal, temporal, and occipital regions and the relationship with the psychological scores may suggest the structural alteration underlying MAUD related psychological disorder.*Clinical Relevance/Application This evidence help shed some light on the neurobiological mechanisms of the psychological difference between HUD and MAUD. Understanding the structural disruption underline the MAUD related psychological symptoms may play an important role in the identification of potential new biomarkers and therapeutic targets.

RESULTS

MAUD demonstrated significantly increased scores in anxiety, hostility, and schizophrenia nuclear symptoms. Higher hostility score was found in MAUD compared with HUD. HUD showed significantly increased global efficiency and network strength than HC, and increased network strength than MAUD. Compared with the HUD, MAUD showed significantly decreased Nodal Strength and efficiency distributed in the temporal, parietal and occipital regions. We also found the network Hubs were decreased in MAUD but increased in HUD. Nodal Strength in right superior temporal gyrus was positively correlated with depression, anxiety, hostile, paranoid, and psychoticism score in MAUD.

CLINICAL RELEVANCE/APPLICATION

This evidence help shed some light on the neurobiological mechanisms of the psychological difference between HUD and MAUD. Understanding the structural disruption underline the MAUD related psychological symptoms may play an important role in the identification of potential new biomarkers and therapeutic targets.

SDP-NR-41 CT Perfusion Deficit Volumes Predict Functional Outcome In Patients With Basilar Artery Occlusion

Participants
Matthias Fabritius, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Basilar artery occlusion (BAO) is associated with high morbidity and mortality. Optimal imaging and treatment strategy are still controversial and prognosis estimation challenging. We therefore aimed to determine the predictive value of CT perfusion (CTP) parameters for functional outcome in patients with BAO in the context of endovascular treatment (EVT).*Methods and Materials Patients with BAO who underwent EVT were selected from a prospectively acquired cohort. Ischemic changes were assessed with the posterior-circulation-Acute-Stroke-Prognosis-Early-CT-Score (pc-ASPECTS) on non-contrast CT, CT angiography (CTA) source images and CTP maps. Basilar artery on CTA (BATMAN) score, posterior circulation CTA score and posterior circulation collateral score were evaluated on CTA. Perfusion deficit volumes were quantified on CTP maps. Good functional outcome was defined as modified Rankin scale smaller/equal 3 at 90 days. Statistical analysis included binary logistic regressions, and receiver operating characteristics (ROC) analyses.*Results Among 49 patients who matched the inclusion criteria, 24 (49.0%) achieved a good outcome. In univariate analysis, age, National Institutes of Health Stroke Scale (NIHSS) score on admission, posterior cerebral artery (PCA) involvement, absence of or hypoplastic posterior communicating arteries, BATMAN score, pc-ASPECTS and perfusion deficit volumes on all CTP parameter maps presented significant association with functional outcome (p smaller 0.05). In multivariate analyses, BATMAN score, pc-ASPECTS (odds ratio [OR] range: 1.31-2.10, 95%-confidence interval [CI] range: 1.00-7.24) and perfusion deficit volumes on all CTP maps (OR range: 0.77-0.98, 95%-CI range: 0.63-1.00) remained as independent outcome predictors. Cerebral blood flow (CBF) deficit volume yielded the best performance for the classification of good clinical outcome with an AUC of 0.92 (95%-CI: 0.84-0.99). Age and admission NIHSS had lower discriminatory power (AUC smaller 0.7).*Conclusions CTP imaging parameters contain prognostic information for functional outcome in patients with stroke due to BAO and may identify patients with higher risk of disability at an early stage of hospitalization.*Clinical Relevance/Application Predictive baseline image parameters can contribute to therapy decision making in BAO. Our findings challenge the concept of randomized controlled BAO trials without imaging selection criteria.

RESULTS

Among 49 patients who matched the inclusion criteria, 24 (49.0%) achieved a good outcome. In univariate analysis, age, National Institutes of Health Stroke Scale (NIHSS) score on admission, posterior cerebral artery (PCA) involvement, absence of or hypoplastic posterior communicating arteries, BATMAN score, pc-ASPECTS and perfusion deficit volumes on all CTP parameter maps presented significant association with functional outcome (p smaller 0.05). In multivariate analyses, BATMAN score, pc-ASPECTS (odds ratio [OR] range: 1.31-2.10, 95%-confidence interval [CI] range: 1.00-7.24) and perfusion deficit volumes on all CTP maps (OR range: 0.77-0.98, 95%-CI range: 0.63-1.00) remained as independent outcome predictors. Cerebral blood flow (CBF) deficit volume yielded the best performance for the classification of good clinical outcome with an AUC of 0.92 (95%-CI: 0.84-0.99). Age and admission NIHSS had lower discriminatory power (AUC smaller 0.7).

CLINICAL RELEVANCE/APPLICATION

Predictive baseline image parameters can contribute to therapy decision making in BAO. Our findings challenge the concept of randomized controlled BAO trials without imaging selection criteria.

SDP-NR-42 Quantitative Muscle Mass Biomarkers Are Independent Prognosis Factors In Primary Central Nervous System Lymphoma: The Role Of L3-skeletal Muscle Index And Temporal Muscle Thickness

Participants
Riccardo Leone, MD, Milan, Italy (*Presenter*) Nothing to Disclose

PURPOSE

Appropriate patient stratification is critical in patients with primary central nervous system lymphomas (PCNSL) to improve therapeutic choices and to reduce treatment-related neurotoxicity. Quantitative muscle biomarkers, such as the skeletal-muscle-index at the third lumbar vertebra (L3-SMI) and temporal muscle thickness (TMT) are associated with worse prognosis in several diseases. We aim to evaluate the role of these biomarkers in predicting survival in patients with PCNSL.*Methods and Materials L3-SMI and TMT were calculated on abdominal CT and brain high-resolution 3D-T1-weighted-MR images, respectively, using predefined validated methods. Standardized sex-specific cut-offs were used to divide patients in different risk categories. Kaplan-Meier plots were calculated, and survival analysis was performed using log-rank tests, univariate, and multivariable Cox-regression models, calculating hazard ratios (HR) and 95% confidence intervals (CI), also adjusting for potential confounders (age, sex, and performance status).*Results Forty-three patients were included in this study. Median follow-up was 23 months (IQR 12-40); at median follow-up, rates of progression-free and overall survival for the cohort were 46% and 57%, respectively. Thirteen (30%) and 11 (26%) patients showed L3-SMI or TMT values below the predefined cut-offs. A significant association was found between quantitative muscle mass biomarkers and progression-free and overall survival. One-year progression free and overall survival rates were 8% and 21% for the 13 patients with L3-SMI below the standard cut-off value, respectively, compared to 66% and 68% for the 30 patients with L3-SMI above the cut-off values. Likewise, one-year progression free and overall survival rates were 10% and 15% for the 11 patients with low TMT, respectively, compared to 61% and 70% for the 32 patients with high TMT. In Cox-regression multivariable analysis patients with low L3-SMI or TMT showed significantly worse progression-free (HR 4.40, 95%CI 1.66-11.61, p = 0.003; HR 4.40, 95%CI 1.68-11.49, p=0.003, respectively) and overall survival (HR 3.16, 95%CI 1.09-9.11, p = 0.034; HR 4.93, 95%CI 1.78-13.65, p=0.002, respectively) compared to patients with high L3-SMI or TMT.*Conclusions Quantitative muscle mass evaluation assessed by both L3-SMI and TMT is a promising tool to identify PCNSL patients at high risk of negative outcome. Confirmatory studies on larger independent series are warranted.*Clinical Relevance/Application Quantitative mass biomarkers could be used to further improve prognostic patient stratification in PCNSL and allow a better therapeutic allocation

RESULTS

Forty-three patients were included in this study. Median follow-up was 23 months (IQR 12-40); at median follow-up, rates of progression-free and overall survival for the cohort were 46% and 57%, respectively. Thirteen (30%) and 11 (26%) patients

showed L3-SMI or TMT values below the predefined cut-offs. A significant association was found between quantitative muscle mass biomarkers and progression-free and overall survival. One-year progression free and overall survival rates were 8% and 21% for the 13 patients with L3-SMI below the standard cut-off value, respectively, compared to 66% and 68% for the 30 patients with L3-SMI above the cut-off values. Likewise, one-year progression free and overall survival rates were 10% and 15% for the 11 patients with low TMT, respectively, compared to 61% and 70% for the 32 patients with high TMT. In Cox-regression multivariable analysis patients with low L3-SMI or TMT showed significantly worse progression-free (HR 4.40, 95%CI 1.66-11.61, p = 0.003; HR 4.40, 95%CI 1.68-11.49, p=0.003, respectively) and overall survival (HR 3.16, 95%CI 1.09-9.11, p = 0.034; HR 4.93, 95%CI 1.78-13.65, p=0.002, respectively) compared to patients with high L3-SMI or TMT.

CLINICAL RELEVANCE/APPLICATION

Quantitative mass biomarkers could be used to further improve prognostic patient stratification in PCNSL and allow a better therapeutic allocation

SDP-NR-43 Radiomics Features From Multi-sequence Conventional MRI Predict TERT Promoter Mutation Status In Glioblastomas

Participants
Jun Lu, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

The mutation status of telomerase reverse transcriptase(TERT) promoter has been proven to be a diagnostic and prognostic biomarker for glioblastoma(GBM). The purpose of this study was to construct a radiomic model to noninvasively predict the TERT promoter mutation status in GBM.*Methods and Materials 116 GBM patients(81 in the training cohort and 35 in the validation cohort) were retrospectively enrolled. A total of 558 radiomics features of the whole tumor were extracted from apparent diffusion coefficient(ADC) and isotropic volumetric contrast-enhanced T1-weighted magnetization prepared rapid acquisition gradient echo(iso-CE-T1-MPRAGE) MRI images, including 18 first order(gray level histogram, GLH), 490 second order[gray level concurrence matrix(GLCM); run length matrix; absolute gradient], and 50 high order(autoregressive model; wavelet transform). The radiomics features were selected by the Fisher coefficient, probability of classification error and average correlation coefficient(POE+ACC) and mutual information. The inter-group comparison was compared with the t test or Mann-Whitney U test. The univariate and multivariate logistic regression were performed to explore potential variables as predictors of TERT status. Multiparameter models were established and receiver operating characteristic analysis was used to evaluate the models. Kaplan-Meier analyses were used to evaluate the progress free survival(PFS) and overall survival(OS) of GBM with different TERT mutation status.*Results Three radiomics prediction models, namely, ADC single model(M1), iso-CE-T1 single model(M2) and integrated multi-sequence model(M3) were built, all of which displayed good performance. The integrated multi-sequence radiomics model, constructed from the combination of both sequences, showed the best performance, with an area under the curve (AUC) of 0.881(0.790-0.942) in the training dataset, and an AUC of 0.933(0.795-0.990) in the validation dataset. Kaplan-Meier curve showed a significant difference of overall survival between different TERT mutation status with an optimal threshold of M3 for discrimination of TERT mutation status(log-rank = 5.2274, p = 0.022).*Conclusions Multi-sequence conventional MRI radiomics models are useful for noninvasively predicting TERT promoter mutation status in GBM patients. The combination of radiomics features from different sequences may be potential for improving the prediction performance and for prognostic assessment of glioblastoma.*Clinical Relevance/Application This study aimed to find imaging biomarkers for noninvasively predicting the TERT mutation status for a tailored treatment plan and prognosis assessment in GBM patients from the initial stage of the tumor diagnosis.

RESULTS

Three radiomics prediction models, namely, ADC single model(M1), iso-CE-T1 single model(M2) and integrated multi-sequence model(M3) were built, all of which displayed good performance. The integrated multi-sequence radiomics model, constructed from the combination of both sequences, showed the best performance, with an area under the curve (AUC) of 0.881(0.790-0.942) in the training dataset, and an AUC of 0.933(0.795-0.990) in the validation dataset. Kaplan-Meier curve showed a significant difference of overall survival between different TERT mutation status with an optimal threshold of M3 for discrimination of TERT mutation status(log-rank = 5.2274, p = 0.022).

CLINICAL RELEVANCE/APPLICATION

This study aimed to find imaging biomarkers for noninvasively predicting the TERT mutation status for a tailored treatment plan and prognosis assessment in GBM patients from the initial stage of the tumor diagnosis.

SDP-NR-44 Deep Learning Reconstruction Helps To Quantify Multiple Sclerosis Lesion Load On Fast Flair Imaging

Participants
Takayuki Yamamoto, MD, Bordeaux, France (*Presenter*) Nothing to Disclose

PURPOSE

Image denoising based on deep learning technology (so called deep learning reconstruction, DLR) can efficiently improve image quality. Our aim is to quantify the diagnostic capability of DLR for lesion detection of multiple sclerosis (MS) for short scan time.*Methods and Materials Twenty-eight MS patients were examined on a Vantage Galan 3T / ZGO (Canon Medical Systems, Japan) using four 3D FLAIR sequences with different TR times (scan time of 4:54; 2:35; 1:40 and 1:15 min, respectively). Each FLAIR was reconstructed with and without DLR. Two experienced neuroradiologists collaboratively created a lesion load gold standard on the longest scan. One neuroradiologist blindly assessed image quality (from -2 "not diagnostic" to +2 "excellent") and delineated the lesion on each scan. Automatic lesion segmentation was also performed by using lesionBrain software freely available on the volBrain platform. The following metrics evaluated manual and automatic segmentation: DICE, absolute volume difference (AVD), Hausdorff distance (HD), F1 score based on the lesion count (F1).*Results DLR was implemented directly in the scanner, and the reconstruction finished within 1 minute. As expected, both image quality evaluations and the various metrics were found decreased by scan time reduction. However, DLR improved all these metrics, particularly for human evaluation. Especially, for the 1:40 min long FLAIR, DLR helped to reach sufficient quality and significantly improved all metrics both in manual delineation and auto-segmentation.*Conclusions Our results evaluated the added value of DLR, in the MS context. The significant improvement in homology metrics such as AVD, DICE, and HD demonstrates that DLR helped to recognize the boundaries of lesions even in short time acquisition. The increase of F1 meant that DLR can retrieve lesions buried in noise or contrast loss.*Clinical Relevance/Application DLR can reduce the scan time while preserving the image quality and lesion detectability. It is highly valuable for mitigating the patient burden by rapid imaging acquisition.

RESULTS

DLR was implemented directly in the scanner, and the reconstruction finished within 1 minute. As expected, both image quality evaluations and the various metrics were found decreased by scan time reduction. However, DLR improved all these metrics, particularly for human evaluation. Especially, for the 1:40 min long FLAIR, DLR helped to reach sufficient quality and significantly improved all metrics both in manual delineation and auto-segmentation.

CLINICAL RELEVANCE/APPLICATION

DLR can reduce the scan time while preserving the image quality and lesion detectability. It is highly valuable for mitigating the patient burden by rapid imaging acquisition.

SDP-NR-45   Multi-parametric Radiogenomic Model To Predict 1p/19q Co-deletion In Patients With Glioma: Added Value To The T2-flair Mismatch Sign

Participants
Arya Derakhshani, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

The "T2-FLAIR mismatch" sign has shown promising results in determination of IDH-mutant 1p/19q non-codeleted gliomas1. We aimed to develop a multiparametric radiogenomic model using a combination of MRI texture features to predict 1p/19q codeletion status in patients with IDH-mutant glioma and to perform a comparative analysis to T2-FLAIR mismatch sign.*Methods and Materials Inclusion criteria for this retrospective study were 1) diagnosis of IDH mutant glioma with known 1p/19q status and 2) availability of preoperative MRI (T2 and FLAIR). Two board certified neuroradiologists reviewed the images independently for T2-FLAIR mismatch sign. In each patient, tumor segmentation was performed to encompass the entire FLAIR hyperintense volume and a total of 92 texture features were extracted using Olea Sphere SP.22. From texture features, an imaging model was developed to predict 1p/19q codeletion status using Least Absolute Shrinkage and Selection Operator (LASSO) regularization to reduce the risk of overfitting. This imaging model was then inserted into a backward stepwise logistic regression in conjunction with variables such as age, sex, tumor volume, tumor location and T2-FLAIR mismatch scores. Receiver-operating characteristic was performed to provide accuracy statistics.*Results A total of 103 patients (age: 41.1 ± 13.2; M 66) were included. 1p/19q status: intact (n=68) and codeleted (n=35). Interobserver agreement between two neuroradiologists in defining T2-FLAIR mismatch was modest (k=0.49). The overall diagnostic performance (sensitivity/specificity/accuracy) of T2-FLAIR mismatch sign in determining 1p/19q status was: 52.9% / 80% / 66.5%. Our imaging model generated from a combination of three texture features (first order uniformity, grey-level run length matrix run percentage, and neighborhood gray tone difference matrix strength) resulted in sensitivity/specificity/accuracy: 75% / 80% / 77.5%. In logistic regression analysis, this radiomic model remained as a significant contributor to the final model. Addition of this radiomic model to T2-FLAIR mismatch, resulted in improving the sensitivity by 14% while maintaining the specificity at 80%.*Conclusions Results show that application of multiparametric radiomic model provides added diagnostic value and in particular increases the sensitivity of the T2-FLAIR mismatch sign in determination of 1p/19q codeletion status in patients with glioma.*Clinical Relevance/Application Despite promising results in prediction of IDH mutant 1p/19q non-codeleted gliomas, T2-FLAIR mismatch sign has limited sensitivity. The described radiomic model provides added sensitivity and an opportunity for a more balance predictive performance.

RESULTS

A total of 103 patients (age: 41.1 ± 13.2; M 66) were included. 1p/19q status: intact (n=68) and codeleted (n=35). Interobserver agreement between two neuroradiologists in defining T2-FLAIR mismatch was modest (k=0.49). The overall diagnostic performance (sensitivity/specificity/accuracy) of T2-FLAIR mismatch sign in determining 1p/19q status was: 52.9% / 80% / 66.5%. Our imaging model generated from a combination of three texture features (first order uniformity, grey-level run length matrix run percentage, and neighborhood gray tone difference matrix strength) resulted in sensitivity/specificity/accuracy: 75% / 80% / 77.5%. In logistic regression analysis, this radiomic model remained as a significant contributor to the final model. Addition of this radiomic model to T2-FLAIR mismatch, resulted in improving the sensitivity by 14% while maintaining the specificity at 80%.

CLINICAL RELEVANCE/APPLICATION

Despite promising results in prediction of IDH mutant 1p/19q non-codeleted gliomas, T2-FLAIR mismatch sign has limited sensitivity. The described radiomic model provides added sensitivity and an opportunity for a more balance predictive performance.

SDP-NR-46   Development Of Machine Learning Algorithms For The Differentiation Of Glioma And Brain Metastases - A Systematic Review

Participants
Waverly Rose Brim, BS, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Medical staging, surgical planning, and therapeutic decisions are significantly different for brain metastases (BM) versus gliomas; yet both pathologies can present similarly on MR imaging. Machine learning (ML) algorithms have been developed as noninvasive techniques for brain metastases and glioma differentiation. We performed a systematic review to characterize these methods and to evaluate their accuracy.*Methods and Materials Studies on the application of ML in neuro-oncology were searched in Ovid Embase, Ovid MEDLINE, Cochrane trials (CENTRAL) and Web of Science Core - Collection. A neuroradiologist, neuroradiology resident, and AI graduate student designed a search strategy alongside two clinical librarians in October 2020 and February 2021. The search strategy comprised of controlled vocabulary including artificial intelligence, machine learning, deep learning, magnetic resonance imaging, and glioma. Candidate articles were screened in Covidence by at least two reviewers each. Bias analysis was conducted in agreement with TRIPOD, a bias assessment tool similar to CLAIM.*Results The search identified 11,727 candidate articles, 1,135 underwent full text review, and after applying our exclusion criteria 29 were used for data extraction. Classical ML (cML) algorithms represented 85% of models used, deep learning (DL) accounted for 15%. cML performed with an average accuracy, sensitivity, and specificity of 82%, 78%, 88%, respectively; DL performed 84%, 79%, 81%. Support vector machine (SVM) was the most commonly used cML model and convolutional neural networks (CNN) were standard for DL. We also found that T1, T1 post-gadolinium and T2 sequences were frequently used for feature extraction. Preliminary TRIPOD analysis yielded an average score of 14.25 (range 8-18).*Conclusions Brain metastases and glioma differentiation ML models have been developed with SVM and CNN being leading approaches.*Clinical Relevance/Application ML offers noninvasive methods for differentiation of gliomas from BM; critical information when biopsy is undesirable. This systematic review identifies leading algorithms for clinical implementation.

RESULTS

The search identified 11,727 candidate articles, 1,135 underwent full text review, and after applying our exclusion criteria 29 were used for data extraction. Classical ML (cML) algorithms represented 85% of models used, deep learning (DL) accounted for 15%. cML performed with an average accuracy, sensitivity, and specificity of 82%, 78%, 88%, respectively; DL performed 84%, 79%, 81%. Support vector machine (SVM) was the most commonly used cML model and convolutional neural networks (CNN) were standard for DL. We also found that T1, T1 post-gadolinium and T2 sequences were frequently used for feature extraction. Preliminary TRIPOD analysis yielded an average score of 14.25 (range 8-18).

CLINICAL RELEVANCE/APPLICATION

ML offers noninvasive methods for differentiation of gliomas from BM; critical information when biopsy is undesirable. This systematic review identifies leading algorithms for clinical implementation.

SDP-NR-48   Choroid Plexus Volume Is A Novel Imaging Marker For Predicting Cognitive Functioning In Elderly Subjects With Cognitive Impairments.

Participants
JONG DUCK CHOI, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Choroid plexus change is recently implicated in AD pathologic process. Our aim was to evaluate whether the volume of choroid plexus on T1-weighted imaging differs between patients with cognitive impairment spectrum and cognitively normal subjects.*Methods and Materials In this IRB-approved retrospective study, we enrolled a total of 616 subjects (73 normal cognition, 296 clinical MCI, 143 clinical AD, 91 other dementia) who underwent cognitive assessments and 3T brain MRI between Jan 2013 and May 2020. After excluding13 subjects due to the poor imaging quality, 603 patients were included in the final analysis. FreeSurfer 6.0 based volumetric segmentation was used to analyze the MRI volumetric data with the help of the deep learning algorithm for the analysis-failure prediction, brain extraction, and structure segmentation. Mean differences of normalized choroid plexus volume (ratio of choroid plexus volume to total intracranial volume) were compared with the Analysis of variance. Effect of choroid plexus volume on cognitive function (MMSE score) were evaluated with linear regression analysis after adjusting confounding factors.*Results AD and other dementia patients were older than MCI and normal cognition subjects (p<0.001). Normalized choroid plexus volume was significantly different between groups (p < 0.001). However, AD and other dementia subjects did not show significant difference in choroid plexus volume (p=0.205).After adjusting age and education, both increased choroid plexus volume (beta -3.183, standard error [SE]=0.505, p < 0.001) and hippocampal atrophy (beta 1.991, SE=0.283, p < 0.001) were the significant predictors of the cognitive declining.*Conclusions Our result suggests that choroid plexus volume predicts cognitive functioning. Choroid plexus volume may be a useful imaging marker for cognitive dysfunction in patients with cognitive complaints.*Clinical Relevance/Application Our study indicates that normalized choroid plexus volume can be an early imaging marker for representing underlying pathologic process in the cognitively impaired subjects.

RESULTS

AD and other dementia patients were older than MCI and normal cognition subjects (p<0.001). Normalized choroid plexus volume was significantly different between groups (p < 0.001). However, AD and other dementia subjects did not show significant difference in choroid plexus volume (p=0.205).After adjusting age and education, both increased choroid plexus volume (beta -3.183, standard error [SE]=0.505, p < 0.001) and hippocampal atrophy (beta 1.991, SE=0.283, p < 0.001) were the significant predictors of the cognitive declining.

CLINICAL RELEVANCE/APPLICATION

Our study indicates that normalized choroid plexus volume can be an early imaging marker for representing underlying pathologic process in the cognitively impaired subjects.

SDP-NR-49   Comparison Of Arterial Spin Labelling (ASL) Metrics And Dynamic Susceptibility Enhanced Perfusion Imaging (DSC-PWI) Parameters In The Diagnosis Of Ischemic Stroke And Prediction Of Patient Outcome

Participants
Liu Chang, Hefei, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the correlation between arterial spin labeling (ASL) indexes (PLD1.5s, 2.5s) and dynamic susceptibility contrast-enhanced perfusion imaging (DSC-PWI) parameters in hemodynamic changes of ischemic stroke patients.And to explore the predictive value of the middle artery crossing artifact (ATA) in ASL for the outcome of stroke patients.*Methods and Materials Eighty patients with arterial stenosis / occlusion treated in the inpatient department between May 2019 and May 2020 were selected. ASL and DSC-PWI scans were completed.After one-year follow-up, patients were divided into groups with and without recurrent ischemic stroke, and the correlation between imaging parameters (ASL-CBF, PWI-CBF,CBV, MTT,TTP) in assessing cerebral hemodynamics was compared.In addition, imaging and parameters were also compared between the two groups to determine whether these parameters were associated with patient outcomes.*Results 1.ASL-CBF(PLD1.5s) was statistically different from PWI-CBF and PWI-CBV (P < 0.05), but ASL-CBF (PLD1.5s) was not statistically different from PWI-MTT,TTP (P > 0.05);After kappa analysis,ASL-CBF (PLD1.5s) showed good agreement with PWI-TTP. 2. Statistically significant differences were found between ASL-CBF (PLD 2.5s) and PWI-MTT,TTP (P < 0.05), but not between ASL-CBF (PLD2.5s) and PWI-CBF, CBV (P > 0.05);After kappa analysis, ASL-CBF (PLD2.5s) showed good agreement with PWI-CBF. 3.80 patients, a total of 46 patients had arterialpenetration artifacts in their ASL maps.As a result of follow-up, 24 patients in the recurrent ischemic stroke group, including 8 patients with arterial penetration artifacts in the ASL maps and 56 patients in the no recurrent group, including 38 patients with arterial penetration artifacts in the ASL maps, showed statistically significant differences between the two groups (P < 0.05).It follows that arterial travel artifacts occur in the ASL map, more often in good prognosis patients, which is helpful in predicting the prognosis of patients.*Conclusions 1. Ischemic stroke patients showed better agreement between ASL-CBF (PLD1.5s) and PWI-TTP parameter results in DSC-PWI technique, better agreement between ASL-CBF (PLD2.5s) and PWI-CBF parameter results in DSC-PWI technique, noninvasive, reproducible, safety and other characteristics of ASL examination. 2. Arterial penetration artifact (ATA) in the ASL perfusion map may serve as a predictor of outcome in patients with ischemic stroke.*Clinical Relevance/Application Magnetic resonance of the nervous system two different methods of perfusion, correlation studies of different parameters between the two groups of methods.Arterial travel artifacts (ATA) arising in ASL, predictive value for outcome of ischemic stroke patients.

RESULTS

1.ASL-CBF(PLD1.5s) was statistically different from PWI-CBF and PWI-CBV (P < 0.05), but ASL-CBF (PLD1.5s) was not statistically different from PWI-MTT,TTP (P > 0.05);After kappa analysis,ASL-CBF (PLD1.5s) showed good agreement with PWI-TTP. 2. Statistically significant differences were found between ASL-CBF (PLD 2.5s) and PWI-MTT,TTP (P < 0.05), but not between ASL-CBF (PLD2.5s) and PWI-CBF, CBV (P > 0.05);After kappa analysis, ASL-CBF (PLD2.5s) showed good agreement with PWI-CBF. 3.80 patients, a total of 46 patients had arterialpenetration artifacts in their ASL maps.As a result of follow-up, 24 patients in the recurrent ischemic stroke group, including 8 patients with arterial penetration artifacts in the ASL maps and 56 patients in the no recurrent group, including 38 patients with arterial penetration artifacts in the ASL maps, showed statistically significant differences between the two groups (P < 0.05).It follows that arterial travel artifacts occur in the ASL map, more often in good prognosis patients, which is helpful in predicting the prognosis of patients.

CLINICAL RELEVANCE/APPLICATION

Magnetic resonance of the nervous system two different methods of perfusion, correlation studies of different parameters between the two groups of methods.Arterial travel artifacts (ATA) arising in ASL, predictive value for outcome of ischemic stroke patients.

SDP-NR-5   Altered Glymphatic Function In Parkinson's Disease

Participants
Yun Jung Bae, MD, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To examine glymphatic function in Parkinson disease (PD) utilizing "Diffusion Tensor Image-Analysis aLong the Perivascular Space (DTI-ALPS)" method.*Methods and Materials This case-control study included 54 consecutive patients diagnosed with de novo PD between June 2017 and March 2019 who underwent DTI with 123I-2ß-carbomethoxy-3ß-(4-iodophenyl)-N-(3-fluoropropyl)-nortropane dopamine transporter imaging and 54 age-sex matched controls. The correlations of DTI-ALPS values with clinical motor and cognition scores and with dopamine transporter uptake were examined.*Results DTI-ALPS values reflecting glymphatic activity were significantly lower in PD group than in controls (Dxproj [×10-3mm2/s], 0.59±0.08 vs 0.65±0.08; ALPS-index, 1.51±0.22 vs 1.66±0.2; both, P<0.0001). Dxproj and the ALPS-index showed significant negative correlations with motor score, and positive correlations with cognition scores (all, P<0.01). There was no significant correlation with dopamine transporter uptake (P>0.05).*Conclusions Glymphatic dysfunction was revealed in patients with PD using DTI-ALPS, correlating with disease severity.*Clinical Relevance/Application DTI-ALPS method can reveal glymphatic dysfunction in patients with Parkinson's disease, which can be correlated with clinical symptom severity, but not with dopamine transporter uptake.

RESULTS

DTI-ALPS values reflecting glymphatic activity were significantly lower in PD group than in controls (Dxproj [×10-3mm2/s], 0.59±0.08 vs 0.65±0.08; ALPS-index, 1.51±0.22 vs 1.66±0.2; both, P<0.0001). Dxproj and the ALPS-index showed significant negative correlations with motor score, and positive correlations with cognition scores (all, P<0.01). There was no significant correlation with dopamine transporter uptake (P>0.05).

CLINICAL RELEVANCE/APPLICATION

DTI-ALPS method can reveal glymphatic dysfunction in patients with Parkinson's disease, which can be correlated with clinical symptom severity, but not with dopamine transporter uptake.

SDP-NR-50   Fast 3D Wheel, Compressed Sensing And Parallel Imaging: Compared Capabilities For Scan Time Reduction And Image Quality And Diagnostic Performance Improvements In Suspected Brain Metastasis Patients

Participants
Kazuhiro Murayama, MD, Toyoake, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation

PURPOSE

To compare the capability for examination time reduction and image quality and diagnostic performance improvements among conventional parallel imaging (PI), compressed sensing (CS) and wheel encoding order (Fast 3D wheel: i.e. Fast 3Dw) methods on contrast-enhanced brain MR examination in suspected brain metastasis patients.*Methods and Materials 35 consecutive patients suspected with brain metastases underwent contrast-enhanced MRI by PI, CS and Fast 3Dw methods. Each examination time was also recorded. SNR of normal white matter and contrast ratio (CR) between lesion and normal white matter were assessed by ROI measurements. Moreover, overall image quality was assessed by a 5-point scale by consensus of two readers. To compare detection performance of brain metastasis on CE-T1WI among all methods, probability of lesion detection at each lesion was assessed by consensus of same readers. To compare examination time, Tukey's HSD test was performed To compare quantitative image quality improvements, SNR and CR were compared among three methods by Tukey's HSD test. To compare detection capability among all data sets, Jackknife alternative free-response receiver operating characteristic (JAFROC) analysis were performed. Finally, sensitivity (SE) and false-positive/case (FPR) was also compared among six data sets by McNemar's test.*Results Mean examination times of CS and Fast 3Dw were significantly shorter than that of PI (p<0.0001). SNR of Fast 3Dw was significantly higher than those of PI and CS (p<0.001). Moreover, SNR of CS was significantly higher than that of PI (p<0.001). Image quality index of Fast 3Dw was significantly higher than those of PI and CS (p<0.05). There were no significant differences of figure of merit among all methods (p>0.05). SE of Fast 3Dw (SE=0.79) had significantly higher than those of PI and CS (PI: SE=0.74, p<0.01; CS: SE=0.73, p<0.01). FPR of all methods had no significant difference (p>0.05).*Conclusions Fast 3Dw has potentials than PI and CS for examination time reduction and image quality and diagnostic performance improvements in suspected brain metastasis patients.*Clinical Relevance/Application Fast 3Dw has potentials than PI and CS for examination time reduction and image quality and diagnostic performance improvements in suspected brain metastasis patients.

RESULTS

Mean examination times of CS and Fast 3Dw were significantly shorter than that of PI (p<0.0001). SNR of Fast 3Dw was significantly higher than those of PI and CS (p<0.001). Moreover, SNR of CS was significantly higher than that of PI (p<0.001). Image quality index of Fast 3Dw was significantly higher than those of PI and CS (p<0.05). There were no significant differences of figure of merit among all methods (p>0.05). SE of Fast 3Dw (SE=0.79) had significantly higher than those of PI and CS (PI: SE=0.74, p<0.01; CS: SE=0.73, p<0.01). FPR of all methods had no significant difference (p>0.05).

SDP-NR-52 Fast Stroke Protocol Development And Validation For A New Point Of Care Low Field Strength MRI

Participants
Kathryn Wagner, Halifax, Nova Scotia (*Presenter*) Nothing to Disclose

PURPOSE

Stroke is a leading cause of death and disability worldwide and rapid imaging is required for an accurate diagnosis. Synaptive's new 0.5T MRI scanner can be used safely in a greater number of patients due to its low field and head only design. The aim of this study was to develop a fast MRI stroke protocol and to assess whether images are of diagnostic quality.*Methods and Materials The novel, head-only, 0.5T EvryTM system provides a unique opportunity to study the potential for point-of- care stroke imaging in low-field systems. The EvryTM is a small foot-print, cryogen free system designed for point of care use, therefore amenable to use in emergency medicine settings. It has high slew rate (400 T/m/s) high strength (100 mT/m) gradients and a 16 channel patient conformable head coil. We developed a stroke protocol containing the following sequences: DWI 1:40 min, T2 FSE 4:15 min, FLAIR 4:15 min, SWI 1:09 min, and optionally TOF MRA 7:38 min; total 11:19 min or 18:57 min. Next, 12 consecutive patients that had recently proven stroke on either CT or MR imaging were scanned. The 0.5T MRI scans were anonymized, after which a blinded, board certified neuroradiologist assessed them for evidence of acute stroke using confidence levels on a Likert scale (1-5, 1=0% confidence, 5=100% confidence).*Results 12 patients with acute ischemic strokes, median age 62, 50% (6/12) males were enrolled. All 0.5T MRI scans assessed confirmed presence of ischemic stroke: 3/12 (25%) patients had subacute strokes and 9/12 (75%) patients had acute strokes that were identified. The radiologist's confidence level was excellent for 9/12 (75%) cases and good in 3/12 (25%) cases.*Conclusions The newly developed sequences for the 0.5T MRI scanner show good to excellent visualization of acute strokes.*Clinical Relevance/Application This acquisition protocol needs further assessment for quality, and optimization for speed, but initial results are promising. Ongoing work examining undersampled acquisitions with deep learning reconstructions is underway, with the ultimate goal of defining a protocol that is "as fast as clinically useful". Doing so could help make MRI the modality of choice for triaging neurological issues in emergency medicine, increase patient throughput, and reduce the overall burden on hospital resources.

RESULTS

12 patients with acute ischemic strokes, median age 62, 50% (6/12) males were enrolled. All 0.5T MRI scans assessed confirmed presence of ischemic stroke: 3/12 (25%) patients had subacute strokes and 9/12 (75%) patients had acute strokes that were identified. The radiologist's confidence level was excellent for 9/12 (75%) cases and good in 3/12 (25%) cases.

CLINICAL RELEVANCE/APPLICATION

This acquisition protocol needs further assessment for quality, and optimization for speed, but initial results are promising. Ongoing work examining undersampled acquisitions with deep learning reconstructions is underway, with the ultimate goal of defining a protocol that is "as fast as clinically useful". Doing so could help make MRI the modality of choice for triaging neurological issues in emergency medicine, increase patient throughput, and reduce the overall burden on hospital resources.

SDP-NR-53 Diffusion Weighted Imaging With Background Suppression Of Tibial And Common Peroneal Nerves In Patients With Guillain-barre Syndrome

Participants
Cao Jinfeng, Zibo, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the feasibility of diffusion weighted imaging with background suppression (DWIBS) in evaluating the peripheral nerve disorders in patients with Guillain-Barre syndrome (GBS).*Methods and Materials 32 GBS patients and 32 sex- and age- matched healthy volunteers underwent DWIBS examination of tibial nerve (TN) and the common peroneal nerve (CPN). Two senior radiologists scored the coronal 3D volume images of TN and CPN after reconstruction by the four-grade scoring system. The value of motor nerve conduction velocity (MCV) and motor nerve conduction amplitude of GBS patients were recorded. Kappa statistic was used to calculate inter-observer agreement for visualization scores. One-way ANOVA method was used to compare the values of MCV and motor nerve conduction amplitude in different scoring groups of the TN and CPN of GBS patients. The Spearman correlation analysis was used to evaluate the correlation between the scores of DWIBS and MCV, motor nerve conduction amplitude of TN and CPN in GBS patients.*Results In the DWIBS images of 32 healthy volunteers, 64 TN and CPN showed clear, sharp edges, good signal intensity, uniformity, and the scores were all 4. The consistency between the two readers was good (Kappa value=1.0). In the 64 TN and CPN of 32 GBS patients, 57 TN and 55 CPN showed abnormal changes in varying degrees, including blurred edges, distortions, difficulty in recognition, and weakened signal strength. The score distributions of TN and CPN were 7 and 9 (score = 1), 20 and 22 (score = 2), 27 and 25 (score = 3), 10 and 8 (score = 4), respectively. The consistency between the two readers was good. The Kappa values of TN and CPN were 0.879 and 0.863, respectively. With the scores of TN and CPN in DWIBS sequence decrease, the MCV and motor nerve conduction amplitude values of TN and CPN of GBS patients decreased, and the differences between the score groups were statistically significant (P<0.05). The scores of TN and CPN in DWIBS were positively correlated with MCV (r=0.83 and 0.84, respectively. P<0.05), motor nerve conduction amplitude (r=0.81 and 0.79, respectively. P<0.05).*Conclusions DWIBS could provide a three dimensional visualization of TN and CPN, and evaluate the disorders of peripheral nerves in patients with GBS. There was a moderate correlation between the scores of TN and CPN in DWIBS and electrophysiology parameters.*Clinical Relevance/Application Although electrophysiological examination can assess the peripheral nerve injury of GBS to a certain extent, it is difficult to provide morphological information to fully evaluate nerve injury and can result in inappropriate treatment.

RESULTS

In the DWIBS images of 32 healthy volunteers, 64 TN and CPN showed clear, sharp edges, good signal intensity, uniformity, and the scores were all 4. The consistency between the two readers was good (Kappa value=1.0). In the 64 TN and CPN of 32 GBS patients, 57 TN and 55 CPN showed abnormal changes in varying degrees, including blurred edges, distortions, difficulty in recognition, and weakened signal strength. The score distributions of TN and CPN were 7 and 9 (score = 1), 20 and 22 (score = 2), 27 and 25 (score = 3), 10 and 8 (score = 4), respectively. The consistency between the two readers was good. The Kappa values of TN and CPN were 0.879 and 0.863, respectively. With the scores of TN and CPN in DWIBS sequence decrease, the MCV and

motor nerve conduction amplitude values of TN and CPN of GBS patients decreased, and the differences between the score groups were statistically significant (P<0.05). The scores of TN and CPN in DWIBS were positively correlated with MCV (r=0.83 and 0.84, respectively. P<0.05), motor nerve conduction amplitude (r=0.81 and 0.79, respectively. P<0.05).

CLINICAL RELEVANCE/APPLICATION

Although electrophysiological examination can assess the peripheral nerve injury of GBS to a certain extent, it is difficult to provide morphological information to fully evaluate nerve injury and can result in inappropriate treatment.

SDP-NR-54 Value Of Adopting Fast Brain MRI Techniques For Outpatient Brain MRI: Proof Of Principle And Operational Impact

Participants
Min Lang, MD, Cambridge, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Clinical validation studies have demonstrated the ability of accelerated MRI sequences to decrease acquisition time and motion artifact while preserving image quality. The operational benefits, however, have been less explored. Here, we report our initial clinical experience in implementing fast MRI techniques across a variety of brain MRI protocols for outpatient imaging during the COVID-19 pandemic.*Methods and Materials In the first half of 2020, our tertiary-care academic medical center implemented fast MRI sequences into the clinical brain MRI protocols on two 3T and one 1.5T outpatient MR scanners to allow for increased time for room sanitization and social distancing. Aggregate acquisition times were extracted from the medical record on consecutive imaging examinations performed during matched pre-implementation (7/1/2019-12/31/2019) and post-implementation periods (7/1/2020-12/31/2020). Expected acquisition time reduction for each MRI protocol was calculated through manual collection of acquisition times for the conventional and accelerated sequences performed during the pre- and post-implementation periods. Aggregate and expected acquisition times were compared for five of the most frequently performed brain MRI protocols: brain without contrast (BR-), brain with and without contrast (BR+), multiple sclerosis (MS), memory loss (MML), and epilepsy (EPL).*Results The average acquisition time reduction for 2D sequences (DWI, T1, FLAIR) was 1.9 min. The average acquisition time reduction for 3D sequences (SWI, SPACE FLAIR, and MPRAGE) was approximately 3 min. The expected time reductions for BR-, BR+, MS, MML, and EPL protocols were 6.6 min, 11.9 min, 14 min, 10.8 min, and 14.1 min, respectively. The overall median aggregate acquisition time was 31.00 [25.00, 36.00] min for the pre-implementation period and 18.00 [15.00, 22.00] min for the post-implementation period, with a difference of 13 min (42%). The median acquisition time was reduced by 5.5 min (20%) for BR-, 14.0 min (44%) for BR+, 13.5 min (37%) for MS, 11 min (52%) for MML, and 16 min (35%) for EPL.*Conclusions The implementation of fast brain MRI sequences significantly reduced the acquisition times for outpatient brain MRI protocols. *Clinical Relevance/Application The real-world implementation of fast brain MRI sequences significantly reduced acquisition times for the most performed brain MRI protocols. The projected benefits to the clinical workflow and patient care are substantial, and include increased imaging volume throughput, improved patient access for valuable MRI resources, increased departmental revenue, and improved patient and healthcare worker safety during the COVID-19 pandemic.

RESULTS

The average acquisition time reduction for 2D sequences (DWI, T1, FLAIR) was 1.9 min. The average acquisition time reduction for 3D sequences (SWI, SPACE FLAIR, and MPRAGE) was approximately 3 min. The expected time reductions for BR-, BR+, MS, MML, and EPL protocols were 6.6 min, 11.9 min, 14 min, 10.8 min, and 14.1 min, respectively. The overall median aggregate acquisition time was 31.00 [25.00, 36.00] min for the pre-implementation period and 18.00 [15.00, 22.00] min for the post-implementation period, with a difference of 13 min (42%). The median acquisition time was reduced by 5.5 min (20%) for BR-, 14.0 min (44%) for BR+, 13.5 min (37%) for MS, 11 min (52%) for MML, and 16 min (35%) for EPL.

CLINICAL RELEVANCE/APPLICATION

The real-world implementation of fast brain MRI sequences significantly reduced acquisition times for the most performed brain MRI protocols. The projected benefits to the clinical workflow and patient care are substantial, and include increased imaging volume throughput, improved patient access for valuable MRI resources, increased departmental revenue, and improved patient and healthcare worker safety during the COVID-19 pandemic.

SDP-NR-55 Efficacy Of Deep Learning Reconstruction For High-resolution Three-dimensional MR Cisternography In Evaluation Of Cerebellopontine Angle Tumors

Participants
Masamichi Hokamura, Kumamoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning reconstruction (DLR) can reduce image noise and increase the signal-to-noise ratio (SNR) of MR images. We aimed to evaluate the efficacy of DLR for high-spatial resolution (HR) three-dimensional (3D) MR cisternography in the evaluation of cerebellopontine angle (CPA) tumors.*Methods and Materials This study included consecutive 13 patients (5 men, 8 women; age range 35-77 years; mean age 54 years) who preoperatively underwent HR 3D isotropic T2-weighted fast asymmetric spin-echo (FASE) imaging (HR MR cisternography) using a 3T MRI scanner with a 32-channel head coil. The CPA tumors were 11 schwannomas and 2 meningiomas. The reconstruction voxel size of HR MR cisternography was 0.23 × 0.23 × 0.5 mm and the scan time 5 min 40 s. The HR MR cisternography was reconstructed with or without DLR. Contrast-to-noise ratio (CNR) between the tumor and trigeminal nerve and between the cerebrospinal fluid and trigeminal nerve were compared between the images with and without DLR. Identification and demarcation of the cranial nerves V-XII contralateral to the tumor were independently rated using a 4-point grading scale on HR MR cisternography with and without DLR. Visualization of the cranial nerves VII/VIII around the tumor on HR MR cisternography were assessed with reference to intraoperatative findings.*Results The mean CNR between the tumor and trigeminal nerve and between the cerebrospinal fluid and trigeminal nerve were significantly higher with DLR than without DLR (16.4 ± 9.3 vs. 12.0 ± 6.7, P < 0.001, 76.1 ± 21.8 vs. 57.6 ± 20.6, P < 0.001). In the identification of lower cranial nerves XI, X, and XI and the demarcation of the cranial nerves VI-XII, the mean score was significantly higher with DLR than without DLR (P < 0.05). The cranial nerves VII/VIII around the tumor were clearly visualized in 4 of 13 (31%) cases on HR MR cisternography with DLR, but in 2 of 13 (15%) without DLR.*Conclusions HR MR cisternography using DLR may improve cranial nerve identification and help detect nerves around CPA tumors.*Clinical Relevance/Application HR MR cisternography using DLR is a promising non-invasive imaging tool for assessing cerebellopontine angle tumors.

RESULTS

The mean CNR between the tumor and trigeminal nerve and between the cerebrospinal fluid and trigeminal nerve were significantly higher with DLR than without DLR (16.4 ± 9.3 vs. 12.0 ± 6.7, P < 0.001, 76.1 ± 21.8 vs. 57.6 ± 20.6, P < 0.001). In the identification of lower cranial nerves XI, X, and XI and the demarcation of the cranial nerves VI-XII, the mean score was significantly higher with DLR than without DLR (P < 0.05). The cranial nerves VII/VIII around the tumor were clearly visualized in 4 of 13 (31%) cases on HR MR cisternography with DLR, but in 2 of 13 (15%) without DLR.

CLINICAL RELEVANCE/APPLICATION

HR MR cisternography using DLR is a promising non-invasive imaging tool for assessing cerebellopontine angle tumors.

SDP-NR-56   Fully Automated Radiomics-based Machine Learning Models For Multiclass Classification Among Glioblastoma, Primary Central Nervous System Lymphoma, And Single Brain Metastasis

Participants
Bio Joo, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic performance and generalizability of fully automated traditional machine learning and deep learning models for multiclass classification of an untreated single brain mass among glioblastoma, primary central nervous system lymphoma, and brain metastasis using radiomics.*Methods and Materials The training and external validation cohorts were comprised of 538 cases with an untreated single brain lesion (300 glioblastomas, 73 lymphomas, and 165 metastases) and 169 cases (101 glioblastomas, 29 lymphomas, and 39 metastases), respectively. All cases were histopathologically-proven. A total of 372 radiomic features extracted on contrast-enhanced T1-weighted images and T2-weighted images based on both enhancing masks and non-enhancing T2 hyperintense masks using a fully automated segmentation method were analyzed. By using a sequential feature selection method with five traditional machine learning classifiers, the optimal classifiers and number of features were chosen. A deep neural network (DNN) model was also trained on the radiomic features. Hyperparameters of each model were optimized through fivefold cross-validation in the training cohort. The diagnostic performance of the optimized models was tested in the external validation cohort.*Results After the feature selection and model optimization, LASSO model and XGBoost model with 15 selected features were chosen. In the external validation, the LASSO model, XGBoost model, and DNN model showed an accuracy of 0.769 (95% CI, 0.698-0.831), 0.710 (95% CI, 0.642-0.778), and 0.716 (95% CI, 0.648-0.784), respectively.*Conclusions Our results revealed that the fully automated traditional machine learning and deep learning models based on radiomic features can serve a generalizable multiclass classification task for differentiation of an untreated single brain mass among glioblastoma, primary central nervous system lymphoma, and brain metastasis.*Clinical Relevance/Application Fully automated radiomics-based models can serve a generalizable multiclass classification task for an untreated single brain mass.

RESULTS

After the feature selection and model optimization, LASSO model and XGBoost model with 15 selected features were chosen. In the external validation, the LASSO model, XGBoost model, and DNN model showed an accuracy of 0.769 (95% CI, 0.698-0.831), 0.710 (95% CI, 0.642-0.778), and 0.716 (95% CI, 0.648-0.784), respectively.

CLINICAL RELEVANCE/APPLICATION

Fully automated radiomics-based models can serve a generalizable multiclass classification task for an untreated single brain mass.

SDP-NR-57   Development And Validation Of Visual Grading System For Intracranial Arterial Stenosis On Time-of-flight Magnetic Resonance Angiography

Participants
Byungjun Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Although overestimation problem of time-of-flight magnetic resonance angiography (TOF-MRA) applying the warfarin-aspirin symptomatic intracranial disease (WASID) method to assess intracranial arterial stenosis has been suggested, no pertinent grading system for TOF-MRA has been developed. We aimed to develop and evaluate the performance of a visual grading system for intracranial arterial stenosis on TOF-MRA (MRAVICAST).*Methods and Materials This single-center cohort study analyzed prospective observational registry data from a comprehensive stroke center between January 2014 and February 2020. Patients with confirmed stenosis of the intracranial large arteries who underwent confirmative digital subtraction angiography (DSA) were included; a four-point grading system was developed based on physical characteristics of TOF-MRA. The overall diagnostic accuracies of MRAVICAST for each grade, interobserver reproducibility, and positive predictive values for >50% and >70% stenoses were evaluated.*Results We analyzed 132 segments with intracranial atherosclerotic stenosis from 71 patients (34 men and 37 women; mean age, 61.0±15.25 years; range, 21-89 years). The overall diagnostic accuracy of MRAVICAST (93.9%, 124/132) was higher than that of MRAWASID (50.8%, 67/132) for each grade. The degree of stenosis did not differ significantly between MRAVICAST and DSAWASID (P=.849). Regarding reproducibility, MRAVICAST demonstrated excellent interobserver agreement (ICC, 0.989; 95% CI, 0.979-0.999). The positive predictive values of MRAVICAST for the diagnosis of >50% and >70% stenoses were 97.3% and 100.0%, respectively.*Conclusions The new intuitive grading system accurately and reliably determined the degree of stenosis in intracranial arterial atherosclerosis patients.*Clinical Relevance/Application In the era of medical treatment for intracranial atherosclerotic stenosis, MRAVICAST could be a versatile alternative method to MRAWASID for evaluating intracranial arterial stenosis.

RESULTS

We analyzed 132 segments with intracranial atherosclerotic stenosis from 71 patients (34 men and 37 women; mean age, 61.0±15.25 years; range, 21-89 years). The overall diagnostic accuracy of MRAVICAST (93.9%, 124/132) was higher than that of MRAWASID (50.8%, 67/132) for each grade. The degree of stenosis did not differ significantly between MRAVICAST and DSAWASID (P=.849). Regarding reproducibility, MRAVICAST demonstrated excellent interobserver agreement (ICC, 0.989; 95% CI, 0.979-0.999). The positive predictive values of MRAVICAST for the diagnosis of >50% and >70% stenoses were 97.3% and 100.0%, respectively.

CLINICAL RELEVANCE/APPLICATION

In the era of medical treatment for intracranial atherosclerotic stenosis, MRAVICAST could be a versatile alternative method to

MRAWASID for evaluating intracranial arterial stenosis.

SDP-NR-58 Measuring Adherence To Tripod Of Artificial Intelligence Papers In The Glioma Segmentation

Participants
Niklas Tillmanns, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Generalizability, reproducibility and objectivity are critical elements that need to be considered when translating machine learning models into clinical practice. While a large body of literature has been published on machine learning methods for segmentation of brain tumors, a systematic evaluation of paper quality and reproducibility has not been done. We investigated the use of "Transparent Reporting of studies on prediction models for Individual Prognosis Or Diagnosis" (TRIPOD) items, which are similar to the CLAIM checklist, among papers published in this relatively new and growing field.*Methods and Materials According to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) a literature review was performed on four databases, Ovid Embase, Ovid MEDLINE, Cochrane trials (CENTRAL) and Web of science core-collection first in October 2020 and a second time in February 2021. Keywords and controlled vocabulary included artificial intelligence, machine learning, deep learning, radiomics, magnetic resonance imaging, glioma, and glioblastoma. The publications were assessed in order to the TRIPOD items.*Results 37 publications from our database search were screened in TRIPOD and yielded an average score of 12.08 with the maximum score being 16 and the minimum score 7. The best scoring item was interpretation (item 19) where all papers scored a point. The lowest scoring items were the title, the abstract, risk groups and the model performance (items number 1, 2, 11 and 16), where no paper scored a point. Less than 1% of the papers discussed the problem of missing data (item 9) and the funding for research (item 22).*Conclusions TRIPOD analysis was applied to machine learning papers that described novel approaches to brain tumor segmentation and showed that majority of the papers do not score high on critical elements that allow reproducibility, translation, and objectivity of research. An average score of 12.08 (40%) indicates that the publications usually achieve a relatively low score. The categories that were consistently poorly described include the ML network description, measuring model performance, title details, and inclusion of information into the abstract.*Clinical Relevance/Application A Systematic adherence-scoring-system enhances objectivity and ensures consistent measurement of adherence to a reporting guideline. This allows reproducibility of data and translation of algorithms into clinical practice.

RESULTS

37 publications from our database search were screened in TRIPOD and yielded an average score of 12.08 with the maximum score being 16 and the minimum score 7. The best scoring item was interpretation (item 19) where all papers scored a point. The lowest scoring items were the title, the abstract, risk groups and the model performance (items number 1, 2, 11 and 16), where no paper scored a point. Less than 1% of the papers discussed the problem of missing data (item 9) and the funding for research (item 22).

CLINICAL RELEVANCE/APPLICATION

A Systematic adherence-scoring-system enhances objectivity and ensures consistent measurement of adherence to a reporting guideline. This allows reproducibility of data and translation of algorithms into clinical practice.

SDP-NR-59 Identifying Clinically Applicable Machine Learning Algorithms For Glioma Segmentation Using A Systematic Literature Review

Participants
Niklas Tillmanns, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Machine learning (ML) algorithms are commonly used for segmentation of gliomas, but which algorithms provide the most accurate method for implementation into clinical practice has not fully been identified. We performed a systematic review of the literature to characterize the methods used for glioma segmentation and their accuracy.*Methods and Materials In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA), a literature review was performed on four databases, Ovid Embase, Ovid MEDLINE, Cochrane trials (CENTRAL) and Web of science core-collection first in October 2020 and in February 2021. Keywords and controlled vocabulary included artificial intelligence, machine learning, deep learning, radiomics, magnetic resonance imaging, glioma, and glioblastoma. Publications were screened in Covidence and the bias analysis was done in agreement with Transparent Reporting of studies on prediction models for Individual Prognosis Or Diagnosis (TRIPOD).*Results The search identified 11,727 candidate articles, 1,135 articles underwent full text review, and 66 articles were used for data extraction. BRATS and TCIA datasets were used in 36.6% of all studies, with average number of patients being 141 (range: 1 to 622). ML methods represented 45.3% of studies, with deep learning used in 54.7%; Dice score for the tumor core ranged from 0.72 to 0.95. The most common algorithm used in the machine learning papers was support vector machines (SVM) and for deep learning papers, it was Convolutional Neural Networks (CNN). Preliminary TRIPOD analysis yielded an average score from 12 (range: 7-16) with the majority of papers demonstrating deficiencies in description of the ML algorithm, funding role, data acquisition and measures of model performance.*Conclusions In the last years, many articles were published on segmentation of gliomas using machine learning, thus establishing this method for tumor segmentation with high accuracy. However, the major limitations for clinically applicable use of ML in glioma segmentation include more than one-third of publications use the same datasets, thus limiting generalizability, increase the likelihood of overfitting, show and lack of ML network description and standardization in accuracy reporting.*Clinical Relevance/Application We present a systematic review on ML approaches, that provide insights on clinically applicable algorithm for segmentation of brain tumors.

RESULTS

The search identified 11,727 candidate articles, 1,135 articles underwent full text review, and 66 articles were used for data extraction. BRATS and TCIA datasets were used in 36.6% of all studies, with average number of patients being 141 (range: 1 to 622). ML methods represented 45.3% of studies, with deep learning used in 54.7%; Dice score for the tumor core ranged from 0.72 to 0.95. The most common algorithm used in the machine learning papers was support vector machines (SVM) and for deep learning papers, it was Convolutional Neural Networks (CNN). Preliminary TRIPOD analysis yielded an average score from 12 (range: 7-16) with the majority of papers demonstrating deficiencies in description of the ML algorithm, funding role, data acquisition and measures of model performance.

CLINICAL RELEVANCE/APPLICATION

We present a systematic review on ML approaches, that provide insights on clinically applicable algorithm for segmentation of brain tumors.

SDP-NR-60 Discrimination Of Intracerebral Tumorous Hemorrhage From Pure Hemorrhage Using CT Texture Analysis

Participants
Kyung-Min Lee, MD, Gyeonggi-do, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Detection of underlying tumor in patients with acute intracerebral hemorrhage (ICH) is critical in initial treatment planning and following prognosis. The purpose of our study was to investigate the diagnostic value of CT texture analysis for discriminating tumorous hemorrhage from pure ICH*Methods and Materials This retrospective study included 50 patients with tumorous hemorrhage and 50 patients with pure ICH who underwent non-enhanced CT scan within 24 hours after symptom onset. CT texture analysis were performed using commercially available TexRAD software. Differences between tumorous hemorrhage and pure ICH were analyzed using ?2 test and independent t-test. ROC curve analysis was performed for discriminating tumorous hemorrhage with texture parameters. Diagnostic performance of texture parameters were compared with those of radiologists who have variable degree of experience in neuroradiology using McNemar test.*Results The location (p=0.583) and size (p=0.545) of ICH were not significantly different between tumorous and pure hemorrhage. All histogram texture features (mean, SD, entropy, skewness, and kurtosis) were significantly different between two groups of ICH. Among 20 second order gray-level co-occurrence matrix (GLCM) features, 19 features of tumorous hemorrhage were significantly different from those of pure ICH. The mean and entropy showed highest AUC, 0.985 with cutoff of 67.98 and 0.916 with cutoff of 3.43, respectively. Diagnostic accuracy of mean (94.0%) and entropy (89.9%) were similar to those of radiologists (88.0~93.0%). When combining the mean and entropy, the accuracy increased to the 100%, although it was not statistically different from those of radiologist (p=0.424, 0.053, 0.077).*Conclusions Texture parameters from non-enhanced CT scan is helpful for differentiating tumorous hemorrhage from pure ICH and the diagnostic performance is not different from that of radiologist.*Clinical Relevance/Application CT texture analysis might be useful for detecting underlying tumor when a patient presents acute intracerebral hemorrhage.

RESULTS

The location (p=0.583) and size (p=0.545) of ICH were not significantly different between tumorous and pure hemorrhage. All histogram texture features (mean, SD, entropy, skewness, and kurtosis) were significantly different between two groups of ICH. Among 20 second order gray-level co-occurrence matrix (GLCM) features, 19 features of tumorous hemorrhage were significantly different from those of pure ICH. The mean and entropy showed highest AUC, 0.985 with cutoff of 67.98 and 0.916 with cutoff of 3.43, respectively. Diagnostic accuracy of mean (94.0%) and entropy (89.9%) were similar to those of radiologists (88.0~93.0%). When combining the mean and entropy, the accuracy increased to the 100%, although it was not statistically different from those of radiologist (p=0.424, 0.053, 0.077).

CLINICAL RELEVANCE/APPLICATION

CT texture analysis might be useful for detecting underlying tumor when a patient presents acute intracerebral hemorrhage.

SDP-NR-61 Glymphatic System Evaluation Using Diffusion Tensor Imaging In Patients With Traumatic Brain Injury

Participants
Sung Hyun An, Sunwon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The activity of the glymphatic system is known to be impaired in animal models of traumatic brain injury (TBI). We evaluated the activity of the human glymphatic system using a non-invasive method called "Diffusion Tensor Image Analysis along the Perivascular Space (DTI-ALPS)" in patients with traumatic brain injury (TBI).*Methods and Materials From June 2018 to May 2020, patients with TBI (n=89) and age- and sex-matched control subjects (n=34) were included. All MRIs were obtained using a 3T scanner with DTI (32 directions of gradients) and MRIs were scanned within 7 to 28 days after the date of injury in TBI patients. Clinical classification of TBI severity was performed based on the electronic medical records (EMR) including the Glasgow Coma Scale (GCS). The presence of diffuse axonal injury (DAI) was evaluated based on the MRI by a neuro-radiologist. DTI-ALPS method was adopted and the index called "ALPS-index" was calculated to quantify the glymphatic system activity along the perivascular space. The independent t-test was used to compare ALPS-index between TBI/control subjects and DAI/no DAI patients. A one-way analysis of variance (ANOVA) was used to determine whether there was a significant difference in ALPS-index between control/mild TBI/moderate to severe TBI patients.*Results ALPS-index was significantly lower in TBI patients (mean±SD, 1.32±0.19) than in normal control subjects (1.52±0.16, P<.001). There was a significant difference of ALPS-index between control subjects and patients with mild or moderate to severe TBI (ANOVA, P<.001; Tukey's test, P<0.05 for control vs. mild or moderate to severe TBI). ALPS-index was significantly lower in TBI patients with DAI than in patients without DAI (1.26±0.16 vs. 1.38±0.2, P=.003).*Conclusions The DTI-ALPS method can be used to assess glymphatic system impairment in patients with TBI.*Clinical Relevance/Application This is the first study to show human glymphatic system impairment in patients with traumatic brain injury. There may be a possible association between TBI-related brain injury and glymphatic dysfunction.

RESULTS

ALPS-index was significantly lower in TBI patients (mean±SD, 1.32±0.19) than in normal control subjects (1.52±0.16, P<.001). There was a significant difference of ALPS-index between control subjects and patients with mild or moderate to severe TBI (ANOVA, P<.001; Tukey's test, P<0.05 for control vs. mild or moderate to severe TBI). ALPS-index was significantly lower in TBI patients with DAI than in patients without DAI (1.26±0.16 vs. 1.38±0.2, P=.003).

CLINICAL RELEVANCE/APPLICATION

This is the first study to show human glymphatic system impairment in patients with traumatic brain injury. There may be a possible association between TBI-related brain injury and glymphatic dysfunction.

SDP-NR-62 Estimation Of R2 From Conventional Mr Images: A Deep Learning Approach

Participants
Dohoon Park, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Most clinical MRI were "weighted" for specific NMR properties, such as T1 or T2 relaxation times. While signal intensities were

Most clinical MRI were "weighted" for specific NMR properties, such as T1 or T2 relaxation times. While signal intensities were closely related to them, they are not quantitative enough, such as radiomics or other parametric approaches. Meanwhile, conventional relaxometry requires very long scan time, especially for R2, which is almost impossible in clinics. In this work we used a deep learning (DL) approach to disentangle the relationship between conventional MRI signals and R2 relaxation time, and explore the potential clinical values.*Methods and Materials We used 125 subjects, 179 MRI sets (training 161 , validation 18) with a MR protocol for demyelinating disease, which included multi-contrast structural images, as well as multi-echo spin echo images (mSE) for R2 mapping. To maximize the information regarding NMR relaxation into DL model, we added all T2-, T1-weighted and T2 FLAIR images as input channels. An exponentially estimated R2 map from mSE was used as the label. Due to limited scan time of clinical MRI, mSE was performed in narrow area of the brain, and training was done within the area with mSE data. Preprocessing steps including brain extraction, linear registration, and normalization. RandomFieldBias augmentation from the TorchIO library was used. We modified 2D U-net structures with axial image input, with about 3600 slices (training 3300, validation 300). The loss function was defined as the sum of L1 loss and 0.1*gradient loss. After training, estimation of whole brain R2 was performed, in and out of the labeled area (matched to mSE data). Evaluation of estimated R2 map was done including correlation coefficient of R2 to reference data according to the brain tissue classes.*Results After 500 epoch of training, DL-based estimated R2 showed good correlation to reference R2 estimation, as well as map quality improvement. Especially, this correlation was excellent in gray and white matters (correlation coefficient > 0.98), as compared to CSF (=0.90). Interestingly, estimation was excellent at the brain area out of the mSE area which was not have training data. Whole brain R2 were well matched known range of the R2, and there were smooth continuation between area with labels and without labels.*Conclusions Using proposed approach, whole brain R2 map can be estimated successfully from a combination of clinically available 'weighted' images.*Clinical Relevance/Application From this approach, estimation of whole brain R2 relaxation time, which is in general very time-consuming, can be obtained from combination of clinically acquired T1 and T2 weighted images and deep learning. It can be used for objective imaging analysis, as well as further image processing, such as radiomics or other parametric mappings.

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After 500 epoch of training, DL-based estimated R2 showed good correlation to reference R2 estimation, as well as map quality improvement. Especially, this correlation was excellent in gray and white matters (correlation coefficient > 0.98), as compared to CSF (=0.90). Interestingly, estimation was excellent at the brain area out of the mSE area which was not have training data. Whole brain R2 were well matched known range of the R2, and there were smooth continuation between area with labels and without labels.

CLINICAL RELEVANCE/APPLICATION

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SDP-NR-64 Deoxyhemoglobin Perfusion MRI In Patients With Steno-Occlusive Vascular Disease

Participants
Ece Su Sayin, BSC, Toronto, Ontario (*Presenter*) Contract, Thornhill Research Inc

PURPOSE

The magnetic properties of hemoglobin depend directly on its oxygenation state. The ability to rapidly control blood oxygenation could therefore be used to generate paramagnetic deoxyhemoglobin (dHb) in the form of a bolus for perfusion imaging. Generating rapid changes in lung PO2 could therefore be applied to control hemoglobin (Hb) oxygen saturation in pulmonary veins thus delivering dHb to the tissues for use as an endogenous paramagnetic contrast agent to acquire maps of CBF metrics.*Methods and Materials 6 healthy controls and 15 patients with steno-occlusive disease were studied. A computer-controlled gas blender was used to control end-tidal gas values using sequential gas delivery. BOLD MRI was acquired on a 3T GE Signa HDx system. The PO2 change was modulated in ranged from 95 mmHg to 40 mmHg. An arterial input function (AIF) was selected using a single voxel with the greatest signal change corresponding to known arterial anatomy. A linear regression of the BOLD signal (S) against the SaO2 calculated from PO2 was used to calculate %BOLD, correlation and time delay (TD) maps. Maps of relative CBF, CBV, and MTT were generated. The mean transit time (MTT) was calculated as $S(t)=(rCBV/MTT)SaO2(t)? e^{(-t/MTT)}$, where the limits were set between 0-8s. The relative CBV (rCBV) was calculated as the area under the curve. The relative CBF (rCBF) was calculated as rCBF = rCBV/MTT.*Results The MTT, rCBF and rCBF showed expected differences in gray matter and white matter in controls while showing longer MTT, increased rCBV, and thereby reduced rCBF in patients.*Conclusions The dHb bolus method has the potential to provide diagnostic quality rCBV, rCBF and MTT maps without using intra-venous contrast. Limited interrupted exposure to 75% SaO2 provides safety (Bickler et al., 2017).*Clinical Relevance/Application Testing in patients shows promise in identifying the effects of steno-occlusive disease on cerebral perfusion. Advantages of this "needle-free" approach include: absence of contrast reactions and toxicities, unlimited repeatability, no recirculation and no extra-vascular leakage from the circulation thus improving measurement of perfusion metrics when the BBB is disrupted.

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SDP-NR-65 Error Quantification Analysis On CT Perfusion Thresholds And Parameters Approaching To Predict Infarct Core Volumes Using Different Commercial Software: Short-interval DWI Follow-up From Initial CT Perfusion

Participants
Chuluunbaatar Otgonbaatar, MD, Ulaanbaatar, Mongolia (*Presenter*) Nothing to Disclose

PURPOSE

Although CTP is widely used practically in the selection of patients and guides decision-making in acute ischemic stroke, still there is a no clear standardization of optimal thresholds and parameters. Nowadays, infarct core volume with rCBF<30% threshold is

commonly used. Several studies were performed in assessing the volumetric agreement of the infarct core volume between CTP and follow-up DWI within 24 hours. Therefore, in this study, we aimed to assess the volumetric agreement of estimated infarct core using different threshold and parameters with commercial software including VITREA and RAPID on CTP and final infarct volume on DWI in patients with short interval times (less than 60 minutes) from CTP to DWI.*Methods and Materials 39 acute ischemic stroke patients with occlusion of a large artery in the anterior circulation were included. The CT perfusion maps were processed with two different CT perfusion software including singular value decomposition plus (SVD+) in VITREA (Vital Images, MN, USA) and RAPID (iSchema View, Menlo Park, CA). The RAPID identifies infarct as tissue with rCBF<20%-42% while CBV reduction of 29%, 35%, 38% and 41% on VITREA. Olea Sphere was used to measure the infarct volume on DWI.*Results The CTP was performed before DWI in all patients and the median time between CTP and DWI was 38 minutes (IQR 21 - 44). The median final infarct volume was 19.75 ml (IQR 7.68 - 73.97) with DWI. The CBV reduction of 29% (mean infarct volume difference 1.68±32.63) for VITREA and rCBF < 38% (mean infarct volume difference 13.62±26.12) for RAPID predicted final infarct volume with the lowest mean infarct volume difference for each software (Table 1 and Figure 1). Compared to default settings of each CTP software, the limits of agreement were smallest with RAPID rCBF < 38% 5.32 to 21.72 ml and VITREA CBV reduction of 29% -8.56 to 11.92 (Figure 2-3). The representative case is shown in Figure 4.*Conclusions The CBV threshold was non-inferior in the estimation of infarct core volume compared to CBF threshold. rCBF<38% proved to estimate infarct core volume more accurately than rCBF<30% while CBV reduction of 29% performed more accurately than the reduction of 41% by lower mean infarct core volume differences.*Clinical Relevance/Application The underestimation and overestimation measurement by different parameters and thresholds could exclude or select the patient for endovascular treatment differently and directly associated with the clinical outcome of the patient.

RESULTS

The CTP was performed before DWI in all patients and the median time between CTP and DWI was 38 minutes (IQR 21 - 44). The median final infarct volume was 19.75 ml (IQR 7.68 - 73.97) with DWI. The CBV reduction of 29% (mean infarct volume difference 1.68±32.63) for VITREA and rCBF < 38% (mean infarct volume difference 13.62±26.12) for RAPID predicted final infarct volume with the lowest mean infarct volume difference for each software (Table 1 and Figure 1). Compared to default settings of each CTP software, the limits of agreement were smallest with RAPID rCBF < 38% 5.32 to 21.72 ml and VITREA CBV reduction of 29% -8.56 to 11.92 (Figure 2-3). The representative case is shown in Figure 4.

CLINICAL RELEVANCE/APPLICATION

The underestimation and overestimation measurement by different parameters and thresholds could exclude or select the patient for endovascular treatment differently and directly associated with the clinical outcome of the patient.

SDP-NR-8   A Novel Method To Visualize Ischemic Cores By Employing Contrast Differences Between Virtual Monoenergetic Images

Participants
Tomomi Omura, Akita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study was to propose a novel method to visualize the ischemic core using the contrast difference of brain tissue between virtual monoenergetic images (VMIs).*Methods and Materials Twenty-eight patients who underwent non-enhanced dual-energy CT (NE-DECT) on suspicion of AIS were scanned using a dual-source DECT (SOMATOM Drive, Siemens Healthineers, Forchheim, Germany). The NE-DECT images were acquired at a kV-pair of 80 kV and 140 kV with tin-filtration at about 70 mGy using automatic exposure control. Mixed-120 kV images were synthesized by compositing both kV images. The native VMIs were generated at 40, 70, 100, 130, 160, and 190 keV using a CT vendor's workstation. The proposed contrast change rate ischemic core (CCI) image, which reflected the contrast difference of brain tissue, was generated by dividing the 130 keV image by the corresponding 40 keV image. The CCI image, all native VMIs, mixed-120 kV images, and DWIs were transformed to the standard brain map using SPM (Wellcome Department of Cognitive Neurology, Institute of Neurology, London, U.K.) and applied the ASPECTS 10-ROIs template to measure pixel values. The ischemic core for CT images was found in the region where its ROI value in the normal hemisphere was higher than the corresponding ROI in the ischemic hemisphere. The ischemic core for DWI was found in the region with the highest signal. Finally, sensitivity and specificity for the CCI image, all keV of the VMIs, and the mixed-120 kV images were calculated by comparing with DWIs.*Results Both the sensitivity and the specificity of the CCI image resulted the highest scores among all images (The CCI image; 0.591/0.609, mixed-120 keV; 0.583/0.296, VMI-40 keV; 0.557/0.365, VMI-70 keV; 0.559/0.346, VMI-100 keV; 0.564/0.309, VMI-130 keV; 0.571/0.306, VMI-160 keV; 0.572/0.301, VMI-190 keV 0.571/0.296). Notably, the specificity was significantly higher in the CCI image.*Conclusions Our proposed method to visualize the ischemic core using the contrast difference of brain tissue between VMIs was able to detect the ischemic core accurately.*Clinical Relevance/Application The higher the VMI in energy (keV), the greater the change in tissue contrast between the lower VMI. Imaging the difference in contrast change is useful for detecting the ischemic core.

RESULTS

Both the sensitivity and the specificity of the CCI image resulted the highest scores among all images (The CCI image; 0.591/0.609, mixed-120 keV; 0.583/0.296, VMI-40 keV; 0.557/0.365, VMI-70 keV; 0.559/0.346, VMI-100 keV; 0.564/0.309, VMI-130 keV; 0.571/0.306, VMI-160 keV; 0.572/0.301, VMI-190 keV 0.571/0.296). Notably, the specificity was significantly higher in the CCI image.

CLINICAL RELEVANCE/APPLICATION

The higher the VMI in energy (keV), the greater the change in tissue contrast between the lower VMI. Imaging the difference in contrast change is useful for detecting the ischemic core.

SDP-NR-9   Assessment Of The Degree Of Arterial Stenosis In Intracranial Atherosclerosis Using 3D High-resolution MRI: Comparison With Time-of-flight MRA, Contrast-enhanced MRA And DSA

Participants
Deng-Ling Zhao, Nanjing, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the accuracy of 3D high-resolution MRI (HR-MRI), time-of-flight magnetic resonance angiography (TOF-MRA), contrast-enhanced magnetic resonance angiography (CE-MRA) and digital subtraction angiography (DSA) in measuring the degree of stenosis in intracranial atherosclerosis.*Methods and Materials All patients with intracranial artery ischemic events underwent HR-MRI, TOF-MRA, and CE-MRA analysis, and some of these patients underwent DSA examination. The correlation between

different methods for measuring the degree of lumen stenosis was analyzed. The accuracy of HR-MRI, TOF-MRA and CE-MRA was evaluated and compared with that of DSA.*Results A total of 189 arterial stenoses were identified in 93 patients. Of them, 72 patients with 142 arterial stenoses underwent DSA examination. A very strong correlation between HR-MRI and CE-MRA measurements was shown (r=0.839). The correlation between HR-MRI and TOF-MRA measurements was strong (r=0.720). A very strong correlation between HR-MRI and DSA measurements was found (r=0.864), and a similar correlation was observed between CE-MRA and DSA measurements (r=0.843). The correlation between TOF-MRA and DSA measurements was strong (r=0.686). There was substantial agreement between HR-MRI and DSA measurements (K=0.772) and between CE-MRA and DSA measurements (K=0.734) that was slightly higher than the agreement between TOF-MRA and DSA measurements (K=0.625).*Conclusions 3D HR-MRI can accurately measure stenosis (especially for moderate and severe stenosis) in intracranial atherosclerosis by direct visualization of the vessel lumen and steno-occlusive plaque.*Clinical Relevance/Application 3D HR-MRI can be used to access the multiple intracranial atherosclerotic arteries. And it is promising to be a reliable and comprehensive clinical assessment method for ischemic stroke risk prediction.

RESULTS

A total of 189 arterial stenoses were identified in 93 patients. Of them, 72 patients with 142 arterial stenoses underwent DSA examination. A very strong correlation between HR-MRI and CE-MRA measurements was shown (r=0.839). The correlation between HR-MRI and TOF-MRA measurements was strong (r=0.720). A very strong correlation between HR-MRI and DSA measurements was found (r=0.864), and a similar correlation was observed between CE-MRA and DSA measurements (r=0.843). The correlation between TOF-MRA and DSA measurements was strong (r=0.686). There was substantial agreement between HR-MRI and DSA measurements (K=0.772) and between CE-MRA and DSA measurements (K=0.734) that was slightly higher than the agreement between TOF-MRA and DSA measurements (K=0.625).

CLINICAL RELEVANCE/APPLICATION

3D HR-MRI can be used to access the multiple intracranial atherosclerotic arteries. And it is promising to be a reliable and comprehensive clinical assessment method for ischemic stroke risk prediction.

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NR03-C

Neuroradiology Tuesday Poster Discussions

Sub-Events

NR03-C1   Multi-phase CTA For The Diagnosis Of ICA Pseudo-occlusion

Participants

Gerald Riccardello, MD, Providence, Rhode Island (*Presenter*) Nothing to Disclose

PURPOSE

Pseudo-occlusion (PO) of the cervical internal carotid artery (cICA) are common and have been shown to have poor outcome after mechanical thrombectomy. Prompt diagnosis and differentiation between ICA POs and true cICA occlusion are thus important. We investigated the diagnostic utility of multiphase CTA for the evaluation of cICA POs.*Methods and Materials We retrospectively reviewed all patients who underwent multiphase CTA and subsequent diagnostic cerebral angiography (DCA) between 1-1-2018 and 12-2019. Results of the DCA were reviewed to determine cICA POs and true cICA occlusion, with PO being defined as complete lack of opacification of any portion of the cICA on CTA without complete occlusion of the cICA on DCA. The Fisher exact test was used in data analysis.*Results 98 patients were found to have complete lack of opacification of the cICA on arterial phase of multiphase CTA and subsequently underwent DCA, and were included in the study. 38 patients were found to have true cICA occlusion on DCA with 0/38 (0%) demonstrating late filling of the ICA on delayed phases of the CTA, while 39 demonstrated cICA PO on DCA with 20/39 (51%) demonstrating late filling of the ICA on delated phases of the CTA (p<0.0001)*Conclusions Multiphase CTA has utility in the diagnosis and differentiation of cICA PO and true cICA occlusion.*Clinical Relevance/Application Multiphase CTA is a readily available and non-invasive test that has the ability to differentiation between cICA PO and true cICA occlusion, which has implications in patient selection and treatment preparation in stroke therapy.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Multiphase CTA is a readily available and non-invasive test that has the ability to differentiation between cICA PO and true cICA occlusion, which has implications in patient selection and treatment preparation in stroke therapy.

NR03-C3   Automated Assessment Of Aneurysm Volume And Size In Subarachnoid Hemorrhage Using Deep Learning: Comparison With Manual Segmentation And Manual Measurement Of Aneurysm Diameters

Participants

Lenhard Pennig, MD, Cologne, Germany (*Presenter*) Speakers Bureau, Koninklijke Philips NV;Institutional Grant, Koninklijke Philips NV

PURPOSE

The selection of the most suitable method of aneurysm embolization in subarachnoid hemorrhage (SAH) depends on various factors including aneurysm location, shape, and size. The purpose of this study was to compare aneurysm volume and size in SAH on computed tomography angiography as determined by I) manual segmentation (reference standard, RS), II) fully automated segmentation by a deep learning model (DLM), and III) approximation from manually measured aneurysm diameters.*Methods and Materials Three DLMs were trained for fully automated 3D voxel-wise segmentation of aneurysms (68 patients, 79 aneurysms) with their outputs being combined using ensemble learning (DLM-Ens). The DLM-Ens was evaluated on an independent test set (104 patients, 126 aneurysms). Manual aneurysm segmentations by two radiologists using 3D voxel-wise regional thresholding in consensus served as the RS. The largest diameters in three dimensions (length, height, and width) of the aneurysms in the test set were manually measured by two radiologists with four (R1) and two years (R2) of experience in diagnostic neuroradiology. The aneurysm volume was estimated using the formula $V=4/3*p*(length/2)*(height/2)*(width/2)$. Pearson's correlation coefficient (r) was used to assess the correlation of aneurysm volume and maximum diameter between the three approaches.*Results In the test set, the DLM-Ens detected and segmented 108 of 126 aneurysms (sensitivity of 85.7%). For these, the maximum aneurysm diameter obtained by the DLM (6.2±5.4 mm, r=0.835, p=0.01) and the readers (R1: 6.6±2.5 mm, r=0.842, p<0.01; R2: 6.4±2.6 mm, r=0.828, p<0.01) correlated strongly with the RS (manual segmentation: 6.4±5.7 mm). Aneurysm volume obtained by the DLM (124.6±182.9 mm3, r=0.916, p<0.01) and the readers (R1: 134.7±194.8 mm3, r=0.959, p<0.01; R2: 132.1±186.8 mm3, r=0.949, p<0.01) correlated even stronger with manual segmentations (138.6±197.4 mm3).*Conclusions Automated delineation of aneurysm volume and diameter strongly correlates with the results from manual segmentations and the approximation from manual aneurysm diameters. Therefore, the DLM has the potential to assist the physician in evaluating intracranial aneurysms while providing 3D geometrical characterization.*Clinical Relevance/Application By delineation of aneurysm volume and maximum diameter, the proposed DLM provides geometrical characterization of aneurysms and can support the physicians in charge for treatment of aneurysms in aSAH.

RESULTS

In the test set, the DLM-Ens detected and segmented 108 of 126 aneurysms (sensitivity of 85.7%). For these, the maximum

aneurysm diameter obtained by the DLM (6.2±5.4 mm, r=0.835, p=0.01) and the readers (R1: 6.6±2.5 mm, r=0.842, p<0.01; R2: 6.4±2.6 mm, r=0.828, p<0.01) correlated strongly with the RS (manual segmentation: 6.4±5.7 mm). Aneurysm volume obtained by the DLM (124.6±182.9 mm3, r=0.916, p<0.01) and the readers (R1: 134.7±194.8 mm3, r=0.959, p<0.01; R2: 132.1±186.8 mm3, r=0.949, p<0.01) correlated even stronger with manual segmentations (138.6±197.4 mm3).

CLINICAL RELEVANCE/APPLICATION

By delineation of aneurysm volume and maximum diameter, the proposed DLM provides geometrical characterization of aneurysms and can support the physicians in charge for treatment of aneurysms in aSAH.

NR03-C6 Resting State Functional Connectivity Patterns Associated With Simple Partial And Complex Partial Seizure Types In Temporal Lobe Epilepsy

Participants
Mashaal Syed, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Since focal epilepsy has been shown to impact neural regions beyond the epileptogenic zone, investigating the underlying functional connectivity patterns of individuals with Temporal Lobe Epilepsy (TLE) with Mesial Temporal Sclerosis (MTS) can improve understanding of this disease's neural connections. In particular those with a pre-operative history of simple partial seizures (SP) and those with a pre-operative history of complex partial seizures (CP) were evaluated to determine associations between resting state functional (rsf) brain connectivity and these seizure types.*Methods and Materials The rsf-MRIs of 17 controls (NC) (aged 21 - 35 years), 10 left-sided TLE-MTS CP (aged 24 - 66 years), and 13 left-sided TLE-MTS SP (aged 24 - 68 years), were compared to determine unique functional connectivity patterns with respect to these seizure types. This regions of interest (ROI)-to-ROI connectivity analysis included a total of 171 ROIs, and accounted for age and duration of epileptic activity. Significant correlations were determined via two-sample t-tests and bonferroni correction with an alpha value of 0.05.*Results Between CP and SP, significant correlation was observed between the contralateral (CL) anterior cingulate gyrus, subgenual region and the CL cerebellum, lobule III (P value = 2.26e-4, mean z-score = -0.05 (SD 0.28), T = -4.23). Comparing NC with SP depicted significant correlation between the CL reuniens nucleus and CL substantia nigra pars compacta (P value = 6.9e-5, mean z-score = 0.08 (SD 0.18), T = -4.64), as well as between the CL hippocampus and the CL cerebellum, lobule X (P value = 1.77e-4, mean z-score = 0.05 (SD 0.17), T = -4.30). Comparison of NC with CP revealed significant correlation between the ipsilateral (IL) parahippocampal gyrus and the CL supplementary motor area (P-value = 5.1e-5, mean z-score = -0.14 (SD 0.15), T = 4.75), the IL nucleus accumbens and the IL medial geniculate nucleus (P value = 1.53e-4, mean z-score = -0.04 (SD 0.18), T = 4.35), and the CL pallidum with the CL inferior temporal gyrus (P value = 1.58e-4, mean z-score = -0.009 (SD 0.15), T = 4.34).*Conclusions Aside from the widespread network disruptions in the limbic and cerebellar networks - in which SP experienced hyperactivity, in comparison to CP and NC - notable alterations were found in the basal ganglia. Furthermore, while both unilateral and bilateral changes were observed in CP, the SP group experienced exclusively unilateral changes of their functional connectivity patterns.*Clinical Relevance/Application Differences in functional connectivity patterns associated with these seizure types further supports the understanding of widespread network disruptions in TLE, and thus, could provide new avenues for pharmaceutical or surgical interventions.

RESULTS

Between CP and SP, significant correlation was observed between the contralateral (CL) anterior cingulate gyrus, subgenual region and the CL cerebellum, lobule III (P value = 2.26e-4, mean z-score = -0.05 (SD 0.28), T = -4.23). Comparing NC with SP depicted significant correlation between the CL reuniens nucleus and CL substantia nigra pars compacta (P value = 6.9e-5, mean z-score = 0.08 (SD 0.18), T = -4.64), as well as between the CL hippocampus and the CL cerebellum, lobule X (P value = 1.77e-4, mean z-score = 0.05 (SD 0.17), T = -4.30). Comparison of NC with CP revealed significant correlation between the ipsilateral (IL) parahippocampal gyrus and the CL supplementary motor area (P-value = 5.1e-5, mean z-score = -0.14 (SD 0.15), T = 4.75), the IL nucleus accumbens and the IL medial geniculate nucleus (P value = 1.53e-4, mean z-score = -0.04 (SD 0.18), T = 4.35), and the CL pallidum with the CL inferior temporal gyrus (P value = 1.58e-4, mean z-score = -0.009 (SD 0.15), T = 4.34).

CLINICAL RELEVANCE/APPLICATION

Differences in functional connectivity patterns associated with these seizure types further supports the understanding of widespread network disruptions in TLE, and thus, could provide new avenues for pharmaceutical or surgical interventions.

NR03-C8 Introduction Of MRI-based AI Model In Prediction Of MCI Conversion To Dementia: Could It Be A Key To Early Diagnosis Of Alzheimer's Disease?

Participants
Eun Kyoung Hong, MD, Gwangmyeong-Si, Korea, Republic Of (*Presenter*) Research Consultant, VUNO Inc

PURPOSE

Mild cognitive impairment (MCI), often recognized as a prodrome of dementia, possesses a 10-15% of risk of converting to Alzheimer's disease (AD). Hence, predicting the conversion of MCI to dementia using various subtle changes of the brain, in association with clinical symptoms and disease progression, is clinically important. The aim of this study is to investigate the prediction performance of a deep learning algorithm in predicting conversion of MCI to dementia.*Methods and Materials This retrospective study included 284 MCI patients (144 early MCI (EMCI) and 140 late MCI (LMCI) patients) who underwent 3D T1-weighted MRI. Among them, 52 MCI patients went through conversion from MCI to AD within 3 years from being diagnosed with MCI. A previously developed deep learning-based AD prediction model (A model trained with 1100 MRI scans of AD and cognitively normal subjects using Inception-v4 architecture) was utilized for the analysis of structural MRI. The output of the model was presented as an AD probability score. AD probability scores from the deep learning model were compared between EMCI vs. LMCI patients and patients who converted to AD vs. those who did not. Thereafter, the performance of AD probability score in predicting conversion of MCI to dementia was analyzed and compared with that of amyloid ß PET.*Results The average of the AD probability scores were 0.38 for EMCI and 0.60 for LMCI (p < 0.001) and 0.69 for patients who converted to AD and 0.41 for patients who did not (p < 0.001). When a cut-off of 0.38 was applied for AD probability score, Accuracies and AUC were 0.83 and 0.77 for AD probability score and 0.92 and 0.82 for amyloid ß PET in predicting dementia conversion from MCI (p = 0.140 and 0.270 for difference). Accuracies of AD probability score and amyloid ß PET were 0.73 and 0.91 for EMCI (p = 0.280), 0.85 and 0.93 for LMCI(p = 0.292). There was no statistically significant difference in prediction performance between the two modalities.*Conclusions A deep learning-based AD prediction model using MRI showed comparable performance in predicting conversion of MCI to dementia in both EMCI and LMCI patients to amyloid ß PET.*Clinical Relevance/Application We found a

comparable performance of a deep learning-based AD prediction model using MRI for predicting MCI patients' risk for AD conversion to amyloid ß PET. The findings of this study suggest that the deep learning-based model potentially can be utilized as a convenient and efficient solution in clinical practices for the early diagnosis of AD.

RESULTS

The average of the AD probability scores were 0.38 for EMCI and 0.60 for LMCI (p < 0.001) and 0.69 for patients who converted to AD and 0.41 for patients who did not (p < 0.001). When a cut-off of 0.38 was applied for AD probability score, Accuracies and AUC were 0.83 and 0.77 for AD probability score and 0.92 and 0.82 for amyloid ß PET in predicting dementia conversion from MCI (p = 0.140 and 0.270 for difference). Accuracies of AD probability score and amyloid ß PET were 0.73 and 0.91 for EMCI (p = 0.280), 0.85 and 0.93 for LMCI(p = 0.292). There was no statistically significant difference in prediction performance between the two modalities.

CLINICAL RELEVANCE/APPLICATION

We found a comparable performance of a deep learning-based AD prediction model using MRI for predicting MCI patients' risk for AD conversion to amyloid ß PET. The findings of this study suggest that the deep learning-based model potentially can be utilized as a convenient and efficient solution in clinical practices for the early diagnosis of AD.

NR03-C9   Rethinking Intravenous Alteplase For Stroke Patients With Large Vessel Occlusions Undergoing Endovascular Treatment - The DEBATE Survey

Participants
Johanna Ospel, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

Current guidelines recommend that eligible acute ischemic stroke (AIS) patients receive intravenous alteplase (IVT) prior to endovascular treatment (EVT). Four randomized controlled trials recently sought to determine the risks and value of administering IVT prior to EVT. It is unclear whether and how the results of these trials will change guidelines. With the DEBATE survey, we aimed to assess the influence of the recent trials on treatment strategies with respect to IVT for large vessel occlusions (LVO).*Methods and Materials Participants were provided with 15 cases of patients with AIS due to LVO and asked whether they would treat with IVT+EVT or EVT alone, before and after publication of the trials. All cases were within a mothership scenario. Multivariable logistic regression clustered by respondent and scenario was performed to assess factors influencing the decision to adopt an EVT alone paradigm.*Results Overall, 291 participants (48 women, 16.5%) from 37 countries provided 4365 responses. 13.4% (586/4365) changed from an IVT+EVT strategy to EVT alone. Interventional neuroradiologists (incidence-rate ratio [IRR] 1.3, 95%CI:1.05-1.58) were more likely to adopt an EVT alone strategy, in contrast to neurosurgeons (IRR 0.69, 95%CI:0.51-0.93). Those with 16-19 years of interventional experience (IRR 0.79, 95%CI:0.60-1.03), and from Europe and Asia were less likely to change (IRR 0.66, 95%CI:0.55-0.81 and IRR 0.70, 95%CI:0.57-0.86, respectively). Scenario characteristics associated with a preference for EVT alone were higher Alberta Stroke Program Early CT score (IRR 1.09, 95%CI:1.00-1.19), higher age (IRR 1.01, 95%CI:1.00-1.02), intracranial internal carotid artery occlusions (IRR 1.8, 95%CI:1.17-2.71), and dominant M2 segment occlusions (0.49, 95%CI:0.38-0.64).*Conclusions In light of the recent trials, a proportion of stroke physicians appear to be rethinking IVT treatment strategies of EVT-eligible patients with AIS due to LVO.*Clinical Relevance/Application This survey provides insight on how randomized trials can change clinical practice.

RESULTS

Overall, 291 participants (48 women, 16.5%) from 37 countries provided 4365 responses. 13.4% (586/4365) changed from an IVT+EVT strategy to EVT alone. Interventional neuroradiologists (incidence-rate ratio [IRR] 1.3, 95%CI:1.05-1.58) were more likely to adopt an EVT alone strategy, in contrast to neurosurgeons (IRR 0.69, 95%CI:0.51-0.93). Those with 16-19 years of interventional experience (IRR 0.79, 95%CI:0.60-1.03), and from Europe and Asia were less likely to change (IRR 0.66, 95%CI:0.55-0.81 and IRR 0.70, 95%CI:0.57-0.86, respectively). Scenario characteristics associated with a preference for EVT alone were higher Alberta Stroke Program Early CT score (IRR 1.09, 95%CI:1.00-1.19), higher age (IRR 1.01, 95%CI:1.00-1.02), intracranial internal carotid artery occlusions (IRR 1.8, 95%CI:1.17-2.71), and dominant M2 segment occlusions (0.49, 95%CI:0.38-0.64).

CLINICAL RELEVANCE/APPLICATION

This survey provides insight on how randomized trials can change clinical practice.

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Abstract Archives of the RSNA, 2021

MK03-D

Musculoskeletal Tuesday Poster Discussions

Sub-Events

MK03-D2 **Comparison Of A Novel MRI Technique That Produces Superior Bone Contrast With 2D CT For The Assessment Of Glenoid Bone Loss**

Participants
Hamza Alizai, MD, Valley Stream, New York (*Presenter*) Nothing to Disclose

PURPOSE

FRACTURE (FFE Resembling A CT Using Restricted Echo-spacing), a 3D gradient echo pulse sequence with restricted echo-spacing combined with an automated post-processing is a technical innovation which provides superior cortical and trabecular bone contrast on MRI. The objective of this study is to validate this technique in a cadaveric glenoid bone loss model using 2DCT as the reference standard*Methods and Materials Glenoid fractures of varying sizes were arthroscopically created in 10 cadaveric shoulders. 2D-CT and MRI FRACTURE (on 3T Philips Ingenia; Philips Healthcare, Best, Netherlands) were performed on all 10 shoulders. The CT and MRI were presented in a blinded fashion to an experienced musculoskeletal radiologist for measurement of the glenoid fracture height and width. Paired t-tests were performed to compare the measurements obtained on CT with those obtained on the MR FRACTURE images.*Results There was no statistically significant difference between CT and MRI in terms of the measured glenoid fracture height (P-value=0.54). The mean height measured on CT was 23.40mm (SD=6.87) and on MRI was 22.50mm (SD=7.28). Additionally, there was no statistically significant difference between CT and MR in terms of the measured glenoid fracture width (P-value=0.86). The mean width on CT measured 7.50mm (SD=3.57) and on MRI measured 7.60mm (SD=3.50).*Conclusions Measurements of glenoid fracture height and width on CT were comparable with measurements obtained using the MR FRACTURE technique.*Clinical Relevance/Application The technique may obviate preoperative CT in patients with anterior shoulder instability.

RESULTS

There was no statistically significant difference between CT and MRI in terms of the measured glenoid fracture height (P-value=0.54). The mean height measured on CT was 23.40mm (SD=6.87) and on MRI was 22.50mm (SD=7.28). Additionally, there was no statistically significant difference between CT and MR in terms of the measured glenoid fracture width (P-value=0.86). The mean width on CT measured 7.50mm (SD=3.57) and on MRI measured 7.60mm (SD=3.50).

CLINICAL RELEVANCE/APPLICATION

The technique may obviate preoperative CT in patients with anterior shoulder instability.

MK03-D4 **Relative Fat Fraction Of Malignant Bone Lesions In Breast Cancer, Prostate And Myeloma Shows Good Inter Observer Agreement And May Aid Disease Detection.**

Participants
Francesca Castagnoli, MD, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

The objective of this study was to compare the relative fat fraction (rFF) of active bone lesions from breast, prostate and myeloma malignancies and normal bone marrow; and to assess its inter-reader agreement.*Methods and Materials Patients with breast cancer (n=26), myeloma (n=32) and prostate cancer (n=52) were retrospectively evaluated. 110 baseline axial rFF maps from whole-body MRI (including Dixon T1 weighted and DWI from skull base to mid-thigh) were reviewed by two radiologists. The rFF maps were calculated by (fat-only image)/(fat-only image + water-only image) x 100%. Regions of interest (ROIs) for up to four focal active bone lesions was drawn on rFF maps, one each at the cervicothoracic spine, lumbosacral spine, pelvis and extremity. The mean and standard deviation of rFF (%) were recorded. The rFF of normal marrow was measured in patients without diffuse pelvic disease (n=88). We compared the rFF of bone lesions and normal marrow using Mann-Whitney test. Interobserver agreement was assessed by interclass correlation (ICC).*Results Malignant bone lesions showed significantly lower median rFF (13.87%) compared with normal bone marrow (89.76%) with little overlap (P<0.0001). There was no significant difference in the median rFF of malignant bone lesions from breast cancer (14.46%), myeloma (13.12%) and prostate cancer (13.67%) (p>0.017, Bonferroni correction). There was also no significant difference in the median rFF of bone disease according to their anatomical locations (p>0.008, Bonferroni correction). There was excellent interobserver agreement of rFF measurements between readers (0.976).*Conclusions The low rFF of active bone lesions in breast cancer, myeloma and prostate cancer, provides high image contrast relative to normal marrow that can enhance disease detection. Furthermore, the rFF also has excellent inter-reader agreement, which could be useful for assessing the treatment response of bone metastases.*Clinical Relevance/Application Relative Fat fraction quantification has the potential to be an important diagnostic and response biomarker for the assessment of malignant bone disease.

RESULTS

Malignant bone lesions showed significantly lower median rFF (13.87%) compared with normal bone marrow (89.76%) with little overlap (P<0.0001). There was no significant difference in the median rFF of malignant bone lesions from breast cancer (14.46%),

myeloma (13.12%) and prostate cancer (13.67%) (p>0.017, Bonferroni correction). There was also no significant difference in the median rFF of bone disease according to their anatomical locations (p>0.008, Bonferroni correction). There was excellent interobserver agreement of rFF measurements between readers (0.976).

CLINICAL RELEVANCE/APPLICATION

Relative Fat fraction quantification has the potential to be an important diagnostic and response biomarker for the assessment of malignant bone disease.

Printed on: 06/28/22

HN04-A

Head and Neck Wednesday Poster Discussions

Sub-Events

HN04-A2   DWI And PWI Assessment Of Hereditary And Non-hereditary Paragangliomas In The Head And Neck

Participants
Yoshiaki Ota, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

This study is aimed to assess the clinical usefulness of diffusion-weighted imaging and dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) in differentiating hereditary and non-hereditary paragangliomas in the head and neck.*Methods and Materials From June 2016 to June 2020, 27 patients (mean age, 48.2 ± 17.2 years; 7 females) pathologically diagnosed with paragangliomas underwent pre-treatment DCE-MRI with conventional MRI in a single center. The genetic testing was performed by the PGLNext panel, which is designed and validated to detect >99.9% of SDH mutations noted above. The variables of apparent diffusion coefficient (ADC) values, DCE-MRI parameters, and tumor characteristics were compared between paragangliomas' mutation status by t-test, Mann-Whitney U test, and Fisher's exact test, as appropriate. For values that showed a statistically significant difference, the optimal cut-off values in ROC analysis were determined by the Youden index, and the diagnostic performances were calculated. Inter-reader agreement for tumor characteristics was assessed by the kappa coefficient.*Results 10 SDH mutation-positive paragangliomas (SDHA: 1, SDHB: 8, SDHC: 2, SDHD: 6) and 17 mutation-negative paragangliomas constituted this study. The patients with SDH mutation-positive paragangliomas were younger than the patients with SDH mutation-negative paragangliomas (mean age: 43.1 ± 17.7 vs 56.8 ± 12.9 years, P = 0.043). As for tumor characteristics, there was no significant difference in other tumor characteristics. As for ADC values, mean ADC and normalized mean ADC were significantly lower in SDH mutation-positive paragangliomas than in SDH mutation-negative paragangliomas (mean ADC: 0.99 ± 0.18 vs 1.27 ± 0.18 × 10-3 mm2/s, P = .0012, normalized mean ADC: 1.25 ± 0.21 vs 1.73 ± 0.32, P < .001, respectively). The diagnostic performances of mean ADC and normalized mean ADC were 0.88 and 0.92 AUCs with the cut-off values of 1.14 × 10-3 mm2/s and 1.52, respectively. As for DCE-MRI dynamic data, there were no parameters that showed statistical significance.*Conclusions Age was lower in SDH mutation-positive paragangliomas than in SDH mutation-negative paragangliomas. Mean and normalized mean ADC values were able to differentiate SDH mutation-positive and SDH mutation-negative paragangliomas with AUCs of 0.88 and 0.92, while DCE-MRI parameters were not.*Clinical Relevance/Application ADC values can be promising as a noninvasive imaging biomarker to predict SDH mutation in head and neck paragangliomas.

RESULTS

10 SDH mutation-positive paragangliomas (SDHA: 1, SDHB: 8, SDHC: 2, SDHD: 6) and 17 mutation-negative paragangliomas constituted this study. The patients with SDH mutation-positive paragangliomas were younger than the patients with SDH mutation-negative paragangliomas (mean age: 43.1 ± 17.7 vs 56.8 ± 12.9 years, P = 0.043). As for tumor characteristics, there was no significant difference in other tumor characteristics. As for ADC values, mean ADC and normalized mean ADC were significantly lower in SDH mutation-positive paragangliomas than in SDH mutation-negative paragangliomas (mean ADC: 0.99 ± 0.18 vs 1.27 ± 0.18 × 10-3 mm2/s, P = .0012, normalized mean ADC: 1.25 ± 0.21 vs 1.73 ± 0.32, P < .001, respectively). The diagnostic performances of mean ADC and normalized mean ADC were 0.88 and 0.92 AUCs with the cut-off values of 1.14 × 10-3 mm2/s and 1.52, respectively. As for DCE-MRI dynamic data, there were no parameters that showed statistical significance.

CLINICAL RELEVANCE/APPLICATION

ADC values can be promising as a noninvasive imaging biomarker to predict SDH mutation in head and neck paragangliomas.

Abstract Archives of the RSNA, 2021

Sub-Events

GI05-A1   **Hydro-MDCT For Gastric Adenocarcinoma Staging. Comparative Study With Surgical And Histopathological Follow-up To Select Patients For Echo-endoscopy**

Participants
Marco Di Girolamo, MD, Rome, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the accuracy of hydro-MDCT in the evaluation of gastric adenocarcinoma with subsequent surgical and histo-pathological specimen and to identify when this technique has the least sensitivity, specificity and diagnostic accuracy in the evaluation of T and N parameter, to select cases for echo-endoscopy.*Methods and Materials 65 patients with gastric adenocarcinoma diagnosed by endoscopy and biopsy, underwent hydro-MDCT (64 detectors). The distension of the gastric lumen was obtained after the oral administration of 500ml of water and i.v. injection of spasmolytic agent. The dynamic study was performed during arterial and portal phase. Sensitivity, specificity and diagnostica accuracy were calculated for T, N and M parameter.*Results Contrast-enhanced Hydro-MDCT always detected the gastric cancer as a focal or diffuse gastric wall thickening with or without abnormal enhancement. The tumor was pre-operatively classified as T1 stage in 11 cases, T2 in 21, T3 in 25 and T4 stage in 8 cases. In 49/65 patients the assessment of local tumor extension on hydro-MDCT was identical to the histopathological results in defining the T category according TNM classification, with overall accuracy of 75%. We found overstaging in 12 and understaging in 4 cases. Local enlarged lymphnodes were always identified but MDCT results in the N stage were in agreement with histo-pathological samples in 69% of cases. For the evaluation of metastatic disease hydro-MDCT had an accuracy of 99%. Hydro-MDCT has proven to be more reliable diagnostic technique in evaluating T3 and T4 stage in comparison with T1 and T2 stage: in the definition of T2 stage we found the highest number of staging errors, equal to 37% of cases.*Conclusions Hydro-MDCT is a reliable technique in the preoperative staging of gastric adenocarcinoma. Echo-endoscopy could be particularly useful in doubtful MDCT cases to evaluate the muscularis propria infiltration (T1 vs T2) and to characterize peri-gastric lymph nodes, as they are fundamental for subsequent therapeutical path.*Clinical Relevance/Application Hydro-MDCT is a reliable technique in preoperative staging of gastric adenocarcinoma. Echo-endoscopy could be proposed to differentiate T1 vs T2 and to characterize peri-gastric lymphnodes where CT has a minor diagnostic accuracy.

RESULTS

Contrast-enhanced Hydro-MDCT always detected the gastric cancer as a focal or diffuse gastric wall thickening with or without abnormal enhancement. The tumor was pre-operatively classified as T1 stage in 11 cases, T2 in 21, T3 in 25 and T4 stage in 8 cases. In 49/65 patients the assessment of local tumor extension on hydro-MDCT was identical to the histopathological results in defining the T category according TNM classification, with overall accuracy of 75%. We found overstaging in 12 and understaging in 4 cases. Local enlarged lymphnodes were always identified but MDCT results in the N stage were in agreement with histo-pathological samples in 69% of cases. For the evaluation of metastatic disease hydro-MDCT had an accuracy of 99%. Hydro-MDCT has proven to be more reliable diagnostic technique in evaluating T3 and T4 stage in comparison with T1 and T2 stage: in the definition of T2 stage we found the highest number of staging errors, equal to 37% of cases.

CLINICAL RELEVANCE/APPLICATION

Hydro-MDCT is a reliable technique in preoperative staging of gastric adenocarcinoma. Echo-endoscopy could be proposed to differentiate T1 vs T2 and to characterize peri-gastric lymphnodes where CT has a minor diagnostic accuracy.

GI05-A10   **Fully Automated Segmentation And Volumetry Of Couinaud'S Liver Segment At CT Prior To Major Hepatectomy Using Deep Learning**

Participants
Tingting Xie JR, MD, Shenzhen, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop a deep learning model for automated segmentation and volumetry of Couinaud's liver segment at CT and to apply it for preoperative volumetric assessment of major hepatectomy.*Methods and Materials A three-dimensional U-Nets model was developed for automated segmentation of the Couinaud's liver segment on contrast enhanced portovenous phase (PVP) CT scans. Images were obtained from patients undergoing CT scans for the upper abdomen from May 2016 to March 2019. A total of 110 PVP images from 110 patients (61 with normal findings and 49 with hepatic steatosis) were recruited. The Couinaud's segmentations were annotated by 2 experienced radiologists. A 3D U-Net model was trained with the images randomly divided into the dataset of the train (n=86), validate (n=12), and test (n=12). The 12 images in the test dataset were used to assess the accuracy of segmentation by using Dice scores. Quantitative volumetry for evaluation of respectability in major hepatectomy was compared between automated and manual segmentation by using Pearson correlation and Bland-Altman analysis.*Results Dice scores in the test dataset for Segment I to VIII ranged from 0.84 ± 0.09 to 0.90 ± 0.04 with an average of 0.88 ± 0.06. Total liver volume and future liver remnant (FLR) % for four types of major hepatectomy measured with manual and automated segmentation agreed closely (95 % limits of agreement: -7.02 mL to 39.08 mL and -3.00 % to 5.34 %, -1.46 % to 1.79 %, -5.32 % to 2.97 %, -5.76 % to 3.13 %). In the qualitative analysis, the consistency between the model and surgeon on the permission of four types of major

hepatectomy was more than 95.83 %.*Conclusions Fully automated segmentation and volumetric analysis of Couinaud's liver segment at CT prior to major hepatectomy are accurate and applicable by using deep learning.*Clinical Relevance/Application This study developed a DL method for automated segmentation and volumetric analysis of Couinaud's liver segment prior to major hepatectomy.

RESULTS

Dice scores in the test dataset for Segment I to VIII ranged from 0.84 ± 0.09 to 0.90 ± 0.04 with an average of 0.88 ± 0.06. Total liver volume and future liver remnant (FLR) % for four types of major hepatectomy measured with manual and automated segmentation agreed closely (95 % limits of agreement: -7.02 mL to 39.08 mL and -3.00 % to 5.34 %, -1.46 % to 1.79 %, -5.32 % to 2.97 %, -5.76 % to 3.13 %). In the qualitative analysis, the consistency between the model and surgeon on the permission of four types of major hepatectomy was more than 95.83 %.

CLINICAL RELEVANCE/APPLICATION

This study developed a DL method for automated segmentation and volumetric analysis of Couinaud's liver segment prior to major hepatectomy.

GI05-A2   Evaluation Oflauren Types Of Gastric Cancer Using Spectral CT Quantitative Parameters

Participants
Zhang Min, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the feasibility of spectral CT quantitative Parameters in distinguishing expression of non-intestinal type gastric cancer.*Methods and Materials 68 patients confirmed of gastric cancer with gastroscopy were preoperatively examined spectral CT and curative gastrectomy. The enrolled patients were divided into intestinal type group and non-intestinal type group according to Lauren type. spectral CT quantitative Parameters, volume iodine content and Slope of energy spectrum curve in every phases were calculated. The differences of parameters in 2 groups were calculated with One-way analysis of variance (ANOVA). A receiver operating characteristic (ROC) analysis was applied to evaluate the diagnostic performance of meaningful spectral CT quantitative parameters.*Results volume iodine content in arterial phase and Slope of energy spectrum curve in artery phases of intestinal type group and non-intestinal type group were 12.44±0.40 (100 μ g / mL),1.68±0.082 ,respectively. The above parameters were significantly different between the two groups.(p<0.05)Areas under the ROC curve for the diagnosis of non-intestinal type gastric cancer by volume iodine content and Slope of energy spectrum curve in artery phases was 0.872(sensitivity, 96.6%; specificity, 70%) ,0.779 (sensitivity, 69.3%; specificity, 88.2%),with the cut-off value of 11.63(100 μ g / mL) and 1.92.*Conclusions Spectrum enhanced CT can accurately evaluate the non-intestinal type gastric cancer with certain quantitative parameters.*Clinical Relevance/Application Spectrum enhanced CT quantitative parameters are potential in the diagnosis of non-intestinal type gastric cancer.

RESULTS

volume iodine content in arterial phase and Slope of energy spectrum curve in artery phases of intestinal type group and non-intestinal type group were 12.44±0.40 (100 μ g / mL),1.68±0.082 ,respectively. The above parameters were significantly different between the two groups.(p<0.05)Areas under the ROC curve for the diagnosis of non-intestinal type gastric cancer by volume iodine content and Slope of energy spectrum curve in artery phases was 0.872(sensitivity, 96.6%; specificity, 70%) ,0.779 (sensitivity, 69.3%; specificity, 88.2%),with the cut-off value of 11.63(100 μ g / mL) and 1.92.

CLINICAL RELEVANCE/APPLICATION

Spectrum enhanced CT quantitative parameters are potential in the diagnosis of non-intestinal type gastric cancer.

GI05-A3   Quantified Small Bowel Motility As A Marker Of Treatment Response In Crohn's Disease: An Audit Of Initial Experience And Comparison To A Validated Activity Index In A Real World Setting

Participants
Safi Rahman, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Commercial software is now available to quantify small bowel motility in Crohn's Disease (CD) from magnetic resonance enterography (MRE) (Menys et al 2018; Plumb et al 2015).Our aim was to compare this against a validated simplified magnetic resonance activity index of CD - sMaRIA (Ordas et al 2019)*Methods and Materials Patients with CD undergoing therapy who had MRE (Jan2020-Jan2021) with motility imaging at two time points were selected. Motility index (arbitrary units, a.u.) derived from 'cine' images using commercially available software (GIQuant®, Motilent, London, UK) was compared with the change in sMaRIA score at the site of most severe disease. Patients were categorised as improving disease (reducing sMaRIA) or no improvement (static/increasing sMaRIA) and the difference in change in the motility index between groups compared using the Mann-Whitney test. Note was made of time taken and processes to calculate both the motility index and the sMaRIA. All results are presented as proportions or median (range).*Results 23 patients (61%M), age 32y (14 to 65) were identified with an interval of 469 (133 to 699) days between MRE. The most severe disease site was the terminal ileum in 19 patients (3 ileum, 1 no disease). 16 (70%) patients had no improvement whilst 9 (30%) had improving disease according to the change in sMaRIA. Motility index increased by 95 a.u. (54 to 113) in patients with improving disease compared to -1.5 a.u. (-58 to 39) in patients with static or worsening disease (p<0.001)The processes and time taken to acquire the motility index and the sMaRIA scores were comparable. The sMaRIA score required an increased number of subjective assessments in comparison to obtaining the motility index.*Conclusions Our results show that the change in motility index acquired using software analysis of cine imaging correlates with a validated MRE disease response assessment (sMaRIA). The process of obtaining the motility index is comparable to sMaRIA scoring with the added advantage of a fewer subjective judgements.*Clinical Relevance/Application Clinical relevance statement: Motility index (GIQuant®, Motilent, London, UK) offers a comparable and less subjective quantification of disease response assessment in patients with CD in comparison to other indices such as sMaRIA.

RESULTS

23 patients (61%M), age 32y (14 to 65) were identified with an interval of 469 (133 to 699) days between MRE. The most severe disease site was the terminal ileum in 19 patients (3 ileum, 1 no disease). 16 (70%) patients had no improvement whilst 9 (30%) had improving disease according to the change in sMaRIA. Motility index increased by 95 a.u. (54 to 113) in patients with improving

disease compared to -1.5 a.u. (-58 to 39) in patients with static or worsening disease (p<0.001)The processes and time taken to acquire the motility index and the sMaRIA scores were comparable. The sMaRIA score required an increased number of subjective assessments in comparison to obtaining the motility index.

CLINICAL RELEVANCE/APPLICATION

Clinical relevance statement: Motility index (GIQuant®, Motilent, London, UK) offers a comparable and less subjective quantification of disease response assessment in patients with CD in comparison to other indices such as sMaRIA.

GI05-A5   MRI Evaluation Of The Tumor Microenvironment In Pancreatic Ductal Adenocarcinoma

Participants
Donghoon Lee, PhD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the tumor microenvironment in pancreatic ductal adenocarcinoma using multi-parametric MRI and correlate the MRI results to histopathology findings.*Methods and Materials We used the KPC genetic mouse model of pancreatic ductal adenocarcinoma (PDA). The KPC mouse model recapitulates the clinical manifestations, histopathology, and genetic progression of the human PDA from inception to invasion and metastasis. KPC mice (n = 22) were enrolled in the study when a mouse had a tumor mass > 250 mm3, which was confirmed by ultrasound imaging. Animals were then scanned on a preclinical 14 tesla (T) MRI system. Multi-parametric MRI was conducted to acquire relaxation times T1 and T2, magnetization transfer ratio (MTR), diffusion parameters, and glycosaminoglycan-chemical exchange saturation transfer (Gag-CEST) response. After completing MRI scans, mice were euthanized for tissue harvest for histopathology including hematoxylin and eosin (H&E), Masson's trichrome, hyaluronic acid (HA) binding protein, Ki67, and CD31 staining.*Results Several MRI parameters showed some correlation with tumor volume and histological measurements. T2 was negatively correlated with the tumor volume (r = -0.64, p = 0.002) while MTR was positively correlated with the tumor volume (r = 0.58, p = 0.005). For diffusion, a negative correlation was found for the low-b ADC versus the tumor volume (r = -0.44, p = 0.02) and a positive correlation was observed for the high-b apparent diffusion coefficient (ADC) versus the tumor volume (r = 0.64, p = 0.002). There was an increase in Gag-CEST values with the tumor volume (r = 0.54, p = 0.01). There were several correlations between some MRI parameters and fibrosis quantified by Masson's trichrome stained images. There was a significant correlation between Gag-CEST values and HA staining (r = 0.81).*Conclusions T2 relaxation, MTR, Gag-CEST, and ADC demonstrated good correlations with histology and may be effective MRI parameters to monitor the tumor microenvironment of PDA.*Clinical Relevance/Application Multi-parametric MRI may be used to non-invasively monitor the tumor microenvironment for patients with PDA.

RESULTS

Several MRI parameters showed some correlation with tumor volume and histological measurements. T2 was negatively correlated with the tumor volume (r = -0.64, p = 0.002) while MTR was positively correlated with the tumor volume (r = 0.58, p = 0.005). For diffusion, a negative correlation was found for the low-b ADC versus the tumor volume (r = -0.44, p = 0.02) and a positive correlation was observed for the high-b apparent diffusion coefficient (ADC) versus the tumor volume (r = 0.64, p = 0.002). There was an increase in Gag-CEST values with the tumor volume (r = 0.54, p = 0.01). There were several correlations between some MRI parameters and fibrosis quantified by Masson's trichrome stained images. There was a significant correlation between Gag-CEST values and HA staining (r = 0.81).

CLINICAL RELEVANCE/APPLICATION

Multi-parametric MRI may be used to non-invasively monitor the tumor microenvironment for patients with PDA.

GI05-A6   A Novel Deep Learning-based Iodine Contrast Boosting Algorithm Of Liver CT For Improvement Of Image Quality And Lesion Conspicuity In Patients At High Risk For HCC

Participants
Jae Hyun Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To assess the feasibility of applying a deep learning-based iodine contrast boosting algorithm to liver computed tomography (CT) for improving image quality and hepatocellular carcinoma (HCC) conspicuity in high-risk patients.*Methods and Materials We retrospectively enrolled 90 high-risk patients who underwent contrast-enhanced liver CT, including 70 consecutive patients without evidence of HCC in January 2010 and 20 consecutive patients with pathologically confirmed single HCC between January 2010 and April 2010. We developed a deep learning-based denoising and iodine contrast boosting algorithm, which was an upgraded version of our previous denoising algorithm (ClariCT.AI, ClariPI). The arterial phase images with algorithm applied and original arterial phase images of 90 patients were prepared. Two abdominal radiologists blindly assessed the two CT data sets for extrahepatic artery clarity, intrahepatic artery clarity, overall image quality, lesion conspicuity, and level of confidence in HCC diagnosis (1-4 Likert scales) in consensus. The Wilcoxon signed-rank test and McNemar test were used for statistical analysis.*Results The proposed deep learning-based algorithm yielded significant improvements of extrahepatic artery clarity (mean 2.89 vs. 3.87, P <0.0001), intrahepatic artery clarity (mean 2.49 vs. 3.47, P<0.0001), overall image quality (mean 2.97 vs. 3.23, P < 0.0001), lesion conspicuity (mean 2.38 vs. 3.48, P = 0.0003), and level of confidence in HCC diagnosis (mean 2.81 vs. 3.78, P = 0.0002). There were no significant differences in sensitivity (100% vs. 100%) and specificity (97.1% vs. 94.3%, P = 0.50) of HCC detection between dataset before and after applying the algorithm.*Conclusions With the proposed deep learning-based iodine contrast boosting algorithm, we can improve the image quality, hepatic vessel clarity, and HCC conspicuity of liver CT images in high-risk patients.*Clinical Relevance/Application The proposed deep learning-based algorithm could help radiologists or clinicians diagnose HCC and identify hepatic artery variation before surgery in contrast-enhanced liver CT.

RESULTS

The proposed deep learning-based algorithm yielded significant improvements of extrahepatic artery clarity (mean 2.89 vs. 3.87, P <0.0001), intrahepatic artery clarity (mean 2.49 vs. 3.47, P<0.0001), overall image quality (mean 2.97 vs. 3.23, P < 0.0001), lesion conspicuity (mean 2.38 vs. 3.48, P = 0.0003), and level of confidence in HCC diagnosis (mean 2.81 vs. 3.78, P = 0.0002). There were no significant differences in sensitivity (100% vs. 100%) and specificity (97.1% vs. 94.3%, P = 0.50) of HCC detection between dataset before and after applying the algorithm.

CLINICAL RELEVANCE/APPLICATION

The proposed deep learning-based algorithm could help radiologists or clinicians diagnose HCC and identify hepatic artery variation

The proposed deep learning-based algorithm could help radiologists or clinicians diagnose HCC and identify hepatic artery variation before surgery in contrast-enhanced liver CT.

GI05-A7 Characterisation Of Abnormalities In The Biliary System By Quantitative MRCP Imaging: A Repeatability And Reproducibility Study

Participants
Andrea Dennis, Oxford, United Kingdom (*Presenter*) Employee, Perspectum Diagnostics Ltd;

PURPOSE

Magnetic resonance cholangiopancreatography (MRCP) is an important tool for the non-invasive diagnosis and monitoring of biliary diseases. However, the assessment of MRCPs is subjective and dependent on radiologist experience, resulting in high intra- and inter- observer variation. A novel MRCP post-processing method, MRCP+, models the biliary tree in 3D, allowing for quantification of the biliary tree volume, local duct diameters, and dilated/strictured regions. We investigated the robustness of biliary stricture/dilatation-related metrics derived from MRCP+ across different MRI scanner models and field strengths.*Methods and Materials Twenty healthy subjects and 20 patients with liver disease (n=10 biliary disease, n=10 parenchymal disease) underwent heavily T2-weighted 3D MRCP scans on Siemens Prisma 3T and Avanto-fit 1.5T. Two acquisition repeats were conducted for each scanner with 15 min breaks between scans. Participants were scanned on different scanner models and field strengths in pseudorandomised order with up to 1 week between scans. Following processing with MRCP+ by two independent operators, 40 biliary stricture/dilation-related metrics were derived. Bland-Altman analysis was performed, and bias, 95% of the limits of agreement (LoA), the intraclass correlation coefficient (ICC) and its confidence intervals (CI) were calculated.*Results Results from 5 MRCP+ metrics with high clinical relevance [Cheng et al. 2020] are summarised below. ICCs from the repeatability test ranged from 0.77 - 0.92, indicating both scanners had excellent repeatability, with the reference scanner (Siemens Prisma 3T) (ICC: 0.87 - 0.92) slightly higher than 1.5T Avanto-fit (0.77 - 0.88). Differences between the two scanners can be attributed to the variation in image contrast due to different field strengths. Moreover, MRCP+ metrics had excellent reproducibility between both scanners, e.g., total length of strictures & dilatations (bias: 13.9 mm, 95% LoA of -86.4 to 114.3 mm, ICC: 0.77), and the number of ducts with dilatations (bias: 0.78, 95% LoA of -6 to 8, ICC: 0.88). In the reproducibility test bias is positive but not significant for the five metrics, indicating Avanto-fit has slightly higher values than Prisma but the differences are not significant (p-value > 0.05).*Conclusions MRCP+ reliably quantifies biliary strictures/dilatations independent of scanner model and field strength (1.5T or 3T), and therefore has potential applications in biliary disease diagnosis, stratification, and monitoring.*Clinical Relevance/Application High scan/rescan repeatability and cross-scanner reproducibility in quantitative MRCP allows for reduced subjectivity in the assessment of biliary tree strictures/dilatations.

RESULTS

Results from 5 MRCP+ metrics with high clinical relevance [Cheng et al. 2020] are summarised below. ICCs from the repeatability test ranged from 0.77 - 0.92, indicating both scanners had excellent repeatability, with the reference scanner (Siemens Prisma 3T) (ICC: 0.87 - 0.92) slightly higher than 1.5T Avanto-fit (0.77 - 0.88). Differences between the two scanners can be attributed to the variation in image contrast due to different field strengths. Moreover, MRCP+ metrics had excellent reproducibility between both scanners, e.g., total length of strictures & dilatations (bias: 13.9 mm, 95% LoA of -86.4 to 114.3 mm, ICC: 0.77), and the number of ducts with dilatations (bias: 0.78, 95% LoA of -6 to 8, ICC: 0.88). In the reproducibility test bias is positive but not significant for the five metrics, indicating Avanto-fit has slightly higher values than Prisma but the differences are not significant (p-value > 0.05).

CLINICAL RELEVANCE/APPLICATION

High scan/rescan repeatability and cross-scanner reproducibility in quantitative MRCP allows for reduced subjectivity in the assessment of biliary tree strictures/dilatations.

GI05-A9 Performance Of Machine Learning And Texture Analysis With 3T MRI In Predicting Response To Neoadjuvant Chemo-Radiotherapy In Locally Advanced Rectal Cancer

Participants
Elena Orlando, MD, Curinga, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To determine the performance of texture analysis (TA) in the prediction of response to neoadjuvant chemo-radio-therapy (CRT) in patients affected by locally advanced rectal cancer (LARC), using machine learning (ML) algorithms in order to improve diagnostic accuracy.*Methods and Materials Forty patients affected by LARC, who underwent pre- and post-CRT 3T MRI examination, were prospectively enrolled. TA was performed on axial T2 weighted images in order to extract texture parameters (skewness, kurtosis, entropy, and mean of positive pixels). After CRT, all patients underwent complete surgical resection and the surgical specimen served as the reference standard. ROC curve analysis was performed to assess the discriminatory power of each quantitative parameter to predict complete response. Artificial Intelligence software was used to evaluate the impact of machine learning algorithms aimed to combine all texture parameters in order to improve diagnostic accuracy.*Results Entropy, kurtosis and MPP showed significant differences before and after CRT in complete responders (CR); partial responders (PR)/non-responders (NR) entropy and skewness showed significant differences before and after CRT (all p<0.05). Absolute changes of entropy, kurtosis, and MPP before and after CRT showed significant differences (0.31±0.35, in CR, -0.02 ± 1.28 in PR/NR, (p=0.04); 1.87 ± 2.19, in CR, -0.06 ± 3.78 in PR/NR(p=0.0005); 107.91 ± 274.40, in CR, -28.33 ± 202.91 in PR/NR, (p=0.004), respectively). ROC curves showed the optimal cut-off value for pre-treatment kurtosis, the best parameter, =3.29, resulting in a sensitivity and specificity for pCR prediction of 81.5% and 61.5%, respectively. A decisional map was defined combining all texture parameters.*Conclusions TA on T2WI can potentially have an important role as imaging biomarker of response to neoadjuvant CRT in LARC. Machine learning software can be applied to combine efficiently all texture parameters with the aim of improving diagnostic accuracy.*Clinical Relevance/Application T2WI analazyed through TA and ML algorithms could play an important role in evaluating response to neoadjuvant CRT in patients affected by LARC.

RESULTS

Entropy, kurtosis and MPP showed significant differences before and after CRT in complete responders (CR); partial responders (PR)/non-responders (NR) entropy and skewness showed significant differences before and after CRT (all p<0.05). Absolute changes of entropy, kurtosis, and MPP before and after CRT showed significant differences (0.31±0.35, in CR, -0.02 ± 1.28 in PR/NR, (p=0.04); 1.87 ± 2.19, in CR, -0.06 ± 3.78 in PR/NR(p=0.0005); 107.91 ± 274.40, in CR, -28.33 ± 202.91 in PR/NR, (p=0.004), respectively). ROC curves showed the optimal cut-off value for pre-treatment kurtosis, the best parameter, =3.29, resulting in a sensitivity and specificity for pCR prediction of 81.5% and 61.5%, respectively. A decisional map was defined

combining all texture parameters.

CLINICAL RELEVANCE/APPLICATION

T2WI analazyed through TA and ML algorithms could play an important role in evaluating response to neoadjuvant CRT in patients affected by LARC.

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VA04-A

Vascular Imaging Wednesday Poster Discussions

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Abstract Archives of the RSNA, 2021

Sub-Events

NMMI04-B1 The Clinical Performance Of Artificial Intelligence Based Fdg Pet Denoising On A Digital Pet/ct

Participants
Kathleen Weyts, Caen, France (*Presenter*) Nothing to Disclose

PURPOSE

In the context of an increasing PET/CT demand, we aimed to investigate the performance of an artificial intelligence (AI) based PET denoising while simulating a 50% FDG PET acquisition time reduction.*Methods and Materials 194 consecutive patients referred for a FDG PET/CT were prospectively included in january-february 2021. The original FDG PET studies (3MBq/kg, 90 sec/bed position, 3D-OSEM + PSF reconstruction-VEREOS SiPM PET/CT) were reconstructed on half of the acquisition time data (45 sec/bed position) and subsequently denoised by Subtle PET® (50% denoised PET), a FDA approved software based on deep learning with deep convolutional neural networks. Five nuclear medicine physicians compared side to side the masked original gold-standard and 50% denoised PET, displayed in a random order. The visual detectability and semi-quantitative parameters of lesions/ foci with increased FDG uptake (malignant or benign), and of the liver as a reference, were collected. For each PET serie a 3-scale global image quality score (IQ) per patient was given (1: bad to 3: good).*Results Of 194 PET examinations, 33 were normal on both PET series. In the remaining 161, 857 FDG avid lesions/foci were visually detected in either of both series. The concordance rate was 98%. There were seven false negative lesions in six patients on the 50% denoised PET, leading to a 99.2% lesion-based sensitivity. False negative lesions showed a small lesion size on CT (median and maximum long axis 5 and 9mm vs 15 and 130mm for true-positive lesions, p=0.009) and low SUL on original PET (median SULpeak 1.5 vs 2.7g/ml, p=0.0008). The per-patient and per-lesion false positive rate on 50% denoised PET was 5% and 1.5%, respectively. Thirteen false positives were found in the liver (n=10), bone (n=2) and spleen (n=1) corresponding to small, indeterminate lesions. Standard and harmonized EARL-1 lesional SULmax , SULpeak, MTV, hepatic SULmean were not significantly different and highly correlated (intraclass correlation coefficients-ICC of at least 0,863 (for MTV) up to 0,996 (for standard and EARL-1 SULpeak and EARL-1 SULmax) between original and 50% denoised PET. Also, the mean visual IQ was similar in the original and 50% denoised PET, 2.94 vs 2.91.*Conclusions This prospective study demonstrates similar performances of 50% denoised and original FDG PET in a digital PET/CT. These data may allow reducing PET acquisition time by half in clinical practice.*Clinical Relevance/Application The use of arteficial intelligence may improve PET image quality and allow an acquisition time reduction while keeping a similar clinical performance.This can lead to a better patient comfort and facilitate the organisation while reducing the patients' delay for having the PET examination.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

The use of arteficial intelligence may improve PET image quality and allow an acquisition time reduction while keeping a similar clinical performance.This can lead to a better patient comfort and facilitate the organisation while reducing the patients' delay for having the PET examination.

NMMI04-B4 Prospective Evaluation Of 18F-DCFPyL PET/CT In Biochemically Recurrent Prostate Cancer: Analysis Of 18F-DCFPyL Uptake In Possible Extra-pelvic Oligometastases

Participants
Hong Song, MD, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

We prospectively evaluated a PET agent targeting prostate specific membrane antigen (PSMA), 18F-DCFPyL, in a single center study for detecting recurrent lesions in prostate cancer patients with biochemical recurrence (BCR).*Methods and Materials We prospectively enrolled 223 men (49-91 years old, mean ± SD: 69.8±8.1) with biochemical recurrence (PSA median 2.0 ng/mL, range 0.12 to 698.4) after primary definitive treatment with prostatectomy (72%), radiotherapy (28%) or both (25%). The 18F-DCFPyL positive lesions compatible with prostate cancer were evaluated by two independent readers. Patients with possible extra-pelvic oligometastases (1-3 lesions with 18F-DCFPyL uptake) were identified. The maximum standardized uptake values (SUV max) of 18F-DCFPyL in these lesions were measured and used to categorize lesions into high uptake (SUV max = parotid gland SUV mean), moderate uptake (parotid gland SUV mean > SUV max = liver SUV mean) and mild uptake (liver SUV mean > SUV max = blood pool

SUV mean).*Results 18F-DCFPyL PET/CT had an overall positivity rate of 84% (172 scans), which increased with higher prostate specific antigen (PSA) levels (ng/mL): 62% (PSA<0.5), 77% (0.5=PSA<1), 90% (1=PSA<2), 92% (2=PSA<5) and 96% (PSA=5), respectively. In the cohort who underwent prostatectomy, 18F-DCFPyL PET/CT had a higher positivity rate in patients with shorter PSA doubling time (PSAdt) (93% in PSAdt 0-3 months vs. 63% in PSAdt > 12 months, P<0.01). Higher positivity rate was also observed in prostatectomy patients with high Gleason score (GS) (92% in GS 8-10 vs 71% in 72% in GS 6-7, P < 0.01). No difference of 18F-DCFPyL positivity rate was observed in post-radiation patients with different PSAdt or GS. We identified 62 patients (28%) with a total of 109 possible extra-pelvic oligometastases. Among them, there are 60 osseous lesions (8 high, 16 moderate and 36 mild uptake), 40 lymph nodes (9 high, 13 moderate and 18 mild uptake) and 9 other lesions such as lung nodules (6 high, 2 moderate and 1 mild uptake). 27 out of the 62 patients (44%) received locally targeted therapy for these lesions (radiation therapy or surgery) with or without androgen deprivation therapy.*Conclusions 18F-DCFPyL PET/CT holds great potential to be a "one-stop shop" diagnostic tool in the work-up of BCR prostate cancer to identify possible extra-pelvic oligometastases for locally targeted therapy.*Clinical Relevance/Application Improve understanding and clinical application of 18F-DCFPyL PET/CT in management of prostate cancer biochemical recurrence.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Improve understanding and clinical application of 18F-DCFPyL PET/CT in management of prostate cancer biochemical recurrence.

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Abstract Archives of the RSNA, 2021

CA04-D

Cardiac Wednesday Poster Discussions

Abstract Archives of the RSNA, 2021

Sub-Events

NPM04-A1   Shaping The Future Of Teaching In Radiology - Results Of An International Study.

Participants
Fabian Stoehr, Mainz, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Due to the outbreak of the coronavirus disease 2019 (COVID-19), it proved necessary to rapidly change medical education from on-site to online teaching. In the wake of the crisis, medical educators were forced to rethink the purpose of teaching and the best form of transmission of knowledge. In cooperation with the European Society of Radiology (ESR), this study investigated the attitudes of radiologists in Europe and North America towards innovative online teaching concepts.*Methods and Materials In total, 224 radiologists from 31 different countries participated in our cross-sectional, web-based survey study. On a 7-point Likert-scale, participants were asked to answer 27 questions about the online teaching situation before and during the pandemic, technical and social aspects of online teaching and the future role of online teaching in radiology.*Results An overwhelming majority stated that radiology is particularly well-suited for online teaching (91%), that online teaching should play a more prominent role even after the pandemic (73%) and that lecturers should be familiar with online teaching techniques (89%). Difficulties include a higher workload in preparing online courses (59%), issues with motivating students to follow online courses (56%) and the risk of social isolation (71%). Before the pandemic, only 12% of teaching was provided online; for the future our participants deemed a balanced ratio of approximately 50% online vs. on-site teaching appropriate (Figure 1).*Conclusions Our participants are open-minded about online teaching in radiology. As the best way of transferring knowledge in medical education is still unclear, online teaching offers potential for innovation in radiology education. To support online teaching development, a structured, framework-based "online curriculum" should be established.*Clinical Relevance/Application We believe that the lessons learned during the pandemic might stimulate beneficial changes in teaching. The future challenge will be to further develop and integrate novel online teaching concepts.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

We believe that the lessons learned during the pandemic might stimulate beneficial changes in teaching. The future challenge will be to further develop and integrate novel online teaching concepts.

NPM04-A2   Current Status Of Clinical And Academic Productivity Bonus Proportions

Participants
Sanaz Ameli, MD, Little Rock, Arkansas (*Presenter*) Nothing to Disclose

PURPOSE

Many radiology practices incentivize clinical productivity. However, studies have shown less widespread incentives dedicated to academic productivity even in university-based settings. We investigated the current state of incentive plans in academic radiology practices.*Methods and Materials A questionnaire was designed based on the literature describing measures of clinical and academic productivity. The electronic survey was emailed to the directors of Diagnostic Radiology (DR, N=189) and Neuroradiology (NR, N=87) programs. The survey queried the proportion of salary appropriated to bonuses, changes in distribution ratio in the past years, and satisfaction levels with the incentive plans.*Results Response rate was 21% for DR and 19.5% for NR to date. Among these, 80% (DR) and 76.5% (NR) reported the presence of an incentive plan. The factors which were incentivized (more than one could apply for each program) were clinical productivity (52.5% DR, 52.9% NR), academic productivity (27.5% DR, 29.4% NR), other factors (35.0% DR, 29.4% NR), or none (20.0% DR, 23.5% NR). From the total incentive budget, 50.5±32.1 (DR) and 48.2±31.6% (NR) were dedicated to clinical productivity, 25.0±22.9% (DR) and 48.8±32.5% (NR) to academic productivity (DR P<0.05), and 24.5±36.8% (DR) and 3.0±6.7% (NR) to other factors. The trend of ratio of the bonus devoted to each category in the past 10 years was reported as below: Clinical productivity (DR & NR): 47.8% & 33.3% increased; 26.1% & 8.3% decreased; 26.1% & 58.3% not changed, respectively. Academic productivity (DR & NR): 20.0% & 9.1% increased; 25.0% & 36.4% decreased; 55% & 54.5% not changed, respectively. For DR & NR, 56.25% & 38.46%, 12.5% & 7.69%, and 31.25% & 53.85% of the directors were satisfied, neutral, or dissatisfied with their current incentive plans, respectively.*Conclusions Less than 30% of the programs incentivize academic productivity. The total budget dedicated to academic productivity is significantly less than clinical productivity by more than 50% in DR programs (P<0.5). In the past 10 years, the incentives dedicated to clinical productivity have mainly increased, while either not changed or decreased for academic productivity.*Clinical Relevance/Application The fact that 1/3 of the programs incentivize academic productivity, and even in those, significantly less money is set aside for academic bonus, raises an alarm for the future of academic radiology.

RESULTS

Response rate was 21% for DR and 19.5% for NR to date. Among these, 80% (DR) and 76.5% (NR) reported the presence of an incentive plan. The factors which were incentivized (more than one could apply for each program) were clinical productivity (52.5% DR, 52.9% NR), academic productivity (27.5% DR, 29.4% NR), other factors (35.0% DR, 29.4% NR), or none (20.0% DR, 23.5% NR). From the total incentive budget, 50.5±32.1 (DR) and 48.2±31.6% (NR) were dedicated to clinical productivity, 25.0±22.9% (DR) and 48.8±32.5% (NR) to academic productivity (DR $P<0.05$), and 24.5±36.8% (DR) and 3.0±6.7% (NR) to other factors. The trend of ratio of the bonus devoted to each category in the past 10 years was reported as below: Clinical productivity (DR & NR): 47.8% & 33.3% increased; 26.1% & 8.3% decreased; 26.1% & 58.3% not changed, respectively. Academic productivity (DR & NR): 20.0% & 9.1% increased; 25.0% & 36.4% decreased; 55% & 54.5% not changed, respectively. For DR & NR, 56.25% & 38.46%, 12.5% & 7.69%, and 31.25% & 53.85% of the directors were satisfied, neutral, or dissatisfied with their current incentive plans, respectively.

CLINICAL RELEVANCE/APPLICATION

The fact that 1/3 of the programs incentivize academic productivity, and even in those, significantly less money is set aside for academic bonus, raises an alarm for the future of academic radiology.

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SDP-RO

Radiation Oncology Pre-recorded Scientific Posters

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Sub-Events

SDP-RO-1   Effects Of P53 Status Of Tumor Cells, 10B Delivery Agent Type And Concentration At The Time Of Administration On The Biological Effectiveness For Boron Neutron Capture Therapy

Participants
Shinichiro Masunaga, MD, Osaka, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To examine the effect of p53 status of tumor cells, including the type and the concentration of 10B delivery agents at the time of administration on the values of compound biological effectiveness (CBE) in boron neutron capture therapy.*Methods and Materials After subcutaneous administration of a 10B delivery agent, boronophenylalanine-10B (BPA) or sodium mercaptododecaborate-10B (BSH), at 2 separate concentrations, the 10B concentrations in implanted p53-wild (SAS/neo) or mutated type (SAS/mp53) tumors were measured using ?-ray spectrometry. The tumor-bearing mice received 5-bromo-2'-deoxyuridine (BrdU) continuously to label all intratumor proliferating (P) tumor cells, then were treated with BPA or BSH. Right after reactor neutron beam irradiation to the tumor, during which intratumor 10B concentrations were kept at levels similar to each other, cells from the tumors were isolated and incubated with a cytokinesis blocker. The responses of tumor cells were assessed based on the frequencies of micronucleation.*Results In both SAS/neo and SAS/mp53 tumors, the CBE values were higher in quiescent (Q) cells and in the use of BPA than total (P+Q) cells and BSH, respectively. The higher the administered concentrations were, the smaller the CBE values became, with a clearer tendency in the use of BPA and SAS/neo tumors than BSH and SAS/mp53 tumors, respectively. The values for 10B delivery agents that deliver into solid tumors more dependently on uptake capacity of cells became more changeable.*Conclusions Tumor characteristics, such as tumor micro-environmental heterogeneity, influence on the CBE value. The CBE value itself can be regarded as the index showing the level of intratumor heterogeneity.*Clinical Relevance/Application The CBE factor for each tissue and tumor, shown to be highly dependent on the degree of ability of distributing 10B from 10B-carriers, may be one of the promising candidates for the index to estimate tumor heterogeneity.

RESULTS

In both SAS/neo and SAS/mp53 tumors, the CBE values were higher in quiescent (Q) cells and in the use of BPA than total (P+Q) cells and BSH, respectively. The higher the administered concentrations were, the smaller the CBE values became, with a clearer tendency in the use of BPA and SAS/neo tumors than BSH and SAS/mp53 tumors, respectively. The values for 10B delivery agents that deliver into solid tumors more dependently on uptake capacity of cells became more changeable.

CLINICAL RELEVANCE/APPLICATION

The CBE factor for each tissue and tumor, shown to be highly dependent on the degree of ability of distributing 10B from 10B-carriers, may be one of the promising candidates for the index to estimate tumor heterogeneity.

SDP-RO-2   Differential Diagnosis Of Inflammatory And Lymphoma And Metastatic Cervical Lymph Nodes By Dual-energy Computed Tomography

Participants
Ronghua Wang, Taiyuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the utility of dual-source dual-energy CT (DECT)-derived imaging in the differential diagnosis between inflammatory, lymphoma and metastatic cervical lymph nodes .*Methods and Materials A retrospective analysis of DECT images of 19 patients with cervical inflammatory lymph node (43 lymph nodes), 21 patients with cervical lymphoma (56 lymph nodes), and 25 patients with cervical lymph node metastases (46 lymph nodes) from a single institution was performed. The iodine map, monochromatic energy images (40-190 keV), and DECT-derived iodine quantitative parameters in the arterial and venous phases of the lymph node lesions were measured and compared. Receiver operating characteristics (ROC) were obtained to evaluate the diagnostic effectiveness of DECT-derived iodine quantitative parameters in differentiating the three groups and calculate the optimal threshold.*Results The iodine overlay values, iodine concentration, and normalized iodine concentrations among inflammatory cervical lymph node, cervical lymphoma, and metastatic cervical lymph node were statistically significantly different (p< 0.01). The values obtained for all iodine parameters of the inflammatory group were higher than those of the other two groups, with the values of the metastatic group being the lowest. Pairwise comparisons demonstrated significant differences in all iodine parameters of inflammatory versus metastatic groups and lymphoma versus metastatic groups. The inflammatory versus lymphoma group displayed a significant difference in the iodine parameters only in the venous phase. Differences in the properties of the tissues were also detectable based on the CT overlay value in the venous phase(CTV) of lymph nodes derived from the monochromatic energy images (p < 0.05) and the slope of the energy-attenuation curves (p < 0.05). ROC curves indicated the iodine concentration in the venous phase (ICVP) displayed better diagnostic efficiency for distinguishing metastatic lymph node from lymphoma (AUC=0.914) and inflammatory lymph nodes (AUC=0.977). The CTV had the highest AUC between lymphoma and inflammatory lymph nodes (AUC=0.876).*Conclusions Dual-source DECT imaging is a promising tool for the differential diagnosis of inflammatory and metastatic cervical lymph nodes and cervical lymphoma. thereby enhancing non-invasive diagnostic capabilities.*Clinical Relevance/Application Scanning at the venous phase is recommended to potentially make a differential diagnosis.

RESULTS

The iodine overlay values, iodine concentration, and normalized iodine concentrations among inflammatory cervical lymph node, cervical lymphoma, and metastatic cervical lymph node were statistically significantly different ($p < 0.01$). The values obtained for all iodine parameters of the inflammatory group were higher than those of the other two groups, with the values of the metastatic group being the lowest. Pairwise comparisons demonstrated significant differences in all iodine parameters of inflammatory versus metastatic groups and lymphoma versus metastatic groups. The inflammatory versus lymphoma group displayed a significant difference in the iodine parameters only in the venous phase. Differences in the properties of the tissues were also detectable based on the CT overlay value in the venous phase(CTV) of lymph nodes derived from the monochromatic energy images ($p < 0.05$) and the slope of the energy-attenuation curves ($p < 0.05$). ROC curves indicated the iodine concentration in the venous phase (ICVP) displayed better diagnostic efficiency for distinguishing metastatic lymph node from lymphoma (AUC=0.914) and inflammatory lymph nodes (AUC=0.977). The CTV had the highest AUC between lymphoma and inflammatory lymph nodes (AUC=0.876).

CLINICAL RELEVANCE/APPLICATION

Scanning at the venous phase is recommended to potentially make a differential diagnosis.

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Sub-Events

PD03-C2   Intra-and Interobserver Agreement In Evaluation Of Image-defined Risk Factors In Pediatric Neuroblastomas: A Multireader Study

Participants
Yaw Amoako-Tuffour, MD, Halifax, Nova Scotia (*Presenter*) Nothing to Disclose

PURPOSE

International-Neuroblastoma-Risk-Group-Staging System (INRGSS) is the latest staging system for pediatric neuroblastomas. INRGSS depends on the presence or absence of image-defined risk factors (IDRFs) on pretreatment imaging. IDRFs were introduced to provide a consensus approach for pretreatment risk stratification and facilitate comparisons across imaging studies. Despite its wide use, no radiological study has validated the reproducibility of IDFRs across radiologists. We aimed to determine the intra and interreader agreement of IDRFs on CT between pediatric radiologists with varying levels of career experience.*Methods and Materials CT scans of 31 children (mean age 3.1 years, male=21) with neuroblastomas who were imaged at our institution between 2006 and 2020, were retrospectively assessed by 7 pediatric radiologists in two rounds. Following an educational session on IDRFs and consensus readings of few cases, radiologists were provided anonymized CTs of patients for assessment. Each CT was accompanied by a customized survey to indicate the presence or absence of IDRFs for each patient. A 3-week period between rounds, as well as randomization and relabeling of the CT studies, was implemented to minimize recall bias. Fleiss' Kappa analysis was used and values less than 0.20 were interpreted as poor, 0.21-0.40 as fair, 0.41-0.60 as moderate, 0.61-0.80 as substantial, and 0.81-1.00 as excellent agreement.*Results In total 559 potentials IDRFs were assessed. Inter-reader agreement among radiologists was 0.65; 95% CI (0.60, 0.69) for the 1st round, 0.62(0.58, 0.66) for the 2nd round and 0.63(0.60, 0.662) for overall reading. Intra-reader agreement for each radiologist ranged from 0.67 (0.60,0.70) to 0.86 (0.82,0.90). IDRF with the highest agreement was "Tumor compressing principal bronchi" [1.0 (1.0-1.0)] and the one with negligible agreement was "Tumor encasing vertebral artery" [-0.077(-0.19-0.04)].*Conclusions Staging of pediatric neuroblastoma using IDRFs yields reproducible and substantial agreement among pediatric radiologists with varying levels of experience. This increases confidence in the use of the INRGSS as a prognostic and clinical decision-making tool.*Clinical Relevance/Application We present an independent external validation for the use of IDRFs in staging of neuroblastoma to confirm reproducibility across pediatric radiologists, which supports its generalizability across different centers.

RESULTS

In total 559 potentials IDRFs were assessed. Inter-reader agreement among radiologists was 0.65; 95% CI (0.60, 0.69) for the 1st round, 0.62(0.58, 0.66) for the 2nd round and 0.63(0.60, 0.662) for overall reading. Intra-reader agreement for each radiologist ranged from 0.67 (0.60,0.70) to 0.86 (0.82,0.90). IDRF with the highest agreement was "Tumor compressing principal bronchi" [1.0 (1.0-1.0)] and the one with negligible agreement was "Tumor encasing vertebral artery" [-0.077(-0.19-0.04)].

CLINICAL RELEVANCE/APPLICATION

We present an independent external validation for the use of IDRFs in staging of neuroblastoma to confirm reproducibility across pediatric radiologists, which supports its generalizability across different centers.

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Abstract Archives of the RSNA, 2021

MK04-A

Musculoskeletal Wednesday Poster Discussions

Sub-Events

MK04-A2 Hip-Spine Syndrome: Lumbosacral Spine Transitional Vertebral Anomalies Are Frequent In Adult Acetabular Dysplasia;#8211;A Cross;#8211;sectional Evaluation Of A Prospective Hip Registry Cohort

Participants
Joshua Sun, Flower Mound, Texas (*Presenter*) Nothing to Disclose

PURPOSE

A subset of patients presenting with hip pain and instability who are found to have acetabular dysplasia (AD) do not experience resolution of symptoms after surgical management. Hip-spine syndrome is a possible underlying cause. We hypothesized that there is increased frequency of radiographic spine anomalies in patients with AD. A secondary aim was to assess between radiographic severity of AD and frequency of spine anomalies.*Methods and Materials This was a cross-sectional analysis of 122 hips in 122 patients who presented with hip pain and had the final diagnosis of AD. Two readers analyzed hip and spine variables using standard hip radiographic series. Frequency of lumbosacral transitional vertebra (LSTV) along with associated Castellvi grade, pars interarticularis defect, and spinal morphological measurements were recorded and correlated with radiographic severity of AD.*Results Out of 122 patients, 110 were females and 12 were males. We analyzed 122 hip radiographic series, 59 from patients with symptoms in the left hip and 63 from patients with symptoms in the right hip. Average age at time of presentation was 34.2 +/- 11.2 years. Frequency of LSTV was high (39-43%), compared to historic records from the general population, with Castellvi type 3b being the most common (60-63%). Patients with AD have increased L4 and L5 interpedicular distance (IPD) compared to published values. Frequency of pars interarticularis defect was 4%. Intraclass correlation coefficient (ICC) for hip and spine variables assessed ranged from good (0.60 - 0.75) to excellent (0.75 - 1.00). Severity of AD did not demonstrate statistically significant correlation with frequency of radiographic spine anomalies.*Conclusions Patients with AD have increased frequency of spinal anomalies seen on standard hip radiographs. However, there exists no correlation between radiographic severity of AD and frequency of spine anomalies.*Clinical Relevance/Application In managing AD patients, clinicians should also assess spinal anomalies that are easily found on standard hip radiographs.

RESULTS

Out of 122 patients, 110 were females and 12 were males. We analyzed 122 hip radiographic series, 59 from patients with symptoms in the left hip and 63 from patients with symptoms in the right hip. Average age at time of presentation was 34.2 +/- 11.2 years. Frequency of LSTV was high (39-43%), compared to historic records from the general population, with Castellvi type 3b being the most common (60-63%). Patients with AD have increased L4 and L5 interpedicular distance (IPD) compared to published values. Frequency of pars interarticularis defect was 4%. Intraclass correlation coefficient (ICC) for hip and spine variables assessed ranged from good (0.60 - 0.75) to excellent (0.75 - 1.00). Severity of AD did not demonstrate statistically significant correlation with frequency of radiographic spine anomalies.

CLINICAL RELEVANCE/APPLICATION

In managing AD patients, clinicians should also assess spinal anomalies that are easily found on standard hip radiographs.

MK04-A3 The Wedged Hip Aspiration Technique: A Primer On A Highly Successful Modified Approach

Participants
Roman Shrestha, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

To describe a wedged hip aspiration technique and compare its success to more standard approaches.*Methods and Materials Our pilot study includes a retrospective chart review of patients over a 2-year period, who underwent a hip aspiration performed by a specific attending. The attending's technique places the patient into a wedged oblique position, accessing proximal to the greater trochanter, and targeting the dependent joint space along the superolateral aspect of the femoral head/neck junction. Evaluation included aspiration success, aspirate volume, culture results, and needle gauge.*Results There were 34 females and 33 males in the pilot study, with an average age of 65 (range of 29-86). A prosthesis was the target for 61 of the procedures. For the purposes of the study, a "dry tap" was considered to be a volume of <1 mL of synovial aspirate. Overall success (=1 mL of aspirate) was found to be 94%, with an average volume of 17.2 mL withdrawn. The most common needle gauge utilized was 20 (range of 18-22) for 94% of the procedures.*Conclusions The wedged hip aspiration technique is highly successful in clinical practice with great reproducibility across all patients. Its success demonstrates great promise compared to more standard approach success rates of 32-49%.*Clinical Relevance/Application The hip is the second most commonly aspirated joint. Creating awareness of this modified technique will hopefully aid other radiologists in a procedure which typically carries a high "dry tap" rate. This approach is also greatly beneficial to many anatomical barriers, such as body habitus, and further reduces risk of injuring the major femoral neurovascular structures. Current plans include expanding the study retrospectively over 10 years.

RESULTS

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There were 54 females and 68 males in the pilot study, with an average age of 65 (range of 29-88). A prosthesis was the target for 61 of the procedures. For the purposes of the study, a "dry tap" was considered to be a volume of <1 mL of synovial aspirate. Overall success (≥1 mL of aspirate) was found to be 94%, with an average volume of 17.2 mL withdrawn. The most common needle gauge utilized was 20 (range of 18-22) for 94% of the procedures.

CLINICAL RELEVANCE/APPLICATION

The hip is the second most commonly aspirated joint. Creating awareness of this modified technique will hopefully aid other radiologists in a procedure which typically carries a high "dry tap" rate. This approach is also greatly beneficial to many anatomical barriers, such as body habitus, and further reduces risk of injuring the major femoral neurovascular structures. Current plans include expanding the study retrospectively over 10 years.

MK04-A4   Cartilage Damage Interpretation At MRI: How To Most Accurately Match Findings At Arthroscopy

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Brian K. Markhardt, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) A gold standard for cartilage assessment does not exist, with both MRI and arthroscopy providing different insights into the disease. (2) Distinction between partial-thickness and full-thickness cartilage lesions is often more accurate and clinically important than distinction between grades of partial-thickness lesions. (3) Osteochondral unit appearance is dependent on MRI parameters and articular surface angle. (4) Understanding the true margin of the subchondral bone plate is important for determining cartilage lesion depth. (5) Hyperintense and hypointense lesions often represent partial-thickness cartilage degeneration at arthroscopy. (6) Subchondral reactive changes increase the likelihood and depth of cartilage damage at arthroscopy. (7) Central osteophytes are associated with cartilage damage but are usually not visualized at arthroscopy. (8) Damaged cartilage in one compartment of the knee may cause marginal osteophytes at another compartment with intact cartilage.

TABLE OF CONTENTS/OUTLINE

(1) Introduction (2) Osteochondral unit anatomy a. Diagrams - zone anatomy and fibril organization b. MRI - anisotropy and dependence on sequence parameters c. CT arthrogram - normal subchondral bone plate thickness d. Histology - columnar organization, vascular and nerve supply (3) Signal abnormality lesions at MRI with arthroscopic correlation (4) Morphologic lesions at MRI with CT and arthroscopic correlation (5) Preferred terminology and synonyms (6) Subchondral bone (7) Osteophytes (8) Synovitis (9) Conclusion

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HN02-A

Head and Neck Monday Poster Discussions

Sub-Events

HN02-A2   Automatic GTV Segmentation Using Versatile DCNN Framework With Multi-modality Support

Participants
Kanchan Ghimire, Arlington, Virginia (*Presenter*) Nothing to Disclose

PURPOSE

The recent development in deep convolutional neural networks (DCNN) have led to accurate segmentation of single-modality medical images; however, there are challenges in effectively utilizing information from multiple modalities. The purpose of this study is to develop a versatile DCNN framework for head and neck (H&N) gross tumor volume (GTV) segmentation with either single-modality or multi-modality 3D images.*Methods and Materials To segment H&N GTV, pre-processing was performed by normalizing the voxel spacing and intensity and fusing the complementary CT and PET scans. Then patch-based 3D U-Nets were trained using channel dropout and conventional vs dilated convolutions, and then finally ensemble modeling was performed to produce the final GTV segmentation. The dataset was provided by MICCAI 2020 'HECKTOR' Challenge, with 201 H&N scans (CT and PET) and annotated GTVs. Channel dropout was used during training to emulate the variance of input modalities and train a single network that supports different combinations of input modalities in deployment.*Results The proposed method using channel dropout yield a Dice Similarity Coefficient (DSC) of 0.777 when tested on combined modalities (CT and PET), DSC of 0.596 on CT and DSC of 0.743 on PET. The results are comparable to models trained and tested on single modality (DSC 0.620 for CT and DSC 0.743 for PET). Finally, ensemble of conventional and dilated convolutions trained with channel dropout yield DSC of 0.803.*Conclusions The proposed DCNN method demonstrated good performance on automatic segmentation of H&N GTV on CT and PET scans. While the fusion of CT and PET scans yield superior result, the channel dropout method allowed for versatile approach in leveraging either single-modality or multi-modality scans. This method has the potential to be applied to real-world clinical practice for accurate, fast and reproducible delineation of GTVs.*Clinical Relevance/Application Automatic segmentation of head and neck (H&N) gross tumor volume (GTV) plays a pivotal role in disease characterization and cancer staging by reducing human efforts and inter-observer variability.

RESULTS

The proposed method using channel dropout yield a Dice Similarity Coefficient (DSC) of 0.777 when tested on combined modalities (CT and PET), DSC of 0.596 on CT and DSC of 0.743 on PET. The results are comparable to models trained and tested on single modality (DSC 0.620 for CT and DSC 0.743 for PET). Finally, ensemble of conventional and dilated convolutions trained with channel dropout yield DSC of 0.803.

CLINICAL RELEVANCE/APPLICATION

Automatic segmentation of head and neck (H&N) gross tumor volume (GTV) plays a pivotal role in disease characterization and cancer staging by reducing human efforts and inter-observer variability.

HN02-A4   The Last Decade Of The Neuroimaging Signs

Participants
Melih Akyuz, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. A large number of journal articles are published each year describing new imaging signs. The most impactful of these transition into radiology textbooks and help in expanding our knowledge base. 2. The clinical utility of a sign published in a journal is determined by its accuracy. Articles describing the most accurate signs invariably accrue the most citations. 3. For this exhibit, we did a comprehensive search of the top neuroimaging journals including the American Journal of Neuroradiology and Neuroradiology. We also searched allied journals from other specialties Neurosurgery, Neurology, Spine, and Otolaryngology. 4. A list of the top 10 articles from the last decade was compiled based on the overall accuracy of the sign and the citations received. Our experience working with that imaging sign is also added.

TABLE OF CONTENTS/OUTLINE

1. Case-based imaging review of the top 10 radiologic signs from the last decade. 2. Description of the imaging sign and its pathophysiological or histopathological basis. 3. Our experience of the applicability of the imaging sign.

Abstract Archives of the RSNA, 2021

NPM04-B

Noninterpretative Wednesday Poster Discussions

Sub-Events

NPM04-B1   Understanding Compliance With Recommendations For Additional Imaging

Participants
Jack Renfrew, MD, phoenix, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

To measure the rate of compliance for recommended additional imaging (RAI) based on whether the recommendation was for immediate or delayed follow-up and whether there was communication of recommendations to the ordering provider.*Methods and Materials We evaluated radiology reports generated over a twelve-month period by a community practice radiology group. We compared whether the recommendations were followed when the RAI was for immediate or delayed imaging and whether the radiologist called the ordering provider with the recommendation that imaging should be performed.*Results We reviewed 237,917 consecutive radiology reports and identified 3,558 (1.50%) reports in which at least one RAI was made. 3,444 of these were analyzed (the others had recommendations beyond the time frame of this report). For the 1,648 reports recommending immediate further imaging, 778 (47.3%) were performed and for the 1,798 reports recommending delayed further imaging, 600 (33.4%) were performed (p<.01). For the 268 reports where the ordering physician was called, 172 (64.2%) were performed and for the 3,176 reports where the ordering physician was not called 1,206 (38.0%) were performed (p<.01). Reports recommending immediate imaging were called much more frequently (14.8%) than reports recommending delayed imaging (3.4%) (p<.01).*Conclusions Recommendations for immediate imaging were followed more frequently than recommendations calling for delayed imaging. Calling the ordering provider with RAI was associated with increased likelihood of the imaging being performed.*Clinical Relevance/Application When constructing follow-up assurance apparatuses, it is important to know which follow-up exams have a high chance of not being performed. Further, the act of physician-to-physician communication helps increase appropriate follow-up completion rate.

RESULTS

We reviewed 237,917 consecutive radiology reports and identified 3,558 (1.50%) reports in which at least one RAI was made. 3,444 of these were analyzed (the others had recommendations beyond the time frame of this report). For the 1,648 reports recommending immediate further imaging, 778 (47.3%) were performed and for the 1,798 reports recommending delayed further imaging, 600 (33.4%) were performed (p<.01). For the 268 reports where the ordering physician was called, 172 (64.2%) were performed and for the 3,176 reports where the ordering physician was not called 1,206 (38.0%) were performed (p<.01). Reports recommending immediate imaging were called much more frequently (14.8%) than reports recommending delayed imaging (3.4%) (p<.01).

CLINICAL RELEVANCE/APPLICATION

When constructing follow-up assurance apparatuses, it is important to know which follow-up exams have a high chance of not being performed. Further, the act of physician-to-physician communication helps increase appropriate follow-up completion rate.

NPM04-B2   Pathway To The C-Suite: An Analysis Of Radiology's Representation In Hospital Leadership Roles In New York State

Participants
Zachary Chung, BS, Elmont, New York (*Presenter*) Nothing to Disclose

PURPOSE

This study analyzes organizational information of academic medical institutions and teaching affiliates in New York State to identify factors associated with ascent to clinical and non-clinical senior leadership hospital roles.*Methods and Materials NY State teaching hospitals and affiliates identified in the 2020 Texas STAR Database and the AMA's ACGME Fellowship & Residency Programs Database Institution Directory were included in the data set. Home health agencies, hospice institutions, rehabilitation centers, stand-alone diagnostic/interventional practices and most ambulatory care facilities were excluded from the data set. Physicians without complete background information on DocInfo tool, AMA DocFinder, the NYS Office of the Professions Verification Search Tool, and, physician self-reports via Doximity and LinkedIn were excluded. Physicians were stratified based on medical and surgical specialties. Leadership designations and roles were subcategorized on the basis of clinical (Chief Medical Officer, Chief Quality Officer, Physician-in-Chief), nonclinical (Chief Executive Officer, Chief Financial Officer) and hybrid (clinical and nonclinical components) responsibilities.*Results 197 physicians were identified in senior hospital leadership positions in New York State. Physician leaders were mostly US medical school graduates with additional degrees and training in the medical specialties.*Conclusions Early data analysis suggests that specialty, US medical school training, and additional degrees beyond the medical degree may influence the likelihood of promotion into senior hospital leadership roles.*Clinical Relevance/Application A critical analysis of the potential etiologies of the disparate representation between radiologists and other specialties/subspecialties will allow modifications to existing radiology graduate medical education and organizational structure to facilitate more robust and comprehensive resident and junior attending leadership education and training.

RESULTS

197 physicians were identified in senior hospital leadership positions in New York State. Physician leaders were mostly US medical school graduates with additional degrees and training in the medical specialties.

CLINICAL RELEVANCE/APPLICATION

A critical analysis of the potential etiologies of the disparate representation between radiologists and other specialties/subspecialties will allow modifications to existing radiology graduate medical education and organizational structure to facilitate more robust and comprehensive resident and junior attending leadership education and training.

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Sub-Events

CA04-A2   The Influence Of Artificial Intelligence Assistance On The Diagnostic Performance Of Ccta In Coronary Stenosis In Radiologists With Different Levels Of Experience

Participants
Xianjun Han, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to investigate radiologists with different levels of experience and whether the diagnostic performance and time efficiency of coronary computed tomography angiography (CCTA) could be improved by the use of CCTA-artificial intelligence (CCTA-AI) assistance.*Methods and Materials This was a single-centre retrospective analysis that included 200 patients (125 men (62.5%), average age: 63.8 ± 8.8) with complete CCTA and invasive coronary angiography (ICA) data, and ICA results were used as the gold standard. Eighteen radiologists with different levels of experience were divided into three groups (novice, junior and senior), and then the three groups were divided into Group A (without AI-assisted, Group 1 to Group 3) and Group B (with AI-assisted, Group 4 to Group 6) by stratified random sampling, totalling 6 groups (avoided readers' recall bias). CCTA-AI and each radiologist interpreted the degree of stenosis in 200 CCTA cases. The average sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV), and accuracy, as measured by the area under the receiver operating characteristic curve (AUC), were reported for the 6 groups on patient-based, vessel-based and segment-based. The interpretation time for each radiologist in Group A and Group B was recorded.*Results Compared to without CCTA-AI, the novice group with CCTA-AI had improved sensitivity (75.0% vs. 83.0% on patient-based, p=0.003). AI assistance could identify more segments and vessels in novices. In the seniors, the specificity was better with CCTA-AI assistance than without. There was no significant improvement in CCTA-AI assistance in juniors. The median interpretation times for Group A and Group B were 615 seconds and 413 seconds, respectively, and the difference was statistically significant (p <0.001).*Conclusions CCTA-AI could assist in and improve the diagnostic performance of radiologists with different levels of experience, with novices exhibiting improved sensitivity while seniors exhibiting improved specificity. Use of CCTA-AI assistance could shorten the training time for radiologists.*Clinical Relevance/Application CCTA-AI could assist in and improve the diagnostic performance of inexperienced radiologists. Use of CCTA-AI assistance could shorten the training time for radiologists.

RESULTS

Compared to without CCTA-AI, the novice group with CCTA-AI had improved sensitivity (75.0% vs. 83.0% on patient-based, p=0.003). AI assistance could identify more segments and vessels in novices. In the seniors, the specificity was better with CCTA-AI assistance than without. There was no significant improvement in CCTA-AI assistance in juniors. The median interpretation times for Group A and Group B were 615 seconds and 413 seconds, respectively, and the difference was statistically significant (p <0.001).

CLINICAL RELEVANCE/APPLICATION

CCTA-AI could assist in and improve the diagnostic performance of inexperienced radiologists. Use of CCTA-AI assistance could shorten the training time for radiologists.

CA04-A3   Photon-Counting CT For Coronary Stent Imaging: A Phantom Study

Participants
Bernhard Petritsch, Wuerzburg, Germany (*Presenter*) Research Consultant, Siemens AG

PURPOSE

To assess in-stent lumen visibility and quantitative image characteristics of different coronary stents using a clinical photon-counting detector (PCD) CT system in comparison to a conventional energy-integrating detector (EID) CT system.*Methods and Materials In this phantom study 18 different coronary stents in 7 different sizes (2.25 mm to 4.5 mm diameter) were expanded into plastic vessel phantom filled with contrast agent. Stent-containing vessel phantoms were positioned in an anthropomorphic phantom (QRM) simulating a medium-sized patient. CT scans were acquired parallel to the scanners z-axis using a novel clinical cadmium-telluride (CdTe) based PCD CT system (SOMATOM CountPlus, Siemens Healthineers) with sub-pixels of 0.275x0.322 mm size. Examinations were performed with two different scan-modes (standard-resolution [SR mode - 2x2 binning] and ultra-high-resolution [UHR mode- subpixels readout separately]). A state of the art EID CT system from the same vendor served as reference standard (SOMATOM Force, Siemens Healthineers). CTDIvol matched images were reconstructed with matched convolution kernels and identical reconstruction parameters. In-stent lumen visibility (in %) and image noise (in HU) were measured. Differences were tested using Wilcoxon signed-rank test.*Results The PCD-UHR mode achieved best in-stent lumen visibility while the PCD-SR mode provided lowest noise levels. In-stent lumen visibility was significantly higher (p < 0.001) with PCD in both, SR mode (66.7%, interquartile range [IQR] 63.3-72.3) and UHR mode (68.9%, IQR 64.4-74.4) when compared to conventional EID (65.4%, IQR 62.2-70.4). Image noise was significantly lower (p <0.001) for PCD in SR mode (21 HU, IQR 21-21) compared to conventional EID images (25 HU, IQR 24-25.0). The difference in image noise was also significant between PCD-SR mode and PCD-UHR mode (p < 0.001).*Conclusions In an in vitro setting, the clinical PCD CT system provides superior in-stent lumen visibility and lowered image noise when compared to state-of-the-art EID CT technology of the same vendor.*Clinical Relevance/Application Clinical PCD CT has

the potential to allow for improved assessment of coronary artery stents and in-stent restenosis in particular, respectively. At the same time it offers possibilities for substantial dose reduction.

RESULTS

The PCD-UHR mode achieved best in-stent lumen visibility while the PCD-SR mode provided lowest noise levels. In-stent lumen visibility was significantly higher (p < 0.001) with PCD in both, SR mode (66.7%, interquartile range [IQR] 63.3-72.3) and UHR mode (68.9%, IQR 64.4-74.4) when compared to conventional EID (65.4%, IQR 62.2-70.4). Image noise was significantly lower (p <0.001) for PCD in SR mode (21 HU, IQR 21-21) compared to conventional EID images (25 HU, IQR 24-25.0). The difference in image noise was also significant between PCD-SR mode and PCD-UHR mode (p < 0.001).

CLINICAL RELEVANCE/APPLICATION

Clinical PCD CT has the potential to allow for improved assessment of coronary artery stents and in-stent restenosis in particular, respectively. At the same time it offers possibilities for substantial dose reduction.

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Sub-Events

PH04-B10   Evaluation Of Dose And Image Quality For Two Cardiovascular Fluoroscopy Systems

Participants
Gregory Anthony, BA, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate two cardiovascular interventional fluoroscopy systems based on dose, image noise, and spatial and temporal resolution.*Methods and Materials Two interventional fluoroscopy systems, Artis Q with Pure/Care+Clear (Siemens Healthineers, Erlangen, Germany) and Azurion with ClarityIQ (Philips Healthcare, Best, Netherlands) were evaluated. The most clinically-used cardiovascular protocol (7.5 f/s at maximum source-to-image distance), on each system was applied. Dose rate was measured at the IEC reference point to test AEC performance for a range of patient thicknesses, simulated with PMMA slabs and copper sheets. Image noise was assessed via SNR measurements in flat field images. Limiting spatial resolution and spatial-temporal resolution were observed with a line pair phantom and rotating spoke phantom, respectively.*Results Air kerma rates were comparable for both systems' low-dose settings. The Artis Q normal mode gave approximately 2-3x higher dose than the low-dose mode. Dose efficiency (defined as SNR divided by square root of dose) for the Artis Q system was generally 2-3x greater than that of the Azurion system. The Artis Q low-dose mode also increased dose efficiency over normal mode for small and intermediate patient sizes. Limiting spatial resolution was comparable for both systems, but Artis Q low-dose images exhibited some loss of spatial resolution. At similar dose levels, Azurion images were visually sharper than Artis Q images. The thinnest resolvable spoke in cineradiography images was identical for both systems. Cineradiography images from the Azurion system appeared to have less uniform noise properties, while Artis Q images had more noticeable edge enhancement artifacts. The measured beam half-value layer was consistently greater for Artis Q.*Conclusions When low-dose settings are selected, both systems can be expected to produce similar patient entrance dose rates. However, Artis Q images had markedly reduced noise, and thus higher dose efficiency. This is likely related to stronger image smoothing or frame averaging, combined with harder beam filtration employed in the Artis Q. The data suggests these two systems have different approaches in AEC function (different Cu filters) and image post-processing. Further study is underway to include task-specific image quality evaluation.*Clinical Relevance/Application Due to the two systems' similar dose rates, electing to use one over another will likely depend on image quality preferences. Images produced by the two systems are very different in their noise and, to some extent, sharpness. Image quality is highly dependent upon post-processing and AEC function, the default settings of which can often be adjusted as per user preference.

RESULTS

Air kerma rates were comparable for both systems' low-dose settings. The Artis Q normal mode gave approximately 2-3x higher dose than the low-dose mode. Dose efficiency (defined as SNR divided by square root of dose) for the Artis Q system was generally 2-3x greater than that of the Azurion system. The Artis Q low-dose mode also increased dose efficiency over normal mode for small and intermediate patient sizes. Limiting spatial resolution was comparable for both systems, but Artis Q low-dose images exhibited some loss of spatial resolution. At similar dose levels, Azurion images were visually sharper than Artis Q images. The thinnest resolvable spoke in cineradiography images was identical for both systems. Cineradiography images from the Azurion system appeared to have less uniform noise properties, while Artis Q images had more noticeable edge enhancement artifacts. The measured beam half-value layer was consistently greater for Artis Q.

CLINICAL RELEVANCE/APPLICATION

Due to the two systems' similar dose rates, electing to use one over another will likely depend on image quality preferences. Images produced by the two systems are very different in their noise and, to some extent, sharpness. Image quality is highly dependent upon post-processing and AEC function, the default settings of which can often be adjusted as per user preference.

PH04-B11   Radiopathomic Correlation Model For Differentiation Of Invasive And Pre-invasive Lung Cancer With LDCT Images

Participants
Chuan Zhou, PhD, Ann Arbor, Michigan (*Presenter*) Scientific Advisory Board, Perception Vision Medical Technology Co., Ltd

PURPOSE

To investigate the feasibility of building radiopathomics correlation maps to improve the classification of pathologic invasive and pre-invasive lung nodules with low dose CT (LDCT) images.*Methods and Materials Previously we developed two support vector machine (SVM) models to differentiate invasive from pre-invasive lung nodules by quantitative analysis of pathologic images (SVM-p) and LDCT images (SVM-ct). With least absolute shrinkage and selection operator (LASSO) method, 11 pathologic and 10 CT image features were identified to be informative features for SVM-p and SVM-ct, respectively. With permission from the National Lung Screening Trial (NLST) project, a data set of 52 cases having both LDCT and pathologic images was used. Among 85 biopsied nodules, 50 and 35 nodules were pathologically diagnosed as invasive and pre-invasive. To establish correlation maps between pathomic and radiomic features, those 11 pathologic and 10 CT features were separately extracted from the corresponding pathologic and LDCT images for each nodule. We then built 11 new SVM models with LASSO method that used the 10 CT radiomic features as the input variables to predict each pathologic feature. We referred to the new set of pathologic features that were

mapped to the CT radiomic features guided by machine learning as radiopathomic features. Finally, a new radiopathomic model was built with the radiopathomic features as the input for classifying invasive and pre-invasive nodules in LDCT images. The performances of the SVM-p, SVM-ct and the radiopathomic models were evaluated using leave-one-case-out cross-validation and the area under the receiver operating characteristic (ROC) curve (AUC).*Results Our radiopathomic model achieved a test AUC of 0.869±0.04. For comparison, the SVM-p and SVM-ct alone achieved a test AUC of 0.915±0.03 and 0.772±0.05, respectively. The differences between pairs of the three models were statistically significant (P<0.05).*Conclusions Our results demonstrated the feasibility of building radiopathomics correlation maps that could translate each pathomic feature to radiomic features and effectively classify invasive and pre-invasive nodules, facilitating the use of CT images for "virtual biopsy".*Clinical Relevance/Application The histopathologic features may be correlated with CT radiomic features to facilitate non-invasive image-based stratification of invasive and indolent lung nodules for guiding management decisions.

RESULTS

Our radiopathomic model achieved a test AUC of 0.869±0.04. For comparison, the SVM-p and SVM-ct alone achieved a test AUC of 0.915±0.03 and 0.772±0.05, respectively. The differences between pairs of the three models were statistically significant (P<0.05).

CLINICAL RELEVANCE/APPLICATION

The histopathologic features may be correlated with CT radiomic features to facilitate non-invasive image-based stratification of invasive and indolent lung nodules for guiding management decisions.

PH04-B4   Exploring The Optimal Monochromatic Energy Level On The Detection Efficiency Of Pulmonary Nodules Using Deep Learning Assisted Lung Nodule Detection System

Participants
Yu Ziting, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the optimal monochromatic energy level on the detection efficiency of pulmonary nodules using deep learning assisted lung nodule detection system.*Methods and Materials Twenty patients underwent chest enhanced CT scans were prospectively enrolled from March to April in 2019 with approval from the ethics committee. All patients signed informed consent before CT examinations. A 256-slice CT was used (Revolution, GE Healthcare) with Pre-ASIR-V weight of 50% and reconstruction slice thickness of 1.25mm. Monochromatic energy levels reconstructed at 50keV,60keV,70keV,80keV and 90keV were selected. Deep learning based AI lung nodule detection system (InferRead CT Lung Research, Infervision, Beijing) was used to analyze the lung nodule detection efficiency for each monochromatic energy levels. Two senior radiologists read the 120kV image with the help of AI to confirm the gold standard nodules by consensus. The number of true and false positive nodules diagnosed by AI in each keV group were recorded by comparing with the gold standard nodules. The lung nodule true positive rate and false positive rate of each monochromatic energy level group were calculated accordingly.*Results A total of 134 nodules were identified in 20 patients as gold standard. AI detected 101, 113, 123, 130 and 129 nodules in 50keV, 60keV, 70keV, 80keV and 90keV energy levels, with 67(51.15%), 87(66.41%), 91(69.47%), 94(71.76%) and 85(64.89%) true positive nodules and 34 (25.95%), 29(22.14%), 32(24.43%), 35(26.72%) and 32(24.43%) false positive nodules. The false positive rate in different keV group tend to be stable with no statistically significant difference. The true positive rate gradually increases from 50 keV to 80 keV while decreases from 80 keV to 90 keV and the maximum true positive value was found at 80keV (71.76%).*Conclusions The optimal monochromatic level for lung nodule detection is 80 keV because it could detect the maximum number of true positive nodules as compared to 50keV, 60 keV, 70 keV and 90keV while false positive rate uncompromised.*Clinical Relevance/Application It is recommended to choose 80 keV as optimal dual energy monochromatic energy level to achieve the highest lung nodule detection rate using deep learning assisted lung nodule detection system.

RESULTS

A total of 134 nodules were identified in 20 patients as gold standard. AI detected 101, 113, 123, 130 and 129 nodules in 50keV, 60keV, 70keV, 80keV and 90keV energy levels, with 67(51.15%), 87(66.41%), 91(69.47%), 94(71.76%) and 85(64.89%) true positive nodules and 34 (25.95%), 29(22.14%), 32(24.43%), 35(26.72%) and 32(24.43%) false positive nodules. The false positive rate in different keV group tend to be stable with no statistically significant difference. The true positive rate gradually increases from 50 keV to 80 keV while decreases from 80 keV to 90 keV and the maximum true positive value was found at 80keV (71.76%).

CLINICAL RELEVANCE/APPLICATION

It is recommended to choose 80 keV as optimal dual energy monochromatic energy level to achieve the highest lung nodule detection rate using deep learning assisted lung nodule detection system.

PH04-B6   Performance Evaluation Of A Super Resolution Deep Learning Reconstruction Algorithm Trained Using Data From A Commercial High Resolution CT System

Participants
Kirsten Lee Boedeker, PHD, Los Angeles, California (*Presenter*) Employee, Canon Medical Systems Corporation

PURPOSE

To evaluate image quality performance of a Super Resolution Deep Learning Reconstruction (SR-DLR) algorithm trained using a commercial High Resolution Computed Tomography (CT) scanner.*Methods and Materials A 20cm Catphan was scanned on a wide volume CT scanner (Canon Aquilion ONE Prism) with a standard cardiac protocol and reconstructed with a prototype SR-DLR which outputs a 1024 matrix and slice width less than the 0.5mm acquisition slice thickness. The raw data was also reconstructed with hybrid iterative reconstruction (AIDR Enhanced), model-based iterative reconstruction (FIRST), and Filtered Backprojection (FBP). A 160mm FOV was used. The SR-DLR uses high-dose CT data acquired on a commercial high resolution CT system (Aquilion Precision) as the training target. The Precision CT system used for training acquires data with a 0.25 mm detector element size at isocenter, both in-plane and longitudinal. Simulated low-dose normal resolution data was used as the training input. The modulation transfer function (MTF), Noise Power Spectra (NPS), and Noise Equivalent Quanta (NEQ) were determined via Fourier analysis. The NEQ was applied to Low Contrast Detectability (LCD) and size differentiation tasks. LCD with a spatial domain model observer was also evaluated as well as the longitudinal noise and spatial resolution for all algorithms.*Results High contrast 10% MTF improved with SR-DLR vs AIDR, FBP, and FIRST, by 4.6lp/cm, 6.0 lp/cm, and 2.8lp/cm, respectively, while maintaining equivalent or improved LCD. The SR-DLR reduced noise vs AIDR, FBP, and FIRST by 14%, 20%, and 54%, respectively, while maintaining good noise texture. NEQ increased across all frequencies. NEQ applied to a ?1mm size discrimination task yielded an 54%, 86%, and 132% increase in detectability for SR-DLR vs AIDR, FBP, and FIRST. Longitudinal resolution significantly improved vs other reconstruction

methods.*Conclusions SR-DLR significantly improves spatial resolution, both in-plane and longitudinal, for a standard cardiac protocol, while maintaining equivalent or improved LCD and other image quality properties, relative to the other reconstruction methods.*Clinical Relevance/Application SR-DLR offers a significant improvement in spatial resolution for Cardiac CT, while maintaining LCD, offering the potential for improved diagnosis and quantification of biomarkers.

RESULTS

High contrast 10% MTF improved with SR-DLR vs AIDR, FBP, and FIRST, by 4.6lp/cm, 6.0 lp/cm, and 2.8lp/cm, respectively, while maintaining equivalent or improved LCD. The SR-DLR reduced noise vs AIDR, FBP, and FIRST by 14%, 20%, and 54%, respectively, while maintaining good noise texture. NEQ increased across all frequencies. NEQ applied to a ?1mm size discrimination task yielded an 54%, 86%, and 132% increase in detectability for SR-DLR vs AIDR, FBP, and FIRST. Longitudinal resolution significantly improved vs other reconstruction methods.

CLINICAL RELEVANCE/APPLICATION

SR-DLR offers a significant improvement in spatial resolution for Cardiac CT, while maintaining LCD, offering the potential for improved diagnosis and quantification of biomarkers.

PH04-B9   Improving Daily CT Quality Control By Identifying Ring Artifacts Using Convolutional Neural Networks: A Proof-of-Concept Simulation Study

Participants
Muhannad Fadhel, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Identifying artifacts in CT phantom images is one of the daily quality control (QC) tasks performed by CT technologists. CT scanners are prone to detector miss-calibrations that result in generation of ring artifacts. Identifying this type of artifact is crucial to avoid repeat exams or potential miss-diagnosis. Given the relatively higher doses associated with CT, this becomes particularly important in pediatric imaging. Due to the random occurrence of ring artifacts of varying magnitude, differing technologist subjectivity & the time constraints associated with the daily QC tasks, image artifacts may be missed. The goal of this project was to create a neural network (NN) model that may be able to identify ring artifacts allowing more robust detection of scanner anomalies, independent of factors discussed.*Methods and Materials 10,000 images of a 32 cm diameter CT uniformity phantom were simulated using Matlab. Half of the simulated images contain three ring artifacts randomly distributed in each phantom image with thicknesses randomly varying between 0.2 cm and 1.0 cm. The ring artifacts were implemented in the sinogram domain for 360 radial projections. The artifactual CT images were computed by filtered back-projection reconstruction technique. Both types of images were randomly displayed and examined just before feeding them in to the convolutional neural network (CNN). A CNN with four convolutional layers followed by a dense layer were trained using Keras in Python with 75% of the images and tested using the rest of the data set. CNN was trained using the RMSProp optimizer. Binary cross entropy loss function was used given the two class classification problem. In the output layer, sigmoid squashing function was employed that maps any predicted value between 0 and 1. We arrived at the employed learning rate based on the accuracy results of the CNN.*Results An optimal learning rate of 0.0001 was arrived at, by repeat trials of the CNN. The results demonstrate a highly reproducible CNN model with an accuracy of more than 99.9% & a loss of 0.3 within 10 epochs.*Conclusions Machine learning algorithms have the potential to effectively assist CT technologists in their daily quality control activities.*Clinical Relevance/Application Quality control of CT scanners is a critical component of a successful clinical CT service, whether it is a stand-alone imaging facility or a large scale health care system like ours. Assessing images for artifactual anomalies on a daily basis is required by accreditation bodies such as ACR, as a part of their CT accreditation program. Our work is a successful first step in an effort to improve outcomes associated with such quality control initiatives, by incorporating state of the art artificial intelligence tools in to daily clinical work flow.

RESULTS

An optimal learning rate of 0.0001 was arrived at, by repeat trials of the CNN. The results demonstrate a highly reproducible CNN model with an accuracy of more than 99.9% & a loss of 0.3 within 10 epochs.

CLINICAL RELEVANCE/APPLICATION

Quality control of CT scanners is a critical component of a successful clinical CT service, whether it is a stand-alone imaging facility or a large scale health care system like ours. Assessing images for artifactual anomalies on a daily basis is required by accreditation bodies such as ACR, as a part of their CT accreditation program. Our work is a successful first step in an effort to improve outcomes associated with such quality control initiatives, by incorporating state of the art artificial intelligence tools in to daily clinical work flow.

Abstract Archives of the RSNA, 2021

Sub-Events

MK01-A1   Are NSAIDs In Suspected Axial Spondyloarthropathy Patients Reducing The Yield Of MRI Imaging?

Participants
Prasanna Partha Sarathy, MBChB,BMedSc, Swansea, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Early diagnosis of Axial Spondyloarthropathy (AxSpA) is essential and hinges on HLA-B27 testing and MRI imaging. Patients suspected to have AxSpA are often started on non-steroidal anti-inflammatory drugs (NSAIDs) for symptomatic relief prior to MRI imaging. Evidence suggests that NSAIDs can lead to improvement in MRI appearances. We aimed to assess the use of MRI in patients with suspected AxSpA and the effect of NSAID on diagnostic yield of MRI scanning.*Methods and Materials A multicentre retrospective cohort study was conducted over 6 months including all patients referred for MRI spine for suspected AxSpA. We collected demographic, clinical, and biochemical data. Patients were asked about NSAID use at the time of MRI. MRI results were collated to assess for evidence of active inflammation. Chi-squared and logistic regression adjusting for age and gender were performed.*Results 74 patients met the inclusion criteria. MRI showed signs compatible with AxSpA in 16 patients (22%). Patients not using NSAIDs at the time of the scan were more likely to have MRI proven inflammation (p=0.017). In the adjusted regression analysis, patients not taking NSAIDs were more likely to have MRI proven inflammation compared to patients taking NSAIDs (OR=8.3; 95% CI: 1.9 to 36; p=0.005). This was mainly driven by the no NSAID vs regular use subgroups (OR=14; 95% CI: 2.1 to 97; p=0.006). The subgroup analysis of patients taking no NSAIDs vs as required NSAIDs and patients taking as required vs regular NSAIDs were not statistically significant (p=0.12 and p=0.289 respectively).*Conclusions This study suggests suspected AxSpA patients not taking NSAIDs were more likely to have MRI proven inflammation compared to patients taking NSAIDs especially those on regular NSAIDs. It is possible that NSAID use at the time of scanning reduces the diagnostic yield of MRI scanning. Further prospective research is warranted to explore this further.*Clinical Relevance/Application Undiagnosed AxSpA can have significant impact on patients' physical and mental health but also their quality of life and livelihood. It is essential that barriers to early and accurate diagnosis such as NSAID use pre-MRI scan be explored and addressed.

RESULTS

74 patients met the inclusion criteria. MRI showed signs compatible with AxSpA in 16 patients (22%). Patients not using NSAIDs at the time of the scan were more likely to have MRI proven inflammation (p=0.017). In the adjusted regression analysis, patients not taking NSAIDs were more likely to have MRI proven inflammation compared to patients taking NSAIDs (OR=8.3; 95% CI: 1.9 to 36; p=0.005). This was mainly driven by the no NSAID vs regular use subgroups (OR=14; 95% CI: 2.1 to 97; p=0.006). The subgroup analysis of patients taking no NSAIDs vs as required NSAIDs and patients taking as required vs regular NSAIDs were not statistically significant (p=0.12 and p=0.289 respectively).

CLINICAL RELEVANCE/APPLICATION

Undiagnosed AxSpA can have significant impact on patients' physical and mental health but also their quality of life and livelihood. It is essential that barriers to early and accurate diagnosis such as NSAID use pre-MRI scan be explored and addressed.

MK01-A2   The Sonographic Quantitative Assessment Of The Deltoid Muscle To Detect Type 2 Diabetes Mellitus: A Potential Noninvasive And Sensitive Screening Method?

Participants
Steven B. Soliman, DO, Ann Arbor, Michigan (*Presenter*) Consultant, General Electric Company;Speaker, General Electric Company

PURPOSE

To evaluate if the sonographic quantitative assessment of the deltoid muscle can be used to detect type 2 diabetes (T2DM).*Methods and Materials Deltoid muscle ultrasound images from 124 patients were stored: 31 obese T2DM, 31 non-obese T2DM, 31 obese non-T2DM, and 31 non-obese non-T2DM. Images were independently reviewed by 3 musculoskeletal radiologists, blinded to the patient's category. Each measured the grayscale pixel intensity of the deltoid muscle and humeral cortex to calculate a muscle/bone ratio for each patient. Following 3 weeks, the 3 radiologists independently repeated measurements on a random 40 subjects. Age, gender, race, body mass index, insulin usage and hemoglobin A1c level were analyzed. The difference among the 4 groups was compared using ANOVA or chi-square tests. Both univariate and multivariate linear mixed models were performed. Multivariate mixed-effects regression models were used, adjusting for demographic and clinical variables. Post hoc comparisons were done with Bonferroni adjustments to identify any differences between groups. The sample size achieved 90% power. Sensitivity and specificity were calculated based on a set ratio threshold. Both inter- and intra-radiologist variability or agreement were assessed.*Results A statistically significant difference in muscle/bone ratios between the groups was identified with the average ratios as follows: obese T2DM, 0.54 (P < 0.001); non-obese T2DM, 0.48 (P < 0.001); obese non-T2DM, 0.42 (P = 0.03); and non-obese non-T2DM, 0.35. There was excellent inter-observer agreement (ICC 0.87) and excellent intra-observer agreements (ICC 0.92, 0.95, and 0.94). Using threshold ratios, the sensitivity for detecting T2DM was 80% with a specificity of 63%.*Conclusions The quantitative assessment of the deltoid muscle by ultrasound is sensitive and accurate for the detection of T2DM. Following further studies, this process could translate into a dedicated, simple and noninvasive screening method to detect T2DM with the hope of identifying some of the 232 million undiagnosed persons globally and could prove especially beneficial in

screening of underserved and underrepresented communities.*Clinical Relevance/Application Quantitative deltoid muscle ultrasound can detect type 2 diabetes with the potential for a highly sensitive noninvasive screening method for identifying some of the 232 million undiagnosed worldwide.

RESULTS

A statistically significant difference in muscle/bone ratios between the groups was identified with the average ratios as follows: obese T2DM, 0.54 ($P < 0.001$); non-obese T2DM, 0.48 ($P < 0.001$); obese non-T2DM, 0.42 ($P = 0.03$); and non-obese non-T2DM, 0.35. There was excellent inter-observer agreement (ICC 0.87) and excellent intra-observer agreements (ICC 0.92, 0.95, and 0.94). Using threshold ratios, the sensitivity for detecting T2DM was 80% with a specificity of 63%.

CLINICAL RELEVANCE/APPLICATION

Quantitative deltoid muscle ultrasound can detect type 2 diabetes with the potential for a highly sensitive noninvasive screening method for identifying some of the 232 million undiagnosed worldwide.

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Abstract Archives of the RSNA, 2021

Sub-Events

NPM04-C2   X-ray And Radiomania

Participants
Priya Dave, BA, Greenwood, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

To discuss the advent of the X-ray and its lasting effects on the public's perception of science, technology, and race. To use a historical perspective to elicit how novel medical and radiologic technologies are accepted by groups of power and the public.*Methods and Materials Analysis of historical documents was conducted through multiple online databases. Documents were also obtained from the National Library of Medicine and the Mount Sinai Medical Archives.*Results Soon after the invention of the X-ray in 1895, it captivated the minds of the public and its advent played a lasting role in the public's perception of medical technology. For a short period at the turn of the century, when its danger remained largely unknown, X-ray devices were pervasive and became a household item. By the 1930s, the X-ray also became a cornerstone of hospital medicine. Records from the Pennsylvania hospital show upwards of one in four admitted patients would undergo imaging. The "Radiomania" settled when the public finally became aware of the X-ray's carcinogenic properties. Upon its advent, the X-ray also played a role in race relations. The ability to see skin-deep challenged preconceived notions about racial superiority and groups in power feared its role as an equalizer.*Conclusions Given its delayed toxicity, the X-ray was one of the first devices warning the public to be cautious towards the long-term effects of technology on the human body. Further, the X-ray allowed the public, for the first time, to see skin deep and has contributed to our modern-day understanding of race relations.*Clinical Relevance/Application As the field of radiology continues to pioneer new technology this presentation discusses how the X-ray, one of the first medical technologies, became integrated into society. Understanding the excitement, followed by distrust, then trust of the device can be a model to understand the degree to which new medical technology might be accepted by groups of power and the public at large.

RESULTS

Soon after the invention of the X-ray in 1895, it captivated the minds of the public and its advent played a lasting role in the public's perception of medical technology. For a short period at the turn of the century, when its danger remained largely unknown, X-ray devices were pervasive and became a household item. By the 1930s, the X-ray also became a cornerstone of hospital medicine. Records from the Pennsylvania hospital show upwards of one in four admitted patients would undergo imaging. The "Radiomania" settled when the public finally became aware of the X-ray's carcinogenic properties. Upon its advent, the X-ray also played a role in race relations. The ability to see skin-deep challenged preconceived notions about racial superiority and groups in power feared its role as an equalizer.

CLINICAL RELEVANCE/APPLICATION

As the field of radiology continues to pioneer new technology this presentation discusses how the X-ray, one of the first medical technologies, became integrated into society. Understanding the excitement, followed by distrust, then trust of the device can be a model to understand the degree to which new medical technology might be accepted by groups of power and the public at large.

IN05-A

Informatics Thursday Poster Discussions

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Abstract Archives of the RSNA, 2021

Sub-Events

PD01-B1   **Quantifying Cobb Angle Measurement Error For Scoliosis Patients Due To Magnification Effect In Biplane EOS Systems**

Participants
Danielle Beaulieu, MS, Stoughton, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To quantify the effect of magnification along the lateral axis on Cobb angle measurements for scoliosis patients due to incorrect patient positioning and/or reference point selection while using low-dose biplanar EOS system frontal images.*Methods and Materials Two methods of quantifying magnification effects were implemented. In the first method, a long steel pipe with outer diameter 1.86 cm was leaned at a known angle against the frontal detector along the center line. The pipe was then scanned using both the frontal and lateral detectors simultaneously, with the patient reference position within the EOS system set to zero (centered along both planes). The lateral image was used to confirm both the diameter and angle of the pipe along the center line, while the frontal image was used to measure the pipe diameter at multiple locations. Linear and polynomial fits were then applied to approximate the magnification factor as a function of displacement from the frontal detector. In the second method, a radiopaque ruler was placed parallel to the frontal detector at the center of the EOS scanner (0 cm reference position) and was then scanned five times with the reference position set to 0, 5, 10, 15, and 20 cm. The ruler was then moved to the 20 cm reference position and scanned again with each reference position set. Lateral magnification of the ruler was measured along 10 cm of the ruler for each image, and the relationship between magnification error and selected reference point was calculated for the ruler at each of the two locations. Theoretical Cobb angle error was calculated for nominal Cobb angles between 0 and 45 degrees at maximum displacement from the reference point.*Results Analysis of the steel pipe images gave a linear approximation of 2.3 mm of lateral magnification for every 10 cm of displacement from the system-set reference point. Magnification errors ranging from -16.9 to 20.2% were measured using the radiopaque ruler across reference points. Error in Cobb angle measurements due to these magnification effects were shown to be between -2.52 and 1.68 degrees for a 10 degree nominal Cobb angle, -6.65 and 4.44 degrees for a 25 degree nominal Cobb angle, and -14.04 and 9.46 degrees for a 45 degree nominal Cobb angle.*Conclusions Incorrect patient placement with respect to the selected reference point caused substantial magnification effects, leading to Cobb angle measurement discrepancies of up to -14.04 degrees.*Clinical Relevance/Application The discrepancies in Cobb angle can change clinical outcomes for scoliosis patients and methods for image correction should be explored in future works.

RESULTS

Analysis of the steel pipe images gave a linear approximation of 2.3 mm of lateral magnification for every 10 cm of displacement from the system-set reference point. Magnification errors ranging from -16.9 to 20.2% were measured using the radiopaque ruler across reference points. Error in Cobb angle measurements due to these magnification effects were shown to be between -2.52 and 1.68 degrees for a 10 degree nominal Cobb angle, -6.65 and 4.44 degrees for a 25 degree nominal Cobb angle, and -14.04 and 9.46 degrees for a 45 degree nominal Cobb angle.

CLINICAL RELEVANCE/APPLICATION

The discrepancies in Cobb angle can change clinical outcomes for scoliosis patients and methods for image correction should be explored in future works.

PD01-B2   **Does Vascular Injury Affect Immature Cartilage Defects Repair?**

Participants
Ali Rashidi, MD, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the effect of vascular injury of premature cartilage on the outcome of cartilage repair with matrix-associated stem cell implants (MASI) in Göttingen minipigs.*Methods and Materials We created full-thickness defects in the vascularized cartilage of the distal femur of immature pigs (n= 12 defects in 6 knee joints of 3 immature pigs; age, 3.5-4 months) or the avascular cartilage of mature pigs (n= 4 defects in 2 knee joints of 1 mature control pig; age, 21 months). Porcine bone marrow stromal stem cells (BMSCs) were implanted into the sixteen cartilage defects (5 mm ø), followed by magnetic resonance imaging (MRI) at 2, 4, 12 (n=16 defects), and 24 weeks (n=8 defects) after MASI. One reviewer evaluated the cartilage repair according to the MR observation of subchondral edema and cartilage repair tissue (MOCART) score. After the last MRI, animals were sacrificed, knee joints explanted and stained with Hematoxylin & Eosin (H+E), Van Giessen, and Mallory stain stains. Cartilage repair was graded according to the Pineda score. Semiquantitative scores for subchondral edema at 2 weeks were correlated with MOCART scores at 12 weeks and Pineda scores at the end of the study.*Results Immature joints demonstrated increasing subchondral edema and increasing subchondral bone defect over time, while mature joints demonstrated progressive healing of cartilage defects: The MOCART score at 12 weeks was significantly higher for mature joints (87.5 ± 2.88) compared to immature joints (30 ± 10) (p < 0.001). Histopathology confirmed microvessel injury in immature cartilage, which presumably led to the subchondral edema and bone defects observed on MRI. The quantitative scores for subchondral edema at 2 weeks demonstrated a negative correlation with MOCART scores at 12 weeks (r=-0.843) and a positive correlation with Pineda scores at the end of the study

(r=0.716).*Conclusions Vascular injury in immature epiphyses negatively affects MASI-mediated cartilage repair due to localized ischemia and subchondral bone defects.*Clinical Relevance/Application MASI is useful in the treatment of cartilage defects, while the effect of vascular injury in immature epiphyses should be considered in the outcome prediction of young patients with full-thickness cartilage defects.

RESULTS

Immature joints demonstrated increasing subchondral edema and increasing subchondral bone defect over time, while mature joints demonstrated progressive healing of cartilage defects: The MOCART score at 12 weeks was significantly higher for mature joints (87.5 ± 2.88) compared to immature joints (30 ± 10) ($p < 0.001$). Histopathology confirmed microvessel injury in immature cartilage, which presumably led to the subchondral edema and bone defects observed on MRI. The quantitative scores for subchondral edema at 2 weeks demonstrated a negative correlation with MOCART scores at 12 weeks ($r=-0.843$) and a positive correlation with Pineda scores at the end of the study ($r=0.716$).

CLINICAL RELEVANCE/APPLICATION

MASI is useful in the treatment of cartilage defects, while the effect of vascular injury in immature epiphyses should be considered in the outcome prediction of young patients with full-thickness cartilage defects.

Abstract Archives of the RSNA, 2021

Sub-Events

GU03-C1　Effect of PI-RADS Minimum Technical Standards Adherence In PI-RADS 3 Vs PI-RADS 4/5 Lesion Designation

Participants
James Ryan, BMedSc,MRCPI, Brookline, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

PI-RADS v2.0 provides a standardized framework for multi-parametric prostate MRI acquisition/reporting. PI-RADS Minimum Technical Standards (MTS) are the recommended mpMRI parameters. PI-RADS lesions are categorized in order of increasing likelihood of clinically significant prostate cancer (csPCa). PI-RADS 3 lesions (P3) have an intermediate risk for csPCa. Most large studies advise biopsy of P3 lesions. We aimed to determine if MTS adherence impacts PI-RADS 3 vs PI-RADS 4/5 (P4/5) designation.*Methods and Materials A retrospective review of the electronic medical record was conducted at 2 academic institutions from July 1, 2014-August 22, 2019. All MRIs containing >/= P3 lesions were included. Patients with a pre-existing diagnosis of csPCa or prior PCa treatment were excluded. Demographic, technical acquisition and MTS data were collected. Groups were compared using logistic regression and conditional odds ratios.*Results The initial cohort was 3238 MRIs, after accounting for eligibility criteria the final cohort was 355 MRIs reported by 41 different radiologists across 2 institutions, with 183 P3 lesions and 172 P4/5s. Overall, 76% of lesions were in the peripheral zone (PZ) and 24% in the transitional zone (TZ). There were 282 (79.4%) MRIs from institution A and 69 (19.4%) from institution B. The median patient age was 66 yrs, median PSA was 6.37ng/mL, and median PSA density was 0.12. Endorectal coils were used in 132 (37.18%) MRIs. Increasing age (OR 0.9, p<0.001), PSA (OR 0.48, p=0.007) and PSA density (OR 0.68, p=0.02) decreased the odds of P3 designation in the PZ whereas institution A (OR 2.2, p=0.019) and endorectal coil use (OR 2.02, p=0.05) increased the odds. The average annual MTS adherence ranged from 71-80%. Regarding T2 weighted sequence (T2WS) MTS adherence; frequency in-plane resolution (0%), phase in-plane resolution (22%) and field of view (63%) were most poorly adhered to over 5-years. For DWI, phase in-plane resolution (54.2%), and DWI field of view (64.8%) were least adhered to.*Conclusions Adherence to MTS did not affect the odds of P3 vs P4/5 designation. Elderly patients with higher PSA values were less likely to have a P3 lesion. MTS compliance is of concern particularly in the T2WS limiting analysis of TZ lesions. There was significant institutional variance in the odds of P3 designation. Endorectal coil use increased the odds of P3 designation. Correlation with histology is needed in the endorectal coil group to determine if coil use affected diagnostic accuracy.*Clinical Relevance/Application Knowledge of patient demographics prior to mpMRI interpretation likely impacts PI-RADS assessment. Improved MTS compliance and standardization of acquisition technique across institutions is needed to optimize lesion assessment.

RESULTS

The initial cohort was 3238 MRIs, after accounting for eligibility criteria the final cohort was 355 MRIs reported by 41 different radiologists across 2 institutions, with 183 P3 lesions and 172 P4/5s. Overall, 76% of lesions were in the peripheral zone (PZ) and 24% in the transitional zone (TZ). There were 282 (79.4%) MRIs from institution A and 69 (19.4%) from institution B. The median patient age was 66 yrs, median PSA was 6.37ng/mL, and median PSA density was 0.12. Endorectal coils were used in 132 (37.18%) MRIs. Increasing age (OR 0.9, p<0.001), PSA (OR 0.48, p=0.007) and PSA density (OR 0.68, p=0.02) decreased the odds of P3 designation in the PZ whereas institution A (OR 2.2, p=0.019) and endorectal coil use (OR 2.02, p=0.05) increased the odds. The average annual MTS adherence ranged from 71-80%. Regarding T2 weighted sequence (T2WS) MTS adherence; frequency in-plane resolution (0%), phase in-plane resolution (22%) and field of view (63%) were most poorly adhered to over 5-years. For DWI, phase in-plane resolution (54.2%), and DWI field of view (64.8%) were least adhered to.

CLINICAL RELEVANCE/APPLICATION

Knowledge of patient demographics prior to mpMRI interpretation likely impacts PI-RADS assessment. Improved MTS compliance and standardization of acquisition technique across institutions is needed to optimize lesion assessment.

GU03-C2　Diagnostic Value Of Synthetic Magnetic Resonance Imaging For Biparametric Evaluation Of Primary Prostate Cancer.

Participants
Yuki Arita, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Recently, the utility of biparametric magnetic resonance imaging (bpMRI), which avoids the costs and potential side-effects of gadolinium-based contrast agents including nephrogenic systemic fibrosis and gadolinium deposition in the brain, has been proposed for screening significant prostate cancer. The aim of the study was to investigate the utility of synthetic MRI for bpMRI-based evaluation of primary prostate cancer.*Methods and Materials One-hundred five prostate cancer-suspected patients who underwent multiparametric MRI and synthetic MRI prior to prostate biopsy were prospectively included. Six radiologists (three expert and three basic prostate radiologists according to the ESUR/ESUI consensus statements) assessed the diagnostic performance of the following datasets for clinically significant prostate cancer (International Society of Urological Pathology grade group =2 according to the Prostate Imaging and Reporting and Data System [PI-RADS] version 2.1): Conventional bpMRI (axial

diffusion-weighted imaging [DWI] scans with a b-value of 2,000 s/mm2 + axial conventional T2-weighted imaging [T2WI] scans) and Synthetic bpMRI (axial DWI scans with a b-value of 2,000 s/mm2 + synthetic T2WI scans). Furthermore, the diagnostic performance of relaxometry measurements from synthetic MRI (T1, T2, and proton density [PD]) was compared with that of the dynamic contrast-enhanced MRI (DCE-MRI) PI-RADS score for PI-RADS category 3 lesions. Radical prostatectomy or systemic biopsy was used as the reference standard.*Results Four-hundred eight lesions (88 clinically significant prostate cancer + 14 clinically insignificant prostate cancer + 306 non-cancerous lesions) in 102 patients were eligible for analysis. The sensitivity and specificity of conventional bpMRI (80.7-87.5% and 81.3-89.1%) were not significantly different from those of synthetic bpMRI (77.3-85.2% and 80.0-87.2%) for all the six radiologists (p =0.35 and 0.24, respectively). There also was no significant difference in the sensitivity and specificity between relaxometry measurements (T1+T2+PD) (84.0-88.0% and 75.4-78.0%) and DCE-MRI (72.0-80.0% and 85.2-86.0%, p = 0.32, 0.16, respectively) for PI-RADS category 3 lesions.*Conclusions The diagnostic performance of synthetic bpMRI was comparable to that of conventional bpMRI for primary prostate cancer evaluation. Moreover, the diagnostic performance of relaxometry measurements from synthetic MRI was similar to that of DCE-MRI for clinically significant prostate cancer diagnosis for PI-RADS category 3 lesions.*Clinical Relevance/Application BpMRI with relaxometry measurements derived from synthetic MRI shows great potential as a contrast agent-free method for primary prostate cancer evaluation.

RESULTS

Four-hundred eight lesions (88 clinically significant prostate cancer + 14 clinically insignificant prostate cancer + 306 non-cancerous lesions) in 102 patients were eligible for analysis. The sensitivity and specificity of conventional bpMRI (80.7-87.5% and 81.3-89.1%) were not significantly different from those of synthetic bpMRI (77.3-85.2% and 80.0-87.2%) for all the six radiologists (p =0.35 and 0.24, respectively). There also was no significant difference in the sensitivity and specificity between relaxometry measurements (T1+T2+PD) (84.0-88.0% and 75.4-78.0%) and DCE-MRI (72.0-80.0% and 85.2-86.0%, p = 0.32, 0.16, respectively) for PI-RADS category 3 lesions.

CLINICAL RELEVANCE/APPLICATION

BpMRI with relaxometry measurements derived from synthetic MRI shows great potential as a contrast agent-free method for primary prostate cancer evaluation.

MK03-C

Musculoskeletal Tuesday Poster Discussions

Sub-Events

MK03-C3   **Adaptable Multi-view Model For Fracture Detection In Hand Radiographs Using Convolutional Neural Network**

Participants
Jin-Kyeong Sung, MD, Seoul, Korea, Republic Of (*Presenter*) Employee, VUNO Inc

PURPOSE

Musculoskeletal radiographs are often taken with a variable combination of views and radiologists interpret images using all views in clinical practice not to miss subtle fractures. However, most deep learning-based models are trained with an image of one view. In this study, we aimed to develop and evaluate an adaptable multi-view model for fracture detection in hand radiographs using convolutional neural network.*Methods and Materials This study included retrospectively collected 5561 hand and wrist radiographs from 902 patients and then 2281 multi view sets (Anteroposterior(AP) + Lateral(Lat): 1334 sets, AP+Lat+Oblique(Obl): 947) using images from the same body parts were constructed. Twelve board-certified radiologists labeled the radiographs as normal or abnormal and annotated the location of each fracture. In this study we propose an approach based on feature aggregation using adaptive pooling layer. Instead of passing a fixed number of images as input, we use a model that receives an adaptable number of input images and then aggregates them through pooling at the feature level. We use ResNext50 encoder with ImageNet pretrained weight and training model with four different combinations of data set: AP only, Lat only, AP with Lat, and AP with Lat and Obl. We evaluated the performance of each model with 5-fold cross validation. In addition, we selected 371 (normal: 216, abnormal: 155) wrist radiographs with various views from MURA (musculoskeletal radiographs) public dataset for external validation. To assess the model performances, we compared the area under the receiver operating characteristic (AUROC), sensitivity, and specitivity among the models with different data sets.*Results When using only AP view image as a training set, the sensitivity, specificity, and AUROC(patient-level) were 92.3%, 85%, and 0.956, respectively. The model trained with AP, Lat view pair showed 93.6%, 96.6% and 0.979. Models using all view position sets (AP, Lat, Obl) showed the best performance at 97.1%, 95.0% and 0.983. External validation results of the best model using the MURA test set (single view image) show 99.6%, 61.1%, and 0.966*Conclusions The deep learning model with multi view inputs showed improved performance in finding fractures compared to the model with single input, and robust performance for the external validation set.*Clinical Relevance/Application The deep learning model with adaptable multi view inputs can be readily used for clinical practice using variable combination of radiographic views.

RESULTS

When using only AP view image as a training set, the sensitivity, specificity, and AUROC(patient-level) were 92.3%, 85%, and 0.956, respectively. The model trained with AP, Lat view pair showed 93.6%, 96.6% and 0.979. Models using all view position sets (AP, Lat, Obl) showed the best performance at 97.1%, 95.0% and 0.983. External validation results of the best model using the MURA test set (single view image) show 99.6%, 61.1%, and 0.966

CLINICAL RELEVANCE/APPLICATION

The deep learning model with adaptable multi view inputs can be readily used for clinical practice using variable combination of radiographic views.

Abstract Archives of the RSNA, 2021

Sub-Events

NR05-A1   **Trends In Development Of Novel Machine Learning Methods For Identification Of Gliomas In Datasets That Include Non-glioma Images: A Systematic Review**

Participants
Harry Subramanian, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

Machine learning (ML), has been applied to the diagnostic imaging of gliomas to augment classification, prognostication, segmentation, and treatment planning. A systematic literature review was performed to identify how machine learning has been applied to identify gliomas in datasets which include non-glioma images thereby simulating normal clinical practice.*Methods and Materials Four databases were searched by a medical librarian and confirmed by a second librarian for all articles published prior to February 1, 2021: Ovid Embase, Ovid MEDLINE, Cochrane trials (CENTRAL), Web of Science-Core Collection. The search strategy included both keywords and controlled vocabulary combining the terms for: artificial intelligence, machine learning, deep learning, radiomics, magnetic resonance imaging, glioma, as well as related terms. Two independent reviewers performed abstract screening, full text screening, data extraction, and TRIPOD bias assessment.*Results A total of 11,727 candidate articles were identified, of which 13 articles were included in the final analysis. Methodology of sample size is mixed, as some studies report the number of individual images (median 390, 10 studies) while others report the number of patients used (median 280, 7 studies). The articles included both high- and low-grade gliomas as well as non-neoplastic neurologic diseases. The datasets used most frequently were BRATS (31%), single institutional dataset (31%), and TCIA (15%). Neural networks were the most common type of algorithm, used in 85% of studies. The accuracy of algorithms ranged from 0.82 to 1.00 (median 0.98, 11 studies). The DICE coefficient ranged from 0.86 to 0.98 (median 0.92, 3 studies). Assessment of the quality of the studies using TRIPOD criteria yielded a median score of 21 (range 10-31, maximum possible score of 35).*Conclusions Systematic review identified 13 articles investigating the differentiation of glioma from non-glioma images. Most articles used neural network algorithms. While most studies used already established databases, the sample sizes were low. TRIPOD criteria scoring indicates that the quality of these studies is lacking in multiple domains.*Clinical Relevance/Application Automatic identification of gliomas in a dataset of normal studies or other pathologies simulates clinical practice and identifies ML algorithms that would be most suitable for clinical translation.

RESULTS

A total of 11,727 candidate articles were identified, of which 13 articles were included in the final analysis. Methodology of sample size is mixed, as some studies report the number of individual images (median 390, 10 studies) while others report the number of patients used (median 280, 7 studies). The articles included both high- and low-grade gliomas as well as non-neoplastic neurologic diseases. The datasets used most frequently were BRATS (31%), single institutional dataset (31%), and TCIA (15%). Neural networks were the most common type of algorithm, used in 85% of studies. The accuracy of algorithms ranged from 0.82 to 1.00 (median 0.98, 11 studies). The DICE coefficient ranged from 0.86 to 0.98 (median 0.92, 3 studies). Assessment of the quality of the studies using TRIPOD criteria yielded a median score of 21 (range 10-31, maximum possible score of 35).

CLINICAL RELEVANCE/APPLICATION

Automatic identification of gliomas in a dataset of normal studies or other pathologies simulates clinical practice and identifies ML algorithms that would be most suitable for clinical translation.

NR05-A4   **Guided Brain Tissue Segmentation: Deep Learning-based Segmentation Using Flair MRI Exclusively**

Participants
ZunHyan Rieu, BS, Seoul, Korea, Republic Of (*Presenter*) Employee, NEUROPHET, Inc

PURPOSE

White matter hyperintensity (WMH) is a primary marker for small vessel disease and may play a role in the brain functional decline in later life. For the detailed WMH study, multi-modal approach, including T1-weighted (T1w) and T2- Fluid Attenuated Inversion Recovery (FLAIR) MRI, is desired to identify normal white matter (WM), deep grey matter (DGM), and WMH. That is because WM and DGM are visible in T1w MRI while WMH noticeable in T2-FLAIR. It is, however, common that only T2-FLAIR available in clinical settings. We thus propose Guided Brain Tissue Segmentation that separate brain tissues, WM, DGM, and WMH, only using FLAIR MRI.*Methods and Materials A total of 100 subjects with paired T1w and FLAIR MRI was utilized from the Catholic Aging Brain Imaging (CABI) database of St. Mary's Hospital, the Catholic University of Korea. Our in-house multi-label brain tissue segmentation tool was applied to obtain the initial 98 segmentations from T1w MRI. Then 98 labels merged into 9 labels: cerebral WM, left and right hemisphere of cerebral GM, DGM, ventricles, left and right hemisphere of cerebellum WM, and left and right hemisphere of cerebellum GM. As for the alignment between T1 MRI into FLAIR MRI, we applied the co-registration using a rigid transform. Finally, we used U-Net based segmentation architecture to train the T1w brain tissue labels into FLAIR MRI. For the segmentation, we distributed the dataset into train and validation with a ratio of 9:1. To increase the robustness of segmentation, we applied augmentation using Rescale-Intensity, and Z-Normalization. We computed the dice score coefficients (DSC) score and relative volume difference between labels from T1w to FLAIR for the performance evaluation.*Results For brain segmentation using FLAIR exclusively, we achieved the average DSC of 0.81±0.08 on the validation. The average relative volume difference between the T1w

and the FLAIR MRI resulted with 5.12%.*Conclusions Guided Brain Tissue Segmentation using FLAIR MRI exclusively was developed, and we demonstrated the feasibility of brain tissue segmentation on FLAIR MRI exclusively.*Clinical Relevance/Application We believe the brain tissue segmentation on FLAIR MRI can provide easy access to the detailed WMH study.

RESULTS

For brain segmentation using FLAIR exclusively, we achieved the average DSC of 0.81±0.08 on the validation. The average relative volume difference between the T1w and the FLAIR MRI resulted with 5.12%.

CLINICAL RELEVANCE/APPLICATION

We believe the brain tissue segmentation on FLAIR MRI can provide easy access to the detailed WMH study.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Sub-Events

NMMI05-A2 Automated Detection Of Primary Lung Cancer Of All Stages And Associated Metastases On FDG-PET/CT Using A Retina-U-Net Algorithm

Participants
Thomas Weikert, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To develop, evaluate and deploy a PET/CT processing pipeline based on a Retina-U-Net for detection of malignant lesions in primary lung cancer.*Methods and Materials A total of 364 patients with histologically confirmed lung cancer that underwent FDG-PET/CT between 01/2010-06/2016 were included. The dataset comprised tumors of all stages (according to the 8th edition of TNM in Lung Cancer). To establish a standard of reference, all lung tumors (T), lymphatic metastases (N) and distant metastases (M) were manually segmented as 3D volumes using the transverse, fused whole-body PET/CT series. The dataset was split into a training (n=216), validation (n=74) and testing dataset (n=74). A Retina-U-Net using both CT and PET component as input was trained on all lesion types (T,N,M). Detection performance for all lesion subtypes was assessed using area under the ROC-curves (AUROC). Furthermore, reasons of false-positive findings were visually assessed by a radiology resident (PGY-5). The algorithm was deployed on a clinic-near radiology viewer enabling swift processing of PET/CTs.*Results General performance was good, e.g. the AUROC for all T-lesions was 0.89. AUC for T1 was good (0.81), but excellent for T2 (0.94), T3 (0.98) and T4 (0.89). We found promising sensitivities of more than 90% for T3 and T4 lesions at low false-positive rates per case of 1. Detection rates of N- and M-lesions were slightly worse. Important reasons for false-positive detections were the normal metabolic signal of bone marrow (16.5%), pulmonary vessels (7.8%) and the myocardium (3.8%).*Conclusions The algorithm presented in this study enables an automated detection of T-, N- and M-lesions in PET/CTs at good performance levels. However, it is not performant enough to enable fully automated reading of PET/CTs without human interaction.*Clinical Relevance/Application The Retina-U-Net presented in this study is a foundation for a tool assisting nuclear medicine physicians with the analysis of PET-CTs. In combination with an intuitive interface allowing for swift approval or modification of automatically generated findings, it can help to improve routine reading workflows.

RESULTS

General performance was good, e.g. the AUROC for all T-lesions was 0.89. AUC for T1 was good (0.81), but excellent for T2 (0.94), T3 (0.98) and T4 (0.89). We found promising sensitivities of more than 90% for T3 and T4 lesions at low false-positive rates per case of 1. Detection rates of N- and M-lesions were slightly worse. Important reasons for false-positive detections were the normal metabolic signal of bone marrow (16.5%), pulmonary vessels (7.8%) and the myocardium (3.8%).

CLINICAL RELEVANCE/APPLICATION

The Retina-U-Net presented in this study is a foundation for a tool assisting nuclear medicine physicians with the analysis of PET-CTs. In combination with an intuitive interface allowing for swift approval or modification of automatically generated findings, it can help to improve routine reading workflows.

NMMI05-A3 18F-fluciclovine Pet/ct-based Salvage Radiotherapy In Patients With Very Low Psa (<=0.3 Ng/ml) Post-radical Prostatectomy.

Participants
Olayinka Abiodun-Ojo, MD,MPH, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

We evaluated the effect of 18F-fluciclovine PET/CT on detection of recurrent prostate cancer (PCa) and treatment decisions in men with prostate-specific antigen (PSA) =0.3 ng/mL after radical prostatectomy (RP).*Methods and Materials Between 2012 and 2019, 165 patients with rising PSA and negative extrapelvic findings on conventional imaging post-RP were randomized to undergo either salvage radiotherapy (XRT) planning based on conventional imaging (MR or CT) alone or XRT based on the addition of fluciclovine PET/CT. In the fluciclovine arm (n=83), initial prospective documented XRT plans 1) to offer XRT and 2) XRT fields were based on conventional imaging, while final treatment plans were based on fluciclovine PET findings. We conducted a post hoc subgroup analysis of patients with PSA =0.3 ng/mL. Fluciclovine positivity rate for detection of recurrence was determined. PSA at PET and Gleason score were compared between patients with positive and negative PET scans using t-test and Fisher's exact test. Initial and final XRT decisions were compared and changes in management decisions noted.*Results Thirty-six patients with mean PSA at PET of 0.17 ng/mL (standard deviation 0.08; median 0.17 ng/mL; interquartile range 0.12-0.23 ng/mL) were analyzed. Fluciclovine PET was positive in 27/36 (75.0%) patients: 21/27 (77.8%) had local recurrence, while 6/27 (22.2%) had pelvic lymph node involvement ± prostate bed (PB) uptake. No extrapelvic nodal, osseous or soft tissue lesion was detected on PET. There was no significant difference in PSA at PET (p = 0.15) and Gleason score (p = 0.45) between patients with positive and negative fluciclovine PET scans. For initial treatment decision, all patients were planned for salvage XRT: 26/36 (72.2%) for XRT of PB only and 10/36 (27.8%) for XRT of PB and pelvic lymph nodes. Although there was no change in the decision to offer XRT, 7/36 (19.4%) patients had a change in radiotherapy fields: 6/27 (22.2%) PET positive and 1/9 (11.1%) PET negative patients. Radiotherapy field decision was altered from PB only to PB and pelvis in 4 patients and from PB and pelvis to PB only in 3 patients.*Conclusions In our

patient cohort with PSA levels =0.3 ng/mL postprostatectomy, fluciclovine PET/CT detects recurrent disease and can guide targeted therapy. Our findings suggest that fluciclovine PET/CT is useful in the management of PCa patients with early biochemical recurrence postprostatectomy even at very low PSA levels.Research support: NIH (R01CA169188), NCT 01666808, Blue Earth Diagnostics, Ltd.*Clinical Relevance/Application Fluciclovine PET was positive in 75.0% of patients and resulted in 19.4% change in salvage radiotherapy planning in patients with early biochemical recurrence and very low PSA levels (=0.3 ng/mL) postprostatectomy.

RESULTS

Thirty-six patients with mean PSA at PET of 0.17 ng/mL (standard deviation 0.08; median 0.17 ng/mL; interquartile range 0.12-0.23 ng/mL) were analyzed. Fluciclovine PET was positive in 27/36 (75.0%) patients: 21/27 (77.8%) had local recurrence, while 6/27 (22.2%) had pelvic lymph node involvement ± prostate bed (PB) uptake. No extrapelvic nodal, osseous or soft tissue lesion was detected on PET. There was no significant difference in PSA at PET (p = 0.15) and Gleason score (p = 0.45) between patients with positive and negative fluciclovine PET scans. For initial treatment decision, all patients were planned for salvage XRT: 26/36 (72.2%) for XRT of PB only and 10/36 (27.8%) for XRT of PB and pelvic lymph nodes. Although there was no change in the decision to offer XRT, 7/36 (19.4%) patients had a change in radiotherapy fields: 6/27 (22.2%) PET positive and 1/9 (11.1%) PET negative patients. Radiotherapy field decision was altered from PB only to PB and pelvis in 4 patients and from PB and pelvis to PB only in 3 patients.

CLINICAL RELEVANCE/APPLICATION

Fluciclovine PET was positive in 75.0% of patients and resulted in 19.4% change in salvage radiotherapy planning in patients with early biochemical recurrence and very low PSA levels (=0.3 ng/mL) postprostatectomy.

NMMI05-A4 C-11-pk11195 Positron Emission Tomography Evaluation Of Neuroinflammation And Its Clinical Correlation In Patients With Relapsing Remitting Multiple Sclerosis

Participants
Ajay Kumar, MD, PhD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the relationships of neuroinflammatory changes with clinical disability in patients with relapsing remitting multiple sclerosis (MS).*Methods and Materials Thirteen MS patients were recruited in this pilot study who underwent Expanded Disability Status Scale (EDSS) and Multiple Sclerosis Functional Composite (MSFC) scoring with its three-components (timed 25-foot walk test (T25FWT), 9-Hole Peg Test (9-HPT) on dominant (9-HPT-D) and non-dominant (9-HPT-ND) hands, Paced Auditory Serial Addition Test (PASAT), followed by whole brain dynamic C-11-PK-11195 (PK) PET scan. Based on a simplified reference region model, regional binding potential (BP), reflecting PK binding to TSPO receptor expressed by activated microglia, was calculated for: normal appearing white matter (NAWM), frontal cortex, parietal cortex, temporal cortex, occipital cortex, whole neocortex, thalamus, caudate nucleus and lentiform nucleus in each hemisphere. The associations between clinical assessments and neuroinflammation, expressed as BP values in various brain regions, were analyzed using multivariate linear regression.*Results Age was positively correlated to BP values in NAWM (age coefficient(B)=0.005, p=0.003), temporal cortex (age B=0.003, p=0.047), neocortex (age B=0.002, p=0.045), thalamus (age B=0.007, p=0.018), caudate nucleus (age B=0.007, p=0.009) and lentiform nucleus (age B=0.005, p=0.008). After adjusting for age, EDSS was positively correlated to BP values in thalamus (EDSS B=0.029, p=0.045), and also showed trends frontal cortex (EDSS B=0.014, p=0.086) and caudate nucleus (EDSS B=0.013, p=0.091). After adjusting for age, T25FWT showed trends in correlations with BP values in NAWM (T25FWT B=0.010, p=0.094) and thalamus (T25FWT B=0.019, p=0.053), while 9HPT-D was positively correlated with BP value in thalamus (9HPT-D B=0.009, p=0.016), and showed trends in correlations with BP values in NAWM (9HPT-D B=0.004, p=0.073), frontal cortex (9HPT-D B=0.004, p=0.090) and lentiform nucleus (9HPT-D B=0.005, p=0.056). PASAT inversely correlated with thalamic BP values (PASAT B=-0.004, p=0.0042) without adjusting for age.*Conclusions Our study revealed neuroinflammatory changes in various brain regions in patients with relapsing remitting multiple sclerosis, and regional extent of neuroinflammation, particularly in the thalamus, maybe a useful biomarker to define motor, cognitive and dexterity impairment and may predict disability in MS.*Clinical Relevance/Application C-11-PK11195 PET scan can be potentially used as an in-vivo neuroinflammatory biomarker to evaluate, prognosticate and monitor patients with relapsing remitting multiple sclerosis.

RESULTS

Age was positively correlated to BP values in NAWM (age coefficient(B)=0.005, p=0.003), temporal cortex (age B=0.003, p=0.047), neocortex (age B=0.002, p=0.045), thalamus (age B=0.007, p=0.018), caudate nucleus (age B=0.007, p=0.009) and lentiform nucleus (age B=0.005, p=0.008). After adjusting for age, EDSS was positively correlated to BP values in thalamus (EDSS B=0.029, p=0.045), and also showed trends frontal cortex (EDSS B=0.014, p=0.086) and caudate nucleus (EDSS B=0.013, p=0.091). After adjusting for age, T25FWT showed trends in correlations with BP values in NAWM (T25FWT B=0.010, p=0.094) and thalamus (T25FWT B=0.019, p=0.053), while 9HPT-D was positively correlated with BP value in thalamus (9HPT-D B=0.009, p=0.016), and showed trends in correlations with BP values in NAWM (9HPT-D B=0.004, p=0.073), frontal cortex (9HPT-D B=0.004, p=0.090) and lentiform nucleus (9HPT-D B=0.005, p=0.056). PASAT inversely correlated with thalamic BP values (PASAT B=-0.004, p=0.0042) without adjusting for age.

CLINICAL RELEVANCE/APPLICATION

C-11-PK11195 PET scan can be potentially used as an in-vivo neuroinflammatory biomarker to evaluate, prognosticate and monitor patients with relapsing remitting multiple sclerosis.

Abstract Archives of the RSNA, 2021

NPM03-A

Noninterpretative Tuesday Poster Discussions

Sub-Events

NPM03-A1   Perceptions Of US Medical Students Towards Radiology Education: A National Survey

Participants
Scott Rohren, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Radiology and medical imaging are an important yet often underrepresented facet of medical education. Notably, radiologists are concerned that students do not receive enough radiology exposure and struggle with medical imaging upon entering residency. Therefore, the purpose of this survey was to identify how undergraduate medical students perceive the radiology curriculum and to determine gaps in delivery.*Methods and Materials This study was a multicenter national survey distributed to medical schools throughout the United States. Questions focused on demographic information, student's exposure to Radiology, teaching methods in the curriculum, and their perceptions towards medical imaging. Objective parameters were measured as percentage correct, while subjective parameters used a 4-point Likert scale.*Results A total of 472 medical students across 31 medical schools completed the surveys. Responses represented all class years within medical schools and showed equal distribution amongst future career plans. The majority of respondents (96%) indicated that their preclinical curriculum included medical imaging. X-ray and ultrasonography were the most commonly encountered imaging modalities. Fluoroscopy and PET were the least seen. Additionally, 87% of students responded that they did not feel they had adequate exposure to radiology during medical school. Clerkship students rated themselves as more confident in image interpretation than preclerkship students.*Conclusions This national survey demonstrates that students value radiology in their curriculum and feel like they do not receive adequate exposure. This survey identifies areas that can be addressed to promote further radiology education, such as increased interaction with radiologists during clinics as well as fostering students' confidence in image interpretation.*Clinical Relevance/Application This information can be used by educators to address learning gaps and promote radiology within the medical school curricula.

RESULTS

A total of 472 medical students across 31 medical schools completed the surveys. Responses represented all class years within medical schools and showed equal distribution amongst future career plans. The majority of respondents (96%) indicated that their preclinical curriculum included medical imaging. X-ray and ultrasonography were the most commonly encountered imaging modalities. Fluoroscopy and PET were the least seen. Additionally, 87% of students responded that they did not feel they had adequate exposure to radiology during medical school. Clerkship students rated themselves as more confident in image interpretation than preclerkship students.

CLINICAL RELEVANCE/APPLICATION

This information can be used by educators to address learning gaps and promote radiology within the medical school curricula.

NPM03-A2   Online Patient Portals Widen Health Disparities In Radiology: Analysis Of Patient Characteristics Of Self-scheduled Online Patient Portal Screening Mammography:

Participants
Patricia Balthazar, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

Patient portals can increase patient access and engagement but can create potential new barriers to care and widen the digital divide. We aimed to identify potential sociodemographic disparities in utilization of an online patient portal to self-schedule screening mammograms (SM) as opposed to a traditional scheduling pathway (scheduler phone call and referral system). We hypothesized patients with limited English proficiency (LEP), racial/ethnic minorities, and low socioeconomic status would be less likely to utilize an online self-scheduling pathway.*Methods and Materials This was a HIPAA-compliant, IRB approved retrospective cohort study at an urban quaternary-care academic medical center with patient portal access to EMR. All female patients undergoing SM from 1/1/2019 to 12/31/2019 were included. Institutional data warehouse was queried to extract these variables: patient scheduling pathway (online self-scheduled vs. traditional), age, language, race, health insurance provider, and zip code. Patient's zip code was linked to Census data to extract the following demographic information: internet access, median household income, education level. Multivariable logistic regression was used to identify independent factors associated with utilizing online self-scheduling pathways for screening mammography.*Results 46,268 patients were included in the study; only 302 (0.7%) used the online self-scheduling pathway. Patients utilizing the self-scheduling pathway had higher odds of being younger (OR for age in year: 0.94; 95% CI: 0.93-0.96), English-speakers (21.6, 3.0-156.5), White (1.7, 1.2-2.5), have private insurance (1.5, 1.0-2.1), to live in zip code areas with higher percentage of access to broadband internet (1.2, 1.1-1.3). Patients living in zip code areas with higher median household income, education level, or with any type of internet access were not significantly associated with the online self-scheduling pathway.*Conclusions Racial ethnic minorities, patients with low socioeconomic status, lower access to broadband internet, and LEP were less likely to use a patient-portal self-scheduling pathway for SM.*Clinical Relevance/Application Understanding the factors associated with patient use of technology and patient portals for access to care can guide interventions to bridge the existing digital divide and promote health equity in radiology.

RESULTS

46,268 patients were included in the study; only 302 (0.7%) used the online self-scheduling pathway. Patients utilizing the self-scheduling pathway had higher odds of being younger (OR for age in year: 0.94; 95% CI: 0.93-0.96), English-speakers (21.6, 3.0-156.5), White (1.7, 1.2-2.5), have private insurance (1.5, 1.0-2.1), to live in zip code areas with higher percentage of access to broadband internet (1.2, 1.1-1.3). Patients living in zip code areas with higher median household income, education level, or with any type of internet access were not significantly associated with the online self-scheduling pathway.

CLINICAL RELEVANCE/APPLICATION

Understanding the factors associated with patient use of technology and patient portals for access to care can guide interventions to bridge the existing digital divide and promote health equity in radiology.

NPM03-A3   FDA - Cleared AI Algorithms: Trends, Strengths, And Limitations Of Validation Studies

Participants
Shadi Ebrahimian, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

The ACR Data Science Institute (DSI) Editorial Board compiles relevant information on the U.S. Food Drug Administration (FDA)-cleared imaging-based artificial intelligence (AI) algorithm including details of body areas, algorithm performance and validation studies. The purpose of our ACR DSI Editorial Board initiative was to assess keys trends, strengths, and gaps in validation studies of FDA-cleared AI algorithms in radiology.*Methods and Materials Our work audited publicly available details of FDA-cleared AI algorithms in imaging from 2008 until 2020. We reviewed 107 AI algorithms to classify information related to their parent company, subspecialty, body area and specific anatomy type, imaging modality, date of FDA clearance, indications for use, target pathology (such as trauma) and findings (such as fracture), CAD technique (triage, detection, characterization, quality, and quantification), product performance, presence, type, strength and available data of clinical validation for each AI algorithm. Pertaining to validation data, where available, we recorded the number of datasets evaluated, and available statistics (such as accuracy, ROC AUC). Two radiologists reviewed and classified types of AI algorithms (detection, quantitative, characterization, etc). Data were analyzed with pivot tables for descriptive statistics.*Results Over one-half of FDA-cleared AI algorithms (60/107) posted no validation claims or data. Al Just 9/107 reviewed AI algorithms had a validation dataset sizes of over 1000, 2/107 algorithms with >5000. The most common type of AI algorithms included detection (CADe; n= 27) and quantitative algorithms (n= 34). Nearly all CADe and CADt (triage) targeted specific radiology finding (one per algorithm). Breast (mammography), chest (chest radiography and CT), and brain (CT and MR) dominated the targeted body regions of interest. Among 33 CADe cleared algorithm, there were no datasets for 14 (42%), while 2/3 CADx (characterization) had either 0 or 50 validation datasets.*Conclusions Insufficient validation datasets in several FDA-cleared AI algorithms makes it difficult to assess generalizability and predict bias in clinical implementation.*Clinical Relevance/Application Insufficient validation datasets in AI algorithms necessitate need for a cautious implementation into clinical routine.

RESULTS

Over one-half of FDA-cleared AI algorithms (60/107) posted no validation claims or data. Al Just 9/107 reviewed AI algorithms had a validation dataset sizes of over 1000, 2/107 algorithms with >5000. The most common type of AI algorithms included detection (CADe; n= 27) and quantitative algorithms (n= 34). Nearly all CADe and CADt (triage) targeted specific radiology finding (one per algorithm). Breast (mammography), chest (chest radiography and CT), and brain (CT and MR) dominated the targeted body regions of interest. Among 33 CADe cleared algorithm, there were no datasets for 14 (42%), while 2/3 CADx (characterization) had either 0 or 50 validation datasets.

CLINICAL RELEVANCE/APPLICATION

Insufficient validation datasets in AI algorithms necessitate need for a cautious implementation into clinical routine.

Abstract Archives of the RSNA, 2021

CA01-A

Cardiac Sunday Poster Discussions

Sub-Events

CA01-A4   Clinical Significance Of An Anomalous Right Coronary Artery Found By Angiography In An Adult

Participants
Aishwarya Gulati, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Anomalous right coronary artery (RCA), the second most common coronary anomaly, is often identified on computed tomography angiography (CTA) in association with atherosclerotic disease, but treatment guidelines are not universally accepted. We evaluated a population with an interarterial course (IAC) of an anomalous right coronary artery (RCA) arising from the left coronary sinus to determine whether this population benefits from bypass surgery.*Methods and Materials Our retrospective review of conventional angiography and CTA studies identified 191 patients over the age of 35 years, including 93 patients with an anomalous RCA and an IAC, and 98 patients with an anomalous left circumflex (LCx) artery with a retro-aortic course; the anomalous LCx population, an accepted benign anomaly, was chosen as our control population. Clinical outcomes for these patients were available with a mean follow-up time of 6 years. Hard outcomes were compared between the two populations, including MI, cardiac death, unstable angina, and all-cause mortality.*Results The demographic distribution of our cases and controls was similar. Hard outcomes were identified among 20 cases and 30 controls. There was no significant difference in hard outcomes (p=0.15), non-fatal hard outcomes (p=0.07), all-cause mortality (p=0.09), and cardiac death (p=0.29) between case and control groups. Using a Cox Proportional Hazard Model, only age (p< 0.02) and coronary artery disease (p<0.01) were significant predictors of hard outcomes and all-cause mortality.*Conclusions There is no significant difference in hard outcomes or overall survival between adults with an anomalous RCA with an IAC versus those with an anomalous LCx. Only age and coronary artery disease burden predict outcomes. Our findings suggest that management of adult patients with an anomalous RCA can be based on atherosclerotic disease burden alone without considering the IAC as an added risk.*Clinical Relevance/Application Given the increasing identification of anomalous coronary arteries on cCTA, evidence-based treatment guidelines are needed. Analysis of clinical outcomes can define appropriate management strategies.

RESULTS

The demographic distribution of our cases and controls was similar. Hard outcomes were identified among 20 cases and 30 controls. There was no significant difference in hard outcomes (p=0.15), non-fatal hard outcomes (p=0.07), all-cause mortality (p=0.09), and cardiac death (p=0.29) between case and control groups. Using a Cox Proportional Hazard Model, only age (p< 0.02) and coronary artery disease (p<0.01) were significant predictors of hard outcomes and all-cause mortality.

CLINICAL RELEVANCE/APPLICATION

Given the increasing identification of anomalous coronary arteries on cCTA, evidence-based treatment guidelines are needed. Analysis of clinical outcomes can define appropriate management strategies.

GI04-D

Gastrointestinal Wednesday Poster Discussions

Sub-Events

GI04-D11   **Impact Of Celiac Trunk Calcification On Clinical Outcome In Patients Undergoing Liver Transplantation**

Participants
Robert Siepmann, MD, Aachen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Post-operative complications after liver transplantation (oLTx) contribute to a 90-day mortality rate of up to 11%. To improve post-operative outcomes, adequate arterial perfusion of the transplant is essential. Aim of this study is to investigate risk factors on pre-operative CT imaging of the celiac vessels and their impact on clinical outcome.*Methods and Materials Retrospective, monocentric study on patients undergoing oLTx between January 2015 and December 2019 who had undergone non-contrast-enhanced CT not longer than one year before surgery. Calcifications of the celiac artery (CA) and the visceral aorta (VA: aorta from aortic hiatus to superior mesenteric artery) were determined by using the Agatson method (cut-off values: CA >50 mm3, VA >100 mm3). Association between visceral calcification and overall survival or graft survival was evaluated using Kaplan-Meier estimator (p<0.05). Mann-Whitney U test (p<0.05) was used to investigate the association between visceral calcification and intraoperative fresh frozen plasma (FFP) units needed, intraoperative red blood cell (RBC) units needed, major complications (MC) (Clavien-Dindo =3b), length of ICU stay (ICUS), length of hospital stay (HS), Charlson Comorbidity Index (CCI) and cost prediction (CP).*Results 138 patients were included. 28/138 had relevant calcifications of the VA alone, 3/138 of the CA alone, and 10/138 of both. VA and CA calcification had no relevant impact on overall survival (p=0.089, p=0.310) or graft survival (p=0.347, p=0.421). However, patients with relevant CA calcification had a significantly higher risk of major complications (p=0.010) and needed significantly more FFPs intra-operatively (p=0.015). CA calcification was not significantly associated with ICUS, HS, CCI, CP or RBC. VA calcification was not significantly associated with any of the outcome metrics under investigation.*Conclusions Patients with relevant calcifications of the celiac artery undergoing liver transplantation face a significantly higher risk of complicated surgery or major postoperative complications.*Clinical Relevance/Application Evaluation of celiac artery calcifications on abdominal CT obtained prior to liver transplant surgery can help identify patients at high-risk of intra- and postoperative complications.

RESULTS

138 patients were included. 28/138 had relevant calcifications of the VA alone, 3/138 of the CA alone, and 10/138 of both. VA and CA calcification had no relevant impact on overall survival (p=0.089, p=0.310) or graft survival (p=0.347, p=0.421). However, patients with relevant CA calcification had a significantly higher risk of major complications (p=0.010) and needed significantly more FFPs intra-operatively (p=0.015). CA calcification was not significantly associated with ICUS, HS, CCI, CP or RBC. VA calcification was not significantly associated with any of the outcome metrics under investigation.

CLINICAL RELEVANCE/APPLICATION

Evaluation of celiac artery calcifications on abdominal CT obtained prior to liver transplant surgery can help identify patients at high-risk of intra- and postoperative complications.

GI04-D9   **Oportunistic Screening For Metabolic Syndrome And Osteoporosis In Non-enhanced Computer Tomography: A Deep Learning Approach**

Participants
Marcelo Takahashi, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

To develop an AI model capable of automatically extracting quantitative biomarkers that are predictors of metabolic syndrome and osteoporosis from non-enhanced abdominal CTs*Methods and Materials Ongoing retrospective study with IRB approval. An in-house developed deep learning algorithm, based on UNet architecture, was utilized for independent volumetric segmentation of liver, visceral fat, abdominal fat and anterior portion of lumbar vertebral bodies. Steatosis evaluation was based on mean attenuation from volumetric liver segmentation.Abdominal fat relation was calculated as the proportion of segmentation area of a single slice (umbilical level) of visceral/subcutaneous fat.Bone density was based on mean attenuation of segmented volume of the sum of all identified lumbar vertebrae.*Results Analysis was made in three distinct patient groups. Liver steatosis group: of 176 exams selected based on the presence/absence of steatosis in the report. With attenuation threshold of <40HU for steatosis and >60UH for normal algorithm 100% accuracy.Abdominal fat group: 39 exams with previous conventional manual single-slice segmentation of visceral and subcutaneous fat at umbilical level. Considering manual segmentation as ground truth algorithm demonstrated an excellent performance with mean absolute error of 1%.Bone density group: 65 pairs of exams of patients who underwent bone densitometry within 30 days of CT. Considering mean attenuation of 158HU as threshold algorithm achieved: 83% accuracy, 76% PPV and 89% NPV.*Conclusions We successfully developed an AI model capable of extracting relevant data from abdominal CT which correlates well to both manual segmentation and bone densitometry results.*Clinical Relevance/Application If integrated to radiologic workflow our models can assist radiologists and/or referring physicians in prospectively detecting patients at risk for metabolic syndrome and osteoporosis/osteopenia through regular non-enhanced abdominal CTs automatic analysis. Retrospective analysis can also be done, as either screening method or as to generate and collect large amounts of population data.

RESULTS

Analysis was made in three distinct patient groups. Liver steatosis group: of 176 exams selected based on the presence/absence of steatosis in the report. With attenuation threshold of <40HU for steatosis and >60UH for normal algorithm 100% accuracy.Abdominal fat group: 39 exams with previous conventional manual single-slice segmentation of visceral and subcutaneous fat at umbilical level. Considering manual segmentation as ground truth algorithm demonstrated an excellent performance with mean absolute error of 1%.Bone density group: 65 pairs of exams of patients who underwent bone densitometry within 30 days of CT. Considering mean attenuation of 158HU as threshold algorithm achieved: 83% accuracy, 76% PPV and 89% NPV.

CLINICAL RELEVANCE/APPLICATION

If integrated to radiologic workflow our models can assist radiologists and/or referring physicians in prospectively detecting patients at risk for metabolic syndrome and osteoporosis/osteopenia through regular non-enhanced abdominal CTs automatic analysis. Retrospective analysis can also be done, as either screening method or as to generate and collect large amounts of population data.

NPM02-B

Noninterpretative Monday Poster Discussions

Sub-Events

NPM02-B1   **Educational Impact Of The Abrupt Conversion Of A Core Medical Student Radiology Clerkship To Remote Learning Secondary To The COVID-19 Pandemic**

Participants
Jonathan Martin, MD, Durham, North Carolina (*Presenter*) Speakers Bureau, Inari Medical, Inc

PURPOSE

Second-year medical students at a single institution undergo a required 4-week clerkship in Radiology. Historically, this course is entirely in-person with approximately 40 lecture hours and 140 clinical hours. In the setting of the COVID-19 pandemic a new hybrid model was created in academic year (AY) 2020-21, consisting of 15 live videoconference lecture hours, 25 prerecorded lecture hours, and approximately 40 in-person clinical hours and 100 remote clinical hours (videoconference readouts), the breakdown of which varied by clinical division. Here we examine if the conversion of an entirely in-person clinical curriculum to a hybrid model resulted in a significant change in student performance or student satisfaction.*Methods and Materials A standardized written exam has been administered at the end of each clerkship block since 2016. Given the propensity for general medical knowledge to increase across the clinical year, exam scores from the 6 completed blocks of AY 2020-21 were compared to results from the first 6 blocks of AY 2016-2020. Student final grades (Satisfactory/Unsatisfactory), lecture evaluation scores and student satisfaction scores on a 5-point Likert scale were also compared. Student suggestions for improvement were compiled.*Results There has been no significant change in mean exam scores pre- and post-curriculum-change (AY 2016-20: mean 89.0, std dev 4.8; AY 2020-21: mean 88.6, std dev 5.1; p=0.26). No students in AY 2020-21 had a failing exam score or received an Unsatisfactory grade. Lecture ratings for AY 2020-21 saw a significant decrease in average score (4.2 vs 4.5, p<0.001). Clinical divisions which had majority in-person clinical hours saw an increase in student satisfaction scores (77.3% favorable or very favorable pre-change, 93.6% post), while divisions with a majority remote clinical hours saw a decrease (77.1% pre; 69.8% post). Additionally, 73% of student suggestions for improvement were centered around remote readouts.*Conclusions With the conversion to a hybrid curriculum, metrics of student performance have remained stable. However, student satisfaction with remote clinical work and evaluations of remote lectures were both decreased compared to in-person learning.*Clinical Relevance/Application While these findings suggest that a hybrid remote and in-person curriculum can maintain student performance, the significant decrease in student satisfaction related to remote clinical work indicates that a return to safe in-person learning should be prioritized.

RESULTS

There has been no significant change in mean exam scores pre- and post-curriculum-change (AY 2016-20: mean 89.0, std dev 4.8; AY 2020-21: mean 88.6, std dev 5.1; p=0.26). No students in AY 2020-21 had a failing exam score or received an Unsatisfactory grade. Lecture ratings for AY 2020-21 saw a significant decrease in average score (4.2 vs 4.5, p<0.001). Clinical divisions which had majority in-person clinical hours saw an increase in student satisfaction scores (77.3% favorable or very favorable pre-change, 93.6% post), while divisions with a majority remote clinical hours saw a decrease (77.1% pre; 69.8% post). Additionally, 73% of student suggestions for improvement were centered around remote readouts.

CLINICAL RELEVANCE/APPLICATION

While these findings suggest that a hybrid remote and in-person curriculum can maintain student performance, the significant decrease in student satisfaction related to remote clinical work indicates that a return to safe in-person learning should be prioritized.

Abstract Archives of the RSNA, 2021

Sub-Events

GI01-A10   Prediction Of KRAS Mutations In Rectal Cancer Based On Clinical Data, Dual-energy Spectral CT Parameters And ADC Values

Participants
Xiaoqiang Lin, Lanzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the value of combined clinical information, dual-energy spectral CT (DESCT) and ADC parameters in predicting KRAS mutations in rectal cancer.*Methods and Materials Forty-nine patients with rectal cancer underwent DWI and triple-phase enhanced DESCT were retrospectively collected and divided into two groups: group A (wild-type) and group B (mutation). Clinical baseline characteristics included age, gender, tumor location and serum tumor markers. A radiologist delineated the regions of interest (ROIs) on the layer of maximum tumor diameter and the nearest upper and lower layers in axial enhanced images and calculated the average value. Effective atomic number (Eff-Z), iodine concentration (IC) of tumor and artery were acquired to calculate normalized iodine concentration (NIC, NIC = ICtumor / ICartery). The apparent diffusion coefficient (ADC) value including minimum ADC (mADC) value, average ADC (aADC) value and relative ADC (rADC) value (rADC = aADCtumor / aADCgluteus) were obtained by drawing ROIs referred to T2 map. The differences of clinical baseline characteristics between groups were checked by ?2 test. The t test or Mann Whitney U test is used for continuous data. Univariate and multivariable logistic regression analysis were used to determine the independent factors of KRAS mutation status. Before the construction of a multivariate model, collinearity diagnostics were performed. Receiver operating characteristic (ROC) curves were generated to assess the predictive performance.*Results The mutation rate of KRAS in superior segment was significantly higher than that in middle and low rectal cancer ($P < 0.05$). The Eff-Z and NIC in venous phase (VP) of group B were significantly higher than group A (both $P < 0.05$), while the aADC and rADC value of group B was significantly lower (both $P < 0.05$). Univariate logistic regression showed that tumor location ($P = 0.031$) and NIC in VP ($P = 0.019$) were risk factors for KRAS mutation, while rADC value was protective factor for KRAS mutation ($P = 0.036$), further multivariate logistic regression analysis of combined tumor location showed that rADC was an independent predictor of KRAS mutation ($P < 0.05$, OR = 0.228). Three significant factors (tumor location, NICVP and rADC) were combined to determine the predictive value for KRAS mutations with the AUC value of 0.806.*Conclusions Tumor location, Eff-Z, NIC in VP, aADC and rADC values of rectal cancer have moderate predictive efficacy for KRAS mutation. Moreover, rADC is an independent predictor of KRAS mutation. Combined model has higher value for predicting KRAS mutation in rectal cancer.*Clinical Relevance/Application Regression models based on tumor segmentation, DSECT and ADC parameters are helpful for preoperative treatment strategy selection.

RESULTS

The mutation rate of KRAS in superior segment was significantly higher than that in middle and low rectal cancer ($P < 0.05$). The Eff-Z and NIC in venous phase (VP) of group B were significantly higher than group A (both $P < 0.05$), while the aADC and rADC value of group B was significantly lower (both $P < 0.05$). Univariate logistic regression showed that tumor location ($P = 0.031$) and NIC in VP ($P = 0.019$) were risk factors for KRAS mutation, while rADC value was protective factor for KRAS mutation ($P = 0.036$), further multivariate logistic regression analysis of combined tumor location showed that rADC was an independent predictor of KRAS mutation ($P < 0.05$, OR = 0.228). Three significant factors (tumor location, NICVP and rADC) were combined to determine the predictive value for KRAS mutations with the AUC value of 0.806.

CLINICAL RELEVANCE/APPLICATION

Regression models based on tumor segmentation, DSECT and ADC parameters are helpful for preoperative treatment strategy selection.

GI01-A12   Detection Of Early-stage Hcc By Abbreviated Mri: Multicenter Validation Against Surgical Pathology

Participants
Takeshi Yokoo, MD, PhD, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Evaluate early-stage detection of dynamic contrast enhanced abbreviated MRI (dynamic AMRI) in cirrhosis, against surgical pathology as reference standard.*Methods and Materials We conducted a multi-center retrospective case-control study at 3 U.S. liver transplantation centers on cirrhosis patients who underwent liver resection or transplant during 2009-2019 and had full dynamic contrast-enhanced liver MRI within 3 months of surgery. Patients were excluded if they had: any cancer therapy prior to surgery, hepatobiliary contrast for MRI, tumor beyond Milan criteria on pathology, or HCC size <1 cm.Dynamic AMRI exam was simulated from the pre-surgical full MRI by retaining only the localizing coronal T2-weighted and dynamic contrast enhanced T1-weighted sequences (pre-contrast, arterial, portal venous, and delayed phases), and omitting most non-contrast sequences. Two abdominal radiologists at each center independently reviewed AMRI images using 2018 Liver Imaging Reporting and Data System (LI-RADS), blinded to all clinical, pathological, and prior imaging data. Patients with liver observations categorized as LI-RADS 4, 5, or M were recorded as "positive" for HCC detection, and "negative" otherwise.Patients with pathologically-confirmed HCC were classified as HCC+, and those without HCC on pathology as HCC-. Patients with pathologically-confirmed non-HCC mass were

classified as HCC-. Early-stage status was pathologically confirmed by applying Milan criteria.Patient-level sensitivity and specificity for early-stage HCC detection were calculated in the HCC+ and HCC- groups, respectively, for each reader as well as for the average reader.*Results We enrolled 166 patients with early-stage HCC and 139 patients without HCC. The most common etiology of cirrhosis was hepatitis C among HCC+ (67.5%) and alcohol-related among controls (55.4%). Most HCC cases had Child Pugh A cirrhosis (89.4%) and treated with resection (79.4%). Most HCC were unifocal (89.4%) and median diameter was 2.4 cm. Pooled sensitivity and specificity of dynamic AMRI for early-stage HCC were 0.888 (95%CI 0.841-0.931) and 0.892% (0.842-0.935), respectively (Table 1). There was variation in performance across readers, sites, and type of surgery (resection vs. transplant). Notably, the sensitivity of AMRI was significantly higher for patients undergoing resection than those undergoing transplantation (95.7% vs. 62.1%).*Conclusions Using surgical pathology as the reference standard, AMRI had sensitivity and specificity of ~90% for detection of early-stage HCC in cirrhosis.*Clinical Relevance/Application Using rigorous reference standard (surgical resection), our data further support the use of abbreviated MRI for early detection of cirrhosis-associated HCC.

RESULTS

We enrolled 166 patients with early-stage HCC and 139 patients without HCC. The most common etiology of cirrhosis was hepatitis C among HCC+ (67.5%) and alcohol-related among controls (55.4%). Most HCC cases had Child Pugh A cirrhosis (89.4%) and treated with resection (79.4%). Most HCC were unifocal (89.4%) and median diameter was 2.4 cm. Pooled sensitivity and specificity of dynamic AMRI for early-stage HCC were 0.888 (95%CI 0.841-0.931) and 0.892% (0.842-0.935), respectively (Table 1). There was variation in performance across readers, sites, and type of surgery (resection vs. transplant). Notably, the sensitivity of AMRI was significantly higher for patients undergoing resection than those undergoing transplantation (95.7% vs. 62.1%).

CLINICAL RELEVANCE/APPLICATION

Using rigorous reference standard (surgical resection), our data further support the use of abbreviated MRI for early detection of cirrhosis-associated HCC.

GI01-A13   An Interactive CT-based Series Of Gastric Pathology

Participants
Edward Lawrence, MD, PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Localizing extraluminal fluid/air can help find the location of perforation. 2. Features that suggest true gastric wall thickening include altered wall enhancement, asymmetric thickening, adjacent stranding, or local adenopathy 3. Lower attenuation (edema) or mural stratification favors benign. Higher attenuation/enhancement is suspicious for infiltrative tumor. 4. The most challenging neoplastic mimics are lymphoma and adenocarcinoma (including linitis plastica)

TABLE OF CONTENTS/OUTLINE

1. 'How to' interact with web-based cases 2. Case based teaching a. Highlight key imaging findings, including companion cases b. Emphasize differentiating inflammatory from malignant etiologies 3. Case examples: a. Gastritis; b. Peptic ulcers (including perforated); c. Emphysematous gastritis; d. Gastric volvulus; e. Gastric adenocarcinoma; f. Gastric lymphoma; g. Gastric GIST; h. Linitis plastica (metastatic breast cancer); i. Gastric neuroendocrine tumor; j. Gastric schwanomma; k. Gastric pseudocysts; l. Ménétrier disease; m. Puetz Jeghers with gastric polyposis; n. Gastric varices

GI01-A3   Diagnostic Performance Of Multiparametric Mr Imaging In Detecting Pathologic Complete Response After Neoadjuvant Therapy In Esophageal Squamous Cell Carcinoma

Participants
Jin Rong Qu, MD,PhD, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To determine the performance of multiparametric magnetic resonance (MR) imaging in evaluating response to neoadjuvant therapy in patients with esophageal squamous cell carcinoma (ESCC).*Methods and Materials Thirty-six ESCC patients with cT2-T4a/N0-N3/M0 stage were retrospectively reviewed utilizing a prospectively maintained database. Biopsy proven staging was performed according to the 7th edition of Union for International Cancer Control/American Joint Committee on Cancer TNM classification of esophageal cancer (EC). MRI was performed before and after neoadjuvant therapy (nT), followed by surgical resection. Lesions were analyzed for five MRI features (changes of size, signal on DWI, ADC map, T2-weighted TSE BLADE and degree of enhancement) and response was assessed by using tumor regression grade (TRG). Chi-square test or Fisher exact test was used, and sensitivity, specificity, positive predictive value, negative predictive value and C-Index were calculated.*Results Five MR features after nT showed strong positive correlations with TRG 0 (r = 0.7432; P<.001). All 10 cases with TRG 0 showed either complete disappearance of the mass or decreased mass with minimal residual thickening of the esophageal wall, iso- or decreased-intensity on DWI, iso- or increased-intensity on ADC map, iso- or decreased-intensity on T2-weighted TSE BLADE, or homogeneous enhancement on high-resolution delayed StarVIBE. These features were different from all the TRG 2-3 in 20 cases. ADC map had the highest performance in distinguishing TRG 0 from non-TRG 0 with the sensitivity of 96.1%, specificity of 76.5%, negative predictive value (NPV) of 74.7%, and positive predictive value (PPV) of 91.6%*Conclusions Multiparametic MR features provide useful diagnostic information of pCR among patients with ESCC who undergo neoadjuvant therapy.*Clinical Relevance/ApplicationMR assessment of changes in tumor size, signal on DWI, ADC map, T2-weighted TSE BLADE, and enhancement pattern may distinguish between biopsy proven TRG 0 and non-TRG 0 in patients with ESCC.

RESULTS

Five MR features after nT showed strong positive correlations with TRG 0 (r = 0.7432; P<.001). All 10 cases with TRG 0 showed either complete disappearance of the mass or decreased mass with minimal residual thickening of the esophageal wall, iso- or decreased-intensity on DWI, iso- or increased-intensity on ADC map, iso- or decreased-intensity on T2-weighted TSE BLADE, or homogeneous enhancement on high-resolution delayed StarVIBE. These features were different from all the TRG 2-3 in 20 cases. ADC map had the highest performance in distinguishing TRG 0 from non-TRG 0 with the sensitivity of 96.1%, specificity of 76.5%, negative predictive value (NPV) of 74.7%, and positive predictive value (PPV) of 91.6%

CLINICAL RELEVANCE/APPLICATION

MR assessment of changes in tumor size, signal on DWI, ADC map, T2-weighted TSE BLADE, and enhancement pattern may

distinguish between biopsy proven TRG 0 and non-TRG 0 in patients with ESCC.

GI01-A4   Gadoxetic Acid-enhanced MR Imaging Predictors Of Mortality And Hepatic Decompensation In Chronic Liver Disease

Participants
Lucian Beer, MD,PhD, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

The Functional Liver Imaging Score (FLIS), derived from hepatobiliary phase MRI, was associated with graft survival in patients who underwent liver transplantation and linked to a first hepatic decompensation and transplant-free survival (TFS) in patients with advanced chronic liver disease (ACLD). The aim of this study was to investigate the accuracy of the FLIS in combination with the spleen craniocaudal diameter (SCCD) for the prediction of hepatic decompensation and TFS in patients with CLD.*Methods and Materials There were 397 patients with CLD who had undergone gadoxetic acid-enhanced liver MRI included. A FLIS was assigned based on the sum of three hepatobiliary-phase features, each scored on an ordinal 0-2 scale: hepatic enhancement; biliary excretion; and the signal intensity in the portal vein. The SCCD was measured. Patients were stratified into three groups according to the Fibrosis-4 score (FIB-4) and present or past hepatic decompensation: non-advanced CLD; compensated-advanced CLD (cACLD); and decompensated-advanced CLD (dACLD). The predictive value of SCCD and FLIS for a first or further hepatic decompensation and TFS was investigated using Kaplan-Meier analysis, log-rank tests, and Cox regression analysis.*Results We observed a strong positive correlation between the measured spleen volume and the SCCD (Spearman's rho = 0.887; P < 0.001). The inter-reader and intra-reader agreement for the SCCD was excellent, with ICC values of 0.982 (range: 0.973-0.955; n = 241) and 0.997 (range: 0.994-0.998; n = 41), respectively.In patients with ACLD, the FLIS was an independent risk factor for mortality (adjusted hazard ratio, [aHR]: 2.38, 95%CI: 1.51-43.76, P < .001). Allocating patients into three groups based on their FLIS and SCCD enabled further stratification of patients according to their risk for mortality (log-rank test: P<.001). The SCCD was further identified as an independent risk factor for a first and further hepatic decompensation in patients with ACLD (aHR: 1.10, 95%CI: 1.02-1.19, P = .01; aHR: 1.13, 95%CI: 1.05-1.22, P = .001).*Conclusions The functional liver imaging score, derived from gadoxetic acid-enhanced MRI in combination with the splenic craniocaudal diameter, identifies patients with advanced chronic liver disease who are at increased risk for hepatic decompensation and for mortality.*Clinical Relevance/Application Gadoxetic acid-enhanced MRI, in combination with the splenic craniocaudal diameter, can be used to identify patients with advanced chronic liver disease who are at increased risk for hepatic decompensation and for mortality.

RESULTS

We observed a strong positive correlation between the measured spleen volume and the SCCD (Spearman's rho = 0.887; P < 0.001). The inter-reader and intra-reader agreement for the SCCD was excellent, with ICC values of 0.982 (range: 0.973-0.955; n = 241) and 0.997 (range: 0.994-0.998; n = 41), respectively.In patients with ACLD, the FLIS was an independent risk factor for mortality (adjusted hazard ratio, [aHR]: 2.38, 95%CI: 1.51-43.76, P < .001). Allocating patients into three groups based on their FLIS and SCCD enabled further stratification of patients according to their risk for mortality (log-rank test: P<.001). The SCCD was further identified as an independent risk factor for a first and further hepatic decompensation in patients with ACLD (aHR: 1.10, 95%CI: 1.02-1.19, P = .01; aHR: 1.13, 95%CI: 1.05-1.22, P = .001).

CLINICAL RELEVANCE/APPLICATION

Gadoxetic acid-enhanced MRI, in combination with the splenic craniocaudal diameter, can be used to identify patients with advanced chronic liver disease who are at increased risk for hepatic decompensation and for mortality.

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PD04-A

Pediatric Wednesday Poster Discussions

Abstract Archives of the RSNA, 2021

Sub-Events

SDP-RI-1   A Clinical And Multimodal MRI-based Radiomics Model For Preoperatively Detecting Concurrent Endometrial Cancer From Atypical Endometrial Hyperplasia

Participants
Jieying Zhang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the capability of multimodal MRI-based radiomics for preoperatively detecting concurrent endometrial cancer (CEC) from atypical endometrial hyperplasia (AEH).*Methods and Materials A total of 87 patients (57 AEHs and 30 CECs) were retrospectively enrolled with preoperative MRI. The radiomics features were extracted basing on T2-weighted imaging (T2WI), diffusion-weighted imaging (DWI), and apparent diffusion coefficient (ADC) maps. A data reduction and feature selection process including the least absolute shrinkage and selection operator algorithm was performed. Single-modal and multimodal radiomics signatures, clinical model and clinical-radiomics model were built using logistic regression. Area under the receiver operating characteristic (ROC) curves (AUC) and calibration curves were used to assess these models. Model internal validations were performed using the enhanced bootstrap resampling method (n=1000). Subgroup analysis was performed according to preoperative endometrial biopsy results.*Results T2WI, DWI, ADC and the combined radiomics signatures all showed good discrimination abilities with an AUC of 0.887 (95%CI: 0.818-0.956), 0.785 (95%CI: 0.688-0.883), 0.833 (95%CI: 0.741-0.925) and 0.920 (95%CI: 0.865-0.974), respectively. The clinical-radiomics model consisted of multimodal radiomics features, endometrial thickness (>11mm), and nulliparity status, achieved the highest AUC of 0.932 (95% CI: 0.880-0.984) and bias-corrected AUC of 0.922. The subgroup analysis showed that this model also performed well in patients with preoperative endometrial biopsy consistent and inconsistent with postoperative pathology (consistent biopsy group, accuracy = 0.848; inconsistent biopsy group, accuracy = 0.905).*Conclusions The clinical- and multimodal MRI-based radiomics model has the potential to be used as a noninvasive imaging tool for preoperatively distinguishing CEC from AEH, especially in patients with under- or over-estimated preoperative endometrial biopsy.*Clinical Relevance/Application We developed a noninvasive, highly sensitive, and specific clinical- and multimodal MRI-based radiomics model for preoperatively detecting CEC from AEH with a supplementary value to endometrial biopsy.

RESULTS

T2WI, DWI, ADC and the combined radiomics signatures all showed good discrimination abilities with an AUC of 0.887 (95%CI: 0.818-0.956), 0.785 (95%CI: 0.688-0.883), 0.833 (95%CI: 0.741-0.925) and 0.920 (95%CI: 0.865-0.974), respectively. The clinical-radiomics model consisted of multimodal radiomics features, endometrial thickness (>11mm), and nulliparity status, achieved the highest AUC of 0.932 (95% CI: 0.880-0.984) and bias-corrected AUC of 0.922. The subgroup analysis showed that this model also performed well in patients with preoperative endometrial biopsy consistent and inconsistent with postoperative pathology (consistent biopsy group, accuracy = 0.848; inconsistent biopsy group, accuracy = 0.905).

CLINICAL RELEVANCE/APPLICATION

We developed a noninvasive, highly sensitive, and specific clinical- and multimodal MRI-based radiomics model for preoperatively detecting CEC from AEH with a supplementary value to endometrial biopsy.

SDP-RI-10   The Value Of IVIM-DWI Combined With DTI In Prediction Of Lymphovascular Space Invasion For Early Cervical Squamous Cell Carcinoma

Participants
Tingting Lin, Hefei, China (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to investigate the prediction of lymphovascular space invasion (LVSI) through a combination of intravoxel incoherent motion diffusion-weighted (IVIM-DWI) with diffusion tensor imaging (DTI) in patients with early cervical squamous cell carcinoma.*Methods and Materials Eighty patients with pathologically confirmed early cervical squamous cell carcinoma underwent conventional MRI, IVIM-DWI and DTI pretreatment. The patients were divided into LVSI positive and LVSI negative groups according to surgical pathology findings. The parameters of IVIM-DWI (ADC, D, D* and f value) and DTI (DCavg and FA) were measured. One-way analysis of variance was performed to compare the differences of preoperative parameters between the two groups, and optimal cut-off values and predictive performance of parameters with statistical significance were estimated by drawing the receiver operator characteristic (ROC) curve.*Results There were 45 patients in LVSI positive and 35 in negative group. The positive group showed a lower D and FA value (all p < 0.05). The area under the ROC curve (AUC) of D and FA was 0.852 and 0.731 respectively, and the combination of D and FA exhibited a higher diagnostic performance compared with individual MRI parameters.*Conclusions Both D and FA value showed promising results for diagnosing LVSI in early cervical squamous cell carcinoma. A combination of D and FA might improve the predictive value.*Clinical Relevance/Application Choose individual treatment for patients with early cervical squamous cell carcinoma.

RESULTS

There were 45 patients in LVSI positive and 35 in negative group. The positive group showed a lower D and FA value (all p <

0.05). The area under the ROC curve (AUC) of D and FA was 0.852 and 0.731 respectively, and the combination of D and FA exhibited a higher diagnostic performance compared with individual MRI parameters.

CLINICAL RELEVANCE/APPLICATION

Choose individual treatment for patients with early cervical squamous cell carcinoma.

SDP-RI-11   **Assessing The Correlation Of Ultrasonographic Placental Thickness And Intraplacental Villous Artery (IPVA) Doppler In Normal Pregnancies And Pregnancies With Intrauterine Growth Restriction(IUGR)**

Participants
Nirali S. Mehta, MBBS, Vadodara, India (*Presenter*) Nothing to Disclose

PURPOSE

To assess the placental thickness in normal pregnancies and pregnancies with IUGR. To compare intraplacental villous artery (IPVA) and umbilical artery(UA) Doppler indices between normal and IUGR pregnancies. To evaluate the role of IPVA Doppler and placental thickness in early detection of IUGR.*Methods and Materials A quantitative prospective was conducted on pregnant females coming for antenatal ultrasound using low frequency (3 to 5 MHz) curvilinear transducer of Philips Affinitti 50G at the Radiology Department. Singleton uncomplicated pregnancies were included. Antenatal females with twin gestation, anomalous foetus, abnormal placentation and any systemic disease were excluded. A total of 124 pregnant females were enrolled and fetal biometric parameters, placental thickness, IPVA and UA Doppler were studied for 4 times between 16 to 20, 24 to 26, 30 to 32 and at 36 weeks of gestation. The data was analysed with standard statistical tests.*Results Out of 124 antenatal females included, 96 had normal pregnancy outcome, 22 developed IUGR and 6 were lost to follow up. There was a significant increase in mean placental thickness with advancing gestational age in normal uncomplicated and IUGR pregnancies (p < 0.001). Placental thickness was significantly lower in IUGR pregnancies as compared to normal uncomplicated pregnancies at all four visits (p < 0.05). There was significant decrease in IPVA and UA Doppler indices (PI, RI and S/D values) with advancing gestational age in normal uncomplicated pregnancies (p < .05). IPVA Doppler indices were significantly higher in IUGR foetuses as compared to normal foetuses (p <0.05) at all four consecutive scans where as there was no statistically significant difference in UA Doppler indices between the two groups as early as 16 to 20 weeks.*Conclusions IPVA resistance indices decrease and placental thickness increase as gestational age advances in normal uncomplicated pregnancies. Lack of decrease in IPVA resistance indices or increase in their values with advancing gestational age and lack of increase in placental thickness with advancing gestational age may be used for early prediction of IUGR.*Clinical Relevance/Application Subnormal placental thickness and raised IPVA Doppler indices can be used as early predictor of IUGR in contrast to the UA Doppler which reflects changes when 2/3rd of uteroplacental circulation is hampered.

RESULTS

Out of 124 antenatal females included, 96 had normal pregnancy outcome, 22 developed IUGR and 6 were lost to follow up. There was a significant increase in mean placental thickness with advancing gestational age in normal uncomplicated and IUGR pregnancies (p < 0.001). Placental thickness was significantly lower in IUGR pregnancies as compared to normal uncomplicated pregnancies at all four visits (p < 0.05). There was significant decrease in IPVA and UA Doppler indices (PI, RI and S/D values) with advancing gestational age in normal uncomplicated pregnancies (p < .05). IPVA Doppler indices were significantly higher in IUGR foetuses as compared to normal foetuses (p <0.05) at all four consecutive scans where as there was no statistically significant difference in UA Doppler indices between the two groups as early as 16 to 20 weeks.

CLINICAL RELEVANCE/APPLICATION

Subnormal placental thickness and raised IPVA Doppler indices can be used as early predictor of IUGR in contrast to the UA Doppler which reflects changes when 2/3rd of uteroplacental circulation is hampered.

SDP-RI-12   **Validating The Diagnostic Accuracy Of An MRI-based Scoring System For Differentiating Benign Uterine Leiomyomas From Leiomyosarcomas**

Participants
Maryam Al-Khouri, MD, Muscat, Oman (*Presenter*) Nothing to Disclose

PURPOSE

The purpose is to propose and validate the diagnostic accuracy of a multi-parametric MRI-based scoring system to differentiate between uterine leiomyomas, Smooth muscle Tumors of Unknown Malignant Potential (STUMP) and leiomyosarcomas.*Methods and Materials An ethics board approved retrospective study was performed at two tertiary care centres. All patients with a pathology-proven uterine mass who underwent a pre-operative pelvic MRI between January 2010-December 2019 were included. Initially, a scoring system was designed based on previously published worrisome MR imaging features of uterine leiomyosarcomas. Each feature was allocated a score according to the strength of association with malignancy and the degree of its overlap with benign masses. Subsequently, the MR images were blindly and independently reviewed by a fellowship-trained radiologist and a clinical fellow/senior resident. Each uterine mass was scored according to their imaging features. The scores were divided into 5 categories according to the sum of scores; I: 0, II: 1-3, III: 4-6, IV: 7-9 and V: >9. Category III and above were considered positive for malignancy or STUMP. Sensitivity, specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) were calculated.*Results A total of 244 women were included (age range 20-74 years, mean 40). Of these, 218 patients had a benign leiomyoma, 13 had a STUMP and 13 had a leiomyosarcoma. The sensitivity and specificity of the scoring system were 92.3% and 64.7%, respectively. The NPV was 98.6%. No leiomyosarcoma was missed using this scoring system. The presence of T2 hyperintensity, that is not cystic, or diffusion restriction in a uterine mass were the most sensitive signs of a uterine malignancy/STUMP.*Conclusions The proposed multi-parametric MRI-based scoring system is useful in differentiating benign uterine leiomyomas from STUMP tumors and leiomyosarcomas.*Clinical Relevance/Application To overcome the pre-operative pelvic MRI challenges in differentiating between benign leiomyoma and leiomyosarcoma, this proposed scoring system can be helpful; however, requires further validation.

RESULTS

A total of 244 women were included (age range 20-74 years, mean 40). Of these, 218 patients had a benign leiomyoma, 13 had a STUMP and 13 had a leiomyosarcoma. The sensitivity and specificity of the scoring system were 92.3% and 64.7%, respectively. The NPV was 98.6%. No leiomyosarcoma was missed using this scoring system. The presence of T2 hyperintensity, that is not cystic, or diffusion restriction in a uterine mass were the most sensitive signs of a uterine malignancy/STUMP.

CLINICAL RELEVANCE/APPLICATION

To overcome the pre-operative pelvic MRI challenges in differentiating between benign leiomyoma and leiomyosarcoma, this proposed scoring system can be helpful; however, requires further validation.

SDP-RI-13 Tumor Immune Evolution Determined By Dynamic PD-L1 Radiomics Signature (PD-L1-R) Is Prognostic In Glioblastoma Patients Treated With Postsurgical Radiochemotherapy

Participants
Francesco Sforazzini, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

We have recently devised a radiomics signature as surrogate for tumor tissue PD-L1 quantification (PD-L1-R) from post contrast agent MR images (T1ce) in Glioblastoma multiforme (GBM) with the PD-L1-R high group demonstrating a better prognosis. Dynamic immune monitoring is currently limited in GBM by the lack of repeated biopsies. We sought to utilize the non-invasive PD-L1-R score to study longitudinal evolution of PD-L1 and correlate its dynamic with clinical outcome.*Methods and Materials Among the 121 primary GBM subjects used to build PD-L1-R, 111 had at least one follow up (FU) time-point (range between 1 and 24, for a total of 557, median FU time: 46 months) after first surgery. T1ce images underwent standard pre-processing (bias field correction, brain extraction) and the features extracted from the gross tumor volumes were used to compute PD-L1-R scores (between 0-1, cutoff for PD-L1-R high (H) /low (L) groups: 0.5). For subjects from H (n=60, 49.6%), the time period to a group switch H to L was evaluated. Median observed time was used to split H based on their PD-L1-R dynamics: high-early h-e and high-late h-l and h-miss if the cutoff was not reached. A treebag model (PDL1R-Dyn) was trained on pre-surgery (TP0) image features to differentiate between h-e/h-miss and h-l (70%/30% training/validation, repeated LASSO on resampled data for robust feature selection). Cox-PH models were used for survival analysis.*Results In TP0, 49% of the tumors were assigned to PD-L1-R H. Post surgery and radiochemotherapy (RCHT) 65% switched from H to L. H was stratified based on the median time to switch (early h-e <3.5mo, n=18, late h-l >= 3.5mo). For n=20, the group threshold was not reached (h-miss) within median of 1.5 time points vs 7.5 and 6.5 for h-e and h-l. h-miss, h-e and h-l showed median OS of 16, 16 and 28mo. H-e and h-miss were merged based on similar survival to train PDL1R-Dyn which yielded an AUC of 84% (95%CI: 0.64-1). Univariate analysis of PDL1R-Dyn in the full cohort (n=121) yielded a hazard ratio (HR) of 1.71 (95 %CI: 1.09-2.66). Multivariate survival analysis (MV) of PD-L1-R and PDL1R-Dyn yielded an AIC of 711.4, slightly outperforming univariate survival models (AIC P-L1-R: 715.0, PDL1R-Dyn: 712.2). HR of PDL1R-Dyn in MV was 1.70 (95%CI: 1.09-2.65).*Conclusions We showed that longitudinal changes of the immune-surrogate PD-L1-R contain prognostic information and that these trajectories might help to discover novel GBM immune-subgroups. Tumors with high PD-L1-R postoperative and delayed switch after RCHT show a more favorable outcome.*Clinical Relevance/Application High PD-L1-R status and delayed switch to PD-L1-R low phenotype are associated with improved prognosis in GBM. MRI may allow deciphering the dynamic of tumor immune status and help in stratification.

RESULTS

In TP0, 49% of the tumors were assigned to PD-L1-R H. Post surgery and radiochemotherapy (RCHT) 65% switched from H to L. H was stratified based on the median time to switch (early h-e <3.5mo, n=18, late h-l >= 3.5mo). For n=20, the group threshold was not reached (h-miss) within median of 1.5 time points vs 7.5 and 6.5 for h-e and h-l. h-miss, h-e and h-l showed median OS of 16, 16 and 28mo. H-e and h-miss were merged based on similar survival to train PDL1R-Dyn which yielded an AUC of 84% (95%CI: 0.64-1). Univariate analysis of PDL1R-Dyn in the full cohort (n=121) yielded a hazard ratio (HR) of 1.71 (95 %CI: 1.09-2.66). Multivariate survival analysis (MV) of PD-L1-R and PDL1R-Dyn yielded an AIC of 711.4, slightly outperforming univariate survival models (AIC P-L1-R: 715.0, PDL1R-Dyn: 712.2). HR of PDL1R-Dyn in MV was 1.70 (95%CI: 1.09-2.65).

CLINICAL RELEVANCE/APPLICATION

High PD-L1-R status and delayed switch to PD-L1-R low phenotype are associated with improved prognosis in GBM. MRI may allow deciphering the dynamic of tumor immune status and help in stratification.

SDP-RI-2 The Predictive Value Of Conventional Mr Features Combined With Radiomics Features In Energy Efficiency Factor Of Hifu Ablation Uterine Fibroids

Participants
Chao Wei, Hefei, China (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study was to explore the additional value of radiomics features on conventional MRI further in predicting energy efficiency factor(EEF) of HIFU ablation uterine fibroids .*Methods and Materials A total of 216 symptomatic uterine &7;broids in 216 female patients were treated with HIFU therapy from October 2015 to March 2020. The baseline clinical and MR parameters before and after HIFU ablation were retrospectively analyzed. And the EEF was calculated according to the above results. Lesions segmented and features extracted were performed by ITK-SNAP and A.K. software on T2WI respectively.The minimum redundancy and maximum (mRMR) were used to select the radiomics features, and 20 features with high correlation but no redundancies with NPVR were retained. SPSS software was used to establish multiple linear regression models using the conventional MR features, conventional MRI and radiomics combined features, respectively. The NPVR related features of the two models were found out, and the prediction efficiency of the two models were compared, statistically. The validation of the predictive effectiveness of the final model was based on the correlation analysis between the predicted EEF value and the actual EEF value.*Results Conventional MRI and radiomics features combined model showed that wavelet _ HHH_ firstorder_ Skewness (X12), T1WI enhancement (X11: mild = 0, moderate = 1, marked = 2), T2WI signal intensity (X9: hyperintense signal = 0, iso-intensesignal = 1, hyperintense signal = 2) and DWI signal intensity (X10: hyporintense signal = 0, iso-intensesignal = 1, hyperintense signal = 2) had positive effect on EEF, original_shape_Maximum2DDiameterSlice(X13) had negative affect on EEF. The regression equation is: EEF = 14.901 + 58.177 X12 + 3.753 X11&3;0.26X13+ 3.089 X9 + 2.828 X10. The adjusted R2 of conventional MRI model and combined model were 0.144 and 0.297 respectively, and the two fitted model was statistically significant (P < 0.05). The Durbin Watson values of the two models were 2.007 and 1.958, respectively. The predicted EEF value of the combined model was 9.61 [3.60; 15.22] J / mm3, and the actual EEF value was 6.24 [3.40; 11.01] J / mm3, with the correlation coefficient r = 0.5.*Conclusions The prediction efficiency of the combined model is better than that of the conventional MRI model, and the radiomics parameters have important supplementary value for conventional MRI. There was moderate correlation between the predicted EEF of the combined prediction model and the actual EEF, which has a certain popularization value.*Clinical Relevance/Application Radiomics have important supplementary value for conventional MRI in predicting EEF of HIFU ablation uterine fibroids.

RESULTS

Conventional MRI and radiomics features combined model showed that wavelet _ HHH_ firstorder_ Skewness (X12), T1WI

enhancement (X11: mild = 0, moderate = 1, marked = 2), T2WI signal intensity (X9: hyporintense signal = 0, iso-intensesignal = 1, hyperintense signal = 2) and DWI signal intensity (X10: hyporintense signal = 0, iso-intensesignal = 1, hyperintense signal = 2) had positive effect on EEF, original_shape_Maximum2DDiameterSlice(X13) had negative affect on EEF. The regression equation is: EEF = 14.901 + 58.177 X12 + 3.753 X11&3;0.26X13+ 3.089 X9 + 2.828 X10. The adjusted R2 of conventional MRI model and combined model were 0.144 and 0.297 respectively, and the two fitted model was statistically significant (P < 0.05). The Durbin Watson values of the two models were 2.007 and 1.958, respectively. The predicted EEF value of the combined model was 9.61 [3.60; 15.22] J / mm3, and the actual EEF value was 6.24 [3.40; 11.01] J / mm3, with the correlation coefficient r = 0.5.

CLINICAL RELEVANCE/APPLICATION

Radiomics have important supplementary value for conventional MRI in predicting EEF of HIFU ablation uterine fibroids.

SDP-RI-3   Ultrasound-based Radiomics Score: A Potential Biomarker For The Prediction Of Progression-free Survival In Ovarian Epithelial Cancer

Participants
Yunjun Yang, Wenzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

More than eighty percent of the ovarian epithelial cancer (OEC) patients showed complete remissions after initial treatment but eventually experience recurrences of the disease. In this study, we aimed to develop a radiomics signature to found a new prognostic indicator based on preoperative ultrasound imaging.*Methods and Materials A total of 111 patients with OEC who underwent transvaginal ultrasound before surgery were included. Of these patients, 76 were divided into the training cohort and 35 to the test cohort. We defined the region of interest (ROI) of the tumor by manually drawing the tumor contour on the ultrasound image of the lesion. The radiomics features were extracted from ultrasound images. Constructing radiomics score (Rad-Score) was applied by Least absolute shrinkage and selection operator (LASSO) analysis and Cox regression. Combined with the ultrasound radiomics features, the significant clinical variables were also used to establish predictive models for 5-year progression-free survival (PFS) prediction. The efficiency of the models was evaluated by the area under the curve (AUC). Kaplan-Meier analysis was used to evaluate the association between the Rad-Score and PFS.*Results The combined model was superior to the clinical and Rad-Score models to estimate 5-year PFS, and achieved an AUC of 0.868 (95%CI: 0.766-0.971) in the training cohort. In the training and the test cohort, Rad-Score was negatively correlated with prognosis.*Conclusions The combined model which incorporated both clinical parameters and ultrasound radiomics features achieved a good performance for prognosis in patients with OEC.*Clinical Relevance/Application The combined model with clinical parameters and ultrasound radiomics features could aid in clinical decision-making.

RESULTS

The combined model was superior to the clinical and Rad-Score models to estimate 5-year PFS, and achieved an AUC of 0.868 (95%CI: 0.766-0.971) in the training cohort. In the training and the test cohort, Rad-Score was negatively correlated with prognosis.

CLINICAL RELEVANCE/APPLICATION

The combined model with clinical parameters and ultrasound radiomics features could aid in clinical decision-making.

SDP-RI-4   Ultrasound Image-based Radiomics To Predict Histologic Subtypes Of Epithelial Ovarian Cancer

Participants
Yunjun Yang, Wenzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Ovarian cancer is one of the most common causes of death in gynecological tumors, and epithelial ovarian cancer (EOC) is the most common category. In this study, we aimed to institute a radiomics signature based on the ultrasound images. And we would compare the performance of radiomics model, clinical model and combined model associating radiomics signature and clinical features in predicting histopathological types of EOC.*Methods and Materials A total of 265 patients with EOC who underwent transvaginal ultrasound before surgery were included. They were divided into a training cohort (n = 186) and a test cohort (n =79). We defined the region of interest (ROI) of the tumor by manually drawing the tumor contour on the ultrasound image of the lesion. The radiomics features were extracted from ultrasound images. Constructing radiomics score (Rad-Score) was applied by Least absolute shrinkage and selection operator (LASSO) analysis. clinical model was combined with the Rad-score model to establish a combined model. The efficiency of the models was evaluated by receiver operating characteristic curves (ROC), calibration curves and decision curve analysis (DCA).*Results The combined model was superior to the clinical and Rad-score models to predict histopathological types of EOC, and achieved an AUC of 0.83 (95%CI: 0.77-0.90) in the training cohort. And the calibration curve and DCA further confirmed the clinical usefulness of the combined model.*Conclusions The combined model which incorporated both clinical parameters and ultrasound radiomics features achieved a good performance in predicting histopathological types of EOC.*Clinical Relevance/Application The combined model with clinical features and ultrasound radiomics features might provide additional benefit to predict histopathological types of EOC.

RESULTS

The combined model was superior to the clinical and Rad-score models to predict histopathological types of EOC, and achieved an AUC of 0.83 (95%CI: 0.77-0.90) in the training cohort. And the calibration curve and DCA further confirmed the clinical usefulness of the combined model.

CLINICAL RELEVANCE/APPLICATION

The combined model with clinical features and ultrasound radiomics features might provide additional benefit to predict histopathological types of EOC.

SDP-RI-5   MRI Radiomics Analysis To Evaluate Clinical Risk For High-risk Patients With Placenta Accreta Spectrum

Participants
Caiting Chu, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the clinical risk assessment of MRI-radiomics based on sagittal FIESTA images in high-risk gravid patients suspected placenta accreta spectrum (PAS).*Methods and Materials From January 2013 and August 2019, a total of 131 patients suspected PAS, were included and data of them were analyzed retrospectively. The volume of interest (VOI) included suspected lesion in placenta and uterus was located and segmented on sagittal FIESTA-sequence. Image feature extraction and selection were performed via mRMR and LASSO. The radiomics model, clinical prediction model and clinical-radiomics combined model were respectively built via univariate or multivariate logistic regression analysis. A clinical-radiomics nomogram was built finally. Univariate associations of patient were analyzed by independent two-sample t test, chi-squared test via SPSS 23.0. Python was used to extract and select the radiomic features. Prediction model were performed with R software (version3.4.2, http://www.Rproject.org). Receiver operating characteristic (ROC) curve was performed to determine the performance of the model.*Results All the patients received cesarean delivery. There were 63 patients without PAS, 31 patients with placenta accreta (PA), 31 patients with Placenta increta (PI) and 6 patients with Placenta percreta (PP). Contrasted with a half of patients with PA needing manual removal placenta, all the patients with Placenta increta PI or PP needed manual removal placenta. In the group with patients of intraoperative hemorrhage (IPH)(=1000ml), the proportion of patients with PI (77.4%) or PP (100%) were more than the one of patients with PA (16.1%). The clinical model, radiomics model and clinical-radiomics combined model for predicting placenta stripping protocol and IPH were respectively built. According to ROC curve, the combined models for two predicting events were optimal. A clinical-radiomics nomogram was built with the selected clinical and radiomics features.*Conclusions The combined clinical-radiomics models can achieve a better performance for risk evaluation in high-risk patients of PAS.*Clinical Relevance/Application The clinical-radiomics nomogram as an individual and visualized tool can make the clinical benefit for high-risk patients of PAS.

RESULTS

All the patients received cesarean delivery. There were 63 patients without PAS, 31 patients with placenta accreta (PA), 31 patients with Placenta increta (PI) and 6 patients with Placenta percreta (PP). Contrasted with a half of patients with PA needing manual removal placenta, all the patients with Placenta increta PI or PP needed manual removal placenta. In the group with patients of intraoperative hemorrhage (IPH)(=1000ml), the proportion of patients with PI (77.4%) or PP (100%) were more than the one of patients with PA (16.1%). The clinical model, radiomics model and clinical-radiomics combined model for predicting placenta stripping protocol and IPH were respectively built. According to ROC curve, the combined models for two predicting events were optimal. A clinical-radiomics nomogram was built with the selected clinical and radiomics features.

CLINICAL RELEVANCE/APPLICATION

The clinical-radiomics nomogram as an individual and visualized tool can make the clinical benefit for high-risk patients of PAS.

SDP-RI-6   Evolution Of Early Post Therapy Apparent Diffusion Coefficient Values In Cervical Cancer: Opportunities For Image Guided Adaptive Radiotherapy

Participants
Megan Jacobsen, PhD, Houston, Texas (*Presenter*) Research Grant, Siemens AG

PURPOSE

Locally advanced cervical cancer poses therapeutic challenges due to potential inadequate tumor control for radiation resistant tumors and toxicity risks from combined chemoradiotherapy (CCRT). MR guided adaptive therapy may enable targeted dose escalation to radioresistant tumor subvolumes and dose de-escalation in responding tumors in the early treatment period. Quantitative biomarkers from diffusion weighted MR are advantageous for image guidance since acquisition does not require contrast agents, can be obtained rapidly, and is ubiquitous in routine patient exams. Prior work has correlated ADC values to tumor cellularity, grade and proliferation, with failure to increase tumor ADC after therapy associated with poor prognosis. The purpose of this study was to evaluate ADC histograms in patients undergoing CCRT prior to therapy and in the early treatment period, within the first 5 weeks of therapy.*Methods and Materials Ten cervical cancer patients who underwent definitive CCRT with MRI prior to and following external beam radiotherapy (EBRT) were retrospectively analyzed. Histogram features were calculated from volumes of interest (VOIs) contoured by an abdominal radiologist on ADC maps. Tumor volume and descriptive statistics for the ADC voxel data, including mean, median, standard deviation, quantiles, skewness, and kurtosis were compared using a paired t-test.*Results Post-CCRT scans were acquired an average of 40.6 days after baseline DWI. The average volume change was -48.8±50.2 cm3 (p = 0.01). Mean ADC was 1102.6±159.0 10-6 mm2/s and 1262.5±175.8 10-6 mm2/s (p = 0.03) pre-CCRT and post-CCRT, respectively. Skewness and kurtosis were 0.84±0.27 and 4.40±1.16 pre-CCRT and 0.34±0.38 and 3.69±0.50 post-CCRT (p = 0.005 and p = 0.03, respectively). All patient tumors decreased in volume, while the mean tumor ADC for three patients decreased.*Conclusions Cervical cancer CCRT results in statistically significant decreases in tumor volume and increases in mean ADC, ADC skewness and kurtosis within the first five weeks of therapy. Integration of tumor ADC segmentation into clinical workflow can facilitate future adaptive radiotherapy. Future work will evaluate ADC of viable tumor subvolumes over time and correlate histogram features with therapeutic response.*Clinical Relevance/Application The evolution of early post therapy ADC values in cervical cancer underscores the utility of DWI parameters in the development of individualized MRI guided adaptive radiotherapy regimens as evidenced by histogram profiling.

RESULTS

Post-CCRT scans were acquired an average of 40.6 days after baseline DWI. The average volume change was -48.8±50.2 cm3 (p = 0.01). Mean ADC was 1102.6±159.0 10-6 mm2/s and 1262.5±175.8 10-6 mm2/s (p = 0.03) pre-CCRT and post-CCRT, respectively. Skewness and kurtosis were 0.84±0.27 and 4.40±1.16 pre-CCRT and 0.34±0.38 and 3.69±0.50 post-CCRT (p = 0.005 and p = 0.03, respectively). All patient tumors decreased in volume, while the mean tumor ADC for three patients decreased.

CLINICAL RELEVANCE/APPLICATION

The evolution of early post therapy ADC values in cervical cancer underscores the utility of DWI parameters in the development of individualized MRI guided adaptive radiotherapy regimens as evidenced by histogram profiling.

SDP-RI-7   The Sonographic Appearance Of Endometrial Intraepithelial Neoplasia

Participants
Charlene Kwan, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

Our goal is to describe US findings of EIN, a precursor of endometrial cancer.*Methods and Materials Cases were found by word search of pathology database 1/2013-6/2019. 176 patients who had US within 1 year prior to biopsy were included. Medical records were searched for patient data such as age, menopausal status, index ultrasound report, and quality of bleeding. Two radiologists independently and blindly classified images. Differences of opinion were decided by correlation with clinical interpretation. Univariate and multivariate analyses were performed.*Results Time between US and first sampling procedure was mean 49 days. Median age was 55 (range 28-85) years. Endometrial thickness ranged from 4-90 mm. Mean endometrial thickness was 12 + 6 mm in the noncancer group and 16 + 11 mm in the cancer group (p=.02). The endometrium was almost always heterogeneous 166/176 (94%). Cysts were almost always multiple (84/93, 90%) and >1 mm (71/93, 76%). Masses were most often > 5mm (52/101, 51%) or ill-defined (41/101, 41%). Vascularity was present in 92/106 patients (87%) and always associated with cysts and/or mass. Vascularity was most often single vessel (57/92, 62%). There were 93 cancers, 24 with invasion (including 4 with tumor extension into adenomyosis). In 48 cases the endometrial-myometrial interface was graded as ill-defined by one or both reviewers, 39 of whom had hysterectomy. There was macroscopic cancer in 10, microscopic cancer in 4, and invasive carcinoma in 13 patients (p for invasive cancer vs all other outcome = .02). EIN and/or endometrial cancer were confined to a polyp in 43 patients, with US findings similar to that of the cohort as a whole. Depth of invasion ranged from 10->95%, with 5 invasive cancers having depth of invasion of >50%. Multivariate analysis showed thickness, polyps, and type of bleeding as the best set of independent variables for cancer (AUC = .74). Replacing type of bleeding with age or menopausal status provides models with nearly identical performance. For invasive cancer with known outcome (hysterectomy), endometrial thickness and age are the best independent variables, with AUC of .79.*Conclusions EIN has a variety of sonographic appearances. It is associated with a thickened endometrium, even in postmenopausal women, with thickness ranging up to 90 mm. Cysts and masses are common. Ill-definition of the endometrial-myometrial interface is a poor prognostic finding.*Clinical Relevance/Application It is important for Radiologists to recognize the term EIN. In early stages it is focal, unlike simple hyperplasia. EIN has a variety of US appearances. Endometrial thickness and appearance of the endometrial-myometrial interface are important findings.

RESULTS

Time between US and first sampling procedure was mean 49 days. Median age was 55 (range 28-85) years. Endometrial thickness ranged from 4-90 mm. Mean endometrial thickness was 12 + 6 mm in the noncancer group and 16 + 11 mm in the cancer group (p=.02). The endometrium was almost always heterogeneous 166/176 (94%). Cysts were almost always multiple (84/93, 90%) and >1 mm (71/93, 76%). Masses were most often > 5mm (52/101, 51%) or ill-defined (41/101, 41%). Vascularity was present in 92/106 patients (87%) and always associated with cysts and/or mass. Vascularity was most often single vessel (57/92, 62%). There were 93 cancers, 24 with invasion (including 4 with tumor extension into adenomyosis). In 48 cases the endometrial-myometrial interface was graded as ill-defined by one or both reviewers, 39 of whom had hysterectomy. There was macroscopic cancer in 10, microscopic cancer in 4, and invasive carcinoma in 13 patients (p for invasive cancer vs all other outcome = .02). EIN and/or endometrial cancer were confined to a polyp in 43 patients, with US findings similar to that of the cohort as a whole. Depth of invasion ranged from 10->95%, with 5 invasive cancers having depth of invasion of >50%. Multivariate analysis showed thickness, polyps, and type of bleeding as the best set of independent variables for cancer (AUC = .74). Replacing type of bleeding with age or menopausal status provides models with nearly identical performance. For invasive cancer with known outcome (hysterectomy), endometrial thickness and age are the best independent variables, with AUC of .79.

CLINICAL RELEVANCE/APPLICATION

It is important for Radiologists to recognize the term EIN. In early stages it is focal, unlike simple hyperplasia. EIN has a variety of US appearances. Endometrial thickness and appearance of the endometrial-myometrial interface are important findings.

SDP-RI-8   Feasibility Of A Magnetic Resonance Imaging-based Radiomics Model For Predicting Deep Stromal Invasion In Patients With Early-stage Cervical Squamous Cell Carcinoma

Participants
Jing Ren, MD,MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the prediction value of a clinical-radiomics model based on T2-weighted magnetic resonance imaging (MRI) for predicting deep stromal invasion (DSI) in patients with early-stage cervical squamous cell carcinoma (CSCC).*Methods and Materials A total of 168 patients with IB1-IIA1 CSCC who underwent radical hysterectomy from January 2017 to February 2021 were enrolled and randomly divided into a training cohort (n = 135) and a validation cohort (n = 33). Radiomics features were extracted from preoperative sagittal T2-weighted images. Significance testing, Pearson's correlation analysis, and Least absolute shrinkage and selection operator was applied for key features selection. Significance testing and multivariate analysis were performed on the clinical parameters to determine the independent risk factors for DSI. A radiomics model and a clinical-radiomics model were developed by logistic regression. Nomogram was developed to facilitate ease of clinical application.*Results Four radiomics features and two clinical parameters (FIGO stage and preoperative squamous cell carcinoma antigen levels) were selected and used to develop models. In validation cohort, the radiomics model and clinical-radiomics model showed an area under the curve, sensitivity, and specificity of 0.793(95% CI: 0.633-0.954), 71.4%, and 84.2%, 0.820 (95% CI: 0.665-0.974), 85.7%, and 73.7%, respectively.*Conclusions The presented clinical-radiomics model can be used for preoperative prediction of DSI in patients with early-stage CSCC.*Clinical Relevance/Application The clinical-radiomics model, which could predict deep stromal invasion, may aid clinicians predict prognosis and select optimal therapies (radical surgery or definitive radiotherapy) for early-stage CSCC.

RESULTS

Four radiomics features and two clinical parameters (FIGO stage and preoperative squamous cell carcinoma antigen levels) were selected and used to develop models. In validation cohort, the radiomics model and clinical-radiomics model showed an area under the curve, sensitivity, and specificity of 0.793(95% CI: 0.633-0.954), 71.4%, and 84.2%, 0.820 (95% CI: 0.665-0.974), 85.7%, and 73.7%, respectively.

CLINICAL RELEVANCE/APPLICATION

The clinical-radiomics model, which could predict deep stromal invasion, may aid clinicians predict prognosis and select optimal therapies (radical surgery or definitive radiotherapy) for early-stage CSCC.

SDP-RI-9   Rethinking The Sonographic Assessment Of Endometrial Polyps

Participants
Cinthia Cruz, MD, Newton, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Determine the prevalence and associations of sonographic features accepted as conventional wisdom, in the diagnosis of endometrial polyps in premenopausal women.*Methods and Materials Consecutive pelvic ultrasounds performed in premenopausal and perimenopausal women between 2018 and 2020 in a single tertiary institution. Inclusion: LMP within the last year as well as hysteroscopy and/or two sonohysterography (SHG) within 1 year. Exclusion criteria: no ultrasound findings, instrumentation or pregnancy within 6 months, concurrent gynecologic or breast malignancy, hormonal replacement therapy, Tamoxifen usage and uterine fibroids. Polyps confirmed through biopsy or repeated visualization of a well-defined, polypoid lesion isoechoic to the endometrium or hyperechoic with attachment to the endometrial-myometrial interphase, on separate SHGs. After a literature review, the most frequent sonographic features in the diagnosis of polyps were identified as: a) Well defined focal avascular echogenic lesion b) Focal vascularity within the endometrium seen on 2 incidences, c) Myometrial-endometrial vessel and d) Heterogenous endometrium. Endometrial thickness was recorded. Statistical analysis used Fisher's exact test.*Results Of 108 patients, 27 were excluded (including 2 with malignant cells). Average age: 41±11 years. 54/81 patients (65.1%) had confirmed polyps and one or more of the features: 38/54 had myometrial-endometrial vessel (p for polyps vs. non-polyps=0.05); 33/54 had focal vascularity in the endometrium (p=0.81); 29/54 had focal avascular echogenic lesion (p=0.085) and 13/54 had heterogeneous endometrium (p=0.58). Average endometrial thickness was 9 mm, with higher thickness significantly associated with the presence of polyps, median of 9 mm with polyps vs 7 mm without (p=0.034).*Conclusions Focal vascularity confined to the endometrium is not a reliable characteristic for the diagnosis of polyps, contradicting accepted wisdom. Whereas myometrial-endometrial vessel is. Endometrial thickness is associated with the presence of polyps, however other endometrial lesions such as cancer were excluded from analysis and further analysis that accounts for menstrual phase is needed.*Clinical Relevance/Application Because of low incidence of cancer in premenopausal women, ultrasound enables triage of premenopausal women who have features suggestive of polyps to the appropriate means of endometrial sampling. Identifying US features that are most associated with polyps, particularly the difference between vascularity limited to the endometrium and that extending along the myometrial-endometrial interphase, is highly important to reduce unnecessary biopsies and overdiagnosis.

RESULTS

Of 108 patients, 27 were excluded (including 2 with malignant cells). Average age: 41±11 years. 54/81 patients (65.1%) had confirmed polyps and one or more of the features: 38/54 had myometrial-endometrial vessel (p for polyps vs. non-polyps=0.05); 33/54 had focal vascularity in the endometrium (p=0.81); 29/54 had focal avascular echogenic lesion (p=0.085) and 13/54 had heterogeneous endometrium (p=0.58). Average endometrial thickness was 9 mm, with higher thickness significantly associated with the presence of polyps, median of 9 mm with polyps vs 7 mm without (p=0.034).

CLINICAL RELEVANCE/APPLICATION

Because of low incidence of cancer in premenopausal women, ultrasound enables triage of premenopausal women who have features suggestive of polyps to the appropriate means of endometrial sampling. Identifying US features that are most associated with polyps, particularly the difference between vascularity limited to the endometrium and that extending along the myometrial-endometrial interphase, is highly important to reduce unnecessary biopsies and overdiagnosis.

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Abstract Archives of the RSNA, 2021

Sub-Events

CA03-A2   **Cardiac Imaging Findings In Rosai-Dorfman Disease: A Systematic Review**

Participants
Daniel Vargas-Zapata, MD, San Antonio, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Rosai-Dorfman disease (RDD), also known as "Sinus Histiocytosis with Massive Histiocytosis", is an uncommon benign histiocytic lymphoproliferative disease of unknown etiology. This study aims to evaluate the clinical presentation and most typical cardiac imaging findings in patients with RDD collected from 2 participant medical centers along with those reported in the literature so far.*Methods and Materials A total of 5 cases of RDD with cardiac manifestations were collected across the 2 participant institutions. Imaging modalities included CT, MRI, PET/CT and echocardiogram. Additionally, a PubMed literature search provided 27 additional cases. The cardiac and extra-cardiac imaging findings as well as relevant clinical history were reviewed.*Results Of the 32 cases of RDD, distribution among males and females was 1:1 with ages ranging from 12 to 79 years (mean = 45.1). The most commonly involved structure was the Right atrium (n = 43.75%), followed by the Aorta (34.4%) and the Pulmonary artery (25%). Most cases demonstrated involvement of multiple cardiac structures (65.6%), however, only 37.5% showed synchronous extra-cardiac manifestations. No significant associated comorbidities were found (50% had no comorbidities).*Conclusions Aside from the usual manifestations of RDD with massive lymphadenopathy being the most frequent, the heart may also be involved in some cases. When present, the most common cardiac manifestation of RDD is that of a homogenously enhancing endoluminal infiltrative soft tissue mass, mostly found within either the Right atrium, Aorta, or Pulmonary artery. The latter, may mimic a Pulmonary artery angiosarcoma. Additionally, pericardial involvement can also be found in some cases manifesting as pericardial thickening and/or effusion.*Clinical Relevance/Application Although, cardiac involvement from RDD has been reported, to our understanding, this is the largest cohort of patients with cardiac manifestations of RDD in which imaging findings have been described up to the date. The data collected in this study contributes to a better understanding of the potential cardiac imaging characteristics in patients with this condition. Even though RDD tends to have a benign course, if severe involvement of vital organs such as the heart are present, fatal outcomes may be encountered. Thus, in these cases, a multidisciplinary approach is warranted for appropriate selection of management options with radiology playing a pivotal role on ruling out potential mimics and excluding involvement of adjacent vital strcutures.

RESULTS

Of the 32 cases of RDD, distribution among males and females was 1:1 with ages ranging from 12 to 79 years (mean = 45.1). The most commonly involved structure was the Right atrium (n = 43.75%), followed by the Aorta (34.4%) and the Pulmonary artery (25%). Most cases demonstrated involvement of multiple cardiac structures (65.6%), however, only 37.5% showed synchronous extra-cardiac manifestations. No significant associated comorbidities were found (50% had no comorbidities).

CLINICAL RELEVANCE/APPLICATION

Although, cardiac involvement from RDD has been reported, to our understanding, this is the largest cohort of patients with cardiac manifestations of RDD in which imaging findings have been described up to the date. The data collected in this study contributes to a better understanding of the potential cardiac imaging characteristics in patients with this condition. Even though RDD tends to have a benign course, if severe involvement of vital organs such as the heart are present, fatal outcomes may be encountered. Thus, in these cases, a multidisciplinary approach is warranted for appropriate selection of management options with radiology playing a pivotal role on ruling out potential mimics and excluding involvement of adjacent vital strcutures.

CA03-A4   **4D-flow MRI Is Knocking At More Doors:**
How To Properly Analyze 3D Blood Flow Dynamics In A Fast, Patient- And Technologist-friendly, Full-chest Sequence

Participants
Maurice Pradella, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

A proposed clinical 4D-Flow MRI sequence allows acquisition of the complete vasculature of the chest in a total of 10-15min scan time without respiratory navigation. This allows qualitative and quantitative evaluation of any larger thoracic vessel's blood flow dynamics post hoc using commercially available software (e.g., cvi42, Circle, Canada). This exhibit summarizes aspects to consider for successful clinically implementation with valid and reproducible results. Key topics include: 1) how to perform image acquisition, 2) how to prepare the 4D-Flow MRI dataset for analysis, 3) how to quantify the aortic and pulmonary blood flow, and 4) identify pitfalls in order to further avoid them.

TABLE OF CONTENTS/OUTLINE

This exhibit will demonstrate a suggested methodology for acquiring and analyzing a 4D-Flow dataset of the whole chest. It will include: 1) basic principles of an easy to use 4D-Flow MRI sequence covering the whole chest, 2) pre-processing the dataset

(noise reduction, Eddy current correction, anti-aliasing), 3) post-processing of the target vessels for dataset analysis (thresh holding, dataset clean up), 4) how to measure blood flow in a 4D dataset in the thoracic aorta, 6) and in the pulmonary artery, 7) pitfalls in data pre- and post-processing and 8) pitfalls 4D-Flow quantification (vortical flow, valve disease)

Abstract Archives of the RSNA, 2021

Sub-Events

RO03-A1   **Magnetic Resonance Imaging-guided Focused Ultrasound Hyperthermia Sensitize Prostate Cancer To Radiation Therapy In Xenograft Mice Model**

Participants
Andreas Melzer, MD, DDS, Dundee, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Focused ultrasound (FUS) has been used in clinic for ablation of uterine fibroids, prostate cancer and essential tremor under magnetic resonance (MR) imaging guidance. FUS-induced hyperthermia (FUS-HT) carries potential rto become adjuvant therapy to other treatment modalities. In this study, we investigated the sensitization effect of FUS-HT to radiation therapy (RT) in a xenograft model of prostate cancer using a new developed preclinical in vivo FUS system.*Methods and Materials A novel MR-compatible phased-array transducer (Fraunhofer IBMT) was developed and installed in a 7T preclinical MRI (Bruker, Pharmascan 7T). The xenograft model of prostate cancer was established by subcutaneous injection of PC-3 cells, tumor-bearing mice were anesthetized with 2% isoflurane before and during treatment. FUS-HT treatment was performed at 2MHz with adjusted power ($\sim$ 4.8W/cm2) to keep the temperature at 45°C for 30min. The real-time temperature was monitored by fiber optics (Luxtron) and MR-thermometry was visualized offline in MATLAB. RT was conducted with a single-dose X-ray at 10Gy (XStrahl Medical). Tumor growth, proliferation and apoptosis were evaluated by H&E staining, immunohistochemistry of ki67 and TUNEL assay with 40 days follow-up, respectively.*Results The combination of FUS-HT and RT leads to a reduction of the tumor nucleoli and increased survival compared to the untreated group without obvious damage to healthy organs. Decreased ki67-positive cells after FUS-HT+RT (7.85 %) treatment indicated inhibition of tumor proliferation in comparison to single RT (59.37 %). Apoptosis effect was enhanced in FUS-HT+RT group showing increased fluorescence surface area compared to single treatment.*Conclusions This study showed the feasibility of non-invasive FUS-HT interventions in a preclinical MR system. Histology results demonstrated that FUS-induced hyperthermia has an additive effect to RT in vivo.*Clinical Relevance/Application FUS ablation has been approved as a clinical treatment for prostate cancer, however, the application of FUS-hyperthermia is not sufficiently investigated yet. We provided the fundamental data in an in vivo study showing the potential of FUS-HT in future clinical applications.

RESULTS

The combination of FUS-HT and RT leads to a reduction of the tumor nucleoli and increased survival compared to the untreated group without obvious damage to healthy organs. Decreased ki67-positive cells after FUS-HT+RT (7.85 %) treatment indicated inhibition of tumor proliferation in comparison to single RT (59.37 %). Apoptosis effect was enhanced in FUS-HT+RT group showing increased fluorescence surface area compared to single treatment.

CLINICAL RELEVANCE/APPLICATION

FUS ablation has been approved as a clinical treatment for prostate cancer, however, the application of FUS-hyperthermia is not sufficiently investigated yet. We provided the fundamental data in an in vivo study showing the potential of FUS-HT in future clinical applications.

Abstract Archives of the RSNA, 2021

Sub-Events

CH01-B1 Likelihood Ratios Of A Semantic Feature Library For Assessing The Risk Of Cancer In Pulmonary Nodules

Participants
Wei Wu, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

Likelihood ratios (LR) help interpret the significance of radiological findings. However, the likelihood ratio hierarchy of semantic features for malignancy in pulmonary nodules summarized 20 years ago has become outdated due to the CT technology development. Furthermore, semantic features including spiculation has not been formally defined, which leads to highly variable diagnostic accuracy in radiologists' actual recommendations. Our goal is to evaluate and compare the likelihood ratios for malignancy of a comprehensive list of well-defined semantic features.*Methods and Materials This retrospective study enrolled 498 patients from a lung cancer early detection and prevention program in our institution. Nodule malignancy was confirmed by histopathology while benignity was confirmed by histopathology, 2-year stability, or resolution. In total, 54 semantic features in 10 categories including nodule count, location, size, margin, density, invasiveness, lymphadenopathy, emphysema, fibrosis and asbestosis, were defined through consensus method by two radiologists. A thoracic radiologist blinded to clinical and histologic findings evaluated the presence or absence of these features, and the positive LR (LR+) of these features were computed.*Results There were 246 patients with malignant pulmonary nodules and 252 patients with benign nodules. The semantic features with the largest effects on the post-test probability of malignancy were: 'size of less than 6 mm' with LR+ of 0.02 (95%CI: 0.01-0.09), 'smooth margin' with LR+ of 0.04 (95%CI: 0.01-0.09), 'spiculation' with LR+ of 28.7 (95%CI: 7.1-116.3), 'corona radiata' with LR+ of 25.6 (95%CI: 3.5-187.5), 'invasion into pleura or fissure' with LR+ of 18.4 (95%CI: 5.8-58.2), 'pseudo-cavitation' with LR+ of 12.3 (95%CI: 1.6-93.8).*Conclusions The diagnostic value of semantic features in pulmonary nodule classification can be compared and easily understood by using the LR for malignancy to assist radiologists and providers with assessing patients' lung cancer risk.*Clinical Relevance/Application A standardized library of semantic feature LRs may assist with provider management of nodule cancer risk and predictive modeling.

RESULTS

There were 246 patients with malignant pulmonary nodules and 252 patients with benign nodules. The semantic features with the largest effects on the post-test probability of malignancy were: 'size of less than 6 mm' with LR+ of 0.02 (95%CI: 0.01-0.09), 'smooth margin' with LR+ of 0.04 (95%CI: 0.01-0.09), 'spiculation' with LR+ of 28.7 (95%CI: 7.1-116.3), 'corona radiata' with LR+ of 25.6 (95%CI: 3.5-187.5), 'invasion into pleura or fissure' with LR+ of 18.4 (95%CI: 5.8-58.2), 'pseudo-cavitation' with LR+ of 12.3 (95%CI: 1.6-93.8).

CLINICAL RELEVANCE/APPLICATION

A standardized library of semantic feature LRs may assist with provider management of nodule cancer risk and predictive modeling.

CH01-B2 AI-aided Diagnosis On The Performance Of Radiologists To Diagnose Lung Nodule Malignancy: A Sequential Reader Study

Participants
Eun Kyoung Hong, MD, Gwangmyeong-Si, Korea, Republic Of (*Presenter*) Research Consultant, VUNO Inc

PURPOSE

To evaluate whether an AI-aided diagnosis system can improve the performance of readers for the diagnosis of malignant lung nodules*Methods and Materials A total of 150 CT scans containing benign nodules and 50 CT scans containing malignant nodules were randomly selected from the NLST dataset. An AI system consisting of 1) characterization of lung nodules (diameter, volume, type, 4X findings) and 2) multivariate logistic regression model for prediction of nodule malignancy was used. The most suspicious malignant nodule was selected for each scan based on the automatically calculated Lung-RADS category from the AI system, and the coordinates were recorded. The system processed each nodule and the binary malignancy classification was performed prior to the reader study. Two experienced radiologists participated in the reader study. Each radiologist first diagnosed each representative nodule without the AI output. And immediately after, they again diagnosed the nodules with reference to AI output. The readers were asked to grade the malignancy probability of the nodule on a five-point scale. (1: mostly benign, 5: mostly malignant) The score was then binarized using the score 3 threshold to compare with binary AI output (less than 3: benign, otherwise malignant).*Results A total of 194 nodules were selected (49 malignant and 145 benign). Without AI as a reference, the performances of reader 1 and 2 were as follows; For reader 1, AUC, sensitivity, and specificity were 0.820, 0.986, and 0.653, respectively. And for reader 2, AUC, sensitivity, and specificity were 0.803, 0.993, and 0.769, respectively. With reference to AI output, the performance of reader 1 and reader 2 was as follows; For reader 1, AUC, sensitivity and specificity 0.891, 0.986, and 0.795. And for reader 2, AUC, sensitivity, and specificity were 0.857, 0.979, and 0.735. In the comparison of without and with AI as a reference, both readers demonstrated improvements in terms of AUC, however, only reader 1 showed statistical significance in AUC by 0.0714 (p = 0.005).*Conclusions From the reader study, readers with CADx output showed a promising improvement of performance on the diagnosis of lung nodule malignancy.*Clinical Relevance/Application The result implies that the computer-aided

diagnosis has the potential to improve the rate of correct diagnosis of malignancy without exaggerating patient harm from overdiagnosis.

RESULTS

A total of 194 nodules were selected (49 malignant and 145 benign). Without AI as a reference, the performances of reader 1 and 2 were as follows; For reader 1, AUC, sensitivity, and specificity were 0.820, 0.986, and 0.653, respectively. And for reader 2, AUC, sensitivity, and specificity were 0.803, 0.993, and 0.769, respectively. With reference to AI output, the performance of reader 1 and reader 2 was as follows; For reader 1, AUC, sensitivity and specificity 0.891, 0.986, and 0.795. And for reader 2, AUC, sensitivity, and specificity were 0.857, 0.979, and 0.735. In the comparison of without and with AI as a reference, both readers demonstrated improvements in terms of AUC, however, only reader 1 showed statistical significance in AUC by 0.0714 (p = 0.005).

CLINICAL RELEVANCE/APPLICATION

The result implies that the computer-aided diagnosis has the potential to improve the rate of correct diagnosis of malignancy without exaggerating patient harm from overdiagnosis.

CH01-B4 Automated Radiographic Quantification Of COVID-19 Pneumonia As A Prognostic Marker Of Outcomes - A One Year Experience

Participants
Abraham Noorbakhsh, MD,MPH, San Diego, California (*Presenter*) Nothing to Disclose

PURPOSE

Chest x-ray (CXR) emerged as an inexpensive and pervasive tool in the triage of COVID-19 patients with suspected lung involvement. We assessed the prognostic value of a deep learning algorithm to quantify pneumonia for patients with COVID-19 presenting to the Emergency Department (ED) over the first year of the pandemic.*Methods and Materials We retrospectively obtained CXRs and clinical data for patients positive for COVID-19 by RT-PCR who presented to the ED at our institution between March 2020 to January 2021. Using a previously developed convolutional neural network (CNN) algorithm, percentage of lung involvement was quantified for all patients who underwent CXR within five days before to one day after date of presentation, and stratified into four categories (0%, 1-25%, 26-50%, and >50%). Primary outcome was progression to severe COVID-19, defined as a composite of ICU admission, discharge to hospice, or death. Kaplan-Meier survival curves and multivariate Cox regression were used for analyses. Clinical factors included in models were age, gender, initial O2 saturation % and initial heart rate.*Results Of 1,682 confirmed COVID-19 positive patients presenting to the ED, 1,254 (75%) had an initial CXR and were included. Mean age was 54 years, 65% were admitted, and 23% developed severe COVID-19. The probability of progression to severe COVID-19 at 1 week, stratified by categories of percentage of lung involvement (0%, 1-25%, 26-50%, and >50%) on initial CXR was 6%, 12%, 15%, and 43% respectively (log-rank p<0.001). On adjusted analyses, the adjusted hazard ratios (HR) for severe outcome increased with increasing lung involvement: HR (95% confidence interval) 1.4 (0.9-2.3, p=0.128) for 1-25%, 2.1 (1.3-3.4, p=0.004) for 26-50%, and 5.4 (3.4-8.4, p<0.001) for >50%, relative to patients with no pneumonia.*Conclusions Automated deep learning quantification of pneumonia on initial CXR strongly prognosticates disease course in patients presenting to the ED with COVID-19.*Clinical Relevance/Application An automated deep learning algorithm can assess severity of lung involvement and prognosticate outcomes in patients with COVID-19, and may support rapid triage of patients presenting to the ED.

RESULTS

Of 1,682 confirmed COVID-19 positive patients presenting to the ED, 1,254 (75%) had an initial CXR and were included. Mean age was 54 years, 65% were admitted, and 23% developed severe COVID-19. The probability of progression to severe COVID-19 at 1 week, stratified by categories of percentage of lung involvement (0%, 1-25%, 26-50%, and >50%) on initial CXR was 6%, 12%, 15%, and 43% respectively (log-rank p<0.001). On adjusted analyses, the adjusted hazard ratios (HR) for severe outcome increased with increasing lung involvement: HR (95% confidence interval) 1.4 (0.9-2.3, p=0.128) for 1-25%, 2.1 (1.3-3.4, p=0.004) for 26-50%, and 5.4 (3.4-8.4, p<0.001) for >50%, relative to patients with no pneumonia.

CLINICAL RELEVANCE/APPLICATION

An automated deep learning algorithm can assess severity of lung involvement and prognosticate outcomes in patients with COVID-19, and may support rapid triage of patients presenting to the ED.

CH01-B5 External Validation Of CORADS-AI To Triage COVID-19 Patients Requiring Immediate Hospitalization In The Moscow Region

Participants
Steven Schalekamp, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

External validation of CORADS-AI to automatically flag patients with severe coronavirus disease (COVID-19) lung disease on CT for immediate hospitalization and comparison with human reading.*Methods and Materials In the Moscow region 1110 COVID-19 suspects in 42 outpatient clinics between March 1 and April 25 2020 received chest CT upon admission. Scans were scored prospectively for severity of COVID-19 induced pneumonia by the on-site physician and an expert radiologist using the following scoring system: 0 (normal), 1 (mild), 2 (moderate), 3 (severe), 4 (very severe). Cases with score 3 and 4 were immediately hospitalized. CORADS-AI, an artificial intelligence system developed in The Netherlands, was used to generate for each case of the full dataset the CT severity score (CTSS, range 0-25), reflecting the percentage of involved lung tissue in COVID-19 pneumonia. Two radiologists in The Netherlands and two radiologists in Moscow, Russia read a subset of the CT scans in a reader study, including all cases of score 3 (45) and score 4 (2) and randomly selected cases of score 0, 1, 2 (in total 133). Area under the receiver operating characteristics curve (AUC) with 95% confidence intervals (95%CI) was used to assess performance. AUC of radiologists were statistically compared with the AUC of the AI system using MedCalc Software Ltd (Ostend, Belgium; v14.8.1). P<0.05 were considered significant.*Results CORADS-AI achieved an AUC of 0.90 (95%CI 0.86-0.94) on the full dataset of 1110 CT scans. Optimal performance was achieved at a CTSS threshold of 5 giving a sensitivity of 77% and a specificity of 87%. In the reader study subset, CORADS-AI reached an AUC of 0.89 (95%CI 0.84-0.94), and was similar or significantly better than the participating radiologists that achieved an AUC of 0.78 (95%CI 0.72-0.84; p<0.001), 0.83 (95%CI 0.77-0.89; p=0.004), 0.87 (95%CI 0.84-0.94; p=0.02), 0.89 (95%CI 0.79-0.91; p=0.99).*Conclusions In a pandemic, CO-RADS-AI could be used for first-line screening of patients who require immediate hospitalization for severe COVID-19 lung disease.*Clinical Relevance/Application CO-RADS AI can be a helpful tool in clinical decision making on hospitalization of patients with COVID-19 based on chest CT upon admission.

RESULTS

CORADS-AI achieved an AUC of 0.90 (95%CI 0.86-0.94) on the full dataset of 1110 CT scans. Optimal performance was achieved at a CTSS threshold of 5 giving a sensitivity of 77% and a specificity of 87%. In the reader study subset, CORADS-AI reached an AUC of 0.89 (95%CI 0.84-0.94), and was similar or significantly better than the participating radiologists that achieved an AUC of 0.78 (95%CI 0.72-0.84; p<0.001), 0.83 (95%CI 0.77-0.89; p=0.004), 0.87 (95%CI 0.84-0.94; p=0.02), 0.89 (95%CI 0.79-0.91; p=0.99).

CLINICAL RELEVANCE/APPLICATION

CO-RADS AI can be a helpful tool in clinical decision making on hospitalization of patients with COVID-19 based on chest CT upon admission.

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Sub-Events

IR05-B1   Utility Of The 2-hour Radiograph In The Prevention Of Delayed Post-Discharge Pneumothorax Following Lung Biopsy

Participants
Elton Law, MD, Hamilton, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

Post-biopsy pneumothorax is a clinically concerning complication of image-guided lung biopsies. In our institution, all patients receive a chest radiograph 1 hour post-lung biopsy to exclude a significant pneumothorax. The purpose of this study is to evaluate the utility of an additional radiograph performed 2 hours post-biopsy following resumption of normal activity for the prevention of delayed post-discharge pneumothorax.*Methods and Materials All CT-guided lung biopsies performed at our institution from January 1, 2017 - April 30, 2020 were reviewed. Cases were excluded if a pneumothorax was detected on intra-procedural imaging. All included patients received a 1 hour post-biopsy radiograph (1HR). Some patients received 2 hour a radiograph (2HR) if they had a negative 1HR study.*Results A total of 900 cases were included in the analysis. The 1HR group had 782 cases, while the 2HR group had 118 cases. A post-biopsy pneumothorax was detected in 81 cases, 74 (91%) were detected in the 1HR group, 31 of which required a chest tube. Seven (9%) cases of pneumothorax were seen only in the 2HR group, with 4 (57%) requiring a chest tube. Nine post-discharge pneumothoraces occurred in the 1HR group; these were detected a median of 86 hours (range 23-193) post-discharge. Of these, 5 (56%) required a chest tube. No post-discharge pneumothorax was found in the 2HR group.The baseline characteristics significantly associated with the development of a pneumothorax were age > 60 (p < 0.01), presence of emphysema in the same lobe as the lesion (p <0.01), lesion location in the upper lobes (p < 0.01), and lesion distance > 3 cm from the pleura (p<0.01).*Conclusions An additional radiograph at 2 hours post-lung biopsy, following an hour of normal activity, identified additional pneumothoraces and prevented delayed post-discharge pneumothoraces.*Clinical Relevance/Application Currently, there is a relative paucity of data with regards to post-lung biopsy imaging in the detection of pneumothoraces. Our findings can be used to help craft a more standardized post-lung biopsy patient care protocol to reduce the risk of a delayed pneumothorax and improve patient safety.

RESULTS

A total of 900 cases were included in the analysis. The 1HR group had 782 cases, while the 2HR group had 118 cases. A post-biopsy pneumothorax was detected in 81 cases, 74 (91%) were detected in the 1HR group, 31 of which required a chest tube. Seven (9%) cases of pneumothorax were seen only in the 2HR group, with 4 (57%) requiring a chest tube. Nine post-discharge pneumothoraces occurred in the 1HR group; these were detected a median of 86 hours (range 23-193) post-discharge. Of these, 5 (56%) required a chest tube. No post-discharge pneumothorax was found in the 2HR group.The baseline characteristics significantly associated with the development of a pneumothorax were age > 60 (p < 0.01), presence of emphysema in the same lobe as the lesion (p <0.01), lesion location in the upper lobes (p < 0.01), and lesion distance > 3 cm from the pleura (p<0.01).

CLINICAL RELEVANCE/APPLICATION

Currently, there is a relative paucity of data with regards to post-lung biopsy imaging in the detection of pneumothoraces. Our findings can be used to help craft a more standardized post-lung biopsy patient care protocol to reduce the risk of a delayed pneumothorax and improve patient safety.

IR05-B4   Safety And Efficacy Of Rotational Thrombectomy For Treatment Infrarenal Arterial Occlusions In A Large Single-center Cohort.

Participants
Christoph Artzner, Tuebingen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the safety and efficacy of rotational thrombectomy (RT) for treatment infrarenal arterial occlusions in a large single center-cohort.*Methods and Materials This HIPPA-compliant, IRB-approved, retrospective study included 397 consecutive interventions in 294 patients between April 2010 and December 2019. All patients underwent RT (Rotarex®S, Straub Medical AG) for infrarenal occlusions of native arteries, arterial stents, and/or bypass grafts. Complications, clinical success, and technical success were assessed by the clinical documentation system. P-values <0.05 were regarded significant.*Results Symptoms were acute, subacute, and chronic in 47.5%, 22.2%, and 30.3% or patients, respectively. Rutherford categories three (23.5%) and four (32.1%) were most prevalent. Target lesions were in the pelvic 7.1%, pelvic/femoral 5%; femoral 59.4%, femoral / below-the-knee (BTK) 27%, and BTK arteries 1.5%. Target lesion characteristics were: length >20 cm 61.5%, after bypass surgery 14.9%, and previous stenting 41.4%. RT device size was 6F 88.6% and 8F 11.4%. Additional lysis after RT was necessary in 24.2% of cases. Subsequent plain balloon or drug-coated balloon angioplasty was performed in 89.5% of cases. Technical and clinical success rates were 90.9% and 90.4%, respectively, with an improvement of ankle-brachial-index from 0.33±0.29 to 0.81±0.25 (p<0.01). Symptom-free walking distance of more than 200m was reported in 78.1% of cases after treatment. Complications occurred in 38.8% of cases with peripheral embolization being most common at 22.4%, of which 65.2% required further treatment. Dissections and perforations occurred less frequently in 9.6% and 2.7% of cases, respectively. RT demonstrated an over-all complication rate

of 6.8%. Of note, dissections that occurred while recanalizing chronic total occlusions were also classified as complication though it might be inevitable.*Conclusions Rotational thrombectomy is a safe and efficacious procedure for the treatment of acute, subacute, and chronic thrombotic occlusion of native arteries, arterial stents, and/or bypass grafts.*Clinical Relevance/Application Rotational thrombectomy is an important/bail-out treatment strategy for a patient with contraindication for lysis. Rotational thrombectomy shows excellent value for acute, subacute, and chronic occlusions. Our data show a good safety profile for rotational thrombectomy in a large cohort.

RESULTS

Symptoms were acute, subacute, and chronic in 47.5%, 22.2%, and 30.3% or patients, respectively. Rutherford categories three (23.5%) and four (32.1%) were most prevalent. Target lesions were in the pelvic 7.1%, pelvic/femoral 5%; femoral 59.4%, femoral / below-the-knee (BTK) 27%, and BTK arteries 1.5%. Target lesion characteristics were: length >20 cm 61.5%, after bypass surgery 14.9%, and previous stenting 41.4%. RT device size was 6F 88.6% and 8F 11.4%. Additional lysis after RT was necessary in 24.2% of cases. Subsequent plain balloon or drug-coated balloon angioplasty was performed in 89.5% of cases. Technical and clinical success rates were 90.9% and 90.4%, respectively, with an improvement of ankle-brachial-index from 0.33±0.29 to 0.81±0.25 (p<0.01). Symptom-free walking distance of more than 200m was reported in 78.1% of cases after treatment. Complications occurred in 38.8% of cases with peripheral embolization being most common at 22.4%, of which 65.2% required further treatment. Dissections and perforations occurred less frequently in 9.6% and 2.7% of cases, respectively. RT demonstrated an over-all complication rate of 6.8%. Of note, dissections that occurred while recanalizing chronic total occlusions were also classified as complication though it might be inevitable.

CLINICAL RELEVANCE/APPLICATION

Rotational thrombectomy is an important/bail-out treatment strategy for a patient with contraindication for lysis. Rotational thrombectomy shows excellent value for acute, subacute, and chronic occlusions. Our data show a good safety profile for rotational thrombectomy in a large cohort.

IR05-B5   **Immunonutritive Scoring In Patients With Hepatocellular Carcinoma Undergoing Transarterial Chemoembolisation: Prognostic Nutritional Index Or Controlling Nutritional Status Score?**

Participants
Lukas Mueller, MD, Mainz, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Both immunonutritive scoring systems, the Prognostic Nutritional Index (PNI) and the Controlling Nutritional Status (CONUT) score, proved their predictive ability in various cancer entities, including hepatocellular carcinoma (HCC). This study aimed to perform the first evaluation of the CONUT score for patients undergoing transarterial chemoembolisation (TACE) and to compare both scores in their ability to predict median overall survival (OS).*Methods and Materials Between 2010 and 2020, we retrospectively identified 237 treatment naïve patients with HCC who underwent initial TACE at our institution. Both scores comprise the albumin level and total lymphocyte count. The CONUT additionally includes the cholesterol level. Both scores were compared with established risk factors using multivariate regression analyses regarding median OS. Furthermore, subgroup analysis was performed on recommended TACE (BCLC A & B) candidates.*Results CONUT score and PNI were associated with an impaired median OS (high vs low CONUT: 8.7 vs 22.3 months, p<0.001; low vs high PNI: 6.8 vs 20.1 months, p<0.001) (Figure 1). In multivariate analysis only the PNI remained an independent prognostic predictor (p=0.003), while the CONUT score lost its predictive ability (p=0.201). For recommended TACE candidates both, CONUT and PNI were able to stratify patients regarding their median OS (10.2 vs 24.0 months, p<0.001 respectively 6.6 vs 19.4 months, p<0.001) (Figure 2). However, only the PNI was an independent prognostic factor (p=0.012).*Conclusions In general, immunonutritive scoring is promising for patients with HCC undergoing TACE. Both the PNI and CONUT score were able to stratify patients according to their median OS. However, taking into account additional established risk factors, only the PNI remained an independent prognostic factor; the CONUT score lost its predictive performance.*Clinical Relevance/Application PNI should be preferred when evaluating the nutritional status of patients undergoing TACE.

RESULTS

CONUT score and PNI were associated with an impaired median OS (high vs low CONUT: 8.7 vs 22.3 months, p<0.001; low vs high PNI: 6.8 vs 20.1 months, p<0.001) (Figure 1). In multivariate analysis only the PNI remained an independent prognostic predictor (p=0.003), while the CONUT score lost its predictive ability (p=0.201). For recommended TACE candidates both, CONUT and PNI were able to stratify patients regarding their median OS (10.2 vs 24.0 months, p<0.001 respectively 6.6 vs 19.4 months, p<0.001) (Figure 2). However, only the PNI was an independent prognostic factor (p=0.012).

CLINICAL RELEVANCE/APPLICATION

PNI should be preferred when evaluating the nutritional status of patients undergoing TACE.

GU03-D

Genitourinary Tuesday Poster Discussions

Sub-Events

GU03-D1   Assessment Of Diagnostic Performance With 18F-DCFPYL-PET/CT In Men With Suspected Recurrence Of Prostate Cancer: A Condor Study Subanalysis Comparing Central And Local Reader Results

Participants
Kenneth L. Gage, MD, PhD, Wesley Chapel, Florida (*Presenter*) Institutional Research Grant, Lantheus Holdings;

PURPOSE

PSMA PET improves the ability to detect prostate cancer (PCa) in patients with biochemical recurrence (BCR). In the phase 3 CONDOR study of PET/CT with 18F-DCFPyL (PyL), a novel PSMA-targeted PET imaging agent, central readers had a correct localization rate (CLR) of approximately 85% in men with BCR. In this subanalysis, the agreement between local and central reader interpretations of PyL scans was assessed.*Methods and Materials Patients with rising PSA after definitive therapy for histologically confirmed PCa and negative or equivocal conventional imaging were administered PyL (~9 mCi (333 MBq)) followed by a whole-body PET/CT scan 1-2 hours later. CLR was defined as the percentage of patients with 1:1 correspondence of at least one lesion identified on PyL-PET/CT and a composite standard of truth. PyL-PET/CT scans were initially reviewed by local readers then centrally reviewed by three blinded independent experts. For local interpretation of PyL-PET/CT, readers were not blinded to clinical or other local imaging results.*Results CLR was determined separately for both PyL-PET/CT central and local readers' interpretations. Local readers reported positive PyL scans in 69.2% (144/208) of patients. Locally determined CLR was 80.3% (95% CI: 72.3% - 86.8%) and the true positive detection rate (DR) was 49.0% (95% CI: 42.2% - 55.8%) compared to CLR of 84.8% to 87.0% (lower bound of 95% CI: 77.8%-80.4%) and a DR of 40.4% to 42.8% for the central readers. Central readers were 75.5% (Fleiss' kappa 0.65 [95% CI 0.58, 0.73]) in agreement regarding the reading of PyL-PET/CT scans. Concordance between each central reader and local reader was 83.2% to 83.7%.*Conclusions The diagnostic performance of 18F-DCFPyL-PET/CT was maintained whether the CLR was determined using the adjudications of three independent central readers or the interpretation of the local readers at each study institution. These data suggest concordance between local and central read results of 18F-DCFPyL PET/CT as an imaging agent in BCR PCa patients. NCT03739684*Clinical Relevance/Application Agreement between local readers and a panel of three independent central readers suggests the data as read locally are concordant, and real-world experience can be relied upon rather than central reads.

RESULTS

CLR was determined separately for both PyL-PET/CT central and local readers' interpretations. Local readers reported positive PyL scans in 69.2% (144/208) of patients. Locally determined CLR was 80.3% (95% CI: 72.3% - 86.8%) and the true positive detection rate (DR) was 49.0% (95% CI: 42.2% - 55.8%) compared to CLR of 84.8% to 87.0% (lower bound of 95% CI: 77.8%-80.4%) and a DR of 40.4% to 42.8% for the central readers. Central readers were 75.5% (Fleiss' kappa 0.65 [95% CI 0.58, 0.73]) in agreement regarding the reading of PyL-PET/CT scans. Concordance between each central reader and local reader was 83.2% to 83.7%.

CLINICAL RELEVANCE/APPLICATION

Agreement between local readers and a panel of three independent central readers suggests the data as read locally are concordant, and real-world experience can be relied upon rather than central reads.

GU03-D2   Follow-up MRI Of Patients Within PI-RADS Category 3: Analysis Of Safety And An Advisable Control Interval

Participants
Tim Ullrich, Duesseldorf, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To analyze follow-up MRI scans of patients with initial PI-RADS 3 including evaluation of safety and of the optimal control interval to exclude significant prostate cancer development.*Methods and Materials This retrospective study includes consecutive patients with PI-RADS category 3 and one or more follow up mpMRI between 2012 and 2018. MRI-targeted and systematic TRUS-guided biopsy was used as histological reference standard. Follow-up mpMRI was evaluated by two readers blinded towards histopathologic results. PI-RADS classification, PSAD, PSA, and prostate volume during follow-up MRIs were assessed in the context of histopathologic results.*Results 89 patients (median PSA 6.6 ng/ml; PSAD 0.13 ng/ml/ml) were included with a follow-up period of 31±18 months. PCA was detected in 19 cases (median PSA 6.0 ng/ml; PSAD 0.13 ng/ml/ml) and csPCA in 5 cases (median PSA 5.5 ng/ml; PSAD 0.13 ng/ml/ml). The median PI-RADS category in follow-up scans was significantly higher in patients with csPCA (4) with a significant upgrade after 12 to 24 months than in healthy controls (3; p<0.001) which had a significant downgrade after 36 to 48 months. Neither PSA nor PSAD, or prostate volume showed a significant difference in follow-up scans.*Conclusions Patients in PI-RADS category 3 and stable PSAD can safely be followed-up using mpMRI after 12-24 months without missing csPCA. There seems to be no benefit of follow-up MRI earlier than 36 months after the first scan in patients with negative biopsy. This may facilitate a reduction of follow-up scans and possible overtreatment.*Clinical Relevance/Application Patients in PI-RADS category 3 and stable PSAD may receive follow-up mpMRI after 12-24 months instead of prompt biopsy without missing csPCA. Patients in PI-RADS category 3 with negative biopsy do not need follow-up mpMRI earlier than 36 months after the first scan.

RESULTS

89 patients (median PSA 6.6 ng/ml; PSAD 0.13 ng/ml/ml) were included with a follow-up period of 31±18 months. PCA was detected in 19 cases (median PSA 6.0 ng/ml; PSAD 0.13 ng/ml/ml) and csPCA in 5 cases (median PSA 5.5 ng/ml; PSAD 0.13 ng/ml/ml). The median PI-RADS category in follow-up scans was significantly higher in patients with csPCA (4) with a significant upgrade after 12 to 24 months than in healthy controls (3; p<0.001) which had a significant downgrade after 36 to 48 months. Neither PSA nor PSAD, or prostate volume showed a significant difference in follow-up scans.

CLINICAL RELEVANCE/APPLICATION

Patients in PI-RADS category 3 and stable PSAD may receive follow-up mpMRI after 12-24 months instead of prompt biopsy without missing csPCA. Patients in PI-RADS category 3 with negative biopsy do not need follow-up mpMRI earlier than 36 months after the first scan.

Printed on: 06/28/22

MK03-B

Musculoskeletal Tuesday Poster Discussions

Sub-Events

MK03-B3   **Comparison Of 3D Automated Ultrasound Tomography With Standard Handheld Ultrasound For The Visualization Of The Hands - Clinical Proof Of Concept**

Participants
Jonas Getzmann, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To assess the technical functioning of a 3D ultrasound (US) tomography prototype (Aison Pro; Aison Technologies AG, Winterthur, Switzerland) and its ability to visualize joint structures healthy hands as well as detect degenerative changes in singular cadaver cases.*Methods and Materials 12 individuals (6 males, 6 females, age 43.5 ± 17.8 years (mean ± SD)) without any known joint disease to the hands were prospectively recruited. Each participant underwent four scans with the Aison Pro (right and left hand, dorsal and palmar, respectively) followed by automated stitching of scan volumes as well as four sets of standard handheld US of predefined anatomic regions of the hands. The 3D US tomographic images and the standard handheld US images were independently assessed by two radiologists more than four weeks after image acquisition with regard to visibility of bone contour, joint capsule and space, and tendons. In addition, three cadaveric hands were scanned with the Aison Pro and MDCT to compare the ability to detect erosions or osteophytes. Standard statistical tests were used for the quantitative analysis. Cohen's kappa (k) was used to assess interreader and intermodality agreement.*Results Mean scan time for both hands was significantly faster with the standard handheld US (10min 30s ± 95s (mean ± SD)) compared to the Aison Pro (32min 9s ± 6s (mean ± SD); P < 0.05). Interreader and intermodality agreement were substantial (0.6 < k = 0.8) to almost perfect (0.8 < k) depending on the underlying qualitative parameter. Overall visibility of bone and joint structures was comparable between the modalities (P > 0.05) with better depiction at the level of the finger joints as opposed to the thumb or wrist in the Aison Pro. In addition, the Aison Pro was able to detect erosions and osteophytes in cadaveric hands which were confirmed by MDCT.*Conclusions The 3D US tomographic images of the Aison Pro are adequately able to visualize joint structures in healthy hands as well as singular erosions and osteophytes in cadaveric hands. Further technical improvements are necessary to shorten scan times and improve automated scanning of the thumb and wrist.*Clinical Relevance/Application The Aison Pro is able to perform quantitative ultrasound with standardized pressure, angle and patient position which could be used for tracking the evolution of rheumatic pathologies or injuries in the future.

RESULTS

Mean scan time for both hands was significantly faster with the standard handheld US (10min 30s ± 95s (mean ± SD)) compared to the Aison Pro (32min 9s ± 6s (mean ± SD); P < 0.05). Interreader and intermodality agreement were substantial (0.6 < k = 0.8) to almost perfect (0.8 < k) depending on the underlying qualitative parameter. Overall visibility of bone and joint structures was comparable between the modalities (P > 0.05) with better depiction at the level of the finger joints as opposed to the thumb or wrist in the Aison Pro. In addition, the Aison Pro was able to detect erosions and osteophytes in cadaveric hands which were confirmed by MDCT.

CLINICAL RELEVANCE/APPLICATION

The Aison Pro is able to perform quantitative ultrasound with standardized pressure, angle and patient position which could be used for tracking the evolution of rheumatic pathologies or injuries in the future.

Abstract Archives of the RSNA, 2021

Sub-Events

BR05-A3   Outcomes Of COVID-19 Vaccination Related Adenopathy In A Population At High Risk For Breast Cancer

Participants
Samantha Zuckerman, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

COVID-19 vaccinations are associated with ipsilateral axillary adenopathy. We evaluate the management of post-vaccination adenopathy in patients who underwent high risk, staging, and abbreviated breast MRI.*Methods and Materials This retrospective study is HIPAA compliant and IRB exempt. Breast MRI reports from initiation of COVID-19 vaccinations, 12/14/2020, to 4/11/2021 at a single institution were queried for vaccine-related adenopathy. Study indication, date, site and type of vaccine, BI-RADS final assessment, and outcomes were recorded. Change in BI-RADS 0 and BI-RADS 3 before and after FDA COVID vaccination approval were assessed using two-sided Fisher's exact test with analysis in Stata v14.2.*Results Of 1899 MRIs performed from 12/14/2020-4/11/2021, 3.5% (66/1899) included comments on vaccine-related adenopathy compared to 0.02% (1/5326, influenza) from the comparison year. Of those, 64 were from COVID-19 vaccinations, 1 from a Shingles vaccination, and 1 from a Pneumovax vaccination. Adenopathy-specific recommendations were as follows: 65% (43/66) BI-RADS category 0 or 3, 27% (18/66) BI-RADS category 1 or 2, and 8% (5/66) BI-RADS category 4. Overall BI-RADS 3 (9.3%, 176/1899) and BI-RADS 0 assessments (1.7%, 33/1899) increased post-vaccination compared to the prior year (BIRADS 3 - 6.5% (346/5326), BI-RADS 0 - 0.8%, (45/5326)), P= <0.0001. Adenopathy thought to be related to vaccination represented 17% of BI-RADS 3 (30/176) and 24% of BI-RADS 0 outcomes (8/33). Adenopathy was evident 5-30 days after the 1st and 1-66 days after the 2nd dose, with 4 exams demonstrating adenopathy >6 weeks after a second dose. 20 women have had follow-up imaging - 55% (11/20) deemed normal or benign, 40% (8/20) recommending additional follow-up, and 1 recommending biopsy. The average time from final vaccination to follow-up exam was 47.6 days (2-78). 3/3 women who underwent nodal biopsy had benign results (1 with prior lymphoma and 2 with new breast cancer diagnoses).*Conclusions MRI-detected axillary adenopathy in the setting of recent COVID-19 vaccination may present management challenges. Adenopathy may be present longer than 6 weeks after 2nd vaccination. Biopsy should be reserved for patients with loss of fatty hila on ultrasound, suspicious breast imaging findings, or with concurrent cancer diagnoses.*Clinical Relevance/Application COVID-19 vaccination related adenopathy results in more false positive breast MRI exams. Our data demonstrates that in women without a cancer diagnosis or suspicious breast findings, biopsy can be deferred and additional imaging may not be necessary.

RESULTS

Of 1899 MRIs performed from 12/14/2020-4/11/2021, 3.5% (66/1899) included comments on vaccine-related adenopathy compared to 0.02% (1/5326, influenza) from the comparison year. Of those, 64 were from COVID-19 vaccinations, 1 from a Shingles vaccination, and 1 from a Pneumovax vaccination. Adenopathy-specific recommendations were as follows: 65% (43/66) BI-RADS category 0 or 3, 27% (18/66) BI-RADS category 1 or 2, and 8% (5/66) BI-RADS category 4. Overall BI-RADS 3 (9.3%, 176/1899) and BI-RADS 0 assessments (1.7%, 33/1899) increased post-vaccination compared to the prior year (BIRADS 3 - 6.5% (346/5326), BI-RADS 0 - 0.8%, (45/5326)), P= <0.0001. Adenopathy thought to be related to vaccination represented 17% of BI-RADS 3 (30/176) and 24% of BI-RADS 0 outcomes (8/33). Adenopathy was evident 5-30 days after the 1st and 1-66 days after the 2nd dose, with 4 exams demonstrating adenopathy >6 weeks after a second dose. 20 women have had follow-up imaging - 55% (11/20) deemed normal or benign, 40% (8/20) recommending additional follow-up, and 1 recommending biopsy. The average time from final vaccination to follow-up exam was 47.6 days (2-78). 3/3 women who underwent nodal biopsy had benign results (1 with prior lymphoma and 2 with new breast cancer diagnoses).

CLINICAL RELEVANCE/APPLICATION

COVID-19 vaccination related adenopathy results in more false positive breast MRI exams. Our data demonstrates that in women without a cancer diagnosis or suspicious breast findings, biopsy can be deferred and additional imaging may not be necessary.

BR05-A5   Comparison Of False Positive Versus True Positive Contrast Enhanced Digital Mammography

Participants
Maxine S. Jochelson, MD, New York, New York (*Presenter*) Speaker, General Electric Company

PURPOSE

To compare false positive (FP) contrast enhanced digital mammograms (CEDM) to true positive (TP) CEDM.*Methods and Materials All baseline screening CEDM performed between 1/2013 and 12/2018 with an American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) category assessment of incomplete, probably benign, suspicious or highly suspicious (BI-RADS 0, 3, 4, 5) were reviewed. Breast density, background parenchymal enhancement (BPE), contrast finding (focus, mass, nonmass enhancement), lesion detection on iodine images and/or 2D images, and on one or two mammographic (MG) projection(s) were recorded. Additional necessary MG views and/or ultrasound (US) was performed at the time of CEDM. Breast MRI was obtained in patients with enhancement on CEDM without a MG or US correlate. FP was defined as an exam in which biopsy (bx) yielded benign pathology or in which MRI and two-year MG follow-up was negative. TP was defined as an exam in which bx yielded

malignancy. A univariate logistic regression analysis was done in the generalized estimating equation (GEE) framework to account for intra-patient correlation. Type I error rate was set to 0.05 (a).*Results 184 baseline screening CEDM met BI-RADS criteria. 27 patients were lost to follow up. 157 patients were included in analysis. 23 patients had TP exams with 26 total TP lesions. 134 patients had FP exams with 144 total FP lesions. Lesions seen on both the 2D and iodine images were more likely to be a TP while lesions seen on iodine only images were more likely to be FP (p=0.007). Lesions with an US or MRI correlate were more likely to be TP (p<0.001, p=0.012). Breast density, BPE, type of contrast finding, and visibility on one or two MG views was not statistically significant in predicting a FP or TP lesion.*Conclusions Findings seen on both low energy and iodine images are more likely to be a TP, as are those with an US or MR correlate. Such findings may help push the radiologist toward bx. Finding type and visibility on one or two views is not significantly associated with a TP or FP and suggests these factors shouldn't sway the radiologist's interpretation of a lesion.*Clinical Relevance/Application Understanding characteristics of TP compared with FP CEDM findings may help improve interpretation accuracy. To our knowledge, no study has been published assessing TP versus FP CEDM.

RESULTS

184 baseline screening CEDM met BI-RADS criteria. 27 patients were lost to follow up. 157 patients were included in analysis. 23 patients had TP exams with 26 total TP lesions. 134 patients had FP exams with 144 total FP lesions. Lesions seen on both the 2D and iodine images were more likely to be a TP while lesions seen on iodine only images were more likely to be FP (p=0.007). Lesions with an US or MRI correlate were more likely to be TP (p<0.001, p=0.012). Breast density, BPE, type of contrast finding, and visibility on one or two MG views was not statistically significant in predicting a FP or TP lesion.

CLINICAL RELEVANCE/APPLICATION

Understanding characteristics of TP compared with FP CEDM findings may help improve interpretation accuracy. To our knowledge, no study has been published assessing TP versus FP CEDM.

BR05-A6 Evaluating Response To Neoadjuvant Chemotherapy In Breast Cancer. A Radiopathological Correlation.

Participants
Sofía Ventura- Diaz, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the ability of Magnetic Resonance Imaging (MRI) to predict pathological complete response (pCR) in locally advanced breast cancers after neoadjuvant chemotherapy (NAC).*Methods and Materials This study retrospectively analyzed patients with locally advanced breast cancers collected from January 2014 to December 2019. Demographic, clinic, radiological and pathological findings were collected in an anomymized database. The imaging response was classified in five patterns according to the Union for International Cancer Control. Histopathological response was measured using two classifications: Miller and Payne (M&P) and residual cancer burden (RCB). A descriptive analysis was performed, subdiving the sample in molecular subtypes. Differents subgroups were compared using Student's t test, ANOVA test or X2 test, when appropriate.*Results 193 patients were included in our study (55,13 ± 12 years). 25,9% were triple negative (TN), 23,8% luminal B HER2+, 23,3% luminal B, 15% pure HER 2 + and 11,9 % luminal A. The most common histological subtype was the infiltrative ductal carcinoma (95,3 %). The highest nuclear degree and Ki67 level were found in TN subtype (p <0,001). The most frequent radiological finding was a nodule (89,1%). Non-masslike enhancement was present in 16,1%. The median size was 34 mm, IQR 24-50 mm. In 64,8% patients the tumor was unique, 28% multifocal, 21,2% multicentric and 4,1% bilateral. The highest rate of multicentricity was found in pure HER 2 +(44,8%, p=0,019). 44% patients had a radiological complete response (rCR). The molecular subtype with the greatest level of rCR was Luminal B HER2+ (13,5%), followed by TN (10,9%). The concentric response was the most common type in all molecular subtypes (33,2%). (M&P): 38,3% patients showed a pathological complete response (pCR), being TN the most responder (13%), followed by HER2+ (12,4%). The higher rates of no response to chemotherapy were seen in Luminal B (17,4%, p<0,001). RBC. 32,6% patients had a complete response. RBC agrees with M&P in TN being the most responder (12,4%), followed by HER 2+ (10,9%). We did not find a good radiopathological correlation being the overall kappa index low (0,25). Kappa index was better in HER2+ subtype (0,62).*Conclusions In 44% patients there is a rCR, mostly refered to Luminal B HER2+. The pathological analysis disagrees, both M&P and RBC say pCR in 32,6% -38,3%, being TN the best responder. Kappa index gets better in HER2+ subgroup.*Clinical Relevance/Application MRI does not accurately predict pCR after NAC but it still is the most accurate preoperative imaging method for assessing the therapeutic efficacy. More tools (such as diffusion) need to be introduced and validated to provide more accuracy in predicting pCR.

RESULTS

193 patients were included in our study (55,13 ± 12 years). 25,9% were triple negative (TN), 23,8% luminal B HER2+, 23,3% luminal B, 15% pure HER 2 + and 11,9 % luminal A. The most common histological subtype was the infiltrative ductal carcinoma (95,3 %). The highest nuclear degree and Ki67 level were found in TN subtype (p <0,001). The most frequent radiological finding was a nodule (89,1%). Non-masslike enhacement was present in 16,1%. The median size was 34 mm, IQR 24-50 mm. In 64,8% patients the tumor was unique, 28% multifocal, 21,2% multicentric and 4,1% bilateral. The highest rate of multicentricity was found in pure HER 2 +(44,8%, p=0,019). 44% patients had a radiological complete response (rCR). The molecular subtype with the greatest level of rCR was Luminal B HER2+ (13,5%), followed by TN (10,9%). The concentric response was the most common type in all molecular subtypes (33,2%). (M&P): 38,3% patients showed a pathological complete response (pCR), being TN the most responder (13%), followed by HER2+(12,4%). The higher rates of no response to chemotherapy were seen in Luminal B (17,4%, p<0,001). RBC. 32,6% patients had a complete response. RBC agrees with M&P in TN being the most responder (12,4%), followed by HER 2+ (10,9%). We did not find a good radiopathological correlation being the overall kappa index low (0,25). Kappa index was better in HER2+ subtype (0,62).

CLINICAL RELEVANCE/APPLICATION

MRI does not accurately predict pCR after NAC but it still is the most accurate preoperative imaging method for assessing the therapeutic efficacy. More tools (such as diffusion) need to be introduced and validated to provide more accuracy in predicting pCR.

BR05-A7 How Long To Wait? Follow-up Imaging Outcomes For Suspected COVID-19 Vaccine Induced Axillary Adenopathy

Participants
Shabnam Mortazavi, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

The optimal time interval for normalization of COVID-19 vaccine axillary adenopathy is unknown. The purpose of this study was to assess the follow-up imaging outcomes of axillary adenopathy caused by COVID-19 vaccination.*Methods and Materials Data from women with suspected COVID-19 vaccine-induced axillary adenopathy detected in breast imaging (screening or diagnostic mammogram, ultrasound and MRI) who received a BI-RADS category 3 were retrospectively reviewed from December 2020 to May 2021. Imaging follow-up recommendations adhered to the Society of Breast Imaging (SBI) guidelines of 4-12 weeks. Age, type of vaccine (when available), vaccine administration dates and imaging dates were reviewed.*Results Imaging follow-up with ultrasound (BI-RADS 3) was recommend in 128 women with presumed COVID-19 vaccine-induced axillary adenopathy. Of the 34 follow-up exams performed to date, 26 had normalization of the axillary adenopathy in the recommended follow-up imaging, while 8 had persistent adenopathy for which additional short-term imaging follow-up was recommended. Thirty three percent had persistent adenopathy when imaging follow-up was done 4 weeks after the second dose of the vaccine compared to 22% when imaging follow-up was done at 9 weeks.*Conclusions Lengthening the follow-up imaging recommendation to 9 or more weeks after the second dose of vaccination may minimize the need for additional follow-up and optimize patient care.*Clinical Relevance/Application Understanding the optimal length of follow-up for suspected COVID-19 vaccine-induced axillary lymphadenopathy is important to minimize use of healthcare resources and optimize patient care.

RESULTS

Imaging follow-up with ultrasound (BI-RADS 3) was recommend in 128 women with presumed COVID-19 vaccine-induced axillary adenopathy. Of the 34 follow-up exams performed to date, 26 had normalization of the axillary adenopathy in the recommended follow-up imaging, while 8 had persistent adenopathy for which additional short-term imaging follow-up was recommended. Thirty three percent had persistent adenopathy when imaging follow-up was done 4 weeks after the second dose of the vaccine compared to 22% when imaging follow-up was done at 9 weeks.

CLINICAL RELEVANCE/APPLICATION

Understanding the optimal length of follow-up for suspected COVID-19 vaccine-induced axillary lymphadenopathy is important to minimize use of healthcare resources and optimize patient care.

BR05-A8   Axillary Lymphadenopathy (LAD) On Breast Imaging After COVID-19 Vaccine

Participants
Stacey Wolfson, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate findings of axillary LAD after COVID-19 vaccination.*Methods and Materials We retrospectively reviewed breast imaging reports from 12/1/19 through 4/12/21 for patients who received the COVID-19 vaccine. Seven radiologists extracted patient demographics, vaccine information, imaging findings, and recommendations. Statistics were calculated in Excel and Mann-Whitney U tests in SPSS.*Results Of the 1217 patients that received the COVID-19 vaccine and had breast imaging, 537 patients (44%) had LAD on at least one exam. 323 patients had mammogram and ultrasound (US) on the same day: 8.0% had LAD identified on mammography alone, 61.0% on US alone, and 31.0% on both exams. Patients had LAD as early as 1 day after the first dose of vaccine and as late as 71 days after the second dose. The timing was significantly different between the groups with and without LAD seen on imaging; LAD was more likely to be seen within 14 days after vaccination and was rare after 50 days after the 2nd dose. Patients with LAD were more likely to have received Moderna (51.8%) and the patients without LAD were more likely to have received Pfizer (55.2%) (p=0.007).21 patients underwent lymph node (LN) biopsy; 52% had a history of current or prior breast cancer. 14 biopsies yielded benign results. 4 patients were diagnosed with breast cancer metastatic to the axilla; all had concurrent imaging findings in the breast and were diagnosed with breast cancer. 3 patients were diagnosed with lymphoma, none of whom had unilateral LAD identified on screening. 38 patients had initial imaging with US and follow up (F/U) US performed after 0.5-13 weeks. 15 patients had decreased LN size at 1.5 to 9 week F/U, 7 of which had F/U </= 4 weeks. 23 patients had no change in LN size on 0.5 to 13 week F/U. Three patients demonstrated stable lymph nodes at F/U intervals of 10, 11, and 13 weeks.*Conclusions A minority of patients with LAD ipsilateral to COVID-19 vaccine underwent biopsy, most frequently in patients with history of breast cancer (52% of biopsies). Patients had stable LAD at 10-13 weeks; therefore, F/U US should be recommended no sooner than three months. In patients with combined mammogram/US exams, evaluating the axilla with US contributed to 61% of the BIRADS 0 and 3 exams; thus, performing breast-only screening US (excluding the axilla) could result in fewer false positive recall and F/U exams.*Clinical Relevance/Application The management of incidental vaccine-related LAD must be elucidated for breast imagers in order to avoid unnecessary follow up exams and biopsies.

RESULTS

Of the 1217 patients that received the COVID-19 vaccine and had breast imaging, 537 patients (44%) had LAD on at least one exam. 323 patients had mammogram and ultrasound (US) on the same day: 8.0% had LAD identified on mammography alone, 61.0% on US alone, and 31.0% on both exams. Patients had LAD as early as 1 day after the first dose of vaccine and as late as 71 days after the second dose. The timing was significantly different between the groups with and without LAD seen on imaging; LAD was more likely to be seen within 14 days after vaccination and was rare after 50 days after the 2nd dose. Patients with LAD were more likely to have received Moderna (51.8%) and the patients without LAD were more likely to have received Pfizer (55.2%) (p=0.007).21 patients underwent lymph node (LN) biopsy; 52% had a history of current or prior breast cancer. 14 biopsies yielded benign results. 4 patients were diagnosed with breast cancer metastatic to the axilla; all had concurrent imaging findings in the breast and were diagnosed with breast cancer. 3 patients were diagnosed with lymphoma, none of whom had unilateral LAD identified on screening. 38 patients had initial imaging with US and follow up (F/U) US performed after 0.5-13 weeks. 15 patients had decreased LN size at 1.5 to 9 week F/U, 7 of which had F/U </= 4 weeks. 23 patients had no change in LN size on 0.5 to 13 week F/U. Three patients demonstrated stable lymph nodes at F/U intervals of 10, 11, and 13 weeks.

CLINICAL RELEVANCE/APPLICATION

The management of incidental vaccine-related LAD must be elucidated for breast imagers in order to avoid unnecessary follow up exams and biopsies.

BR05-A9   Quantitative Analysis Enhancement Characteristics Of Contrast Enhanced Spectral Mammography In Indistinguishing Malignant And Benign Breast Masses

Participants
Huizhi Cao, PhD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To retrospectively analyze the roles of quantitative variables and kinetic enhancement patterns between different imaging acquisition phases in distinguishing the pathologically confirmed malignant breast masses from benign ones using contrast-enhanced spectral mammography (CESM).*Methods and Materials Pathologically confirmed breast masses from patients who underwent CESM were retrospectively analyzed, including 30 benign and 84 malignant ones. Contrast-based mammography performed with different energy exposures were taken after i.v. injection of contrast agent for less than 2min (early phase), between 3 to 6 min (second phase), and between 7 to 8 min (late phase), respectively. The differential enhancement of benign and malignant masses in the early, second, and late phases were analyzed; the lesion signal, signal noise ratio (SNR), the difference of enhancing lesion signal between different phases (% RS) were measured for each lesion. The kinetic enhancement pattern was assessed based on SNR and % RS changes across all these three phases.*Results The enhancement was statistically stronger in malignancies compared with benign lesions. The lesion signal and SNR for breast cancer and benign lesions were significantly different at the early phase (p < 0.05); the accuracy of lesion signal- and SNR-based analysis was 75.4% and 80.7%, respectively, at the early phase. No statistically significant differences were found at the second or late phase (p > 0.05). Analyzing based on the % RS, the enhancement pattern between the early and second phase and the kinetic enhancement pattern (changes across all three phases) were found to be statistically significant for the breast cancer and benign lesions (p<0.05); Regarding the kinetic enhancement patterns, 71.40% (60/84) breast cancer and 50.00% (15/30) benign lesions presented a depressed-depressed pattern based on RS% changes; while an elevated-elevated pattern was only found in the breast benign lesions (3/30,10.00%). In particular, 46.40% (39/84) breast cancers presented in depress-depress pattern and 25.00% (21/84) showed an elevated-depressed pattern; while the elevated-elevated pattern was found most for benign lesions with an incident rate of 33.30% (10/30).*Conclusions Quantitative variables and kinetic enhancement pattern analysis of breast lesions on CESM may be useful in distinguishing breast cancers and benign masses.*Clinical Relevance/Application The intensity and patterns of enhancement on CESM may contribute to the differential diagnosis of benign and malignant lesions.

RESULTS

The enhancement was statistically stronger in malignancies compared with benign lesions. The lesion signal and SNR for breast cancer and benign lesions were significantly different at the early phase (p < 0.05); the accuracy of lesion signal- and SNR-based analysis was 75.4% and 80.7%, respectively, at the early phase. No statistically significant differences were found at the second or late phase (p > 0.05). Analyzing based on the % RS, the enhancement pattern between the early and second phase and the kinetic enhancement pattern (changes across all three phases) were found to be statistically significant for the breast cancer and benign lesions (p<0.05); Regarding the kinetic enhancement patterns, 71.40% (60/84) breast cancer and 50.00% (15/30) benign lesions presented a depressed-depressed pattern based on RS% changes; while an elevated-elevated pattern was only found in the breast benign lesions (3/30,10.00%). In particular, 46.40% (39/84) breast cancers presented in depress-depress pattern and 25.00% (21/84) showed an elevated-depressed pattern; while the elevated-elevated pattern was found most for benign lesions with an incident rate of 33.30% (10/30).

CLINICAL RELEVANCE/APPLICATION

The intensity and patterns of enhancement on CESM may contribute to the differential diagnosis of benign and malignant lesions.

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Abstract Archives of the RSNA, 2021

BR03-B

Breast Tuesday Poster Discussions

Sub-Events

BR03-B1   Association Of Automated Breast Positioning Assessment With Technical Repeats And Recalls In The Nationalized U.K. Screening Program

Participants
Brian Drohan, PhD, Waltham, Massachusetts (*Presenter*) Employee, Volpara Health Technologies Limited

PURPOSE

This study investigated the association between images repeated due to inadequate positioning and automated scoring for breast positioning, based on a PGMI (Perfect, Good, Moderate, Inadequate) quality classification system.*Methods and Materials A retrospective dataset of negative, four-view mammographic screening exams were identified from the OPTIMAM database (screening mammograms from two sites in the UK NHS Breast Screening Programme between 2012-2015) from among those without any repeated views and among those with image retakes due to inadequate positioning. This comprised of 1340 accepted exams with no repeated views (AE), 2134 "technical repeats" which included a single, same-day repeated view (TP) and 144 "technical recalls" which included =1 repeated view on a later exam date (TR). Volpara algorithms (Volpara Health Ltd, NZ) were used to evaluate breast volume (BV), volumetric breast density (VBD) and breast positioning, assessing images as passing or failing a set of positioning metrics and assigning an image PGMI score. Univariate statistical analyses were used to investigate the associations between the PGMI system and TP, TR and AE image features.*Results Compared to women with TP, median age (58 vs 60 years) and BV (663 vs 775 cm3) were lower and VBD higher (8.1 vs 6.3%) for women with TR (p<0.01). TP had a significantly higher proportion of medio-lateral oblique (MLO) images than TR (83 vs 76%, p<0.01). Comparing TP/TR as a combined group to AE, there were significantly different (p<0.001) proportions of images which failed all positioning metrics except cranio-caudal (CC) nipple in profile. Comparing TP and TR, MLO TP had significantly more tissue cut off (7 vs 3%, p<0.05) and CC TR had more images where the CC posterior nipple line (PNL) was more than 1cm shorter than the corresponding MLO PNL (90 vs 64%, p<0.001). Comparing image PGMI score for TR to AE there were significantly more inadequate MLOs (48 vs 3%) and less perfect views (MLO; 3 vs 13%, CC; 2 vs 21%), all p<0.001. Comparing TP to AE there were significantly more inadequate views (MLO; 47 vs 3%, CC; 8 vs 2%) and less perfect views (MLO;1 vs 13%, CC; 9 vs 21%), all p<0.001.*Conclusions Automated breast positioning assessment showed significant differences in PGMI scores between groups of TP, TR and AE views. Between-group proportion differences identified specific positioning metrics that may be more difficult for technologists to identify at the time of the exam, thus, having timely automated feedback has the potential to reduce TR.*Clinical Relevance/Application Automated image quality assessment algorithms can help provide objective and timely feedback to technologists to aid continual monitoring to facilitate quality improvement of breast positioning to meet MQSA standards.

RESULTS

Compared to women with TP, median age (58 vs 60 years) and BV (663 vs 775 cm3) were lower and VBD higher (8.1 vs 6.3%) for women with TR (p<0.01). TP had a significantly higher proportion of medio-lateral oblique (MLO) images than TR (83 vs 76%, p<0.01). Comparing TP/TR as a combined group to AE, there were significantly different (p<0.001) proportions of images which failed all positioning metrics except cranio-caudal (CC) nipple in profile. Comparing TP and TR, MLO TP had significantly more tissue cut off (7 vs 3%, p<0.05) and CC TR had more images where the CC posterior nipple line (PNL) was more than 1cm shorter than the corresponding MLO PNL (90 vs 64%, p<0.001). Comparing image PGMI score for TR to AE there were significantly more inadequate MLOs (48 vs 3%) and less perfect views (MLO; 3 vs 13%, CC; 2 vs 21%), all p<0.001. Comparing TP to AE there were significantly more inadequate views (MLO; 47 vs 3%, CC; 8 vs 2%) and less perfect views (MLO;1 vs 13%, CC; 9 vs 21%), all p<0.001.

CLINICAL RELEVANCE/APPLICATION

Automated image quality assessment algorithms can help provide objective and timely feedback to technologists to aid continual monitoring to facilitate quality improvement of breast positioning to meet MQSA standards.

BR03-B3   Tomosynthesis-driven AI-derived Breast Cancer Scoring Among A Racially Diverse Cohort Of Women Undergoing Screening: Potential For Triage And Precision Cancer Screening

Participants
Emily F. Conant, MD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Hologic, Inc;Advisory Panel, Hologic, Inc;Research Grant, OM1, Inc;Research Grant, iCad, Inc;Advisory Panel, iCad, Inc;Speaker, Medscape, LLC

PURPOSE

To evaluate the impact of race on the performance of a deep convolutional neural network artificial intelligence (AI) software to identify digital breast tomosynthesis (DBT) screening exams with low-likelihood of cancer towards triaging workload and aiding in precision screening*Methods and Materials This IRB-approved, HIPAA-compliant observational study included consecutive DBT screening exams performed from 2/4/2020 to 1/3/2021 at a single academic site and processed with an FDA-approved, DBT AI-CAD software (ProFound AI 2.0, iCAD, Inc.). The distribution of AI-derived case-score deciles for the entire population, as well as for the two largest racial subgroups (White and Black), were determined separately for controls and breast cancer cases, including true positive (TP) cancer detections and false negatives (FN). In addition, the performance of the AI algorithm as a standalone interpretation was calculated via area under the ROC curve (AUC). All FNs were reviewed at consensus to determine if they were

"detectable" or not at index imaging.*Results Of 9,113 women screened, 41.0% were White, 52.4% Black, and 6.7% were "other" races. Ages ranged from 24-96 years (median = 59 years). Of the entire cohort, 717 were recalled (7.9%) with 58 cancers detected (CDR/1000 screened = 6.4 overall) and 659 false positives (FP). Of women with at least 1 year follow-up, there were 7 FNs, with case scores of 6, 18, 25, 26, 46, 62, and 75; 2 in White and 5 in Black women. The three lowest case score FNs were deemed non-detectable at index imaging (2 in Black women, 1 in a White woman). AI case-score distribution varied by race for controls (chi-square test, p < 0.001), but not for cases (p = 0.12). In addition, the AI algorithm demonstrated high standalone performance, which however, varied slightly by race (AUC for all women = 0.83 95% CIs [0.77, 0.87] (cases=65, controls=9,048); for White = 0.84 [0.77, 0.89] (cases=29, controls=3,705); for Black = 0.80 [0.70, 0.88] (cases=27, controls=4,745). There were 9 TP cases in race "Other".*Conclusions Preliminary data across a racially diverse screening population suggests there may be differences in the distribution of case scores and performance of a DBT-AI algorithm based on race.*Clinical Relevance/Application Artificial intelligence algorithms for CAD-driven triaging and precision breast cancer screening paradigms may require incorporation of racial data for further refinement of prediction models.

RESULTS

Of 9,113 women screened, 41.0% were White, 52.4% Black, and 6.7% were "other" races. Ages ranged from 24-96 years (median = 59 years). Of the entire cohort, 717 were recalled (7.9%) with 58 cancers detected (CDR/1000 screened = 6.4 overall) and 659 false positives (FP). Of women with at least 1 year follow-up, there were 7 FNs, with case scores of 6, 18, 25, 26, 46, 62, and 75; 2 in White and 5 in Black women. The three lowest case score FNs were deemed non-detectable at index imaging (2 in Black women, 1 in a White woman). AI case-score distribution varied by race for controls (chi-square test, p < 0.001), but not for cases (p = 0.12). In addition, the AI algorithm demonstrated high standalone performance, which however, varied slightly by race (AUC for all women = 0.83 95% CIs [0.77, 0.87] (cases=65, controls=9,048); for White = 0.84 [0.77, 0.89] (cases=29, controls=3,705); for Black = 0.80 [0.70, 0.88] (cases=27, controls=4,745). There were 9 TP cases in race "Other".

CLINICAL RELEVANCE/APPLICATION

Artificial intelligence algorithms for CAD-driven triaging and precision breast cancer screening paradigms may require incorporation of racial data for further refinement of prediction models.

BR03-B5   AI Algorithm Performs Better On DBT Than 2D Mammography

Participants
Abdul Rahman Diab, Cambridge, Massachusetts (*Presenter*) Employee, RadNet, Inc

PURPOSE

To assess AI performance on DBT compared to 2D mammography (FFDM and 2D synthetics).*Methods and Materials Screening FFDM and DBT mammograms were retrospectively collected from different women at 7 clinical sites under an IRB-approved protocol. Two types of exams were collected: negative exams, defined as BIRADS 1 or 2 screening mammograms followed by a BIRADS 1 or 2 negative screening mammogram 24+ months later, and cancer exams, defined as screening mammograms with malignant pathology confirmation within the 3 months following the exam. The FFDM data consisted of 832 negative exams and 501 cancer exams (1333 total), and the DBT data consisted of 850 negative exams and 469 cancer exams (1319 total). Two MQSA-qualified radiologists reviewed each collected case to ensure that it met the inclusion criteria specified in the case type definitions. An AI model generated predictions on the exams, and the model's performance was assessed using the area under the ROC curve (AUC). P-values for comparing AUC results were computed using bootstrapping with 10,000 samples, and confidence intervals were computed using the DeLong method. The AI algorithm contains two core AI models: one trained to evaluate 2D images, and one trained to evaluate 3D images. The algorithm combines model outputs into a single case-level score. DBT results were computed in two ways: 1) using all available images in the study and 2) using only synthetic 2D images. FFDM results were computed using all available images for each study.*Results The highest performance (AUC=0.987, CI: 0.982,0.992) was achieved when using all available images from DBT exams. Performance was lower when using only synthetic 2D images from the same DBT exams (AUC=0.962, CI: [0.951, 0.973], p < 0.0001) and when using FFDM exams (AUC=0.966, CI: [0.957, 0.975], p < 0.0001). At a specificity of 88.9% (BCSC mean radiologist specificity [Lehman et. al 2017]), sensitivity on DBT exams using all images was 0.968, sensitivity on DBT exams using only synthetic 2D images was 0.904, and sensitivity on FFDM exams was 0.912.*Conclusions AI performs well across all tested image types, and incorporating 3D information present in DBT exams leads to higher performance compared to using FFDM exams or only using 2D synthetics from DBT exams.*Clinical Relevance/Application The results indicate that AI can effectively utilize DBT data to improve performance over 2D mammography, reinforcing clinical experience that DBT is an invaluable mammographic tool.

RESULTS

The highest performance (AUC=0.987, CI: 0.982,0.992) was achieved when using all available images from DBT exams. Performance was lower when using only synthetic 2D images from the same DBT exams (AUC=0.962, CI: [0.951, 0.973], p < 0.0001) and when using FFDM exams (AUC=0.966, CI: [0.957, 0.975], p < 0.0001). At a specificity of 88.9% (BCSC mean radiologist specificity [Lehman et. al 2017]), sensitivity on DBT exams using all images was 0.968, sensitivity on DBT exams using only synthetic 2D images was 0.904, and sensitivity on FFDM exams was 0.912.

CLINICAL RELEVANCE/APPLICATION

The results indicate that AI can effectively utilize DBT data to improve performance over 2D mammography, reinforcing clinical experience that DBT is an invaluable mammographic tool.

BR03-B6   Demographic And Socioeconomic Risk Factors For Granulomatous Mastitis: A Case-control Study

Participants
Nina Capiro, MD, Culver City, California (*Presenter*) Nothing to Disclose

PURPOSE

To identify demographic and socioeconomic factors associated with granulomatous mastitis (GM).*Methods and Materials A retrospective case-control study was performed of 62 female patients with biopsy-proven GM at our institution from 11/2015 to 10/2020. Two age-matched controls per case were selected from patients presenting for diagnostic breast imaging. Demographic and socioeconomic characteristics were collected. Data were analyzed using univariable (odds ratio (OR) and 95% confidence interval (CI)) and multivariable conditional logistic regressions, and p<0.05 is statistically significant.*Results The mean (SD) age was 38.1 (8.9) and 38.1 (8.8) years for cases and controls respectively. When compared to age-matched controls, GM patients were more likely to identify as Hispanic/Latina (OR=5.7, CI=1.9, 16.6), to list Spanish as their preferred language (OR=5.5, CI=2.4,

12.7), and to be born in Mexico (OR=4.8, CI=1.6, 14.2). Cases were more likely to have no designated primary care provider (PCP) (OR=5.1, CI=2.2, 11.8) and to use Emergency Medi-Cal, a subset of California's Medicaid program for undocumented adults (OR=3.2, CI=1.6, 6.3). Although not statistically significant, there was a trend towards cases living in communities with slightly higher levels of poverty (cases 34% vs. controls 31% of population in home zip code living below 150% of the federal poverty level, p=0.06). These factors were not independently associated with GM in a multivariable model.*Conclusions Risk factors for GM include being Hispanic/Latina, having Spanish as a preferred language, being born in Mexico, and having limited healthcare access. Although most patients had government-assisted health insurance, cases were more likely to use Emergency Medi-Cal, suggesting that being undocumented is a risk factor for GM. These risk factors suggest that environmental and/or genetic factors are likely involved in the diagnosis of GM.*Clinical Relevance/Application GM is a benign inflammatory breast disease that can have an extended clinical course impacting quality of life and resulting in breast disfigurement. Diagnosis is often made by core-needle biopsy, and current treatment recommendations are controversial in the United States. Prior studies in the U.S. report GM predominantly affecting Hispanic/Latina patients, however we present the first study to further describe these patients as having Spanish as their preferred language, being born in Mexico, having poor healthcare access and being undocumented. Our institution provides care to an underserved community, however the cohort of GM patients proves to be uniquely underserved. By bringing to light such healthcare disparities, we hope to encourage further research to determine more effective treatments.

RESULTS

The mean (SD) age was 38.1 (8.9) and 38.1 (8.8) years for cases and controls respectively. When compared to age-matched controls, GM patients were more likely to identify as Hispanic/Latina (OR=5.7, CI=1.9, 16.6), to list Spanish as their preferred language (OR=5.5, CI=2.4, 12.7), and to be born in Mexico (OR=4.8, CI=1.6, 14.2). Cases were more likely to have no designated primary care provider (PCP) (OR=5.1, CI=2.2, 11.8) and to use Emergency Medi-Cal, a subset of California's Medicaid program for undocumented adults (OR=3.2, CI=1.6, 6.3). Although not statistically significant, there was a trend towards cases living in communities with slightly higher levels of poverty (cases 34% vs. controls 31% of population in home zip code living below 150% of the federal poverty level, p=0.06). These factors were not independently associated with GM in a multivariable model.

CLINICAL RELEVANCE/APPLICATION

GM is a benign inflammatory breast disease that can have an extended clinical course impacting quality of life and resulting in breast disfigurement. Diagnosis is often made by core-needle biopsy, and current treatment recommendations are controversial in the United States. Prior studies in the U.S. report GM predominantly affecting Hispanic/Latina patients, however we present the first study to further describe these patients as having Spanish as their preferred language, being born in Mexico, having poor healthcare access and being undocumented. Our institution provides care to an underserved community, however the cohort of GM patients proves to be uniquely underserved. By bringing to light such healthcare disparities, we hope to encourage further research to determine more effective treatments.

BR03-B7   Parenchymal Field Effect Analysis For Breast Cancer Risk Assessment: Evaluation Of FFDM Similarity Using Deep Learning Features

Participants
Natalie Baughan, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

In women with biopsy-proven breast cancer, histologically normal areas of the parenchyma and the tumor have shown molecular similarity, supporting the hypothesis of a cancer field effect. The purpose of this work was to further investigate a potential field effect in mammographic parenchymal patterns in multiple regions across the breast.*Methods and Materials The study included 103 FFDMs with at least one identified malignant tumor. All images (12-bit quantization, 70-micron pixels) were acquired with a Hologic Lorad Selenia system. Regions of interest (ROI) of 128x128 pixels were selected within the identified tumor, adjacent to the tumor, distant from the tumor, and behind the nipple in the contralateral breast within the craniocaudal projection. 1472 deep learning features were extracted using a VGG19 architecture. Features with low variance were excluded and principal component analysis was used to reduce dimensionality. The Kolmogorov-Smirnov (KS) test was used to assess similarity between the distributions of the first 20 principal components (86.5% of the total variance) for each ROI region, taken to be pseudo-features. Using the KS test statistic and a 95% confidence interval (CI) calculated using 2000 bootstrap iterations, compared distributions were claimed to be statistically equivalent if the CI fell below a critical value calculated at the p=0.05 threshold. Euclidean distance between the geometric means of each ROI region plotted using the first two principal components was also used to examine relationships between ROI regions.*Results KS test results indicated that 90.5% of feature distributions across all ROI regions achieved statistical equivalence. Distance between the tumor cluster geometric mean and the near, distant, and contralateral ROI cluster geometric means was 0.165, 0.219, and 0.197, respectively, with the tumor cluster showing more overlap with features from the near ROI region.*Conclusions Results indicate broad similarity across tumor and non-tumor regions in mammographic parenchymal patterns, while features extracted from ROIs closer to the tumor tend to show more similarity to the tumor than features extracted from distant ROIs.*Clinical Relevance/Application This study provides evidence in support of a breast cancer field effect that is identifiable through mammographic image analysis, which could improve risk assessment and guide screening.

RESULTS

KS test results indicated that 90.5% of feature distributions across all ROI regions achieved statistical equivalence. Distance between the tumor cluster geometric mean and the near, distant, and contralateral ROI cluster geometric means was 0.165, 0.219, and 0.197, respectively, with the tumor cluster showing more overlap with features from the near ROI region.

CLINICAL RELEVANCE/APPLICATION

This study provides evidence in support of a breast cancer field effect that is identifiable through mammographic image analysis, which could improve risk assessment and guide screening.

BR03-B9   Barriers And Facilitators To Implementation Of Breast Cancer Risk Assessment: The Healthcare Team Perspective

Participants
Lucy Spalluto, MD,MPH, Nashville, Tennessee (*Presenter*) Nothing to Disclose

PURPOSE

Breast cancer risk assessment (RA) tools can identify women at high risk for developing breast cancer. The American College of Radiology and American Society of Breast Surgeons recently issued recommendations for women to have breast cancer RA

performed no later than age 30. Yet, while breast cancer RA tools are widely available, they are not used routinely in standard clinical practice. This gap in evidence-based practice may lead to missed opportunities to identify women at high risk for breast cancer. The objective of our study is to assess healthcare professionals' perceived barriers and facilitators to the utilization of breast cancer risk assessment tools through stakeholder interviews.*Methods and Materials We performed a cross-sectional observational study of telephone interviews with healthcare team members with a role in breast cancer screening. We recruited from three organizations: 1) state breast and cervical screening program 2) federally qualified health center, and 3) safety net hospital. A research team member conducted recorded interviews that followed a semi-structured guide developed using the Consolidated Framework for Implementation Research (CFIR). An initial emergent hierarchical coding system was developed using the interview guide and a preliminary review of the transcripts. Reliability was established by three coders independently coding four transcripts. Coding was then compared and discrepancies resolved. Coders divided and independently coded the remaining quotes. The codebook evolved as new themes arose in subsequent transcripts. Analysis consisted of interpreting the coded quotations and identifying higher order themes.*Results Of 73 participants invited, 27 agreed to participate. Of those, 24 completed an interview. We identified several emerging themes. Perceived patient barriers: cost, insurance coverage, distrust, lack of interest/motivation. Clinic workflow barriers: shortage of staff, language barriers, staff buy-in, documentation. Barriers to follow-up: cost, transportation, finding high-quality care. Facilitators to increase utilization of RA: independent and workshop learning, team meetings, leadership buy-in, coordination of guidelines.*Conclusions We identified several emerging themes regarding barriers to and facilitators of implementation of breast cancer RA. Barriers include perceived patient barriers, clinic workflow and follow-up challenges. Facilitators include improved learning, leadership buy-in, and coordination of guidelines.*Clinical Relevance/Application Our results will inform a larger scale intervention study to develop implementation strategies to increase uptake of breast cancer risk assessment.

RESULTS

Of 73 participants invited, 27 agreed to participate. Of those, 24 completed an interview. We identified several emerging themes. Perceived patient barriers: cost, insurance coverage, distrust, lack of interest/motivation. Clinic workflow barriers: shortage of staff, language barriers, staff buy-in, documentation. Barriers to follow-up: cost, transportation, finding high-quality care. Facilitators to increase utilization of RA: independent and workshop learning, team meetings, leadership buy-in, coordination of guidelines.

CLINICAL RELEVANCE/APPLICATION

Our results will inform a larger scale intervention study to develop implementation strategies to increase uptake of breast cancer risk assessment.

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> **IR03-C**
>
> **Interventional Radiology Tuesday Poster Discussions**

Sub-Events

IR03-C1 First-in-human Evaluation Of An AR Platform With Real-time Projection And Wireless Sharing Of Live Images During Ultrasound-guided Procedures

Participants
Gaurav Gadodia, MD, Cleveland, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Current ultrasound (US) guided procedures utilize monitors fixed to machines or projected locally to screens usually within the procedure room. The purpose of this study is to describe the first-in-human clinical evaluation of an augmented reality (AR) platform that allows for customizable real-time holographic projection, sharing, and annotation of live-streaming images during US-guided procedures.*Methods and Materials A team at our institution developed an AR platform using the Microsoft Hololens (Washington, USA) head-mounted display (HMD) that can capture live images from an US machine and project them as holograms on a heads-up display on the HMD. The heads-up display can be moved anywhere in space by gestures made by the primary operator. Platform functionality also incorporates real-time sharing of the holograms projected on the heads-up display, including the live US images, to other devices via wireless transmission, with the ability for two-way communication. The first case of an IRB-approved study evaluating the utility of this platform in US-guided procedures has been completed so far, with the platform being used in a case of US-guided central venous access.*Results In this first use to date evaluating this platform, the moveable and scalable holographic heads-up display allowed the operator to position the US-images to a location in space per their preference. Furthermore, the image sharing and active communication features were used successfully, with a second operator able to watch the procedure from a first-person perspective of the on-site operator in real time from another location on their mobile device, and discuss the case directly with the primary operator during needle placement.*Conclusions First-in-human testing of this US-based AR HMD platform demonstrated the ability for improved ergonomic positioning of the live US images as compared to the traditional fixed monitor, which may allow for improved hand-eye coordination during needle placement. Additionally, successful use of the image sharing and communication functions exhibits the potential for remote collaboration. Further clinical investigation of this platform for use in US-guided procedures is ongoing.*Clinical Relevance/Application The improved ergonomics and potential resulting improved hand-eye coordination afforded by this AR HMD platform can improve success of needle placement and, thus, patient outcomes. Moreover, the remote collaboration functionality has implications for telehealth and procedural training.

RESULTS

In this first use to date evaluating this platform, the moveable and scalable holographic heads-up display allowed the operator to position the US-images to a location in space per their preference. Furthermore, the image sharing and active communication features were used successfully, with a second operator able to watch the procedure from a first-person perspective of the on-site operator in real time from another location on their mobile device, and discuss the case directly with the primary operator during needle placement.

CLINICAL RELEVANCE/APPLICATION

The improved ergonomics and potential resulting improved hand-eye coordination afforded by this AR HMD platform can improve success of needle placement and, thus, patient outcomes. Moreover, the remote collaboration functionality has implications for telehealth and procedural training.

IR03-C2 Initial Experience Using A Novel Computed Tomography System With Fully Integrated 3D Laser Guidance System For CT Based Interventions

Participants
Roy Marcus, MD, Meggen, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

The spectrum and precision of CT interventions highly benefit from dedicated either integrated or secondary add-on navigations systems. Integrated laser navigation systems are limited by providing a laser beam perpendicular to the x-ray beam (in plane) within the CT gantry while secondary nonintegrated systems require cumbersome calibration and image registration tasks. Here, we report our initial experience with a novel CT system enhanced with a fully integrated realtime 3D laser guidance system that allows needle guidance outside the CT gantry and needle track planning in double-oblique orientations (through plane). *Methods and Materials Various CT interventions of total 20 patients (tumor biopsy 17, abscess drainage 3) were performed on a novel 128 row MDCT scanner system with fully integrated 3D laser guidance navigation system. A total of 4 laser modules integrated into the front-face of the CT gantry allow the projection of two laser planes with a corresponding intersection line providing the needle path for the preplanned intervention. The laser 3D guidance is projected on the patient in a parking position outside the CT gantry. CT interventions were analyzed for ease of use, reliability, through plane intervention capability and compared to standard in gantry CT fluoroscopy procedures.*Results All 20 interventions were successfully performed using the novel 3D integrated Laser guidance system. The cutaneous puncture site was determined in all patients in park position outside the gantry using the guidance system. In all patients the needle advancement along the provided path was achieved up to half of the final distance by using the 3D system uniquely and was followed by a position control scan using a standard CT fluoroscopic mode in gantry approach. The

number of CT fluoroscopic views was reduced by approximately half the amount compared to standard guidance systems. The 3D planning tool made it possible to perform CT interventions off the normal in plane orientation, which would otherwise not have been possible using standard in gantry navigation systems.*Conclusions The use of a novel CT system with fully integrated 3D laser guidance system allows structured and dedicated pre-interventional planning, enhances safety during intervention with a fixed, laser guided puncture path and provides a comfortable and safe procedure outside of the gantry with the ultimate potential to reduce radiation dose due to lesser use of fluoroscopy views. Difficult CT interventions, requiring a double-oblique off plane needle path orientation, became possible using this 3D laser guidance system.*Clinical Relevance/Application 3D laser guidance system allows a safe and comfortable CT intervention with potential dose saving

RESULTS

All 20 interventions were successfully performed using the novel 3D integrated Laser guidance system. The cutaneous puncture site was determined in all patients in park position outside the gantry using the guidance system. In all patients the needle advancement along the provided path was achieved up to half of the final distance by using the 3D system uniquely and was followed by a position control scan using a standard CT fluoroscopic mode in gantry approach. The number of CT fluoroscopic views was reduced by approximately half the amount compared to standard guidance systems. The 3D planning tool made it possible to perform CT interventions off the normal in plane orientation, which would otherwise not have been possible using standard in gantry navigation systems.

CLINICAL RELEVANCE/APPLICATION

3D laser guidance system allows a safe and comfortable CT intervention with potential dose saving

IR03-C3   Non-anatomical Resections Vs. Image-guided Ablations In Multimodal Treatment Of Colorectal Cancer Liver Metastases: An Intraindividual Comparison

Participants
Lea Hitpass, MD, Aachen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To compare the results of local ablation and non-anatomical resection in patients who underwent both treatments as part of multimodal therapy of colorectal cancer liver metastases (CRCLM).*Methods and Materials All patients who underwent both image-guided ablation and non-anatomical parenchymal sparing resection of CRCLM in curative intent between January 2010 and December 2020 were included in this retrospective study. Only first treatments of each lesion were included, regardless of modality, and each lesion only received one kind of treatment. Both intraoperative US-guided and percutaneous CT-guided ablations were included. The incidence and time to local recurrence of the treated lesions within each treatment modality group were compared using the chi-square test and Kaplan-Meier analysis, respectively.*Results A total of 41 patients (27 male, 14 female) undergoing 110 non-anatomical resections and 66 ablations (mean 2.7 and 1.6 per patient, respectively) were analysed. Of the latter, 23/66 were radiofrequency ablations (RFA) and 43/66 microwave ablations (MWA). There were no statistically significant differences in recurrence rates between resections and ablations (n = 19, 17% vs. n = 8, 12%, p = 0.359) or between ablation types (RFA n = 2, 8,7% vs. MWA n = 6, 14%, p = 0.533). Moreover, there was no difference in time to local recurrence within 12 months (median 11.1 vs 11.0 months, p = 0.803) or 3 years (median 30.5 months vs 30.0 months, p = 0.921). Median follow-up was 20.5 month (range: 1-114 month).*Conclusions There is no significant difference in recurrence rates or time to local recurrence when non-anatomical parenchyma-sparing resections and local ablations of colorectal cancer liver metastases are compared in the same patients.*Clinical Relevance/Application An intraindividual comparison of non-anatomical resection and ablation demonstrates equivalent outcomes where recurrence rates and time to local recurrence are concerned. Therefore, choice of modality should be based on tumor localization and accessibility, as well as patient physical condition.

RESULTS

A total of 41 patients (27 male, 14 female) undergoing 110 non-anatomical resections and 66 ablations (mean 2.7 and 1.6 per patient, respectively) were analysed. Of the latter, 23/66 were radiofrequency ablations (RFA) and 43/66 microwave ablations (MWA). There were no statistically significant differences in recurrence rates between resections and ablations (n = 19, 17% vs. n = 8, 12%, p = 0.359) or between ablation types (RFA n = 2, 8,7% vs. MWA n = 6, 14%, p = 0.533). Moreover, there was no difference in time to local recurrence within 12 months (median 11.1 vs 11.0 months, p = 0.803) or 3 years (median 30.5 months vs 30.0 months, p = 0.921). Median follow-up was 20.5 month (range: 1-114 month).

CLINICAL RELEVANCE/APPLICATION

An intraindividual comparison of non-anatomical resection and ablation demonstrates equivalent outcomes where recurrence rates and time to local recurrence are concerned. Therefore, choice of modality should be based on tumor localization and accessibility, as well as patient physical condition.

IR03-C4   Magnetic Resonance Guided Focused Ultrasound Surgery For The Treatment Of Oligometastatic Prostate Cancer Bone Metastasis. Can Sound Waves Downstage Cancer Spread?

Participants
Alessandro De Maio, Rome, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To assess the ability of Magnetic Resonance guided Focused Ultrasound Surgery (MRgFUS) to target bone metastasis and so downstage patients affected by oligometastatic prostate cancer using a single treatment session.*Methods and Materials Eligibility criteria included the presence of bone metastasis accessible to MRgFUS (InSightec, Israel) for a safe procedure in locations accepted by international consensus. Baseline measurable patients' characteristics included dynamic contrast enhanced MRI study (Gd-BOPTA, Bracco; GE 750 3T magnet) with semiquantitative perfusion analysis, PSA levels (ng/ml) and choline PET Standardized Uptake Value (SUV). Such variables of interest were obtained at treatment time, 3 months, 12 months and 24 months follow-up, then analysed via paired samples t-test.*Results A total of 18 patients fulfilled the inclusion criteria for this study and safely underwent MRgFUS procedure for metastatic bone ablation. Lesions were located in the pelvis (n=11), scapula (n=3) and long bones (n=4). At baseline DCE perfusion imaging, all targeted metastases showed evidence of highly vascular characteristics. A mean perfusion reduction of 88% from baseline was found at 3 months follow-up (CI: 100-50; p<0.001), then stable at subsequent follow-up scans. Similarly, PSA levels decreased from a mean baseline of 19 (ng/ml) to mean values of 7.1 (p<0.001 for comparison), 2.9 and 2.1, respectively at 3, 12 and 24 moths follow-up. SUV showed a comparable trend of reduction from a baseline mean of 8.9 to subsequent follow-up mean values equal to 3.0 (p<0.001 for comparison), 2.3 and 1.7. No treatment-

related adverse events were reported during the study.*Conclusions MRgFUS is a non-invasive procedure that can obtain nearly complete bone metastasis ablation in patients affected by oligometastatic prostate cancer. The technique features a radiation-free approach that can significantly reduce the risk of toxic effects in oncological patients, not only for palliative purposes, but possibly ablative too. Larger-sample studies are needed in order to advance this possibility into practice.*Clinical Relevance/Application The presented study on feasibility of MRgFUS, targeting bone metastasis, for the purpose of downstaging in patients affected by oligometastatic prostate cancer shows promising initial results of such an application.

RESULTS

A total of 18 patients fulfilled the inclusion criteria for this study and safely underwent MRgFUS procedure for metastatic bone ablation. Lesions were located in the pelvis (n=11), scapula (n=3) and long bones (n=4). At baseline DCE perfusion imaging, all targeted metastases showed evidence of highly vascular characteristics. A mean perfusion reduction of 88% from baseline was found at 3 months follow-up (CI: 100-50; $p<0.001$), then stable at subsequent follow-up scans. Similarly, PSA levels decreased from a mean baseline of 19 (ng/ml) to mean values of 7.1 ($p<0.001$ for comparison), 2.9 and 2.1, respectively at 3, 12 and 24 moths follow-up. SUV showed a comparable trend of reduction from a baseline mean of 8.9 to subsequent follow-up mean values equal to 3.0 ($p<0.001$ for comparison), 2.3 and 1.7. No treatment-related adverse events were reported during the study.

CLINICAL RELEVANCE/APPLICATION

The presented study on feasibility of MRgFUS, targeting bone metastasis, for the purpose of downstaging in patients affected by oligometastatic prostate cancer shows promising initial results of such an application.

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Sub-Events

NMMI02-B2 Detection Of Additional Primary Neoplasms On 18F-FACBC PET/CT In Patients With Primary Prostate Cancer

Participants
Ashwin Parihar, MBBS, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the detection rate of incidental second primary neoplasms in patients with prostate cancer on 18F-FACBC PET/CT.*Methods and Materials Imaging reports and patient demographic data were retrospectively reviewed from 663 clinical 18F-FACBC (FACBC) PET/CT studies, performed in 601 patients for the assessment of their prostate cancer from August 2016 to April 2021. SUVmax values of the suspected second neoplasms were determined. The results of FACBC PET/CT were correlated with clinical and radiological studies to determine the nature of the suspected second neoplasms.*Results 55 patients (9.1%) had findings suspicious for a second neoplasm. 39/55 had a known second malignancy diagnosis prior to the PET/CT. An incidental second primary neoplasm was first suspected on FACBC PET/CT in 16/601 patients (2.7%). 3/16 patients had PET/CT suggestive of a benign meningioma that was corroborated on magnetic resonance imaging (MRI). Of the remaining 13 patients, 11 had a tissue diagnosis confirming a malignancy. Second malignancies included renal cell carcinoma (RCC; 5/11; 45.5%), urothelial carcinoma (n=2), multiple myeloma, chondrosarcoma, cutaneous squamous cell carcinoma, squamous cell carcinoma of the esophagus and lung (n=1, each; except for esophageal and lung carcinoma being diagnosed in a single patient). Among histopathologic confirmed malignancies, clear-cell RCC had the lowest uptake (SUVmax 3.4), and cutaneous squamous cell carcinoma had the highest uptake (SUVmax 13.6). Of the two patients with no histopathologic confirmation, one had ultrasound and MRI findings corroborating the diagnosis of RCC. The other patient had a solitary lung nodule suspicious for primary lung carcinoma and elected to undergo observation.*Conclusions Incidental findings consistent with a second primary neoplasm are not infrequently seen on FACBC PET/CT for prostate cancer (9.1%). Of the incidentally detected primary cancers, RCC was the most common (45.5%). These findings indicate the need for a careful analysis of FACBC PET/CT images, and confirm the broad tumor imaging capabilities of FACBC. *Clinical Relevance/Application 18F-FACBC is a synthetic amino-acid analog and is not tumor-specific. This review of 663 FACBC PET/CT studies in 601 patients, which to our knowledge is the largest of its kind, has shown that some malignancies such as clear-cell RCC, can be identified on a routine PET/CT and need special attention to prompt further investigations. Additionally, abnormal areas of focal tracer avidity that are not typical of spread of prostate cancer need evaluation for a second neoplasm. In our series, incidental thyroid cancers were not a frequent finding, which differs from previously reported observations with 18F-FDG PET/CT.

RESULTS

55 patients (9.1%) had findings suspicious for a second neoplasm. 39/55 had a known second malignancy diagnosis prior to the PET/CT. An incidental second primary neoplasm was first suspected on FACBC PET/CT in 16/601 patients (2.7%). 3/16 patients had PET/CT suggestive of a benign meningioma that was corroborated on magnetic resonance imaging (MRI). Of the remaining 13 patients, 11 had a tissue diagnosis confirming a malignancy. Second malignancies included renal cell carcinoma (RCC; 5/11; 45.5%), urothelial carcinoma (n=2), multiple myeloma, chondrosarcoma, cutaneous squamous cell carcinoma, squamous cell carcinoma of the esophagus and lung (n=1, each; except for esophageal and lung carcinoma being diagnosed in a single patient). Among histopathologic confirmed malignancies, clear-cell RCC had the lowest uptake (SUVmax 3.4), and cutaneous squamous cell carcinoma had the highest uptake (SUVmax 13.6). Of the two patients with no histopathologic confirmation, one had ultrasound and MRI findings corroborating the diagnosis of RCC. The other patient had a solitary lung nodule suspicious for primary lung carcinoma and elected to undergo observation.

CLINICAL RELEVANCE/APPLICATION

18F-FACBC is a synthetic amino-acid analog and is not tumor-specific. This review of 663 FACBC PET/CT studies in 601 patients, which to our knowledge is the largest of its kind, has shown that some malignancies such as clear-cell RCC, can be identified on a routine PET/CT and need special attention to prompt further investigations. Additionally, abnormal areas of focal tracer avidity that are not typical of spread of prostate cancer need evaluation for a second neoplasm. In our series, incidental thyroid cancers were not a frequent finding, which differs from previously reported observations with 18F-FDG PET/CT.

NMMI02-B4 Intravenous Short-acting Insulin Therapy Impact On The 18F-FDG PET-CT Biodistribution On Incidentally Detected Hyperglycemic Patents

Participants
Aurora Mercado Sanchez, MD, Monterrey, Mexico (*Presenter*) Nothing to Disclose

PURPOSE

18F-FDG is the most used radiotracer in PET/CT, however, different situations may alter its biodistribution, hyperglycemia being one of the most frequent and with a great impact on its diagnostic accuracy; international guidelines have proposed different patient preparation protocols; with some controversy on the use of hypoglycemic agents on high FBG levels. The aim of this study is to evaluate the use of IV short-acting insulin through a safe and effective protocol to obtain acceptable image quality, without significant alteration of FDG biodistribution and the need to reschedule patients with hyperglycemia >190 mg/dl prior to the

administration of the radiotracer.*Methods and Materials A retrospective, cross-sectional, analytical study, was developed with 50 patients divided into two groups. Group I: with FBG>190 mg/dl and Group II: with FBG <180 mg/dl. Group I, received 25 IU IV short-acting insulin infusion until an FBG of <160 mg/dl was obtained, post insulin after 30 minutes radiotracer injection was given and PET/CT scan was obtained 60 min post radiotracer injection. A qualitative analysis of radiotracer was performed using a biodistribution score and a semi-quantitative analysis with the measurement of the standardized uptake value (SUV) on brain, myocardium, liver, and gluteal muscle.*Results Group I, showed a significant decrease in FBG levels (273.80 ± 48.59 to 135.30 ± 23.90mg/dL) and acceptable image quality, also when comparing to Group II, no significant difference on myocardium/liver SUVmean (2.86+1.45/2.28+0.63) respectively, was found. Diabetes was a significant factor for a non-acceptable biodistribution with p value <0.05. No patient had any complications.*Conclusions This protocol on hyperglycemic patients was safe and effective. Liver uptake, a standard measurement for many disorders, had no significant uptake alteration, being useful for accurate diagnosis. Group I showed acceptable biodistribution on 50%, nevertheless, 100% of the patients within revealed hypermetabolic tumor activity, without the need to reschedule.*Clinical Relevance/Application Short-acting insulin on hyperglycemic patients at hospitals with adequate infrastructure may be safe and effective and would reduce costs related to rescheduling and the delay in patient's diagnosis.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Short-acting insulin on hyperglycemic patients at hospitals with adequate infrastructure may be safe and effective and would reduce costs related to rescheduling and the delay in patient's diagnosis.

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Abstract Archives of the RSNA, 2021

Sub-Events

HN01-A3   **Imaging Assessment Of Head And Neck Paragangliomas With Emphasis On Detection Of Gene Mutation, Posttreatment Changes, And Differentiation From Other Tumors**

Participants
Yoshiaki Ota, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is 1. To review genetics and tumorigenesis of hereditary head and neck paragangliomas2. To predict succinate dehydrogenase (SDH) mutations using diffusion-weighted images, MR spectroscopy, and T2 texture analysis3. To demonstrate post-radiation therapy changes and differentiation from other tumors using DCE-MRI

TABLE OF CONTENTS/OUTLINE

1. Genetics and tumorigenesis- Succinate dehydrogenase mutations: SDHA, SDHB, SDHC, SDHD, and SDHAF2 - Pathophysiology of tumorigenesis associated with loss of SDH 2. Prediction of SDH mutation status - MR spectroscopy- Diffusion-weighted images- T2 texture analysis 3. Assessment of post-radiation therapy changes and differentiation from other tumors using DCE-MRI- Conventional MRI- DCE-MRI

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PD03-A

Pediatric Tuesday Poster Discussions

Sub-Events

PD03-A2   **Risk Of Hypersensitivity Reactions To Iopromide In Children And Elderly: An Analysis Of 132,850 Patients From Four Observational Studies And Pharmacovigilance Covering 287 Million Administrations**

Participants
Jan Endrikat, Berlin, Germany (*Presenter*) Researcher, Bayer AG

PURPOSE

To analyze the risk of hypersensitivity reactions (HSRs) to iopromide in children and elderly patients in comparison to adults.*Methods and Materials Four observational studies were pooled and analyzed (Analysis I). In addition, spontaneous reports from 1985 to 2020 from the global pharmacovigilance database (GPV) were evaluated (Analysis II). All patients received iopromide for angiographic procedures or contrast enhanced computed tomography in various indications. Analysis I. An observational nested case-control analysis, including a multivariable logistic regression model, based on an integrated pooled database was performed. Cases were defined as patients with a typical and unequivocal HSR, controls were patients without any recorded reaction. Analysis II: All spontaneous reports on HSRs after iopromide administration recorded in the GPV database were descriptively analyzed. Exposure estimates were derived from sales data and data from market research. The primary target variable was the risk of HSR to iopromide in children (<18 years) and elderly patients (=65 years) compared to adults (=18 to <65 years).*Results Analysis I A total of 132,850 patients were included: 2978 children, 43,209 elderly and 86,663 adults. HSRs were significantly less frequent in children (0.47%) and elderly (0.38%) compared to adults (0.74%). The adjusted odds ratio (vs. adults) for children was 0.58 ([95% CI: 0.34 - 0.98], p<0.043) and 0.51 ([95% CI: 0.43 - 0.61] for elderly p<0.001), indicating a lower risk for both sub-populations as compared to adults. Analysis II: Of the overall >287 million iopromide administrations 5.87, 114.18 and 167.97 million administrations were applied to children, elderly and adults, respectively. The reporting rate for HSRs in children (0.0114%) and elderly (0.0071%) was significantly lower as compared to adults (0.0143%) (p<0.0001).*Conclusions HSRs to iopromide were significantly less frequent in children and elderly compared to adults. This could be related to the less active immune system in these age groups.*Clinical Relevance/Application HSRs are less frequent in the clinically important age groups of children and elderly.

RESULTS

Analysis I A total of 132,850 patients were included: 2978 children, 43,209 elderly and 86,663 adults. HSRs were significantly less frequent in children (0.47%) and elderly (0.38%) compared to adults (0.74%). The adjusted odds ratio (vs. adults) for children was 0.58 ([95% CI: 0.34 - 0.98], p<0.043) and 0.51 ([95% CI: 0.43 - 0.61] for elderly p<0.001), indicating a lower risk for both sub-populations as compared to adults. Analysis II: Of the overall >287 million iopromide administrations 5.87, 114.18 and 167.97 million administrations were applied to children, elderly and adults, respectively. The reporting rate for HSRs in children (0.0114%) and elderly (0.0071%) was significantly lower as compared to adults (0.0143%) (p<0.0001).

CLINICAL RELEVANCE/APPLICATION

HSRs are less frequent in the clinically important age groups of children and elderly.

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Abstract Archives of the RSNA, 2021

Vascular Imaging Thursday Poster Discussions

Sub-Events

VA05-A1   **Comparison Of 2D And 3D Quiescent Interval Slice-selective Non-contrast MR Angiography In Patients With Peripheral Artery Disease**

Participants
Akos Varga-Szemes, MD, PhD, Charleston, South Carolina (*Presenter*) Research Grant, Siemens AGResearch Consultant, Elucid Bioimaging IncResearch Consultant, Bayer AG

PURPOSE

To evaluate the potential clinical benefit of the superior spatial resolution of 3D prototype thin-slab stack-of-stars (tsSOS) quiescent interval slice-selective (QISS) MRA over standard 2D-QISS MRA for the detection peripheral artery disease (PAD), using computed tomography angiography (CTA) as reference.*Methods and Materials Twenty-three patients (70±8 years, 18 men) with PAD who had previously undergone run-off CTA were prospectively enrolled. Patients underwent non-contrast MRA using 2D-QISS and tsSOS-QISS at 1.5T. Eighteen arterial segments were evaluated for subjective and objective image quality (normalized signal-to-noise, nSNR), vessel sharpness, and area under the curve (AUC) for >50% stenosis detection.*Results Overall subjective image quality ratings for the entire run-off were not different between tsSOS-QISS and 2D-QISS (3 [3; 4] vs 4 [3; 4], respectively; P=0.813). Sharpness of primary branch vessels demonstrated improved image quality using tsSOS-QISS compared with 2D-QISS (4 [3; 4] vs 3 [2; 3], P=0.008). Objective image quality measures were not different between 2D-QISS and tsSOS-QISS (nSNR 5.0±1.9 vs 4.2±1.8; P=0.132). AUCs for significant stenosis detection by tsSOS-QISS and 2D-QISS were 0.877 and 0.856, respectively (P=0.336).*Conclusions The prototype 3D tsSOS-QISS technique provides similar accuracy in patients with PAD to a standard commercially available 2D-QISS technique, indicating that the use of relatively thick slices does not limit the diagnostic performance of 2D-QISS. However, subjective image quality for branch vessel depiction is improved using the 3D approach.*Clinical Relevance/Application The 3D tsSOS-QISS approach obviates the need for breath-holding in the abdomen and upper pelvis and improves image quality for branch vessel depiction, therefore may supplement standard QISS if visualization of small caliber arteries is needed.

RESULTS

Overall subjective image quality ratings for the entire run-off were not different between tsSOS-QISS and 2D-QISS (3 [3; 4] vs 4 [3; 4], respectively; P=0.813). Sharpness of primary branch vessels demonstrated improved image quality using tsSOS-QISS compared with 2D-QISS (4 [3; 4] vs 3 [2; 3], P=0.008). Objective image quality measures were not different between 2D-QISS and tsSOS-QISS (nSNR 5.0±1.9 vs 4.2±1.8; P=0.132). AUCs for significant stenosis detection by tsSOS-QISS and 2D-QISS were 0.877 and 0.856, respectively (P=0.336).

CLINICAL RELEVANCE/APPLICATION

The 3D tsSOS-QISS approach obviates the need for breath-holding in the abdomen and upper pelvis and improves image quality for branch vessel depiction, therefore may supplement standard QISS if visualization of small caliber arteries is needed.

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Abstract Archives of the RSNA, 2021

CA04-B

Cardiac Wednesday Poster Discussions

Sub-Events

CA04-B1   Diagnostic Value Of Dual-energy Cardiac CTA In Left Atrial Appendage Thrombus

Participants
Feifei Zhang, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To exploring the diagnosis value of dual-energy cardiac computed tomography angiography (CTA) in detecting left atrial appendage thrombus.*Methods and Materials 180 Patients with atrial fibrillation who underwent cardiac CTA protocol (dual-energy scan for arterial phase and conventional scan for delay phase) were retrospectively enrolled in our study. The diagnosis results based on the delay phase images served as the reference standard for left atrial appendage thrombus. Quantitative dual-energy parameters, including virtual non-contrast(VNC) CT value, the added contrast CT value(?CT value), iodine concentration(IC), normalized iodine concentration (NIC) and energy spectrum curve slope (Slope) were measured for the left atrial appendage regions. The between group differences were compared by independent t-test or Wilcoxon rank sum test regarding to the normality test. The diagnosis performance of the dual-energy parameters was assessed using receiver operating characteristic curve(ROC) analysis and area under curve(AUC).*Results A total of 52 patients (25 M/22 F;mean age 62.25 ± 9.65 years) with left atrial appendage thrombus (n=10) and circulatory stasis (n=42) were finally included. The?CT values, IC, NIC and Slope were demonstrated significantly difference between left atrial appendage thrombus and circulatory stasis group (?CT values:12.64 vs 62.94HU; IC:0.12 vs 2.47; NIC:0.00 vs 19.87; Slope: -0.20 vs -5.29; p<0.05, respectively). ROC analysis revealed Slope was the most predictive parameter with area under curve equal to 0.974.In addition,the radiation dose (mSV) in the duel-energy CTA was 2.48±0.38mSV.*Conclusions Dual-energy CTA scanning shows great diagnosis value in detecting left atrial appendage thrombus with lower radiation dose.*Clinical Relevance/Application Arterial phase duel-energy CTA is recommended to replace conventional two-phase acquisition to detecting left atrial appendage thrombus and obtaining clear anatomical structure in patients with atrial fibrillation.

RESULTS

A total of 52 patients (25 M/22 F;mean age 62.25 ± 9.65 years) with left atrial appendage thrombus (n=10) and circulatory stasis (n=42) were finally included. The?CT values, IC, NIC and Slope were demonstrated significantly difference between left atrial appendage thrombus and circulatory stasis group (?CT values:12.64 vs 62.94HU; IC:0.12 vs 2.47; NIC:0.00 vs 19.87; Slope: -0.20 vs -5.29; p<0.05, respectively). ROC analysis revealed Slope was the most predictive parameter with area under curve equal to 0.974.In addition,the radiation dose (mSV) in the duel-energy CTA was 2.48±0.38mSV.

CLINICAL RELEVANCE/APPLICATION

Arterial phase duel-energy CTA is recommended to replace conventional two-phase acquisition to detecting left atrial appendage thrombus and obtaining clear anatomical structure in patients with atrial fibrillation.

Abstract Archives of the RSNA, 2021

Sub-Events

BR05-B1   Cardio Mammographic Serendipity Correlation Of Breast Vascular Calcification With Intima Media Thickness Surrogate Marker Of Cardiac Health

Participants
Sanjivanee Ingole, MBBS,MD, Amravati, India (*Presenter*) Nothing to Disclose

PURPOSE

To establish correlation of breast vascular calcification (BAC) with carotid intima media thickness(C-IMT) by comparing them with those without breast arterial calcifications, thus defining the status of cardiac health.*Methods and Materials Present study is hospital based prospective study. The sample size consisted of 272 women, all of whom underwent Mammogram. Relevant clinical history including diabetes mellitus, hypertension, heart disease & menopausal history was noted.The study group was divided into two groups of 136 subjects each depending on the presence of BAC. Group 1: Case group- BAC present. Group 2: Control group- BAC absent. All patients underwent ultrasound evaluation 8-13 MHz probe for C-IMT in bilateral common carotid arteries 1 cm proximal to the carotid bulb. The C-IMT in group 1 and group 2 were compared with vascular calcification seen on mammography.*Results The study included patients with age between 40-80 years. The mean age in case group was 56.89 ± 6.99 years and that in control group was 49.19 ± 7.59 years. Mean C-IMT in case group was 0.86 ± 0.14 mm and in control group was 0.63 ± 0.14 mm. Independent t test and Pearson correlation coefficient were performed. The study showed significant correlation of presence of BAC and increased C-IMT(p value = 0.009). Independent correlation of BAC was seen with diabetes, hypertension, heart disease (p value= 0.005) and with menopause (p value=0.00).*Conclusions ACR recommends screening mammograms for all women above 40 years of age for carcinoma screening. BAC is an incidental finding on a fair number of mammograms. C-IMT is a practical surrogate marker of coronary artery disease and in turn cardiovascular mortality and morbidity. C-IMT measurement is thus a predictor of future cardiovascuar morbidity and mortality. In this study we conclude that the presence of BAC shows statistically significant correlation increased C-IMT. In addition to this BAC also shows correlation with age, menopausal status & co-morbidities.*Clinical Relevance/Application Breast arterial calcification can give a clue toward cardiovascular health of the patient, guiding us towards further management thus reducing future cardiac morbidity and mortality

RESULTS

The study included patients with age between 40-80 years. The mean age in case group was 56.89 ± 6.99 years and that in control group was 49.19 ± 7.59 years. Mean C-IMT in case group was 0.86 ± 0.14 mm and in control group was 0.63 ± 0.14 mm. Independent t test and Pearson correlation coefficient were performed. The study showed significant correlation of presence of BAC and increased C-IMT(p value = 0.009). Independent correlation of BAC was seen with diabetes, hypertension, heart disease (p value= 0.005) and with menopause (p value=0.00).

CLINICAL RELEVANCE/APPLICATION

Breast arterial calcification can give a clue toward cardiovascular health of the patient, guiding us towards further management thus reducing future cardiac morbidity and mortality

BR05-B4   Using The Kaiser Score As A Clinical Decision Rule For Breast Lesion Classification: Do We Need Computer-assisted Curve Type Analysis?

Participants
Nina Poetsch, MD, Wien, Austria (*Presenter*) Nothing to Disclose

PURPOSE

The Kaiser score (KS) is a clinical decision rule to distinguish benign from malignant enhancing lesions in breast MRI. Enhancement curve type is the second most important criterion within the KS and can be assessed both visually and by using computer-assisted automated methods.*Methods and Materials For this IRB-approved retrospective cross-sectional study, we analyzed consecutive patients who underwent breast MRI for a BI-RADS 0, 4 or 5 rating in conventional imaging. Imaging was performed in prone position using a 1.5T scanner with a dedicated multichannel coil; the protocol included axial T2w and dynamic contrast enhanced sequences. The curve type was defined according to BI-RADS as Persistent, Plateau or Wash-out. Curve types were analyzed visually and with a pixel-wise computed parametric map (the latter using a relative initial enhancement threshold of 30%). The KS, a clinical decision rule was applied by rating five criteria (enhancement curve type, internal enhancement, margin features circumscribed vs. irregular, presence of spiculations and edema) resulting in assignment categories from 1 (= lowest risk of breast cancer) to 11 (= highest risk of breast cancer). Differences in curve type rating as well as final KS rating were compared using the AUC of the ROC curve. Inter-reader agreement was calculated with the Cohen's kappa statistics in a subset of 51 cases.*Results A total of 146 lesions (96 benign, 50 malignant) including mass (n=101 and 8 mass with associated non-mass) as well as non-mass lesions (n=37) were analyzed. Performance in distinguishing benign from malignant lesions using the KS did not differ significantly between visual analysis and parametric map (p=0.907; AUC visual 0.841 vs. AUC map 0.839). Using a KS >4 as a cut-off, we found a sensitivity of 92% and 94% at a specificity of 59% and 55% for visual analysis and parametric map respectively. Inter-reader agreement was moderate for both visual analysis (0.483) and parametric maps (0.428).*Conclusions Visual curve type analysis is as accurate as automatic curve type analysis using parametric maps.*Clinical Relevance/Application These results confirm the

robustness of the Kaiser score as its performance is not influenced by the way the enhancement curve type is assessed.

RESULTS

A total of 146 lesions (96 benign, 50 malignant) including mass (n=101 and 8 mass with associated non-mass) as well as non-mass lesions (n=37) were analyzed. Performance in distinguishing benign from malignant lesions using the KS did not differ significantly between visual analysis and parametric map (p=0.907; AUC visual 0.841 vs. AUC map 0.839). Using a KS >4 as a cut-off, we found a sensitivity of 92% and 94% at a specificity of 59% and 55% for visual analysis and parametric map respectively. Inter-reader agreement was moderate for both visual analysis (0.483) and parametric maps (0.428).

CLINICAL RELEVANCE/APPLICATION

These results confirm the robustness of the Kaiser score as its performance is not influenced by the way the enhancement curve type is assessed.

BR05-B6   Impact Of Race, Ethnicity, And Insurance Status On Breast Cancer Mortality At A Safety Net Academic Medical Center

Participants
Alexander Boyko, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Social determinants of health are factors impacting patient access to healthcare and affect disease outcomes. With decreased access, preventative interventions, such as routine screening mammography, are often underutilized, which may lead to increased mortality. We undertook this study to investigate whether race, ethnicity, and insurance status impact breast cancer mortality.*Methods and Materials This retrospective study was IRB-approved and HIPAA compliant. A review of the breast cancer registry at Boston Medical Center identified women diagnosed with breast cancer from 2008-2014. Data regarding the patient's demographics, insurance status, AJCC staging, and vital status was collected. Multivariate logistic regression modeling was used to assess mortality, and adjusted odds ratio (aOR) with 95% confidence interval (CI) were computed.*Results Of 1,155 patients who met the study criteria, 1,084 (93.9%) had complete information on all variables. The median age was 59 years (range 20-96). Distribution of race was as follows: White (n=477; 44.0%), Black (n=445, 41.1%) Asian (n=42, 3.9%) and Other (n=120, 11.1%). 909 (83.9%) patients identified as non-Hispanics. Distribution of insurance was as follows: Medicaid (n=370; 34.1%), Medicare (n=318, 29.3%), Private insurance (n=251, 23.2%), unspecified (n=62, 5.7%) and uninsured (n=83, 7.7%). Early and advanced-stage disease were present in 86% (n=932), and 14% (n=152), respectively. In multivariate analysis, no significant difference in mortality were noted by race (p=0.409) and ethnicity (p=0.398). Increasing age (aOR=1.03, 95% CI=1.01-1.05, p=0.0003) and advanced stage disease (aOR=8.24, 95% CI=5.47-12.41, p<0.0001) were associated with increased risk of death. Compared to privately insured patients, patients on Medicare had worse survival (aOR=1.77, 95% CI=1.02-3.08, p=0.041) but no difference was noted for patients on Medicaid (p=0.793), unspecified insurance (p=0.425) and uninsured (p=0.066).*Conclusions Race and ethnicity were not associated with survival in this study. Increasing age and patients with Medicare insurance reported worse survival after accounting for patient and clinical factors. Future analysis will explore these factors' impact on access to and compliance with screening mammography.*Clinical Relevance/Application Identifying factors that impact breast cancer mortality will help direct interventions to improve overall disease outcomes.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Identifying factors that impact breast cancer mortality will help direct interventions to improve overall disease outcomes.

BR05-B7   Features Of COVID-19 Vaccination Induced Axillary Lymphadenopathy And Subsequent Outcomes In Women Presenting For Breast Imaging

Participants
Aishwarya Gulati, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To assess features and outcomes of COVID-19 vaccination induced axillary lymphadenopathy (LAD) in women presenting for breast imaging.*Methods and Materials Rolling retrospective study of women with recent COVID-19 vaccine administration who presented for either screening or diagnostic mammogram or axillary ultrasound (US) between January-April 2021. All included patients had axillary LAD, underwent axillary ultrasound, and had at least one vaccine dose prior to imaging. Patients with breast cancer history or findings in the breast were not excluded. Those with systemic disease known to cause LAD were excluded. Patient characteristics, US features of LAD, and management of these patients were reviewed.*Results 30 women met inclusion criteria with an average age of 51.4 ± 13 years. 19 cases of LAD were incidentally identified on screening mammography and recalled for further evaluation; 11 cases presented for diagnostic imaging of which 72% were for axillary symptoms. The diagnostic US was a mean of 19 ± 14 days after the most recent vaccination dose. In all cases LAD was seen only ipsilateral to the side of vaccine administration and in the majority of cases (70%, 21/30) multiple enlarged nodes were seen. Mean dimensions of the largest node in each patient were 20 x 13 mm (± 6. 5 x 5.6 mm). Average cortical thickness of enlarged nodes was 4.7 ± 1.6 mm. Asymmetric cortical thickening was the most commonly seen feature (70%, 21/30) followed by partial loss of fatty hilum (23%, 7/30). 4 cases demonstrated non-hilar blood flow. Two of these patients had ipsilateral breast findings, one of which was benign and one malignant, the nodes were benign in both cases. At the time of conclusion, 66% (20/30) patients were assigned continued follow-up (BIRADs 3).*Conclusions LAD due to COVID-19 vaccination retains characteristics of benign reactive nodes such as increased cortical thickness, multiplicity, and is predominantly without non-hilar blood flow or change in shape. Reporting patterns suggest radiologists are more comfortable assigning BIRADs 3 than BIRADs 2 for this finding. Continued follow-up imaging is awaited to

better understand natural progression and timeline for resolution of LAD.*Clinical Relevance/Application This study allows better understanding of imaging features of COVID-19 vaccine induced axillary LAD, its natural history, and management patterns, both for patients with a history of breast malignancy and without.

RESULTS

30 women met inclusion criteria with an average age of 51.4 ± 13 years. 19 cases of LAD were incidentally identified on screening mammography and recalled for further evaluation; 11 cases presented for diagnostic imaging of which 72% were for axillary symptoms. The diagnostic US was a mean of 19 ± 14 days after the most recent vaccination dose. In all cases LAD was seen only ipsilateral to the side of vaccine administration and in the majority of cases (70%, 21/30) multiple enlarged nodes were seen. Mean dimensions of the largest node in each patient were 20 x 13 mm (± 6. 5 x 5.6 mm). Average cortical thickness of enlarged nodes was 4.7 ± 1.6 mm. Asymmetric cortical thickening was the most commonly seen feature (70%, 21/30) followed by partial loss of fatty hilum (23%, 7/30). 4 cases demonstrated non-hilar blood flow. Two of these patients had ipsilateral breast findings, one of which was benign and one malignant, the nodes were benign in both cases. At the time of conclusion, 66% (20/30) patients were assigned continued follow-up (BIRADs 3).

CLINICAL RELEVANCE/APPLICATION

This study allows better understanding of imaging features of COVID-19 vaccine induced axillary LAD, its natural history, and management patterns, both for patients with a history of breast malignancy and without.

BR05-B8   Subclinical Unilateral Axillary Lymphadenopathy After COVID-19 Vaccination

Participants
Sean Raj, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

This retrospective study aims to evaluate prevalence of unilateral axillary lymphadenopathy (LAD) on screening mammogram in women who have received either the first or second dose of the Pfizer-BioNTech or Moderna COVID-19 vaccines compared to women who have not. Unilateral axillary LAD can be concerning for underlying malignancy, warranting diagnostic workup and associated cost. Other vaccines such as the influenza vaccine can cause reactive lymphadenopathy and has been observed that the highly immunogenic mRNA COVID-19 vaccines cause reactive and often subclinical lymphadenopathy.*Methods and Materials In this IRB-approved study from 12/14/20 to 4/14/21, 1027 patients presented for screening mammography to our breast imaging centers across North Texas and met inclusion criteria, encompassing the date the first COVID-19 vaccine was administered and the four months following. All women who received a screening mammogram were included in the study. Vaccination status was considered if received within the 4 weeks preceding mammography. History of baseline LAD or prior cancer diagnosis were excluded. All BIRADS 0 exams for patients with any additional findings in the breast were excluded. Prior imaging results were cross-referenced to evaluate for new LAD.*Results 43 women were recalled for unilateral LAD (4.2%). 34 women (3.3%) received a COVID-19 vaccination on the ipsilateral side as the LAD (Pfizer n=19, 44.2%; Moderna n=15, 34.9%). Vaccinated women represented 79% of patients recalled for unilateral LAD. Incidence of unilateral axillary LAD was significantly higher (p-value<0.01) in those who received a COVID-19 vaccination in the 4 weeks preceding screening mammogram. The Pfizer-BioNTech vaccine produced a more robust lymphatic response compared to the Moderna vaccine, trending towards significance.*Conclusions Women who have received COVID-19 vaccines may benefit from scheduling their screening mammogram before they get vaccinated or consider delaying screening mammography to avoid a potentially extensive, financially costly, and emotionally taxing false positive work-up.*Clinical Relevance/Application Unilateral axillary LAD on screening mammography can be concerning for breast cancer and warrants diagnostic evaluation and possible biopsy. However, unilateral axillary LAD can be a normal sign of an immune response in the setting of vaccination, such as the COVID-19 vaccines. Women who received COVID-19 vaccination have presented with unilateral axillary LAD, either palpable or incidental on mammography, after vaccination. Updating screening recommendations to suggest patients schedule their mammograms either before vaccination or several weeks after vaccination can help avoid both of these issues.

RESULTS

43 women were recalled for unilateral LAD (4.2%). 34 women (3.3%) received a COVID-19 vaccination on the ipsilateral side as the LAD (Pfizer n=19, 44.2%; Moderna n=15, 34.9%). Vaccinated women represented 79% of patients recalled for unilateral LAD. Incidence of unilateral axillary LAD was significantly higher (p-value<0.01) in those who received a COVID-19 vaccination in the 4 weeks preceding screening mammogram. The Pfizer-BioNTech vaccine produced a more robust lymphatic response compared to the Moderna vaccine, trending towards significance.

CLINICAL RELEVANCE/APPLICATION

Unilateral axillary LAD on screening mammography can be concerning for breast cancer and warrants diagnostic evaluation and possible biopsy. However, unilateral axillary LAD can be a normal sign of an immune response in the setting of vaccination, such as the COVID-19 vaccines. Women who received COVID-19 vaccination have presented with unilateral axillary LAD, either palpable or incidental on mammography, after vaccination. Updating screening recommendations to suggest patients schedule their mammograms either before vaccination or several weeks after vaccination can help avoid both of these issues.

Abstract Archives of the RSNA, 2021

Sub-Events

CH02-A1   Cochrane 'Living' Systematic Review On Diagnostic Accuracy Of Chest Imaging For COVID-19: Version 4

Participants
Sanam Ebrahimzadeh, Ottawa, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

This fourth version of an ongoing Cochrane 'living' systematic review aims to evaluate the diagnostic accuracy of chest imaging (computed tomography (CT), X-ray and ultrasound) in individuals with suspected COVID-19.*Methods and Materials The Bern COVID-19 Living Database, Cochrane COVID-19 Register, and CDC Library were searched through 17/02/2021. Cross-sectional diagnostic accuracy studies involving participants of all ages with suspected COVID-19 were included. Screening, data extraction, and risk of bias assessments using the QUADAS-2 tool were completed independently, in duplicate. Pooled accuracy estimates and 95% confidence intervals (CI) were determined using a bivariate random effects model. Modalities were compared using meta-regression.*Results Ninety-nine studies (38604 participants, 19905 (52%) cases) were included; 91 studies evaluated one imaging modality each, and eight studies evaluated two modalities each. All studies used reverse transcriptase polymerase chain reaction (RT-PCR) as the reference standard. Risk of bias concerning: participant selection was high in 12 and unclear in 43 studies; reference standard was high in 27 and unclear in 36 studies; index test was high in 8 and unclear in 36 studies; and flow and timing was high in 10 and unclear in 43 studies. Chest CT (73 studies, 28937 participants) had pooled: sensitivity of 86.9% (95%CI 83.7-89.4) and specificity of 79.3% (74.3-83.5). Chest X-ray (18 studies, 9065 participants) had pooled: sensitivity of 74.4% (65.7-81.4) and specificity of 72.6% (61.8-81.3). Ultrasound (16 studies, 2259 participants) had pooled: sensitivity of 82.8% (73.8-89.1) and specificity of 29.3% (17.3-45.1). Chest CT had a higher sensitivity than chest X-ray (p<0.001); ultrasound had similar sensitivities compared to chest CT and X-ray (p>0.05). Chest CT and chest X-ray had higher specificities than ultrasound (p<0.001 for both); chest CT and X-ray had similar specificities (p>0.05).*Conclusions Chest CT is sensitive and moderately specific for diagnosing individuals with suspected COVID-19. Chest X-ray is moderately sensitive and moderately specific. Ultrasound is moderately sensitive, but not specific. However, the high or unclear risk of bias of included studies limits confidence in these findings. Compared to the findings of our previous reviews, specificity of chest CT has notably increased since the initial review version, and specificity of ultrasound has decreased since version three. Sensitivities of all modalities and specificity of chest X-ray have remained similar across all versions.*Clinical Relevance/Application Chest CT may be useful for ruling out COVID-19 in suspected individuals, but not for distinguishing COVID-19 from other respiratory illnesses.

RESULTS

Ninety-nine studies (38604 participants, 19905 (52%) cases) were included; 91 studies evaluated one imaging modality each, and eight studies evaluated two modalities each. All studies used reverse transcriptase polymerase chain reaction (RT-PCR) as the reference standard. Risk of bias concerning: participant selection was high in 12 and unclear in 43 studies; reference standard was high in 27 and unclear in 36 studies; index test was high in 8 and unclear in 36 studies; and flow and timing was high in 10 and unclear in 43 studies. Chest CT (73 studies, 28937 participants) had pooled: sensitivity of 86.9% (95%CI 83.7-89.4) and specificity of 79.3% (74.3-83.5). Chest X-ray (18 studies, 9065 participants) had pooled: sensitivity of 74.4% (65.7-81.4) and specificity of 72.6% (61.8-81.3). Ultrasound (16 studies, 2259 participants) had pooled: sensitivity of 82.8% (73.8-89.1) and specificity of 29.3% (17.3-45.1). Chest CT had a higher sensitivity than chest X-ray (p<0.001); ultrasound had similar sensitivities compared to chest CT and X-ray (p>0.05). Chest CT and chest X-ray had higher specificities than ultrasound (p<0.001 for both); chest CT and X-ray had similar specificities (p>0.05).

CLINICAL RELEVANCE/APPLICATION

Chest CT may be useful for ruling out COVID-19 in suspected individuals, but not for distinguishing COVID-19 from other respiratory illnesses.

CH02-A3   The Comparative Spectrum Of Chest CT Manifestations In COVID-19 Associated Acute Pneumonia Patients With And Without Cards (COVID-19 Associated Acute Respiratory Distress Syndrome); Mortality Influencing Factors.

Participants
Arturs Shilovs, MD, Riga, Latvia (*Presenter*) Nothing to Disclose

PURPOSE

Today, more than a billion of COVID-19 pneumonia patients worldwide are at potential risk of developing CARDS, which brings major challenges for healthcare systems and patients survival. Verification of prognostic CARDS factors, including radiology, are essential. We present our data and comparative analysis of early chest CT acute pneumonia signs in association with main clinical factors in COVID-19 patients with and without CARDS.*Methods and Materials Acute patients with confirmed SARS-CoV 2 infection upon hospitalization treated in a university hospital were enrolled in retrospective analysis study. Patients gender, age, comorbidities, general complains, clinical severity, chest CT findings and hospital outcomes were assessed. Severe illness patients were grouped according presence or absence of CARDS. Mild illness patients were excluded. Chest CT was assessed using originally created

protocol with detailed evaluation of typical radiological COVID-19 signs. Descriptive and analytical statistics was performed using SPSS software, significance was considered with p<0.05.*Results Study group comprised 245 patients with median age 67.0 [Confidence interval: 64.0 - 68.0]. 33% had no comorbidities. Overall hospital death outcome was in 26.9%; in CARDS group 75.0%. Upon hospitalization only dyspnea showed significant correlation with CARDS (p=0.01). CARDS progressed more frequently in patients with early chest CT showing consolidations, mediastinal lymphadenopathy and lung damage volume over 25% (p=0.001, p<0.001, p<0.001, respectively). There was no correlation between lung damage volume and comorbidities (p>0.05). However, diabetes and coronary artery disease had significant association with patients developing CARDS (p<0.001, p=0.01, respectively).*Conclusions Lung damage volume, mediastinal lymphadenopathy, and consolidations on CT are independent factors associated with CARDS. Patients with comorbidities and higher lung damage volume showed higher frequency of developing CARDS, which corresponds to higher mortality in this group of patients.*Clinical Relevance/Application Study shows importance of early detailed chest CT symptoms assessment in acute severe COVID-19 pneumonia patients. Definite radiological signs can be a prognostic factor of intra-hospital risk for developing CARDS and higher mortality risk.

RESULTS

Study group comprised 245 patients with median age 67.0 [Confidence interval: 64.0 - 68.0]. 33% had no comorbidities. Overall hospital death outcome was in 26.9%; in CARDS group 75.0%. Upon hospitalization only dyspnea showed significant correlation with CARDS (p=0.01). CARDS progressed more frequently in patients with early chest CT showing consolidations, mediastinal lymphadenopathy and lung damage volume over 25% (p=0.001, p<0.001, p<0.001, respectively). There was no correlation between lung damage volume and comorbidities (p>0.05). However, diabetes and coronary artery disease had significant association with patients developing CARDS (p<0.001, p=0.01, respectively).

CLINICAL RELEVANCE/APPLICATION

Study shows importance of early detailed chest CT symptoms assessment in acute severe COVID-19 pneumonia patients. Definite radiological signs can be a prognostic factor of intra-hospital risk for developing CARDS and higher mortality risk.

CH02-A4 Does Imaging Pattern Differ Between COVID19 Infection Due To Initial Sars-cov-2 Virus And Variant Of Concern 202012/1 Known As The Uk Variant?

Participants
Olivier Lucidarme, MD, Paris, France (*Presenter*) Speaker, Bracco Group;Speaker, F. Hoffmann-La Roche Ltd;Expert Witness, Bayer AG

PURPOSE

A variant of concern (VOC-202012/1 known as the UK variant) of SARS-COV-2 virus was identified in early October 2020 and rapidly replaced the Wuhan strains. The authors reported in early 2021 that infections with this new variant were associated with a significantly increased risk of death. The patterns of Covid19-induced pulmonary CT were described during 2020 prior to the emergence of this variant and the objective of this study was to investigate whether pulmonary involvement is different with this new variant.*Methods and Materials This retrospective study was approved by our institutional review board. Between December 22, 2020, and March 19, 2021, a senior chest radiologist reviewed chest CT scans of 242 patients with RT-PCR positive for SARS-COV-2. She was unaware of the results of the genotyping variant identification performed for each patient or the quantification of virus copies. She used a standardized reading grid that included the indication and timing of CT and the CT patterns classically reported in the literature. Comparison between the groups of patients infected with Wuhan strain and VOC 202012/1 and correlations with the virus copy number were performed.*Results 118 patients (mean age 66 years, men 57%) were infected with Wuhan strain (group 1), 124 (mean age 65 years, men 52%) with VOC 202012/1 (group 2). Bilateral and multifocal ground-glass opacities (GGO) were observed in 92% and 91% of patients in groups 1 and 2 respectively (NS). Consolidations were found in 69% (group 1) and in 72% (group 2)(NS), Crazy paving was present in 70% (group 1) and 78% (group 2)(NS). A pulmonary embolism was found in 9% in group 1 and in 4% in group 2 (NS). The topography of the lesion was also similar, essentially peripheral for both groups. The extension of the disease did not vary significantly between both groups and was not correlated with the viral load (virus copy number).*Conclusions The CT signature of the Wuhan and UK variants did not differ.*Clinical Relevance/Application The UK variant of SARS-COV2 induces macroscopically the same lesions on chest CT as the original Wuhan virus. Chest CT cannot be used to distinguish between these two viruses.

RESULTS

118 patients (mean age 66 years, men 57%) were infected with Wuhan strain (group 1), 124 (mean age 65 years, men 52%) with VOC 202012/1 (group 2). Bilateral and multifocal ground-glass opacities (GGO) were observed in 92% and 91% of patients in groups 1 and 2 respectively (NS). Consolidations were found in 69%(group 1) and in 72% (group 2)(NS), Crazy paving was present in 70% (group 1) and 78% (group 2)(NS). A pulmonary embolism was found in 9% in group 1 and in 4% in group 2 (NS). The topography of the lesion was also similar, essentially peripheral for both groups. The extension of the disease did not vary significantly between both groups and was not correlated with the viral load (virus copy number).

CLINICAL RELEVANCE/APPLICATION

The UK variant of SARS-COV2 induces macroscopically the same lesions on chest CT as the original Wuhan virus. Chest CT cannot be used to distinguish between these two viruses.

CH02-A7 Diffuse Alveolar Hemorrhage: A Practical Approach For The General Radiologist

Participants
Julia Asmar, MD, Kansas City, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

Discuss etiology, histopathology and clinical presentation of diffuse alveolar hemorrhage (DAH)

TABLE OF CONTENTS/OUTLINE

Alveolar hemorrhage is defined pulmonary alveolar blood and often manifests with hemoptysis, but up to 30% of patients have nonspecific symptoms. Most exhibit diffuse alveolar hemorrhage (DAH), based on extent of involvement, but focal hemorrhage also occurs. Idiopathic pulmonary hemorrhage/hemosiderosis (IPH) is a distinct entity, but other conditions associated with DAH must be excluded including autoimmunity (capillaritis), bland hemorrhage (e.g. edema, anticoagulation). DAH often presents a diagnostic challenge for radiologists, particularly in the absence of hemoptysis or when associated conditions are not known or considered.We

present a practical strategy for the imaging assessment of DAH optimized for the general radiologist that relies on careful analysis of clinical history and laboratory findings. Specific clinical scenarios include:1. Anti-glomerular basement membrane disease (Goodpasture syndrome), granulomatosis with polyangiitis (GPA) and microscopic polyangiitis (MCP) cause DAH and renal failure; GPA and MCP are often associated with neuropathy.2. DAH may affect young women with systemic lupus erythematosus, but is rarely the initial manifestation.3. Antiphospholipid syndrome may produce various vascular manifestations including DAH.4. Drug toxicity may manifest with DAH.5. Pulmonary fibrosis is a known complication of recurrent DAH, particularly IPH.

Abstract Archives of the RSNA, 2021

Sub-Events

SDP-MS-1   Hyperpolarized 13C-pyruvate MR Imaging In Rodent Model Of Ventricular Fibrillation Cardiac Arrest: A Feasibility Study

Participants
Ilwoo Park, PhD, Gwangju, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To explore the feasibility of hyperpolarized (HP) 13C MRI in assessing metabolic changes in brain within 1 hour of return of spontaneous circulation (ROSC) in the rodent model of ventricular fibrillation-induced cardiac arrest (VFCA).*Methods and Materials 9-week-old 8 male rats, including 5 cardiac arrest (CA) and 3 sham controls, were included. Under isoflurane anesthesia, oral intubation and mechanical ventilation were performed. VFCA was induced by trans-esophageal electrical stimulation. After 7min of untreated VFCA, resuscitation was started with manual chest compressions (250/min). At 2 minutes of CPR, defibrillation attempts repeated every 2min. Epinephrine (20ug/kg) and bicarbonate (1mEq/kg) were given iv 30s prior to the start of CPR. Epinephrine alone at 10ug/kg was administered 90s after the start of CPR and repeated every 2min during CPR. Upon achieving spontaneous circulation that defined mean arterial pressure above 50mmHg for 5min and after 20 minutes stabilizing period, animals were transferred to scanner for MR exam. MR data were obtained within 1 hour of return of ROSC using a 3T scanner with a multi-nuclear capability. Slice-localized (25mm) 13C MRS data were acquired from brain with injection of 3mL, 100 mM 13C1-pyruvate solution, which had been polarized using DNP polarizer. At 72 hours post-CA, the brains of rats were harvested for pathology.*Results Fig1 shows representative 13C dynamic spectra. CA models had significantly higher Lactate/Pyruvate than sham control (Fig2), indicating a cellular metabolic change occurring in the brain of CA animals at early ROSC. Pathological analysis revealed marked differences between the brains of CA and sham animals. In contrast to sham, a large amount of neuronal damage and reactive astrocytes appeared in region CA1 of CA model.*Conclusions We demonstrated that HP 13C MRI can identify the metabolic changes within 1 hour of return of ROSC in rodent model of VFCA.*Clinical Relevance/Application This novel technique may provide a unique and noninvasive imaging biomarker for identifying the sign of neurologic abnormality, which is a fundamental base of post-CA care for further supportive interventions.

RESULTS

Fig1 shows representative 13C dynamic spectra. CA models had significantly higher Lactate/Pyruvate than sham control (Fig2), indicating a cellular metabolic change occurring in the brain of CA animals at early ROSC. Pathological analysis revealed marked differences between the brains of CA and sham animals. In contrast to sham, a large amount of neuronal damage and reactive astrocytes appeared in region CA1 of CA model.

CLINICAL RELEVANCE/APPLICATION

This novel technique may provide a unique and noninvasive imaging biomarker for identifying the sign of neurologic abnormality, which is a fundamental base of post-CA care for further supportive interventions.

SDP-MS-2   Worklist Reprioritization Using Artifical Intelligence Improves Turnaround Times Of Chest CT Examinations Positive For Acute Pulmonary Embolism

Participants
Brendan Harrison, MD, Burlington, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the effect of an AI algorithm for the detection of pulmonary embolism on study turnaround time.*Methods and Materials A total of 4,069 CT chest with contrast scans performed at a tertiary care medical center between October 2019 and February 2020 were retrospectively identified (ED - 1470, Inpatient - 667, Outpatient - 1932). During this time period, 2,742 scans were analyzed by a commercially available artificial intelligence (AI) algorithm utilized for the detection of PE (CT pulmonary angiograms) and incidental PE (on contrast enhanced CT of the chest not performed to evaluate for PE). Positive cases were flagged by the algorithm and brought to the top of the radiology worklist. The remaining 1,327 scans, were read according to their priority, with no AI prioritization. All 4,069 cases reports were classified as positive or negative for pulmonary embolism using Natural Language Processing (NLP) on the radiology report to establish ground truth. The radiology turnaround time (RTAT) between positive and negative cases was compared for the cases that had AI result, and cases that didn't, and stratified by patient class. RTAT was defined as the time difference between scan completion and report completion time (when the report enters preliminary or final status, whichever comes earlier). An RTAT threshold was set for each patient class to exclude extreme outliers : ED - 160 minutes, IP - 300 minutes, OP - 500 minutes.*Results The average TAT of positive pulmonary embolism (by NLP) cases that were analyzed by AI was 34.2 minutes, while the average TAT of negative pulmonary embolism cases was 68.25 minutes. The difference between positive and negative cases of pulmonary embolism was 34.05 minutes (CI: 21.3275 to 46.7725 P < 0.01). The average TAT of positive pulmonary embolism (by NLP) cases that were NOT analyzed by AI was 58.80 minutes while the average TAT of negative incidental pulmonary embolism cases was 51.18 minutes. The difference between positive and negative cases of incidental pulmonary embolism was +7.62 minutes.*Conclusions Using an AI algorithm that prioritizes cases with a positive pulmonary embolism, positive cases of pulmonary embolism, including incidentally detected pulmonary embolism have a substantially shorter

turnaround time when compared to negative cases.*Clinical Relevance/Application Through the implementation of commercially available AI software which accurately and quickly identifies cases of pulmonary embolism for worklist prioritization, radiology practices can improve their turnaround time of positive cases, allowing for expedited therapeutic intervention.

RESULTS

The average TAT of positive pulmonary embolism (by NLP) cases that were analyzed by AI was 34.2 minutes, while the average TAT of negative pulmonary embolism cases was 68.25 minutes. The difference between positive and negative cases of pulmonary embolism was 34.05 minutes (CI: 21.3275 to 46.7725 P < 0.01). The average TAT of positive pulmonary embolism (by NLP) cases that were NOT analyzed by AI was 58.80 minutes while the average TAT of negative incidental pulmonary embolism cases was 51.18 minutes. The difference between positive and negative cases of incidental pulmonary embolism was +7.62 minutes.

CLINICAL RELEVANCE/APPLICATION

Through the implementation of commercially available AI software which accurately and quickly identifies cases of pulmonary embolism for worklist prioritization, radiology practices can improve their turnaround time of positive cases, allowing for expedited therapeutic intervention.

SDP-MS-3   Dynamic Nuclear Polarization MRI For Detecting The Reactive Oxygen Species Using Spin-trapping Agent

Participants
Shinichi Shoda, RT,PhD, Gifu City, Japan (*Presenter*) Nothing to Disclose

PURPOSE

With the aim of developing a technique for visualizing the Reactive Oxygen Species (ROS) caused by inflammation and radiation, we attempted to visualize hydroxyl radicals (•OH) production using Dynamic Nuclear Polarization-MRI (DNP-MRI). In addition, we investigated the imaging of the effect of thiol compounds on •OH production as an antioxidant by DNP-MRI.*Methods and Materials We used a low magnetic field DNP-MRI system (Keller) using electron spin resonance as hyperpolarized MRI. The Fenton reaction was used in the phantom tubes to generate hydroxyl radicals. A spin trap agent, 5,5-dimethyl-1-pyrroline N-oxide (DMPO), was used to detect •OH, and DMPO-OH was detected as its spin adduct. First, the generation of hydroxyl radicals was confirmed by detecting DMPO-OH using an X-band EPR. In DNP-MRI, phantom imaging by DNP-MRI was performed while changing the EPR irradiation frequency from 460 to 483 MHz at intervals of 0.5 MHz or 1 MHz in order to determine the optimum EPR excitation irradiation frequency. Subsequently, a thiol compound was added to the phantom as a radical scavenger, and an antioxidant for •OH production was evaluated by EPR. After that, the OH scavenging effect was imaged by DNP-MRI using the determined optimum EPR irradiation frequency.*Results •OH produced by the Fenton reaction was reacted with DMPO, and four peaks (ratio 1: 2: 2: 1) were detected in the EPR spectrum, confirming that DMPO-OH was generated. Imaged by DNP-MRI at various EPR frequencies to obtain the DNP effect, the maximum enhancement of DMPO-OH was observed at 474.5 MHz. The augmentation factor (DNP on / DNP off) was 3.07 at 474.5MHz. Furthermore, it was shown that the use of DMSO, which inhibits OH production, suppresses the DNP enhancement of DMPO-OH. We then selected multiple thiol compounds and realized that the radical scavenging effects of multiple DNP-MRI samples could be visualized simultaneously.*Conclusions We succeeded in visualizing hydroxyl radicals using DNP-MRI and DMPO, and showed that the effect of scavenging hydroxyl radicals can be evaluated.*Clinical Relevance/Application Visualization of •OH may help in the early diagnosis of reactive oxygen species-related inflammations and diseases. In KORTUC, which is attracting attention as a new radiation sensitization treatment, radiation therapy is performed after injecting a drug containing H2O2 into tumor tissue. It is considered that •OH imaging can be used to obtain information on radical localization in the treatment area. It is expected to expand to new seranostics by enhancing the radiotherapy effect and at the same time visualizing the therapeutic area.

RESULTS

•OH produced by the Fenton reaction was reacted with DMPO, and four peaks (ratio 1: 2: 2: 1) were detected in the EPR spectrum, confirming that DMPO-OH was generated. Imaged by DNP-MRI at various EPR frequencies to obtain the DNP effect, the maximum enhancement of DMPO-OH was observed at 474.5 MHz. The augmentation factor (DNP on / DNP off) was 3.07 at 474.5MHz. Furthermore, it was shown that the use of DMSO, which inhibits OH production, suppresses the DNP enhancement of DMPO-OH. We then selected multiple thiol compounds and realized that the radical scavenging effects of multiple DNP-MRI samples could be visualized simultaneously.

CLINICAL RELEVANCE/APPLICATION

Visualization of •OH may help in the early diagnosis of reactive oxygen species-related inflammations and diseases. In KORTUC, which is attracting attention as a new radiation sensitization treatment, radiation therapy is performed after injecting a drug containing H2O2 into tumor tissue. It is considered that •OH imaging can be used to obtain information on radical localization in the treatment area. It is expected to expand to new seranostics by enhancing the radiotherapy effect and at the same time visualizing the therapeutic area.

SDP-MS-4   Employing A Natural Language Processing (NLP) Model To Predict And Compare Case Acuity Based On Radiological Reports In A 5-Hospital Academic Health System

Participants
Sina Mazaheri, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

There has been limited research on acuity specifically pertaining to radiologic image findings, or report acuity. Report acuity can be leveraged as a triage process for patients within their care pathway. The purpose of this study was to develop a tool to assess report acuity and compare acuity across 5 hospitals within our Academic Health System (AHS).*Methods and Materials Hospital records were used to collect descriptive characteristics. The radiology reports of emergency room patients in 2019 were extracted and annotated by 5 radiology residents under faculty supervision using an annotation key developed by ACR's Actionable Reporting Work Group. A Transformer-based NLP called Bidirectional Encoder Representations from Transformers (BERT) was employed to analyze the multi-modal radiology reports and classify them into Non-Acute, Acute and Critical categories. Report acuity was calculated as the fraction of Acute and Critical cases.*Results Hospital 1 is a Safety Net Hospital (SNH) and a comprehensive stroke and Level 1 trauma center. Hospitals 1, 2 and 3 are the major teaching hospitals. Hospitals 4 and 5 are community-based. Hospital 1 had a higher volume of emergency department imaging than the remaining hospitals combined (166,789 vs. 159,767). Hospital 1 had significantly higher acute and critical imaging findings (28.9% vs. 15.2-15.6%, p < 0.001). The BERT NLP model

achieved 93% precision, 95% recall and 0.94 f1-score for identifying acute cases, and 82% precision and recall with a 0.82 f1-score for critical cases. The algorithm achieved high performance for non-acute cases (98 precision, 96% recall and 0.97 f1-score). The overall NLP accuracy was 95%.*Conclusions The BERT NLP model achieved a high performance in predicting acuity of multi-modal emergency imaging studies, demonstrating a higher level of acuity in Hospital 1 compared to other hospitals in our AHS. This type of information provided by similar NLP models may be beneficial in tasks such as patient triage, resource allocation, and staffing.*Clinical Relevance/Application Understanding report acuity can aid in beneficial tasks such as patient triage, resource allocation, and staffing models across busy health systems.

RESULTS

Hospital 1 is a Safety Net Hospital (SNH) and a comprehensive stroke and Level 1 trauma center. Hospitals 1, 2 and 3 are the major teaching hospitals. Hospitals 4 and 5 are community-based. Hospital 1 had a higher volume of emergency department imaging than the remaining hospitals combined (166,789 vs. 159,767). Hospital 1 had significantly higher acute and critical imaging findings (28.9% vs. 15.2-15.6%, p < 0.001). The BERT NLP model achieved 93% precision, 95% recall and 0.94 f1-score for identifying acute cases, and 82% precision and recall with a 0.82 f1-score for critical cases. The algorithm achieved high performance for non-acute cases (98 precision, 96% recall and 0.97 f1-score). The overall NLP accuracy was 95%.

CLINICAL RELEVANCE/APPLICATION

Understanding report acuity can aid in beneficial tasks such as patient triage, resource allocation, and staffing models across busy health systems.

SDP-MS-5 **High-Resolution MRI With Extended Delayed Imaging For Identification Of Peritoneal Disease**

Participants
Milica Medved, PhD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

We introduce a novel, high-resolution (HR) MRI protocol with extended delayed imaging for improved detection of malignant peritoneal mesothelioma (MPM). We examine MPM signal enhancement patterns to identify optimal post-contrast imaging delay time.*Methods and Materials 14 patients with MPM scheduled for laparoscopy/laparotomy received MRI scans on a 3T Philips Ingenia dStream scanner. The MRI protocol included pre-contrast axial 2D T2w and coronal 2D T2w, pre-contrast free breathing axial T2w with fat saturation, and pre-and post-contrast (10 min delay) axial 3D T1w sequences at spatial resolutions of 1.2-1.7 mm in-plane. The novel sequences included a pre-contrast free breathing HR coronal 2D T2w sequence at 0.8 mm spatial resolution and pre-and post-contrast 3-breatholds HR coronal 3D T1w mDixon sequences at 1.2 mm spatial resolution, centered on the liver dome and acquired with an approximately 7, 13, 16, and 20 min delay after injection of a double dose of gadoterate meglumine. MPM lesions were identified with reference to laparoscopy. Lesion signal was measured on the HR coronal 3D T1w images, normalized to fat at each post-contrast timepoint, and modeled as a linear function of time. We explored the correlation of slope (Sl) of the normalized signal change with time with lesion shape (mass vs linear) on a per-lesion basis. Average Sl was correlated with histologic grade, pathology score, presence of heart disease, prior chemotherapy status, and age on a per-patient basis. Multiple regression analysis was used to construct an improved predictor of Sl.*Results Average Sl was 0.009 ± 0.067 1/min (range -0.04 - 0.20 1/min). Statistically significant correlation (r = -0.56) of Sl with pathology score was observed, with higher scores predicting a washout pattern (Sl < 0). Presence of heart disease correlated with an uptake pattern (Sl > 0). A composite classifier including pathology score and presence of heart disease achieved a correlation coefficient of r = 0.65.*Conclusions A moderately delayed (7-12 min) T1w sequence may be more sensitive to high-grade MPM in patients without heart disease, while a longer delay (15+ min) may be more sensitive in patients with low-grade MPM and heart disease.*Clinical Relevance/Application A 10 min post-contrast high resolution T1w MRI is appropriate for high grade peritoneal disease. A longer delay may show higher sensitivity in low grade disease or patients with heart disease.

RESULTS

Average Sl was 0.009 ± 0.067 1/min (range -0.04 - 0.20 1/min). Statistically significant correlation (r = -0.56) of Sl with pathology score was observed, with higher scores predicting a washout pattern (Sl < 0). Presence of heart disease correlated with an uptake pattern (Sl > 0). A composite classifier including pathology score and presence of heart disease achieved a correlation coefficient of r = 0.65.

CLINICAL RELEVANCE/APPLICATION

A 10 min post-contrast high resolution T1w MRI is appropriate for high grade peritoneal disease. A longer delay may show higher sensitivity in low grade disease or patients with heart disease.

Abstract Archives of the RSNA, 2021

Sub-Events

HN03-C1 **Dual-energy Parathyroid CT: Optimizing Differentiation Of Parathyroid Lesions From Thyroid Using Noncontrast Virtual Monoenergetic Images**

Participants
Paul Latterman, MD, Winston Salem, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

Noncontrast dual-energy CT (DECT) 40 keV virtual monoenergetic images (VMI) reportedly facilitate discrimination of parathyroid lesions from thyroid gland by disproportionately increasing thyroid attenuation and the associated thyroid:parathyroid contrast-to-noise ratio (CNR) compared to standard (70 keV VMI) noncontrast DECT images.We hypothesize additional CNR gains at keVs intermediate between 40 and 70 keV VMI resulting by balancing the disproportionate increase in thyroid iodine attenuation at lower keV against the cost of increased noise. Our purpose is to test this hypothesis through quantitative image assessment.*Methods and Materials This single institution, retrospective study included patients undergoing parathyroid DECT prior to parathyroidectomy for primary hyperparathyroidism. Patients were excluded for prior thyroidectomy or if the largest pathologically-proven parathyroid lesion measured less than 1 cm.Regions of interest (ROIs) were placed within the thyroid, the largest proven parathyroid lesion, and subcutaneous neck fat by a radiology resident on noncontrast 40, 45, 50, 55, 60, 65, and 70 keV VMI. Mean and SD HU attenuation were recorded.Thyroid:parathyroid CNR was calculated using: (ROIthy - ROIpar)/SD, where ROIthy = mean thyroid HU, ROIpar = mean parathyroid lesion HU, and SD = SD of mean subcutaneous fat HU.*Results The final cohort included 24 patients (10 male, 14 female, median age 64 years).Median thyroid:parathyroid CNR for the overall cohort was greatest (4.95) at 45 keV and least at 70 keV (4.46; p=0.007, Wilcoxon signed rank test).Among individuals, thyroid:parathyroid CNR was greatest at a keV intermediate between 40 and 70 keV in 17 (71%) patients, greatest at 40 keV in 7 (29%) patients, and greatest at 70 keV in 0 patients.Among the 17 for whom CNR was greatest at an intermediate keV, CNR was maximum at 65 keV for 10, 60 keV for 1, 55 keV for 4, 50 keV for 1, and 45 keV for 1.Overall cohort median CNR at 40 keV (4.83) was not significantly different from 45 keV (4.95, p=0.48, Wilcoxon signed rank test), 50 keV (4.82, p=0.30), 55 keV (4.93, p=0.35), 60 keV (4.83, p=0.77), or 65 keV (4.79, p=0.62).*Conclusions Although noncontrast parathyroid DECT VMI spanning 45 keV to 65 keV enable small increases in thyroid:parathyroid CNR for most patients compared to CNR at 40 keV, these increases are not statistically significant, and there is no single optimal keV that maximizes CNR in all patients.*Clinical Relevance/Application No optimal intermediate VMI keV was identified for discriminating parathyroid lesions from thyroid gland on the noncontrast phase of parathyroid DECT. As such, we will continue our baseline practice of reconstructing and reviewing both 40 keV and 70 keV noncontrast VMI in all patients.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

No optimal intermediate VMI keV was identified for discriminating parathyroid lesions from thyroid gland on the noncontrast phase of parathyroid DECT. As such, we will continue our baseline practice of reconstructing and reviewing both 40 keV and 70 keV noncontrast VMI in all patients.

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Sub-Events

RI03-C1 **Chiari II And Percutaneous Fetoscopic Spina Bifida Repair: Frequency Of Imaging Findings In Fetal MRI.**

Participants
Mariana Rodrigues, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

Chiari II malformation has a relatively high prevalence with possible prenatal correction, which provides better motor outcomes and reduces the need for ventricular shunt. Our aim was to describe Chiari II malformation imaging findings, their associations, and review pre and post fetoscopic repair features in fetal MRI.*Methods and Materials Our database of fetal MRI was fully reviewed from 2006 to 2020 in our institution. Inclusion criteria encompassed fetuses with diagnosis of Chiari II malformation and complete central nervous system characterization, submitted to exams in 1.5 MRI equipment. We have listed the imaging findings and investigated their associations. We have reviewed cases according to ventricular dilation degree, third ventricle diameter, measure of tonsillar herniation, grading of cerebellar ectopia and subarachnoid space (SAS), categorized myelomeningocele sac (flaccid versus tense) and sagittal superior sinus (SSS) diameter.*Results Among 129 fetal mri exams, 49 were diagnosed with Chiari II malformations, which represented 38 different pregnant patients, including 11 exams performed post fetoscopy surgery.Enlarged SAS in fetuses without surgery were more common in tense sacs, 11/16 of cases, and no case of sulcal effacement among tense sacs were observed. On the other hand, flaccid sacs were associated with partial SAS effacement 16/20, or total extra-axial cerebrospinal fluid effacement 4/20 cases (P< 0.05). The SSS diameter was thinner in tense sacs fetuses compared to flaccid / poorly defined sacs and post surgery measures, a medium size of 3.19, 3.31 and 3.56 respectively (boxplot chart). The regression of the tonsillar herniation was observed in all cases (11/11) that underwent percutaneous fetoscopic spina bifida repair, and enlargement of ventricles after surgery was present in 11/11 of cases.*Conclusions Besides fundamental features of Chiari II malformation, our study provides data supporting percutaneous fetoscopic spina bifida repair for meningomyelocele repair, direct association of the tension of sacs with enlargement of SAS and conversely proportion tendency of sagittal sinus diameter and the tension of myelomeningocele sacs.*Clinical Relevance/Application A well described report containing complete information helps on central nervous system assessment and supports the decision on whether or not to operate in utero. A comparison of pre and post percutaneous fetoscopic spina bifida repair is also essential to the improvement of surgery technique.

RESULTS

Among 129 fetal mri exams, 49 were diagnosed with Chiari II malformations, which represented 38 different pregnant patients, including 11 exams performed post fetoscopy surgery.Enlarged SAS in fetuses without surgery were more common in tense sacs, 11/16 of cases, and no case of sulcal effacement among tense sacs were observed. On the other hand, flaccid sacs were associated with partial SAS effacement 16/20, or total extra-axial cerebrospinal fluid effacement 4/20 cases (P< 0.05). The SSS diameter was thinner in tense sacs fetuses compared to flaccid / poorly defined sacs and post surgery measures, a medium size of 3.19, 3.31 and 3.56 respectively (boxplot chart). The regression of the tonsillar herniation was observed in all cases (11/11) that underwent percutaneous fetoscopic spina bifida repair, and enlargement of ventricles after surgery was present in 11/11 of cases.

CLINICAL RELEVANCE/APPLICATION

A well described report containing complete information helps on central nervous system assessment and supports the decision on whether or not to operate in utero. A comparison of pre and post percutaneous fetoscopic spina bifida repair is also essential to the improvement of surgery technique.

NMMI04-D

Nuclear Medicine/Molecular Imaging Wednesday Poster Discussions

Sub-Events

NMMI04-D1 DIFFERENTIATION OF RENAL ONCOCYTOMA FROM RENAL CELL CARCINOMA BY MEANS OF 99MTC-SESTAMIBI SPECT/CT

Participants
Antonios Tzortzakakis, Stockholm, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

An increasing body of literature indicates the beneficial role of 99mTc-Sestamibi SPECT/CT in the non-invasive differentiation of renal oncocytoma (RO) from renal cell carcinoma (RCC). We present a comprehensive approach of 99mTc-Sestamibi SPECT/CT examination following the implementation of quantitative tools in addition to visual assessment. An additional aim is to explain the differences in 99mTc-Sestamibi uptake among the different RCC subgroups on histometabolomic grounds.*Methods and Materials 57 radiologically detected kidney tumours from 52 patients were examined. Each participant underwent a 99mTc-Sestamibi SPECT/CT examination before nephrectomy or percutaneous kidney biopsy. Kidney tumours with increased 99mTc-Sestamibi uptake were classified as positive. In contrast, those with equal or decreased 99mTc-Sestamibi compared to the ipsilateral non-tumoral kidney parenchyma were classified as negative. Following the visual assessment, quantitative SUVmean and SUVmax measurements performed in the examined kidney tumour and the non-tumoral kidney parenchyma that correlated with the histopathological results. Additional immunohistochemical investigation, in situ metabolomics profile characterisation and correlation of mitochondrial content with 99mTc-Sestamibi SPECT/CT data, were performed.*Results Visual assessment of 99mTc-Sestamibi SPECT/CT resulted in a sensitivity of 82% whereas, the quantitative assessment showed a sensitivity of 64% regarding the preoperative characterisation of RO. 99mTc-Sestamibi SPECT/CT identifies a larger Sestamibi-positive tumour group containing RO, hybrid oncocytic chromophobe tumour (HOCT) and the majority of chromophobe RCC (chRCC). A discriminatory metabolomic signature was identified for Sestamibi positive Birt-Hogg-Dubè-associated HOCT vs other renal oncocytic tumours. Metabolomic differences were found between Sestamibi positive and negative chRCCs.*Conclusions Sestamibi positive kidney tumours on SPECT/CT are possibly of benign nature. Quantitative assessment with SUV SPECT measurements did not improve the diagnostic performance of 99mTc-Sestamibi SPECT/CT.*Clinical Relevance/Application Sestamibi negative kidney tumours should be considered for surgery due to their possibly malignant nature. On the other hand, Sestamibi positive kidney tumours could be suited for biopsy and/or follow up according to surveillance protocols.

RESULTS

Visual assessment of 99mTc-Sestamibi SPECT/CT resulted in a sensitivity of 82% whereas, the quantitative assessment showed a sensitivity of 64% regarding the preoperative characterisation of RO. 99mTc-Sestamibi SPECT/CT identifies a larger Sestamibi-positive tumour group containing RO, hybrid oncocytic chromophobe tumour (HOCT) and the majority of chromophobe RCC (chRCC). A discriminatory metabolomic signature was identified for Sestamibi positive Birt-Hogg-Dubè-associated HOCT vs other renal oncocytic tumours. Metabolomic differences were found between Sestamibi positive and negative chRCCs.

CLINICAL RELEVANCE/APPLICATION

Sestamibi negative kidney tumours should be considered for surgery due to their possibly malignant nature. On the other hand, Sestamibi positive kidney tumours could be suited for biopsy and/or follow up according to surveillance protocols.

NMMI04-D2 A Role Of 18F-FDG-PET/CT In The Detection Of The Cause Of Fever In Post-COVID-19 Syndrome

Participants
Jiri Ferda, MD, PhD, Pilsen, Czech Republic (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the relationship between the 18F-FDG-PET/CT findings and the detection of the febrile state in postCovid-19 patients*Methods and Materials During the secondary and tertiary pandemic wave of the infections by new coronavirus SARS-CoV2, there were performed 43 examinations of the patients (19 female, males, 24 males, mean age 59,6). All patients suffered from the recurrent febrile state of uncertain origin occuring more than 14 days after they underwent COVID-19, and remained unclear after clinical, laboratory or conventional imaging. PET/CT including intravenous application of the iodinated contrast material (80 ml, 370 mg I/ml, and with the application of 2.5 MBq/kg of 18F-fluorodeoxyglucose. Data acquisition started after 60 min after the radiopharmaceutical aplication.*Results The following findings were seen to be related with the febrile state: 14 cases of persistent inflammatory, FDG avid changes in lung parenchyma, 11 cases of colitis (in 7 of them followed confirmation of Clostridium difficile), 6 cases of the FDG avid multiple lymph nodes in mediastinum or in retroperitoneum, 3 cases of detected lung tumors, 3 cases of vasculitis with the FDG accumulation within the arterial wall, and no relevant finding in 6 cases thus the cause of fever remained undetected.*Conclusions Even the most frequent finding in febrile post-COVID-19 syndrome is teh presence of the metabolical active lung involvement, the important group of the patients are those who suffering from the colitis. The Clostridium difficile is relatively frequently found, probable as a consequence to the excessive use of wide-spectral antibiotics during severe state of COVID-19 pneumonia.*Clinical Relevance/Application PET/CT with the application of 18-fluorodeoxyglucose aids in the detection of the complications after COVID-19 in patients suffering from febrile state, the results may to trigger relevant therapy.

RESULTS

The following findings were seen to be related with the febrile state: 14 cases of persistent inflammatory, FDG avid changes in lung parenchyma, 11 cases of colitis (in 7 of them followed confirmation of Clostridium difficile), 6 cases of the FDG avid multiple lymph nodes in mediastinum or in retroperitoneum, 3 cases of detected lung tumors, 3 cases of vasculitis with the FDG accumulation within the arterial wall, and no relevant finding in 6 cases thus the cause of fever remained undetected.

CLINICAL RELEVANCE/APPLICATION

PET/CT with the application of 18-fluorodeoxyglucose aids in the detection of the complications after COVID-19 in patients suffering from febrile state, the results may to trigger relevant therapy.

NMMI04-D3 Normal Tissue Uptake Of 18F-fluorestradiol In Whole Body PET/CT Imaging To Develop Guidelines For Quantitative Analysis.

Participants
Mark Muzi, MS,PhD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

18F-fluoroestradiol (FES), a commercially available PET-tracer, enables in-vivo visualization of estrogen receptor status in breast cancer patients. For quantitative analysis, adequate knowledge of normal tissue uptake and distribution are indispensable for clinical assessment of breast cancer patients. This study aimed to quantitatively examine normal tissue FES uptake of in the most prevalent metastatic sites of breast cancer assessing the range of uptake to develop guidelines for clinical assessment of FES imaging of metastatic disease.*Methods and Materials Sixty-five FES PET/CT whole-body scans from 32 breast cancer patients were retrospectively evaluated. Volumes-of-interests were placed in normal sites from brain, lung, breast, liver, uterus and bone (thoracic, lumbar, ilium). Analysis used mean, max, and peak standardized uptake value (SUVmean, SUVmax, and SUVpeak). Additional normalization for lean-body mass was also applied. Qualitatively, anomalous uptake patterns were documented for potential pitfalls in clinical interpretation of FES uptake, particularly in the gastrointestinal (G.I.) tract.*Results SUVmax uptake in normal brain, lung, breast, and bone regions were not statistically different between each other (Figure 1). A table of normal FES uptake values, ranges and 95% CI are presented for clinical reference. FES uptake above normal limits (mean+95% CI) for these regions (SUVmax>1.5) would be considered elevated uptake for potential tumor delineation. Elevated uptake in liver was expected due to hepatic metabolism of FES, and in the uterus, an estrogen receptor rich organ. Anomalous uptake patterns were observed in the venous line leading to the heart and in the G.I. tract.*Conclusions An empirical threshold of FES SUVmax>1.5 has been used clinically for the assessment of tumor metastases. Statistical evaluation of normal tissue FES uptake confirms this level. Potential pitfalls were documented to prevent clinical misinterpretation, like G.I. tract uptake, intense liver metabolism of FES and in the venous injection line. In response monitoring trials using FES PET imaging, normal tissue uptake will lay the groundwork for clinical interpretation of metastatic disease.*Clinical Relevance/Application Normal tissue FES uptake provides a threshold SUVmax that can be used in combination with other clinical information for the determination of metastatic disease sites in breast cancer patients.

RESULTS

SUVmax uptake in normal brain, lung, breast, and bone regions were not statistically different between each other (Figure 1). A table of normal FES uptake values, ranges and 95% CI are presented for clinical reference. FES uptake above normal limits (mean+95% CI) for these regions (SUVmax>1.5) would be considered elevated uptake for potential tumor delineation. Elevated uptake in liver was expected due to hepatic metabolism of FES, and in the uterus, an estrogen receptor rich organ. Anomalous uptake patterns were observed in the venous line leading to the heart and in the G.I. tract.

CLINICAL RELEVANCE/APPLICATION

Normal tissue FES uptake provides a threshold SUVmax that can be used in combination with other clinical information for the determination of metastatic disease sites in breast cancer patients.

NMMI04-D4 The Value Of PSMA-targeted 18F-DCFPyL PET-CT Scan In The Management Of Patients With Prostate Cancer, A Prospective Study

Participants
Soheil Kooraki, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

A second generation prostate-specific membrane antigen (PSMA)-targeted tracer, 18F-DCFPyL has been promising for detection of intraprostatic and extraprostatic lesions in patients with biochemical recurrence (BCR) of treated prostate cancer (PCa). This study aimed to investigate the efficacy and clinical impact of 18F-DCFPyL PET/CT scan in various clinical status of PCa.*Methods and Materials This IRB-approved, HIPAA-compliant, open label, single-center, prospective clinical trial has been conducted since April 2020 in patients with histologically proven PCa. The preliminary study cohort included 63 men (mean age 72 years, ranged 57-92) divided into three subcohorts based on the indication of the study: initial staging (N=12), restaging in patients under active surveillance (N=34), and restaging in BCR of treated PCa (N=14). All patients underwent PET/CT approximately one hour after injection of 9 ± 1 mCi 18F-DCFPyL. The pre- and post- PET/CT questionnaires were completed by the referring physician within two weeks before and four weeks after reviewing the results of the 18F-DCFPyL PET/CT study, respectively.*Results 18F-DCFPyL PET/CT scan upgraded the initially presumed PCa stage in 35.9% (23/64) of the study cohort. The clinical surveys showed that by using 18F-DCFPyL PET/CT, additional diagnostic images or invasive procedures were precluded in 38.1% (24/63) of patients. In the other hand, 18F-DCFPyL PET/CT results prompted performing prostate, lymph node or bone biopsy in 14.3% (9/63) of the study cohort. Overall, 18F-DCFPyL PET/CT altered the clinical management in 47.6% (30/63) of the study cohort. In the subcohorts of PCa-BCR, PCa-initial staging and PCa-restaging, the management plan were altered in 71.4% (10/14), 41.7% (5/12) and 44.1% (15/34) of individuals, respectively.*Conclusions 18F-DCFPyL PET/CT scan resulted in altering the clinical management in 47.6% of the patients with PCa. Acquiring 18F-DCFPyL PET/CT scan was of particular benefit in individuals with BCR of treated PCa.*Clinical Relevance/Application The preliminary results show that 18F-DCFPyL PET/CT scan can act as an important diagnostic tool for localization of intraprostatic and extraprostatic lesions in patients with initially diagnosed PCa, those under active surveillance or in patients with BCR of treated PCa.

RESULTS

18F-DCFPyL PET/CT scan upgraded the initially presumed PCa stage in 35.9% (23/64) of the study cohort. The clinical surveys showed that by using 18F-DCFPyL PET/CT, additional diagnostic images or invasive procedures were precluded in 38.1% (24/63) of

patients. In the other hand, 18F-DCFPyL PET/CT results prompted performing prostate, lymph node or bone biopsy in 14.3% (9/63) of the study cohort. Overall, 18F-DCFPyL altered the clinical management in 47.6% (30/63) of the study cohort. In the subcohorts of PCa-BCR, PCa-initial staging and PCa-restaging, the management plan were altered in 71.4% (10/14), 41.7% (5/12) and 44.1% (15/34) of individuals, respectively.

CLINICAL RELEVANCE/APPLICATION

The preliminary results show that 18F-DCFPyL PET/CT scan can act as an important diagnostic tool for localization of intraprostatic and extraprostatic lesions in patients with initially diagnosed PCa, those under active surveillance or in patients with BCR of treated PCa.

Abstract Archives of the RSNA, 2021

Sub-Events

SDP-GU-1   Comprehensive Application Of PI-RADS V2.1 And Deep Learning-based Prostate AI In The Diagnosis Of CSPCa

Participants
Wei Xie, MMed, Kunming, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the efficacy of PI-RADS V2.1, prostate AI and their integration model in the diagnosis of clinically significant prostate cancer(CSPCa), and to explore the comprehensive application of these methods.*Methods and Materials Cases with suspected PCa for qualitative diagnosis were screened from the mpMRI follow-up database of our hospital from February 2015 to December 2017. All enrolled cases underwent 3.0T prostate mpMRI: T2WI (three directions), DWI (0/1000/1400 s/mm2), and DCE (temporal resolution=15s). PCa prediction were performed by learning-based prostate AI, and the highest predicted value lesions were recorded directly in patients as the original AI prediction. Significant false-positive predictors were removed (extraprostatic detection, hemorrhage, abscess, etc.) as revised AI prediction. Another experienced radiologist performed retrospective PI-RADS V2.1 scoring without knowing the pathological and clinical information. Then the PI-RADS V2.1 + AI score was obtained by the radiologist referring to the revised prediction results of prostate AI. The results of biopsy and surgical pathology and Gleason score were taken as the gold standard (the Gleason score =3 + 4 or =T3 was CSPCa). ROC curve was used to compare the diagnostic efficacy of original AI prediction, revised AI prediction, PI-RADS V2.1 score and PI-RADS V2.1 + AI score in the diagnosis of CSPCa by SPSS 23.0.*Results A total of 398 patients were enrolled in this study. There were 112 cases of CSPCa and 286 of Non-CSPCa(CISPCa and Non-PCa). The cut-off value was defined as =4 according to the Youden index. The AUC, sensitivity, specificity, PPV, NPV, and accuracy of original AI prediction/ revised AI prediction/ PI-RADS V2.1 score/ PI-RADS + AI score were 0.749/0.777/0.843/0.871, 91.1%/91.1%/92.0%/93.8%, 58.7%/64.3%/76.6%/80.4%, 46.4%/50%/60.6%/65.2%, 94.4%/94.9%/96.1%/97.1%, 67.8%/71.9%/80.9%/84.2%. PI-RADS V2.1 + AI score was superior to the other three, and the improvement of PI-RADS V2.1 score compared to PI-RADS V2.1 was not statistically significant (P > 0.05) , but was significantly higher than that of original AI prediction and revised AI prediction (P = 0.000) .*Conclusions Prostate AI has high diagnostic sensitivity, but it is not specific enough. Moreover, there are a few false positive results in the original prediction. The combination of the revised prediction with the PI-RADS V2.1 score could further improve the diagnostic efficacy for CSPCa.*Clinical Relevance/Application There is deficiency to apply the prediction result of prostate AI directly to clinic. Based on the PI-RADS V2.1, the prediction result of prostate AI is used to adjust the score, it is helpful to further improve the diagnosis of CSPCa.

RESULTS

A total of 398 patients were enrolled in this study. There were 112 cases of CSPCa and 286 of Non-CSPCa(CISPCa and Non-PCa). The cut-off value was defined as =4 according to the Youden index. The AUC, sensitivity, specificity, PPV, NPV, and accuracy of original AI prediction/ revised AI prediction/ PI-RADS V2.1 score/ PI-RADS + AI score were 0.749/0.777/0.843/0.871, 91.1%/91.1%/92.0%/93.8%, 58.7%/64.3%/76.6%/80.4%, 46.4%/50%/60.6%/65.2%, 94.4%/94.9%/96.1%/97.1%, 67.8%/71.9%/80.9%/84.2%. PI-RADS V2.1 + AI score was superior to the other three, and the improvement of PI-RADS V2.1 score compared to PI-RADS V2.1 was not statistically significant (P > 0.05) , but was significantly higher than that of original AI prediction and revised AI prediction (P = 0.000) .

CLINICAL RELEVANCE/APPLICATION

There is deficiency to apply the prediction result of prostate AI directly to clinic. Based on the PI-RADS V2.1, the prediction result of prostate AI is used to adjust the score, it is helpful to further improve the diagnosis of CSPCa.

SDP-GU-10   Clear Cell Renal Cell Carcinoma: Value Of Dynamic Enhanced CT Combined With Different Levels Of Volume Of Interest Delineation Uncertainties In Machine Learning-based Fuhrman Nuclear Grade Prediction

Participants
Ruili Wei, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the predictive value of different machine learning models for the discrimination of low and high nuclear grade clear cell renal cell carcinoma (ccRCC) by using dynamic contrast enhanced CT when introducing with various levels of volume of interest (VOI) delineation uncertainties.*Methods and Materials This study retrospectively collected 177 patients with pathologically proven ccRCC, including 124 low-grade (grade 1 or 2) and 53 high-grade (grade 3 or 4) ccRCC. VOI was obtained for each tumor by manual segmentation, followed by introducing different levels of uncertainties on VOIs delineations as follows: (i) contour-focused VOI, (ii) erosive by 2 mm or 4 mm (VOI_e2 or VOI_e4) and (iii) dilated with perirenal fat (Fat_d2, Fat_d4, Fat_d6) or peritumoral renal parenchyma (Margin_d2, Margin_d4, Margin_d6) by 2 mm or 4 mm or 6 mm. Radiomics features were extracted from four-phase CT images [unenhanced phase (UP), corticomedullary phase (CMP), nephrographic phase (NP) and excretory phase (EP)], including 14 shape features, 18 first-order features and 75 texture features. 15 concatenations of the four-phasic features (UP, CMP, NP, EP, UP+CMP, UP+NP, UP+EP, CMP+NP, CMP+EP, NP+EP, UP+CMP+NP, UP+CMP+EP, UP+NP+EP, CMP+NP+EP, UP+CMP+NP+EP) were fed

into 176 classification models (built with 8 classifiers and 22 feature selection methods), the classification performances of the 2640 resultant discriminative models were compared, the best graphic processing and superior CT phase were elected, and the top-ranked features were analyzed.*Results CT Image features extracted from UP demonstrated outstanding performances over features from other three phases, followed by EP. Shape features showed superior discriminate capabilities over others. The model composed of "Random Forest" and "CIFE" yielded satisfactory performance of AUC of 0.87 with radiomics features extracted from UP and EP based on VOI. VOI, VOI_e2, Fat_d2, Margin_d2 achieved similar performance.*Conclusions Features extracted from UP+EP images (especially shape features) are more effective than other single/combined phase(s) in differentiating low and high nuclear grade ccRCC. Furthermore, compared with original VOI, there is no apparent performance differences on nuclear grading capability by introducing different delineation uncertainties on the VOIs.*Clinical Relevance/Application Segmentation is one of the most critical and challenging procedures of radiomics studies. Identifying the appropriate VOI could provide a reference for further radiomics investigations with manual or automated segmentation.

RESULTS

CT Image features extracted from UP demonstrated outstanding performances over features from other three phases, followed by EP. Shape features showed superior discriminate capabilities over others. The model composed of "Random Forest" and "CIFE" yielded satisfactory performance of AUC of 0.87 with radiomics features extracted from UP and EP based on VOI. VOI, VOI_e2, Fat_d2, Margin_d2 achieved similar performance.

CLINICAL RELEVANCE/APPLICATION

Segmentation is one of the most critical and challenging procedures of radiomics studies. Identifying the appropriate VOI could provide a reference for further radiomics investigations with manual or automated segmentation.

SDP-GU-11   Noninvasive Assessment Of Chronic Kidney Disease In Children With Blood Oxygenation Level-dependent MRI And Intravoxel Incoherent Motion Diffusion-weighted Imaging

Participants
Ping Liang, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the diagnostic performance of blood oxygenation level-dependent MRI (BOLD-MRI) and intravoxel incoherent motion diffusion-weighted imaging (IVIM-DWI) for evaluating renal function in children with chronic kidney disease (CKD).*Methods and Materials Fifty-one children with CKD stage 1-3, 12 children with CKD stage 4-5, and 11 healthy volunteers underwent a renal MRI including conventional coronal T2-weighted (T2WI), axial T1-weighted (T1WI), T2-weighted (T2WI) and BOLD, DWI sequences. We measured T2*, ADC, Dt, Dp, and fp values of the renal cortex and medulla on BOLD and DWI images. We applied appropriate statistical methods to compare the differences of MRI-derived parameters between the three groups, and calculated the correlation coefficient between MRI-derived parameters and clinical data. Receiver operating characteristic (ROC) analysis was used to evaluate the diagnostic performance of MRI-derived parameters.*Results Cortex T2*, ADC, Dt, fp and medulla T2*, ADC, Dt showed significant differences between the three groups. Cortex Dp and medulla Dp, fp showed no significant differences between the three groups. The values of cortex T2*, ADC, Dt, DP, fp and medulla T2*, ADC, Dt, Dp, fp were in the order of CKD stage 4-5 < CKD stage 1-3 < healthy volunteers. Cortex and medulla T2*, ADC, Dt were all significantly correlated with eGFR, serum creatinine, cystatin C. In addition, cortex T2* and eGFR showed the highest correlation coefficient (r = 0.824, P < 0.001). Cortex Dt and medulla T2* were optimal parameters for differentiating healthy volunteers and CKD stage 1-3 or CKD stage 1-3 and CKD stage 4-5, respectively.*Conclusions BOLD and IVIM-DWI might be feasible for noninvasive evaluation of renal function in children with CKD.*Clinical Relevance/Application Multiparametric MRI including BOLD MRI and IVIM-MRI, especially T2* relaxation time, ADC and Dt values, might be feasible for noninvasive evaluation of renal function in children with CKD.

RESULTS

Cortex T2*, ADC, Dt, fp and medulla T2*, ADC, Dt showed significant differences between the three groups. Cortex Dp and medulla Dp, fp showed no significant differences between the three groups. The values of cortex T2*, ADC, Dt, DP, fp and medulla T2*, ADC, Dt, Dp, fp were in the order of CKD stage 4-5 < CKD stage 1-3 < healthy volunteers. Cortex and medulla T2*, ADC, Dt were all significantly correlated with eGFR, serum creatinine, cystatin C. In addition, cortex T2* and eGFR showed the highest correlation coefficient (r = 0.824, P < 0.001). Cortex Dt and medulla T2* were optimal parameters for differentiating healthy volunteers and CKD stage 1-3 or CKD stage 1-3 and CKD stage 4-5, respectively.

CLINICAL RELEVANCE/APPLICATION

Multiparametric MRI including BOLD MRI and IVIM-MRI, especially T2* relaxation time, ADC and Dt values, might be feasible for noninvasive evaluation of renal function in children with CKD.

SDP-GU-12   Vascular, Extracellular, And Restricted Diffusion For Cytometry In Tumors MRI For The Detection And Assessment Of Clinically Significant Prostate Cancer

Participants
Xiangyu Wang, Shenzhen, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic efficiency of parameters derived from the Vascular, Extracellular, and Restricted Diffusion for Cytometry in Tumors (VERDICT) model in discriminating clinically significant PCa from insignificant PCa.*Methods and Materials After multiparametric and VERDICT acquisition in our institution, MRI/US fusion-guided targeted biopsy of index lesions and 12-core routine systematic biopsies were then performed. Data from 40 PCa foci, 28 stromal BPH foci and 31 nonstromal BPH foci of 56 participants were analyzed. The VERDICT parameters included fEES (extracellular extravascular space fraction), fIC (intracellular volume fraction) and fVASC (vascular fraction). Dunn's Kruskal-Wallis multiple comparison test, Mann-Whitney test, Delong test, logistic regression and receiver operating characteristic (ROC) analyses were performed.*Results The fIC, fEES and fVASC parameters were significantly different between the PCa group and nonstromal BPH group and between the clinically significant and insignificant PCa groups (all P <0.001) but not significantly different between the PCa and stromal BPH groups. Compared with the ADC value, the VERDICT parameters showed higher diagnostic efficiency in differentiating clinically significant and insignificant PCa, but there was no significant difference (adjusted P > 0.05). However, the AUC of the fIC+fEES+fVASC parameter was significantly higher than that of ADC (adjusted P <0.001).*Conclusions Both VERDICT parameters and ADC can be used as quantitative parameters in the differentiation between benign and cancer regions. In addition, the VERDICT parameters can improve the diagnostic performance in discriminating clinically significant PCa from insignificant PCa compared with the ADC value.*Clinical

Relevance/Application a) The VERDICT model provides useful microstructural parameter assessments,including cellular, vascular, extravascular, and extracellular volume assessments.b) fIC, fEES and fVASC were significantly different between PCa group and non-stromalBPH group, between clinically significant and insignificant PCa group.c) Compared to ADC value, The VERDICT parameters provide better diagnosticperformance of clinically insignificant PCa which can potentially reduceunnecessary treatment.d) The combination of VERDICT parameters showed the best diagnostic efficiency in detection and assessment of clinically significant PCa.

RESULTS

The fIC, fEES and fVASC parameters were significantly different between the PCa group and nonstromal BPH group and between the clinically significant and insignificant PCa groups (all P <0.001) but not significantly different between the PCa and stromal BPH groups. Compared with the ADC value, the VERDICT parameters showed higher diagnostic efficiency in differentiating clinically significant and insignificant PCa, but there was no significant difference (adjusted P > 0.05). However, the AUC of the fIC+fEES+fVASC parameter was significantly higher than that of ADC (adjusted P <0.001).

CLINICAL RELEVANCE/APPLICATION

a) The VERDICT model provides useful microstructural parameter assessments,including cellular, vascular, extravascular, and extracellular volume assessments.b) fIC, fEES and fVASC were significantly different between PCa group and non-stromalBPH group, between clinically significant and insignificant PCa group.c) Compared to ADC value, The VERDICT parameters provide better diagnosticperformance of clinically insignificant PCa which can potentially reduceunnecessary treatment.d) The combination of VERDICT parameters showed the best diagnostic efficiency in detection and assessment of clinically significant PCa.

SDP-GU-13 Comparison Of Biparametric And Multiparametric MRI For Prostate Cancer Of Peripheral Zone Detection With Pi-rads Version 2.1

Participants
Jiahui Zhang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic performance for detecting Prostate Cancer (PCa) and clinically significant Prostate Cancer (csPCa) in peripheral zone of biparametric MRI (bpMRI) and multiparametric MRI (mpMRI) using the Prostate Imaging and Reporting Data System version 2.1 (PI-RADS v2.1).*Methods and Materials Clinical and MRI datas of 334 prostate patients admitted to our hospital from January 2015 to September 2018 were retrospectively collected. BpMRI without Dynamic contrast enhanced (DCE) sequence and mpMRI with DCE were independently scored by two radiologists. All patients were scored using a double-blind method using the PI-RADS v2.1. Using PI-RADS=4 as the positive threshold and pathology of biopsy or prostatectomy as the gold standard, the diagnostic efficacy of bpMRI and mpMRI in PCa and csPCa of peripheral zone were compared. Statistical analysis was performed using the kappa statistic and McNemar and Delong tests.*Results A total of 307 prostate patients were included in the study, including 142 non-PCa patients and 165 PCa patients, 130 of which were csPCa. The AUCs of PCa diagnosed by mpMRI and bpMRI were 0.717 and 0.733, respectively, and the difference was not statistically significant (P=0.317). The sensitivity, specificity and accuracy of mpMRI in PCa diagnosis were 89.1%, 54.2% and 73.0%, respectively. The sensitivity, specificity and accuracy of bpMRI in PCa diagnosis were 81.8%, 64.8% and 73.9%, respectively. The AUCs of csPCa diagnosed by mpMRI and bpMRI were 0.594 and 0.602, respectively, and the difference was not statistically significant (P=0.756). The sensitivity, specificity and accuracy of mpMRI in csPCa diagnosis were 93.1%, 25.7% and 78.8%, respectively. The sensitivity, specificity and accuracy of bpMRI in csPCa diagnosis were 86.2%, 34.3% and 75.2%, respectively. The sensitivity of mpMRI in the diagnosis of PCa and csPCa was higher than that of bpMRI, but the specificity of mpMRI was lower than that of bpMRI (All P < 0.001).When PI-RADS was 3 and 4 scores, the detection rates of PCa and csPCa in peripheral zone were different between mpMRI and bpMRI, but the differences were not statistically significant (All P > 0.05).*Conclusions For detecting PCa and csPCa using PI-RADS v2.1, the diagnostic performance of bpMRI was comparable with those of mpMRI. Moreover, bpMRI has higher diagnostic specificity and can avoid unnecessary biopsy.*Clinical Relevance/Application BpMRI of PI-RADS v2.1 can be used to detect Prostate Cancer of peripheral zone.

RESULTS

A total of 307 prostate patients were included in the study, including 142 non-PCa patients and 165 PCa patients, 130 of which were csPCa. The AUCs of PCa diagnosed by mpMRI and bpMRI were 0.717 and 0.733, respectively, and the difference was not statistically significant (P=0.317). The sensitivity, specificity and accuracy of mpMRI in PCa diagnosis were 89.1%, 54.2% and 73.0%, respectively. The sensitivity, specificity and accuracy of bpMRI in PCa diagnosis were 81.8%, 64.8% and 73.9%, respectively. The AUCs of csPCa diagnosed by mpMRI and bpMRI were 0.594 and 0.602, respectively, and the difference was not statistically significant (P=0.756). The sensitivity, specificity and accuracy of mpMRI in csPCa diagnosis were 93.1%, 25.7% and 78.8%, respectively. The sensitivity, specificity and accuracy of bpMRI in csPCa diagnosis were 86.2%, 34.3% and 75.2%, respectively. The sensitivity of mpMRI in the diagnosis of PCa and csPCa was higher than that of bpMRI, but the specificity of mpMRI was lower than that of bpMRI (All P < 0.001).When PI-RADS was 3 and 4 scores, the detection rates of PCa and csPCa in peripheral zone were different between mpMRI and bpMRI, but the differences were not statistically significant (All P > 0.05).

CLINICAL RELEVANCE/APPLICATION

BpMRI of PI-RADS v2.1 can be used to detect Prostate Cancer of peripheral zone.

SDP-GU-14 Diagnostic Accuracy And Inter-reader Reliability Of Ultrasound O-RADS Risk Stratification Amongst Less Experienced Readers In A North American Institution With And Without Pre-test Training

Participants
Prayash Katlariwala, BSC, Edmonton, Alberta (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic accuracy and inter-reader reliability of ultrasound O-RADS risk stratification amongst less experienced readers in a North American institution without and with pre-test training.*Methods and Materials A single center retrospective cohort study evaluating 50 adult female-sex pelvic ultrasounds with ovarian lesions of varying O-RADS classifications was performed. Reference standard O-RADS scores were established through consensus of three fellowship-trained body imaging radiologists. Three PGY-4 residents were independently evaluated for diagnostic accuracy and inter-reader reliability without and with pre-test O-RADS training performed 6 weeks apart. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), area and under the curve (AUC) were used to measure accuracy. Fleiss kappa and weighted quadratic (pairwise)

kappa values were used to measure inter-reader reliability. Statistical significance was p < 0.05.*Results Mean patient age was 40 ± 16 years with a range of lesion sizes from 1.2 cm to 22.5 cm. Readers demonstrated excellent specificities (85-100% pre-training and 91-100% post-training) and NPVs (89-100% pre-training and 91-100% post-training) across the O-RADS categories. Sensitivities were variable, particularly for higher O-RADS categories (55-100% pre-training and 64-100% post-training). Considering O-RADS 4 and O-RADS 5 lesions as malignant,pre-training and post-training AUC values were 0.87-0.95 and 0.94-098, respectively (P < 0.001). Fleiss kappa inter-reader reliability was 'good' for pre-training and post-training assessment (k= 0.76 and 0.77, respectively). Pairwise inter-reader reliability was 'very good' for pre-training and post-training assessment (k= 0.77-0.87 and 0.85-0.89, respectively).*Conclusions Excellent specificities and AUC values with very good pairwise inter-reader reliability can be achieved by less experienced readers in North America. Less experienced readers may be subject to misclassification of potentially malignant lesions, and specific training around typical ultrasound dermoid features and smooth versus irregular inner wall/septation morphology may help improve sensitivity.*Clinical Relevance/Application Less experienced readers in North America can successfully adopt and integrate the O-RADS risk classification with good outcomes with or without training. Specific training on dermoid features and inner wall morphology may help improve performance.

RESULTS

Mean patient age was 40 ± 16 years with a range of lesion sizes from 1.2 cm to 22.5 cm. Readers demonstrated excellent specificities (85-100% pre-training and 91-100% post-training) and NPVs (89-100% pre-training and 91-100% post-training) across the O-RADS categories. Sensitivities were variable, particularly for higher O-RADS categories (55-100% pre-training and 64-100% post-training). Considering O-RADS 4 and O-RADS 5 lesions as malignant,pre-training and post-training AUC values were 0.87-0.95 and 0.94-098, respectively (P < 0.001). Fleiss kappa inter-reader reliability was 'good' for pre-training and post-training assessment (k= 0.76 and 0.77, respectively). Pairwise inter-reader reliability was 'very good' for pre-training and post-training assessment (k= 0.77-0.87 and 0.85-0.89, respectively).

CLINICAL RELEVANCE/APPLICATION

Less experienced readers in North America can successfully adopt and integrate the O-RADS risk classification with good outcomes with or without training. Specific training on dermoid features and inner wall morphology may help improve performance.

SDP-GU-15 Application Of Deep Learning-based Reconstruction Of Ultra-low Dose Abdominal CT In The Diagnosis Of Renal Calculi

Participants
Xiaoxiao Zhang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the image quality, diagnostic ability and radiation dose of abdominal ultra-low dose CT deep learning-based reconstruction (DLR) algorithm in the diagnosis of renal calculi.*Methods and Materials From November 2020 to December 2020, 60 patients with suspected renal calculi were prospectively scanned with low-dose and ultra-low-dose CT. Low-dose CT images were reconstructed with hybrid iterative reconstruction((adaptive iterative dose reduction [AIDR] 3D,LD-AIDR 3D) and ultra-low dose CT images were reconstruction with AIDR 3D (UD-AIDR 3D) and deep learning-based reconstruction (UD-DLR).A radiologist recorded the number of renal calculi and the diameter of the largest stones in these three groups of images, evaluated the number of lesions in abdominal organs and the diameter of maximum lesions, measured the CT value and noise of abdominal tissues and organs, and calculated the contrast noise ratio (CNR) and signal-to-noise ratio (SNR). The image quality of the three groups of images was evaluated, and the radiation doses of low dose and ultra-low dose scanning were compared.*Results A total of 130 kidney stones were detected in LD-AIDR 3D images (76 in left kidney and 54 in right kidney). Taking LD-AIDR 3D as the standard, the detection rates of stones in UD-AIDR 3D and UD-DLR images were 96.2% and 98.5% and the ratio was 100% for stones larger than 3mm. There was no statistical difference in the diameter of the largest stone among the three groups(P>0.05). Except for 3 cases of hepatic cysts smaller than 5mm, the lesions detected by LD-AIDR 3D images could be observed in UD-DLR images. There was no significant difference in image noise between LD-AIDR 3D and UD-DLR (7.97±1.25HU vs. 7.58±1.67HU) (P>0.05), both of them were significantly lower than UD-AIDR 3D image noise (12.14±2.13HU) (P<0.05).There was no significant difference in CT value and CNR of liver, spleen, kidney and aorta between LD-AIDR 3D image and UD-DLR image(P>0.05), which was higher than that of UD-AIDR 3D images(P<0.05), SNR of each organ and tissue of UD-DLR images was higher than that of LD-AIDR 3D and UD-AIDR 3D, and the subjective image quality of LD-AIDR 3D was similar to that of UD-DLR images, which was better than that of UD-AIDR 3D images. The mean effective radiation dose of low dose scan and ultra-low dose scan was2.75±0.50mSv,0.64±0.17mSv. The radiation dose of ultra-low dose scanning is about 77% lower than that of low dose scanning.*Conclusions Abdominal ultra-low dose CT scan combined with DLR reconstruction can greatly reduce the radiation dose while maintaining the image quality, and can be used in the clinical diagnosis of renal calculi.*Clinical Relevance/Application The study could promote the clinical application of ultra-low dose CT scan for renal calculi.

RESULTS

A total of 130 kidney stones were detected in LD-AIDR 3D images (76 in left kidney and 54 in right kidney). Taking LD-AIDR 3D as the standard, the detection rates of stones in UD-AIDR 3D and UD-DLR images were 96.2% and 98.5% and the ratio was 100% for stones larger than 3mm. There was no statistical difference in the diameter of the largest stone among the three groups(P>0.05). Except for 3 cases of hepatic cysts smaller than 5mm, the lesions detected by LD-AIDR 3D images could be observed in UD-DLR images. There was no significant difference in image noise between LD-AIDR 3D and UD-DLR (7.97±1.25HU vs. 7.58±1.67HU) (P>0.05), both of them were significantly lower than UD-AIDR 3D image noise (12.14±2.13HU) (P<0.05).There was no significant difference in CT value and CNR of liver, spleen, kidney and aorta between LD-AIDR 3D image and UD-DLR image(P>0.05), which was higher than that of UD-AIDR 3D images(P<0.05), SNR of each organ and tissue of UD-DLR images was higher than that of LD-AIDR 3D and UD-AIDR 3D, and the subjective image quality of LD-AIDR 3D was similar to that of UD-DLR images, which was better than that of UD-AIDR 3D images. The mean effective radiation dose of low dose scan and ultra-low dose scan was2.75±0.50mSv,0.64±0.17mSv. The radiation dose of ultra-low dose scanning is about 77% lower than that of low dose scanning.

CLINICAL RELEVANCE/APPLICATION

The study could promote the clinical application of ultra-low dose CT scan for renal calculi.

SDP-GU-4 A Novel Radiogenomics Biomarkerbased On Hypoxic-genesubset : Accurate Survival And Prognostic Prediction Of Renal Clear Cell Carcinoma

Participants

Jiahao Gao, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To construct a novel radiogenomics biomarker based on hypoxic-gene subset for the accurate prognostic prediction of renal clear cell carcinoma.*Methods and Materials Firstly, we screened for the desired hypoxic-gene sbuset by performing KEEG analysis in the TCGA database. And by univariate and multivariate cox regression to discover survival-related hypoxia genes, a genomics signature was constructed in the TCGA-KIRC database. Immediately afterwards, we successfully built a hypoxia-gene related radiogenomics biomarker (prediction of hypoxia-genes signature by contrast-enhanced CT radiomics) in the TCIA database by extracting features in venous phase of contrast-enhanced CT images, selecting features using the mRMR and LASSO algorithm, and building logistic regression models. Finally, we validated the prognostic ability of the new prognostic biomarker for patients with renal clear cell carcinoma in an independent validation cohort at Huashan Hospital, Shanghai, China.*Results The hypoxia-gene related genomics signature consisting of five genes, IFT57, PABPN1, RNF10, RNF19B and UBE2T, was shown to be significantly associated with the survival status for patients with renal clear cell carcinoma in the TCGA-KIRC database (by grouping of signature: low or high risk). In the TCIA database, we constructed a radiogenomics biomarker consisting of 13 radiomics features that were good predictors of hypoxia-gene signature expression levels (low or high risk) in patients at each institution, acquring AUC values of 0.91 and 0.91 in the training and validation group, respectively. In the independent validation cohort at Huashan Hospital, our radiogenomics biomarker was significantly associated with prognostic survival of patients with renal clear cell carcinoma (p=0.0018).*Conclusions The novel prognostic radiogenomics biomarker we built achieved good survival prediction results in both the cohort of TCIA/TCGA database and the independent validation cohort in Huashan hospital for patients with renal clear cell carcinoma, and may assist in clinical preferential treatment decisions and promote the process of precision theranostics in the future.*Clinical Relevance/Application This radiogenomics bimarker is expected to serve as a potential clinical non-invasive prognostic marker for renal clear cell carcinoma and to facilitate the process of individualized and accurate diagnosis and treatment of renal clear cell carcinoma.

RESULTS

The hypoxia-gene related genomics signature consisting of five genes, IFT57, PABPN1, RNF10, RNF19B and UBE2T, was shown to be significantly associated with the survival status for patients with renal clear cell carcinoma in the TCGA-KIRC database (by grouping of signature: low or high risk). In the TCIA database, we constructed a radiogenomics biomarker consisting of 13 radiomics features that were good predictors of hypoxia-gene signature expression levels (low or high risk) in patients at each institution, acquring AUC values of 0.91 and 0.91 in the training and validation group, respectively. In the independent validation cohort at Huashan Hospital, our radiogenomics biomarker was significantly associated with prognostic survival of patients with renal clear cell carcinoma (p=0.0018).

CLINICAL RELEVANCE/APPLICATION

This radiogenomics bimarker is expected to serve as a potential clinical non-invasive prognostic marker for renal clear cell carcinoma and to facilitate the process of individualized and accurate diagnosis and treatment of renal clear cell carcinoma.

SDP-GU-5   **Impact Of Deep Learning Reconstruction Combined With Sharpening Filter On High-resolution Single-shot Fast Spin Echo T2-weighted MRI Of The Uterus.**

Participants
Takahiro Tsuboyama, MD, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the effect of deep learning reconstruction (DL) and post-processing sharpening filter on the image quality of high-resolution single-shot fast spin echo (SSFSE) T2-weighted MRI of the uterus.*Methods and Materials Thirty patients with uterine diseases underwent pelvic MRI. Parasagittal T2-weighted imaging at 4-mm thickness was obtained with periodically rotated overlapping parallel lines with enhanced reconstruction (PROPELLER) and SSFSE. In-plane resolution was 0.75×0.75 and 0.8×0.8 mm, and the mean scan time was 204 and 22 sec in PROPELLER and SSFSE, respectively. Three types of SSFSE images were generated by the following techniques: conventional reconstruction (SSFSE-C), deep learning reconstruction (SSFSE-DL), and DL with post-processing sharpening filter (SSFSE-DLF). PROPELLER and the three types of SSFSE imaging were quantitatively and qualitatively assessed by one and two radiologists, respectively, and compared using repeated measures of ANOVA or Friedman's test.*Results In the quantitative comparisons, SSFSE-C had significantly the lowest signal-to-noise ratio (SNR) (P < .01). SSFSE-DL provided significantly the highest SNR (P < .01) but the lowest contrast between junctional zone and the myometrium (P < .01). SSFSE-DLF showed the same SNR and contrast between junctional zone and the myometrium with PROPELLER. There was not significant difference in contrast between malignant tumors and piriformis muscle among the 4 types of imaging. In Qualitative assessment, 3 types of SSFSE were significantly superior to PROPELLER in motion artifacts (P < .01). SSFSE-C and SSFSE-DL showed significantly lower sharpness but SSFSE-DLF provided significantly higher sharpness than PROPELLER (P < .01). Furthermore, conspicuity of the uterine architecture and lesions were significantly the highest on SSFSE-DLF (P < .01). SSFSE-DLF exhibited overall image quality significantly higher than SSFSE-C and SSFSE-DL, and comparable to PROPELLER (P < .01).*Conclusions The combination of deep learning reconstruction and post-processing sharpening filter extremely increases the image quality of high-resolution SSFSE of the uterus to the same level of PROPELLER.*Clinical Relevance/Application High-resolution SSFSE with DL and post-processing sharpening filter yields high image quality in a short acquisition time and can be a powerful back-up sequence or even have a potential to replace the conventional FSE imaging.

RESULTS

In the quantitative comparisons, SSFSE-C had significantly the lowest signal-to-noise ratio (SNR) (P < .01). SSFSE-DL provided significantly the highest SNR (P < .01) but the lowest contrast between junctional zone and the myometrium (P < .01). SSFSE-DLF showed the same SNR and contrast between junctional zone and the myometrium with PROPELLER. There was not significant difference in contrast between malignant tumors and piriformis muscle among the 4 types of imaging. In Qualitative assessment, 3 types of SSFSE were significantly superior to PROPELLER in motion artifacts (P < .01). SSFSE-C and SSFSE-DL showed significantly lower sharpness but SSFSE-DLF provided significantly higher sharpness than PROPELLER (P < .01). Furthermore, conspicuity of the uterine architecture and lesions were significantly the highest on SSFSE-DLF (P < .01). SSFSE-DLF exhibited overall image quality significantly higher than SSFSE-C and SSFSE-DL, and comparable to PROPELLER (P < .01).

CLINICAL RELEVANCE/APPLICATION

High-resolution SSFSE with DL and post-processing sharpening filter yields high image quality in a short acquisition time and can be a powerful back-up sequence or even have a potential to replace the conventional FSE imaging.

SDP-GU-6   Association Of US/MRI Misregistration And False Negative Fusion Biopsy Of PI-RADS 4 And 5 Lesions On MRI

Participants
Miyad Movassaghi, MD,MSc, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To investigate whether misregistration between US and MRI during fusion biopsy, caused by discrepant prostate segmentation, and other patient or imaging-based factors are associated with a false negative (FN) fusion biopsy of PI-RADS 4/5.*Methods and Materials 530 consecutive patients with 685 PI-RADS 4 or 5 lesions on MRIs performed 11/2015-12/2020 and subsequent US/MRI fusion biopsy were retrospectively collected. Biopsied lesions were separated into true positive (TP), false positive (FP) and false negative (FN) using a combination of systematic and fusion biopsy and grade group 2 or higher as the reference standard. FP cases were excluded. FN fusion biopsy was defined as negative targeted fusion cores with adjacent positive systematic cores. The impact of patient and imaging specific factors including PSA, use of an enema prep before MRI, lesion size, prostate volume, absolute and percent difference in segmented prostate volume between US and MRI during the fusion process, and urologist performing the biopsy, on the probability of a FN fusion biopsy were tested using logistic regression.*Results 361 lesions in 290 patients (median age 69 years, IQR 63-75, median PSA 6.5 ng/ml, IQR 4.7-9.3), including 67 (19%) FN and 294 TP (81%) were included. There was a significant inverse association between lesion size and probability of FN (odds ratio (OR): 0.90, 95%CI: 0.85-0.95, p-value: <0.0001). Similarly, PSA level was inversely associated with FN, (OR: 0.86, 95%CI: 0.77-0.93, p-value: 0.0003). However, the probability of a FN fusion biopsy was not associated with use of an enema prep before MRI, size of prostate gland, discrepancy between US and MRI segmented prostate volume or the operator (p-value>0.05).*Conclusions Lower PSA values and smaller PI-RADS 4/5 lesions are associated with FN fusion biopsy. Discrepant US and MRI prostate segmentation volumes derived as part of fusion biopsy were not associated with a FN biopsy.*Clinical Relevance/Application Discrepant US and MRI segmentation volumes during the fusion biopsy process may not contribute significantly to missed MRI lesions during biopsy.

RESULTS

361 lesions in 290 patients (median age 69 years, IQR 63-75, median PSA 6.5 ng/ml, IQR 4.7-9.3), including 67 (19%) FN and 294 TP (81%) were included. There was a significant inverse association between lesion size and probability of FN (odds ratio (OR): 0.90, 95%CI: 0.85-0.95, p-value: <0.0001). Similarly, PSA level was inversely associated with FN, (OR: 0.86, 95%CI: 0.77-0.93, p-value: 0.0003). However, the probability of a FN fusion biopsy was not associated with use of an enema prep before MRI, size of prostate gland, discrepancy between US and MRI segmented prostate volume or the operator (p-value>0.05).

CLINICAL RELEVANCE/APPLICATION

Discrepant US and MRI segmentation volumes during the fusion biopsy process may not contribute significantly to missed MRI lesions during biopsy.

SDP-GU-7   Inter-observer Reliability Of Mr Angiography For Preoperative Assessment Of Potential Renal Donors

Participants
Ali Elmokadem, MD,PhD, Mansoura, Egypt (*Presenter*) Nothing to Disclose

PURPOSE

To assess the inter-observer reliability of non-enhanced MR angiography as a non-invasive method for evaluating the anatomical findings of potential living kidney donors.*Methods and MaterialsAll potential donors were referred from specialized kidney transplantation unit and underwent non contrast MR angiography of the renal arteries on a 1.5-T closed MRI unit using a respiratory-triggered magnetization prepared three-dimensional balanced steady-state free precession (b-SSFP) with inversion recovery pulses and fat saturation (Inhance 3D Inflow IR; GE health care). Two experienced radiologists evaluated non-contrast MRA images. Observers were asked to evaluate both renal arteries anatomy and their branching pattern, presence of accessory or aberrant renal arteries, and identify any anatomical variant. Lin's correlation test was performed to test MRA readings by each of the two observers against CTA findings which considered as the gold standard for assessment of renal arteries. Additionally, observers were asked to assess the image quality based on sharpness, presence of artifacts, and diagnostic acceptability.*ResultsThis study included 60 potential kidney donors (43 males & 17 females) with mean age ± SD of 31.3 ± 5.6 years. Excellent to very good inter-observer agreement was found between both observers in the assessment of renal arteries by non-enhanced MRA. There was perfect concordance between MRA and CTA findings in detecting early arterial division, caliber, and length of left extra-parenchymal segmental branches. Moderate concordance was found in the assessment of the supplied segments of extra-parenchymal segmental renal arterial branches. There was substantial concordance between both MRA observers' findings in the remaining variables of the study. There was excellent agreement between both observers in the assessment of image quality parameters.*ConclusionsNon-contrast enhanced MR angiography for the renal arteries is an effective alternative for CTA without the risks of radiation or contrast media.*Clinical Relevance/Application MR angiography for the renal donors without contrast administration can have an impact on donor selection, operative planning, and minimizing post-operative complication.

RESULTS

This study included 60 potential kidney donors (43 males & 17 females) with mean age ± SD of 31.3 ± 5.6 years. Excellent to very good inter-observer agreement was found between both observers in the assessment of renal arteries by non-enhanced MRA. There was perfect concordance between MRA and CTA findings in detecting early arterial division, caliber, and length of left extra-parenchymal segmental branches. Moderate concordance was found in the assessment of the supplied segments of extra-parenchymal segmental renal arterial branches. There was substantial concordance between both MRA observers' findings in the remaining variables of the study. There was excellent agreement between both observers in the assessment of image quality parameters.

CLINICAL RELEVANCE/APPLICATION

MR angiography for the renal donors without contrast administration can have an impact on donor selection, operative planning, and minimizing post-operative complication.

Compressed Sensing And Deep Learning Reconstruction On Women's Pelvic MRI At 1.5 T MR System: Utility For Improving Image Quality And Examination Time As Compared With Parallel Imaging

Participants
Takahiro Ueda, Toyoake, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To determine the utility of compressed sensing (CS) and deep learning reconstruction (DLR) for improving image quality and examination time on women's pelvic MRI at 1.5 T system as compared with parallel imaging (PI).*Methods and Materials 52 consecutive female patients with various pelvic diseases underwent T1WI and T2WI by CS and PI. Then, each CS data was reconstructed with and without DLR, and examination times of CS and PI were recorded in all patients. For quantitative assessment, SNR of muscle and CNR between fat tissue and iliac muscle on T1WI, and endometrium and myometrium on T2WI were determined by ROI measurement. For qualitative assessment, two board certified radiologists assessed overall image quality and diagnostic confidence level by 5-point scales, and each final score was determined as consensus of two readers. To compare the capability for examination time reduction, mean examination times of both sequences were compared among all data sets by Tukey's HSD test. To determine quantitative image quality improvement on each CS data by DLR, SNRs and CNRs were compared among all methods by Tukey's HSD test. On qualitative image quality evaluations, inter-observer agreement on each data set was assessed by ? statistics followed by ?2 test. Finally, both indexes on T1WI and T2WI were compared among all methods by Wilcoxon signed-rank test.*Results Mean examination times of T1WI and T2WI obtained by CS and reconstructed with and without DLR were significantly shorter than that of PI (T1WI: $p<0.001$; T2WI, $p<0.001$). On T1WI and T2WI, SNR and CNR of CS with DLR were significantly higher than those of CS without DLR and PI ($p<0.05$). Inter-observer agreements were determined as 'substantial' or 'almost perfect' ($0.71<?<0.99$, $p<0.0001$). On T1WI and T2WI, overall image quality of CS with DLR was significantly higher than that of PI and CS without DLR ($p<0.001$). Diagnostic confidence level of T2WI by CS with DLR was significantly higher than that by PI and CS without DLR ($p<0.05$).*Conclusions CS with DLR is considered as useful for image quality improvement with reducing examination time on women's pelvic MRI at 1.5 T system, when compared with PI.*Clinical Relevance/Application CS with DLR is considered as useful for image quality improvement with reducing examination time on women's pelvic MRI at 1.5 T system as compared with PI.

RESULTS

Mean examination times of T1WI and T2WI obtained by CS and reconstructed with and without DLR were significantly shorter than that of PI (T1WI: $p<0.001$; T2WI, $p<0.001$). On T1WI and T2WI, SNR and CNR of CS with DLR were significantly higher than those of CS without DLR and PI ($p<0.05$). Inter-observer agreements were determined as 'substantial' or 'almost perfect' ($0.71<?<0.99$, $p<0.0001$). On T1WI and T2WI, overall image quality of CS with DLR was significantly higher than that of PI and CS without DLR ($p<0.001$). Diagnostic confidence level of T2WI by CS with DLR was significantly higher than that by PI and CS without DLR ($p<0.05$).

CLINICAL RELEVANCE/APPLICATION

CS with DLR is considered as useful for image quality improvement with reducing examination time on women's pelvic MRI at 1.5 T system as compared with PI.

Deep Learning With Bayesian Inference For Prostate Cancer Diagnosis Across Longitudinal Biparametric MRI

Participants
Anindo Saha, MSc, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Despite increasing use of active surveillance via biparametric MR imaging (bpMRI) for prostate cancer (PCa) management, there is a lack of research in medical image computing that utilize longitudinal studies to assist present-day diagnosis. Our goal is to investigate the efficacy of a deep learning-based PCa detection model, that integrates past bpMRI exams and population-level anatomical priors via Bayesian inference.*Methods and Materials This retrospective study included 250 consecutive biopsy-naïve men (median age: 64 yrs; IQR: 60-69) with elevated levels of PSA (median level: 8 ng/mL; IQR: 5-11), who underwent at least two consecutive MRI exams between 2016-2018 (N=500). Intra-patient bpMRI scans were rigidly registered, paired with expert voxel-level annotations of PI-RADS 2-5 lesions and subsequently used to train a deep learning model to predict and localize all PI-RADS findings. Radiologists utilize prior studies to inform present-day diagnosis. Similarly, for each patient case, computer-aided diagnosis for the follow-up bpMRI exam was derived via Bayesian modelling; probabilistically integrating past exams and a population prior for spatial PCa prevalence and zonal anatomy. Diagnostic performance was evaluated by the ability to accurately discriminate patients with benign prostatic tissue (n=10) or PI-RADS = 3 lesions (n=159), from those carrying PI-RADS = 4 lesions (n=81), over 5-fold cross-validation. Normalized Wilcoxon Mann-Whitney U statistic was used to derive AUROC and confidence intervals were computed over 5000 replications of bootstrapping.*Results Computer-aided diagnosis of follow-up studies without priori, yielded an AUROC of 0.77 (95% CI: 0.71, 0.83), F0.5 score of 0.51 (95% CI: 0.42, 0.61), positive predictive value (PPV) of 0.51 (95% CI: 0.40, 0.60) and negative predictive value (NPV) of 0.78 (95% CI: 0.71, 0.83). Computer-aided diagnosis of follow-up studies with the inclusion of priori via Bayesian inference yielded an AUROC of 0.80 (95% CI: 0.76, 0.84), F0.5 score of 0.58 (95% CI: 0.48, 0.68), PPV of 0.60 (95% CI: 0.48, 0.72) and NPV of 0.78 (95% CI: 0.72, 0.85). In comparison to stand-alone diagnosis, factoring in prior studies resulted in a 41.4% reduction of AUROC standard deviation across each fold.*Conclusions Incorporating past studies and clinical priors via Bayesian inference can improve diagnostic certainty and robustness of deep learning in follow-up patient exams.*Clinical Relevance/Application Prostate cancer is one of the most prevalent cancers in men worldwide. In the absence of experienced radiologists, its morphological heterogeneity can lead to low inter-reader agreement. Automated, reliable detection algorithms can improve diagnostic accuracy with consistent quantitative analysis.

RESULTS

Computer-aided diagnosis of follow-up studies without priori, yielded an AUROC of 0.77 (95% CI: 0.71, 0.83), F0.5 score of 0.51 (95% CI: 0.42, 0.61), positive predictive value (PPV) of 0.51 (95% CI: 0.40, 0.60) and negative predictive value (NPV) of 0.78 (95% CI: 0.71, 0.83). Computer-aided diagnosis of follow-up studies with the inclusion of priori via Bayesian inference yielded an AUROC of 0.80 (95% CI: 0.76, 0.84), F0.5 score of 0.58 (95% CI: 0.48, 0.68), PPV of 0.60 (95% CI: 0.48, 0.72) and NPV of 0.78 (95% CI: 0.72, 0.85). In comparison to stand-alone diagnosis, factoring in prior studies resulted in a 41.4% reduction of AUROC standard deviation across each fold.

CLINICAL RELEVANCE/APPLICATION

Prostate cancer is one of the most prevalent cancers in men worldwide. In the absence of experienced radiologists, its morphological heterogeneity can lead to low inter-reader agreement. Automated, reliable detection algorithms can improve diagnostic accuracy with consistent quantitative analysis.

Abstract Archives of the RSNA, 2021

CA03-D

Cardiac Tuesday Poster Discussions

Sub-Events

CA03-D2 **T1 And T2 Map-based MRI Radiomics Analysis Improves The Diagnostic Accuracy Of Chronic Myocardial Inflammation Detection In Heart Failure With Reduced Ejection Fraction Patients**

Participants
Tilman Emrich, MD, Charleston, South Carolina (*Presenter*) Speaker, Siemens AG;Travel support, Siemens AG

PURPOSE

The purpose of this study was to evaluate the diagnostic accuracy of myocardial T1 and T2 mapping based radiomics analysis for the detection of chronic myocardial inflammation against endomyocardial biopsy-(EMB) as reference in patients with Heart Failure with reduced Ejection Fraction (HFrEF).*Methods and Materials The study population consisted of 58 retrospectively identified HFrEF patients who had previously undergone EMB and myocardial T1 and T2 mapping MRI at 3T. EMB served as the reference standard for the presence of myocardial inflammation. Radiomics analysis on T1 and T2 maps was performed using Slicer (Version-Nr 4.10.2 r28257). Out of 779 features identified, features with the highest accuracy were selected by recursive feature elimination, and a classification model was created using a linear support vector machine with 10-fold cross validation. The model-based analysis was subsequently compared to conventional T1 and T2 relaxation times in regard to diagnostic accuracy.*Results Out of the 58 patients with HFrEF, 32 patients (55.2%) had chronic myocardial inflammation detected by EMB. Left ventricular EF in the EMB+ and EMB- groups was 31±12% and 31±13%, respectively (p=0.97). The average T1 and T2 values between EMB+ and EMB- patients were not statistically different (T1: 1289 ± 76 and 1299 ± 63 ms, respectively, p=0.76; T2: 40.0 ± 6.4 ms and 40.1 ± 3.5 ms, respectively, p=0.49), resulting in poor diagnostic power (T1: AUC 0.6 Sensitivity 56% Specificity 69%; T2: AUC 0.53, Sensitivity 94%, Specificity 15%). The T2 map-based radiomics analysis model significantly improved diagnostic accuracy for the discrimination of EMB+ and EMB- HFrEF patients (AUC: 0.87, Sensitivity 78%, Specificity 99%) and outperformed the T1 map-based radiomics analysis model (AUC: 0.83, Sensitivity 68%, Specificity 99%) .*Conclusions Adding radiomics analysis of T1 and T2 maps to conventional T1 and T2 map assessment improves diagnostic accuracy of the detection of chronic myocardial inflammation in HFrEF patients.*Clinical Relevance/Application Non-invasive detection of chronic myocardial inflammation by radiomics analysis may reduce the need for invasive procedures and serve as a marker for treatment monitoring under immunosuppression.

RESULTS

Out of the 58 patients with HFrEF, 32 patients (55.2%) had chronic myocardial inflammation detected by EMB. Left ventricular EF in the EMB+ and EMB- groups was 31±12% and 31±13%, respectively (p=0.97). The average T1 and T2 values between EMB+ and EMB- patients were not statistically different (T1: 1289 ± 76 and 1299 ± 63 ms, respectively, p=0.76; T2: 40.0 ± 6.4 ms and 40.1 ± 3.5 ms, respectively, p=0.49), resulting in poor diagnostic power (T1: AUC 0.6 Sensitivity 56% Specificity 69%; T2: AUC 0.53, Sensitivity 94%, Specificity 15%). The T2 map-based radiomics analysis model significantly improved diagnostic accuracy for the discrimination of EMB+ and EMB- HFrEF patients (AUC: 0.87, Sensitivity 78%, Specificity 99%) and outperformed the T1 map-based radiomics analysis model (AUC: 0.83, Sensitivity 68%, Specificity 99%) .

CLINICAL RELEVANCE/APPLICATION

Non-invasive detection of chronic myocardial inflammation by radiomics analysis may reduce the need for invasive procedures and serve as a marker for treatment monitoring under immunosuppression.

Printed on: 06/28/22

MS04-B
Multisystem Wednesday Poster Discussions

Sub-Events

MS04-B1   **"Making The Unknown Known": Choosing The Appropriate Radiological Investigation In Cancer Of Unknown Primary.**

Participants
Alice Spencer, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

True cancer of unknown primary (CUP) are metastatic malignancies with positive histological diagnoses, but no identifiable primary tumour site. CUP diagnoses account for up 3-5% of malignant epithelial diagnoses, but accounts for the third to fourth highest cause of cancer-related deaths worldwide. A unique radiological challenge, patients who come through a CUP pathway have had varying imaging at diagnosis. Our single centre analysis over 5 years considers which imaging modality adds the most value to establishing a primary site.*Methods and Materials Data for 5 years (2016-2021) of multidisciplinary team (MDT) meetings for Cancer of Unknown Primary were obtained for our institution, a tertiary cancer centre providing for a population of 1.5 million. These patients were analysed to define a cohort of 72 "true" CUP patients, whose primary malignancy site was not established after initial investigations. From this we analysed investigations in the 3 months surrounding their discussion in MDT meetings to establish which investigation of CT, nuclear medicine, and MRI added the most value.*Results 58 patients received a CT scan of chest, abdomen and pelvis as a first imaging modality (as recommended by the NICE and suggested by NIH) around the time of MDT. Of these patients, a later PET scan added diagnostic value in 10 patients (17.2%). MRI imaging as a secondary modality confirmed sites of disease in 2 patients. A nuclear medicine bone scan, when performed before PET-CT, added value in 0 patients.*Conclusions Our data suggests that MRI adds little diagnostic value in imaging patients with cancer of unknown primary. As PET-CT becomes more widely accessible, it is a recommendable first modality of good diagnostic value. For those patients who had CT imaging first, PET adds value. A bone scan was performed in a small proportion of patients, and added no value.*Clinical Relevance/Application Cancer of unknown primary (CUP) patients have no identifiable primary tumor site. Choosing the correct imaging will help improve use of resources and reduce patient radiation doses.

RESULTS

58 patients received a CT scan of chest, abdomen and pelvis as a first imaging modality (as recommended by the NICE and suggested by NIH) around the time of MDT. Of these patients, a later PET scan added diagnostic value in 10 patients (17.2%). MRI imaging as a secondary modality confirmed sites of disease in 2 patients. A nuclear medicine bone scan, when performed before PET-CT, added value in 0 patients.

CLINICAL RELEVANCE/APPLICATION

Cancer of unknown primary (CUP) patients have no identifiable primary tumor site. Choosing the correct imaging will help improve use of resources and reduce patient radiation doses.

Abstract Archives of the RSNA, 2021

Sub-Events

GI02-A10   **High Visceral Fat Area Is Associated With Posttransplant Early Allograft Dysfunction In Liver Transplantation Recipients: A Propensity Score Analysis**

Participants
Guanjie Yuan, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the association between adipose tissue distribution and the occurrence of early allograft dysfunction (EAD) in liver transplantation recipients.*Methods and Materials A total of 175 patients who received liver transplantation (LT) from January 2015 to September 2020 were enrolled in this retrospective study. The areas of abdominal adipose tissue and skeletal muscle of all patients were measured based on the preoperative CT images. The appropriate statistical methods including the propensity score-matched (PSM) analysis were performed to identify the association between adipose tissue distribution and the occurrence of EAD.*Results Of 175 liver transplantation recipients, 55 patients (31.4%, 55/175) finally developed EAD. The multivariate logistic analysis revealed that preoperative serum albumin (OR: 0.34, 95% CI: 0.17 to 0.70, p=0.004), platelet-lymphocyte ratio (OR: 2.35, 95% CI: 1.16 to 4.79, p=0.018), and visceral fat area (OR: 3.17, 95% CI: 1.56 to 6.44, p=0.001) were independent risk factors of the occurrence of EAD. After PSM analysis, visceral fat area was still significantly associated with EAD (OR: 3.95, 95% CI: 1.65-9.46, p=0.002). The visceral fat area demonstrated good prediction of EAD according to the receiver operating characteristic (ROC) curves. The area under ROC curves were 0.67 (95% CI: 0.58-0.76) and 0.71(95% CI: 0.60-0.81) before and after PSM analysis, respectively. The ability of visceral fat area to predict long-term prognosis including one-year graft failure and overall survival(OS) was also studied. No significant difference was identified in one-year graft failure (hazard ratio 2.11, p=0.22), and conversely result was identified in OS (hazard ratio 4.10, p=0.01).But the multivariate Cox regression analysis showed that the value of visceral fat area in predicting OS was limited (hazard ratio 3.48, p=0.19). *Conclusions High visceral fat area was an independent risk factor for the occurrence of EAD, and it might also have certain clinical value for predicting the long-term prognosis of patients undergoing LT.*Clinical Relevance/Application The results of this study suggest that clinicians should take timely steps to lose weight (especially the steps to reduce waistlines) in recipients with high visceral fat area before liver transplantation to improve short - and long-term outcomes.

RESULTS

Of 175 liver transplantation recipients, 55 patients (31.4%, 55/175) finally developed EAD. The multivariate logistic analysis revealed that preoperative serum albumin (OR: 0.34, 95% CI: 0.17 to 0.70, p=0.004), platelet-lymphocyte ratio (OR: 2.35, 95% CI: 1.16 to 4.79, p=0.018), and visceral fat area (OR: 3.17, 95% CI: 1.56 to 6.44, p=0.001) were independent risk factors of the occurrence of EAD. After PSM analysis, visceral fat area was still significantly associated with EAD (OR: 3.95, 95% CI: 1.65-9.46, p=0.002). The visceral fat area demonstrated good prediction of EAD according to the receiver operating characteristic (ROC) curves. The area under ROC curves were 0.67 (95% CI: 0.58-0.76) and 0.71(95% CI: 0.60-0.81) before and after PSM analysis, respectively. The ability of visceral fat area to predict long-term prognosis including one-year graft failure and overall survival(OS) was also studied. No significant difference was identified in one-year graft failure (hazard ratio 2.11, p=0.22), and conversely result was identified in OS (hazard ratio 4.10, p=0.01).But the multivariate Cox regression analysis showed that the value of visceral fat area in predicting OS was limited (hazard ratio 3.48, p=0.19).

CLINICAL RELEVANCE/APPLICATION

The results of this study suggest that clinicians should take timely steps to lose weight (especially the steps to reduce waistlines) in recipients with high visceral fat area before liver transplantation to improve short - and long-term outcomes.

GI02-A12   **Fontan-associated Liver Disease (FALD) In Adult Patients: What Radiologists Need To Know**

Participants
Yasaman Moazeni, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Fontan-Associated Liver Disease (FALD) and other late post-Fontan complications in adult patients are more commonly encountered in daily practice as an increasing number of these patients survive into adulthood. 2. FALD encompasses a spectrum of diffuse and focal liver pathologies with overlapping imaging findings. Advanced fibrosis and hepatocellular carcinoma (HCC) are the direst complications in this spectrum. Accurate non-invasive diagnosis of these conditions can be challenging.

TABLE OF CONTENTS/OUTLINE

Introduction • Indications and surgical aspects of Fontan procedure • Effects of Fontan procedure on the hemodynamics of liver perfusion FALD: Pathophysiology and imaging manifestations • Diffuse Diseases: Fibrosis, Sinusoidal Dilatation • Focal Diseases: Regenerative Hyperplasia, FNH-like Lesions, HCC Pitfalls and Challenges in Imaging-based Diagnosis of FALDs • Low specificity of conventional morphological criteria and elastography for detection of advanced fibrosis, given the presence of congestive hepatopathy. • Low specificity of OPTN and ACR LIRADS criteria for detection of HCC Future Directions • MR-Elastography as a

marker of Fontan pressure • Novel quantitative techniques Volumetric analysis

GI02-A13   MR Imaging Of Perianal Fistulas

Awards
Cum Laude

Participants
David Ballard, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to:1. Illustrate normal perianal anatomy on MR, provide a search pattern and discuss patterns of perianal fistulas2. Discuss perianal fistulas in Crohn disease and the role of MR in monitoring response to therapy3. Provide a case-based review of the appearance of common and complex fistula patterns with a focus on using different MR sequences to the radiologist's advantage

TABLE OF CONTENTS/OUTLINE

1. Anatomy: Internal and external sphincters, anorectal junction, surrounding soft tissue structures and their appearance on MR2. MR techniquei. Building blocks of perianal MR protocolii. Axial and coronal imaging planes relative to the anal canaliii. Role of different sequences with illustrative examplesiv. Practical pairing a perianal MR protocol with MR enterography3. MR implications for patient managementi. ACR Appropriateness Criteria on Anorectal Disease4. Patterns of perianal fistulasi. Parks and St. James classification systemsii. Inter-, trans-, supra- and extra-sphincteric perianal fistulasiii. Complex perianal fistulasiv. Abscess formation and locationv. Scarring and closure/improvement of fistula tracts5. Perianal fistula in Crohn diseasei. Prevalence and treatment optionsii. MR imaging as a response to medical therapyiii. MR scoring systemsA. Van Assche index (VAI) and modified VAIB. MAGNIFI-CD6. Pitfalls and special considerationsi. Identifying setons on MRii. Suboptimal imaging planesiii. Cancer formation in chronic fistula tractsiv. 3D printed models in treatment planning

GI02-A6   Application Of Intravoxel Incoherent Motion In Preoperative Evaluation Of The Lymphovascular Invasion Of Esophageal Squamous Cell Carcinoma

Participants
Tao Song, MMed, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the value of intravoxel incoherent motion(IVIM) in preoperative evaluating and predicting lymphovascular invasion (LVI) in esophageal squamous cell carcinoma (ESCC).*Methods and Materials Sixty-three patients who planned to undergo resection of esophageal cancer from April 2016 to April 2019 were prospectively collected. All patients underwent IVIM sequence and routine MR examination before operation. The apparent diffusion coefficient (ADC), true diffusion coefficient (D), pseudodiffusion coefficient (D*) and pseudodiffusion fraction (f) were measured. The differences of parameter values between ESCC with and without LVI were analyzed using Student's t test and Wilcoxon rank sum tests. Receiver operating characteristic (ROC) curves were performed to compare the diagnosis performance for identifying LVI.*Results 63 patients were divided into LVI group (30 cases) and no LVI group (33 cases). The difference of ADC, D and f values between two groups showed statistically significant (all P<0.001). The D* values showed no statistically significant differences between ESCC with and without LVI (P>0.05). The ROC analyses demonstrated that the areas under the curve (AUC) of ADC, D and f values in predicting LVI of ESCC were 0.787, 0.822 and 0.853, respectively. D combined with f had highest AUC (0.917) in predicting the LVI of ESCC, sensitivity and specificity were 93.3% and 75.8%.*Conclusions IVIM can provide effective functional information to preoperative evaluate and predict the LVI of ESCC. The combined application of D and f values could provide the highest accuracy in predicting ESCC with and without LVI.*Clinical Relevance/Application IVIM could be used as an effective functional imaging modality for preoperative evaluation and prediction of the LVI of ESCC.

RESULTS

63 patients were divided into LVI group (30 cases) and no LVI group (33 cases). The difference of ADC, D and f values between two groups showed statistically significant (all P<0.001). The D* values showed no statistically significant differences between ESCC with and without LVI (P>0.05). The ROC analyses demonstrated that the areas under the curve (AUC) of ADC, D and f values in predicting LVI of ESCC were 0.787, 0.822 and 0.853, respectively. D combined with f had highest AUC (0.917) in predicting the LVI of ESCC, sensitivity and specificity were 93.3% and 75.8%.

CLINICAL RELEVANCE/APPLICATION

IVIM could be used as an effective functional imaging modality for preoperative evaluation and prediction of the LVI of ESCC.

GI02-A8   Machine-learning Models Based On Magnetic Resonance Enterography (MRE) Improves The Assessment Of Mucosal Healing In Pediatric Crohn's Disease (CD)

Participants
Itai Guez, Karmiel, Israel (*Presenter*) Nothing to Disclose

PURPOSE

Mucosal healing (MH) is considered a major Crohn's Disease (CD) treatment goal. Simple Endoscopic Score of Crohn's Disease (SES-CD) assessed by ileocolonoscopy is a standard quantitative score for assessing MH. While the majority of patients have terminal ileum (TI) involvement, intubation failure is common. Our aim is to assess the added value of machine-learning (ML) models in imputing TI SES-CD from MRE data.*Methods and Materials This is a substudy of the ImageKids study in which 240 pediatric patients with CD (22 centers, age 14.2 ± 2.5 years) underwent a baseline ileocolonoscopy scored by SES-CD, followed by an MRE examination within 14 days. We used a non-linear ML random-forest (RF) model and a multiple linear regression model (LR) with two sets (in total 4 models) of biomarkers as input: Magnetic Resonance Index of Activity (MaRIA) biomarkers (wall thickness, ulcers, edema, relative contrast enhancement (RCE)) and the Pediatric Inflammatory Crohn's MRE Index (PICMI) biomarkers (wall thickness, diffusion weighted imaging, ulcers, edema, comb sign). We used stratified 2-fold validation, repeated 50 times, in order to train each algorithm version with a random set of patients used for derivation and validation. We assessed the added-value of ML models in imputing SES-CD values by comparing RF-MaRIA vs. LR-MaRIA, and for RF-PICMI vs. LR-PICMI. We determined which set of biomarkers (PICMI vs. MaRIA) provides more accurate predictions. The mean squared error (MSE) from the reference SES-CD was

used as accuracy measure . Statistical analysis was performed with the Wilcoxon non-parametric test on the validation cohort MSE.*Results The overall ileal intubation failure rate was 17%. A subsample of 107 patients had all relevant TI items scored by central radiologists and reference SES-CD. RF-based models significantly reduced MSE over MLR-based models for both the PICMI biomarkers (RF-PICMI 11.74 [10.46,12.54] vs. LR-PICMI 12.49 [11.64,13.79], p-value<1e-5) and the MaRIA biomarkers (RF-MaRIA 12.07 [11.05,13.23] LR-MaRIA 13.56 [12.54,14.57], p-value<1e-5) PICMI-based models had lower MSE compared to MaRIA-based models (LR-PICMI vs LR-MaRIA p-value<1e-5, RF-PICMI vs RF-MARIA p- value<1e-5).*Conclusions ML non-linear models are more accurate than linear regression models in predicting TI SES-CD when using the same MRE-based biomarkers. PICMI-based models are more accurate than MaRIA-based models in predicting TI SES-CD using same data from Imagekids.*Clinical Relevance/Application Ileal intubation failure during ileocolonoscopy occurs in 20% to 25% of pediatric CD patients, challenging the role of endoscopic assessment as the gold standard for clinical trials. Therefore, accurate SES-CD imputation by an imaging modality is necessary.

RESULTS

The overall ileal intubation failure rate was 17%. A subsample of 107 patients had all relevant TI items scored by central radiologists and reference SES-CD. RF-based models significantly reduced MSE over MLR-based models for both the PICMI biomarkers (RF-PICMI 11.74 [10.46,12.54] vs. LR-PICMI 12.49 [11.64,13.79], p-value<1e-5) and the MaRIA biomarkers (RF-MaRIA 12.07 [11.05,13.23] LR-MaRIA 13.56 [12.54,14.57], p-value<1e-5) PICMI-based models had lower MSE compared to MaRIA-based models (LR-PICMI vs LR-MaRIA p-value<1e-5, RF-PICMI vs RF-MARIA p- value<1e-5).

CLINICAL RELEVANCE/APPLICATION

Ileal intubation failure during ileocolonoscopy occurs in 20% to 25% of pediatric CD patients, challenging the role of endoscopic assessment as the gold standard for clinical trials. Therefore, accurate SES-CD imputation by an imaging modality is necessary.

GI02-A9   Natural History Of LIRADS 2 And 3 Observations: A Retrospective Cross Sectional Study.

Participants
Damithri Ranathunga, MD,FRCPC, Ottawa, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

LR-2 category includes probably benign observations and LR-3 category includes observations with intermediate probability of malignancy. Percentages of hepatocellular carcinoma (HCC) are 16% for LR-2 and 37% for LR3. However, these estimates are not considered to be accurate, primarily due to selection and confirmation bias. The purpose of this retrospective cross-sectional study was to determine the natural history of LR-2 and LR-3 observations.*Methods and Materials IRB-approved search of the institutional database was performed to select a consecutive sample of 100 patients meeting the following inclusion criteria: patients meeting LIRADS v2018 criteria for high risk of HCC with untreated LR-2 or 3 observations on CT or MRI; at least 12 months follow-up with CT or MRI; minimum technical parameters recommended by LIRADS v2018. Exclusion criteria: patients with known non-HCC malignancy with active disease within 5 years; minimally invasive local therapies and non-localized therapies prior to the index test or between the index and follow-up study.Four radiologists independently verified the LIRADS categories of index and follow-up observations (50 patients each) as per LI-RADS v2018 criteria with discrepancies resolved by consensus discussion with a third reviewer.*Results Ninety-eight patients with: 50 LR-2 and 189 LR-3 index observations (11 on CT, 228 on MR) were included. Two (4%, 95% CI: 0.484 - 14.4) LR-2 and 4 (2.12%,95% CI: 0.58-5.4) LR-3 observations progressed to LR-5 and none (0%, 95% CI: 0 - 7.38) of the LR-2 and 8 (4.23%, 95% CI: 1.83-8.36) LR-3 observations progressed to LR-4 on follow-up with no statistically significant difference. Eleven (22%, 95% CI: 11.0-39.4) LR-2 and 106 (56.1%, 95% CI: 45.9-67.8) LR-3 observations regressed to a lower LIRADS category on follow-up. The remaining observations stayed in the same category on follow-up.*Conclusions Observations categorized as LR-2 or LR-3 in high-risk patients have a lower likelihood of progressing to LR-4 or LR-5 categories than estimated in recent systematic reviews. This confirm the hypothesis that prior work is prone to selection and confirmation bias.*Clinical Relevance/Application This study suggests that LIRADS v2018 follow-up recommendations for LR-2 and LR-3 observations are reasonable, given the lower percentage of LR-2 and LR-3 observations that progressed to LR-4 and LR-5 than previously identified.

RESULTS

Ninety-eight patients with: 50 LR-2 and 189 LR-3 index observations (11 on CT, 228 on MR) were included. Two (4%, 95% CI: 0.484 - 14.4) LR-2 and 4 (2.12%,95% CI: 0.58-5.4) LR-3 observations progressed to LR-5 and none (0%, 95% CI: 0 - 7.38) of the LR-2 and 8 (4.23%, 95% CI: 1.83-8.36) LR-3 observations progressed to LR-4 on follow-up with no statistically significant difference. Eleven (22%, 95% CI: 11.0-39.4) LR-2 and 106 (56.1%, 95% CI: 45.9-67.8) LR-3 observations regressed to a lower LIRADS category on follow-up. The remaining observations stayed in the same category on follow-up.

CLINICAL RELEVANCE/APPLICATION

This study suggests that LIRADS v2018 follow-up recommendations for LR-2 and LR-3 observations are reasonable, given the lower percentage of LR-2 and LR-3 observations that progressed to LR-4 and LR-5 than previously identified.

Abstract Archives of the RSNA, 2021

IR04-D

Interventional Radiology Wednesday Poster Discussions

Sub-Events

IR04-D1   **Long-term Survival And Local Recurrence With A Minimum Of 5 Years Of Follow Up After Thermal Ablation For Renal Cell Carcinoma**

Participants
Wenhui Zhou, MD, PhD, Menlo Park, California (*Presenter*) Nothing to Disclose

PURPOSE

To assess the long-term oncological outcomes of image-guided percutaneous thermal ablation for cT1N0M0 renal cell carcinoma (RCC).*Methods and Materials This retrospective study includes 152 consecutive patients (M: F = 99:53, mean age = 72 yrs) who had a minimum imaging follow-up time of 5 years after computed tomography-guided thermal ablation. Assessment of the rates of complications, residual disease and local recurrence was performed. Local recurrence-free, metastatic-free and overall survival rates were calculated using the Kaplan-Meier method.*Results 158 biopsy-proven T1 RCC measuring 0.4 to 6.1 cm (mean = 2.8 cm) were successfully treated without major complications. During the median follow-up time of 7.4 yrs, (SD = 1.7 yrs), residual disease was observed in 10/158 (6%) of cases, all of which were successfully re-treated with thermal ablation. Local recurrence occurred in 14/158 (9%) of cases. At the 10-year follow-up, the calculated RCC-specific survival rate was 94% (95% CI: 87%-98%), local recurrence free survival was 84% (95% CI: 82%-95%), and metastatic free survival was 90% (95% CI: 80%-93%).*Conclusions Over a minimum follow-up period of at least 5 years, thermal ablation achieved durable tumor control, low rate of local recurrence and favorable survival outcomes, thereby representing a reliable treatment strategy for cT1 RCC.*Clinical Relevance/Application Thermal ablation offers an effective and durable non-surgical treatment for patients with T1 renal cell carcinoma. Future studies are needed to determine the optimal imaging interval to monitor for disease recurrence.

RESULTS

158 biopsy-proven T1 RCC measuring 0.4 to 6.1 cm (mean = 2.8 cm) were successfully treated without major complications. During the median follow-up time of 7.4 yrs, (SD = 1.7 yrs), residual disease was observed in 10/158 (6%) of cases, all of which were successfully re-treated with thermal ablation. Local recurrence occurred in 14/158 (9%) of cases. At the 10-year follow-up, the calculated RCC-specific survival rate was 94% (95% CI: 87%-98%), local recurrence free survival was 84% (95% CI: 82%-95%), and metastatic free survival was 90% (95% CI: 80%-93%).

CLINICAL RELEVANCE/APPLICATION

Thermal ablation offers an effective and durable non-surgical treatment for patients with T1 renal cell carcinoma. Future studies are needed to determine the optimal imaging interval to monitor for disease recurrence.

IR04-D3   **Liver Abscess Formation After Drug Eluting Chemoembolization (dtace) In Patients With Metastatic Hepatic Tumors: A Single Center Retrospective Study Of 137 Cases**

Participants
Xiangwen Xia, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

Liver abscess formation is a severe complication after intraarterial chemoembolization in patients with hepatic tumors; however, the incidence rate and risk factors of liver abscess formation after drug-eluting bead chemoembolization (DEB-TACE) in patients with metastatic hepatic tumors are far less investigated.*Methods and Materials In this study, we retrospectively analyzed the clinical data of 137 patients with metastatic hepatic tumors who received DEB-TACE in our institute from June 2015 to September 2020. Patients were evaluated for the presence or absence of liver abscess occurring at least 1 month after DEB-TACE procedure. Univariable and multivariable analyses were used to investigate risk factors of liver abscess formation.*Results The incidence of liver abscess formation after DEB-TACE procedure was 8.76% per patient and 5.53% per procedure. Univariable and multivariable analyses showed that grade 2 embolization and systemic chemotherapy within 3 months before DEB-TACE procedure were independent risk factors.*Conclusions The incidence rate of liver abscess formation after DEB-TACE procedure in patients with metastatic hepatic tumors appears to be higher than those with primary hepatic tumors reported in literatures. Grade 2 embolization and systemic chemotherapy within 3 months before procedure were independent risk factors.*Clinical Relevance/Application These findings indicate that interventional radiologists should be more cautious when designing DEB-TACE strategies in patients with metastatic hepatic tumors who have these risk factors.

RESULTS

The incidence of liver abscess formation after DEB-TACE procedure was 8.76% per patient and 5.53% per procedure. Univariable and multivariable analyses showed that grade 2 embolization and systemic chemotherapy within 3 months before DEB-TACE procedure were independent risk factors.

CLINICAL RELEVANCE/APPLICATION

These findings indicate that interventional radiologists should be more cautious when designing DEB-TACE strategies in patients

with metastatic hepatic tumors who have these risk factors.

CH05-B

Chest Thursday Poster Discussions

Sub-Events

CH05-B2   **Deep Screening: A Deep Learning Based Screening Model To Predict Pulmonary Function Through Chest CT**

Participants
Hyunjung Park, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To propose a screening model with deep learning to predict pulmonary function through chest CT presenting anatomical lung and chest organs among health check-up examinees.*Methods and Materials 16164 participants who undertook low dose CT (LDCT) images and pulmonary function test (PFT) on the same day as health check-up in XXX from 2014-2018, their CT images and PFT data were collected. Dataset was split into two groups, internal (N = 13444) and external datasets (N=2720) based on the year of the first visit: date of first visits in 2014-2017 as internal data set and in 2018 as external data set. The internal set again was split randomly into 3 groups of training, tuning, validation sets. CT images, which originally have 2.51 ± 0.09 mm slice thickness and $0.69 \pm. 0.05$ mm pixel spacing, were resampled into 2.5mm isotropic voxel. Each volume was cropped or padded to make 180 * 140 * 178 sizes. A GoogLeNet based I3D (inflated-3D) network was trained to predict PFT parameters such as forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) with LDCT scans in a regression manner, using mean squared error as loss function. Performance was evaluated by the coefficient of determination(R^2) of a regression model, root mean squared error (RMSE), and mean absolute error (MAE). Bland-Altman plots were also used to evaluate the agreement and characteristics of difference between actual and predicted PFT values.*Results For predicting FVC, R2, MAE, RMSE were 0.8602, and 0.2458, 0.3159, respectively and for FEV1, R2, MAE, and RMSE were 0.7972, 0.2367, and 0.3025, respectively in the external validation data set. In the same validation, limit of agreements of Bland-Altman plot for both sexes were -0.57 and 0.66(bias=0.05); -0.61 and 0.69 in male, and -0.48 and 0.59 in female for FVC prediction. For FEV1 prediction, -0.57 and 0.61 for both sexes; -0.62 and 0.66 in male, -0.48 and 0.52 in female. Grad-CAM from each of the models for predicting FVC and FEV1 shows more attention on the right lung but spotted slightly different sites based on different PFT parameters.*Conclusions Bland-Altman plot showed that the predicted values converge to the mean value of the target label. The PFT values could be predicted with relatively nice performances with this deep learning model on volumetric chest CT, which could be used as a screening tool for classifying patients with low pulmonary function.*Clinical Relevance/Application Estimating high-risk factors of respiratory diseases on CT images with this model may be useful to screen patients in early stage of respiratory diseases.

RESULTS

For predicting FVC, R2, MAE, RMSE were 0.8602, and 0.2458, 0.3159, respectively and for FEV1, R2, MAE, and RMSE were 0.7972, 0.2367, and 0.3025, respectively in the external validation data set. In the same validation, limit of agreements of Bland-Altman plot for both sexes were -0.57 and 0.66(bias=0.05); -0.61 and 0.69 in male, and -0.48 and 0.59 in female for FVC prediction. For FEV1 prediction, -0.57 and 0.61 for both sexes; -0.62 and 0.66 in male, -0.48 and 0.52 in female. Grad-CAM from each of the models for predicting FVC and FEV1 shows more attention on the right lung but spotted slightly different sites based on different PFT parameters.

CLINICAL RELEVANCE/APPLICATION

Estimating high-risk factors of respiratory diseases on CT images with this model may be useful to screen patients in early stage of respiratory diseases.

MK05-B

Musculoskeletal Thursday Poster Discussions

Sub-Events

MK05-B2 **A New Photon Counting Detector CT For Assessment Of Osseointegration In Joint Replacement Implants. A Case Report Of Two Acetabular Cup Revisions**

Participants
Anders Persson, MD, PhD, Linkoping, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

To assess superiority of a new photon counting detector CT to detect osseointegration through increased spatial resolution in comparison with a standard CT.*Methods and Materials We used two acetabular implants retrieved during revision surgery. Patient 1 had a primary uncemented cup revised due to prosthetic joint infection. Patient 2 had his cemented primary cup revised due to extensive osteolysis. Both cups showed areas with osseointegration during extraction and on visual inspection. We used a photon-counting detector CT (PCD-CT; SOMATOM Count Plus; Siemens Healthineers, Forchheim, Germany) and an energy integrating detector CT (EID-CT; SOMATOM Force; Siemens Healthineers, Forchheim, Germany) to assess osseointegration radiographically. Osseointegration was defined as trabeculae attached to the implant or cement surface and was assessed with an inner ear high resolution protocol. The PCD-CT was operated at 140 kVp, 179 mAs, slice thickness 0.2 mm (0.1 mm increment), Kernel Br89u, 1024 matrix. The EID-CT was operated at Sn150 kV, 112 mAs, 0.4/0.1 mm, kernel U77 with ADMIRE strength 3. A visual comparison between the images was done.*Results The PCD-CT allowed visualization of the implant-bone interface with higher resolution. In specific, particular trabeculae could be visualized more clearly.*Conclusions With the higher resolution in the PCD-CT the interface between bone and implant could be evaluated more properly. Further investigations to assess implant loosening pre-operatively are warranted.*Clinical Relevance/Application The increased spatial resolution of the PCD-CT system might help in the assessment of implant osseointegration and thereby aid in the decision making for or against revision surgery.

RESULTS

The PCD-CT allowed visualization of the implant-bone interface with higher resolution. In specific, particular trabeculae could be visualized more clearly.

CLINICAL RELEVANCE/APPLICATION

The increased spatial resolution of the PCD-CT system might help in the assessment of implant osseointegration and thereby aid in the decision making for or against revision surgery.

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Abstract Archives of the RSNA, 2021

Sub-Events

MS02-A1   Ordering Characteristics Associated With Positive Head CT In The Emergency Department Setting

Participants
Debayan Bhaumik, MD, Denver, Colorado (*Presenter*) Nothing to Disclose

PURPOSE

Determine patient and ordering factors which correlate with positive head CT findings.*Methods and Materials Retrospective analysis was conducted within a single institution for all patients who underwent a single non-contrast Head CT exam between January 2010 and January 2017. Each exam's impression was assessed and deemed to be positive if it contained acute findings which would alter medical management or demonstrated interval worsening of prior findings. Indications for each exam as well patient demographics and time and date of the study were also recorded. After exclusion of cases with missing data, 6,904 exams met inclusion criteria. Patient and ordering characteristics were analyzed via multivariate logistic regression to identify significant associations with odds of a positive CT scan.*Results Patient age significantly correlated to CT positivity, increasing on a yearly basis (p < 0.001). Study indications of "trauma" and "vertigo/dizziness" were associated with an odds ratio less than 1 (p <0.001 and p < 0.05 respectively). Study indications of "malignancy" and any "focal neurologic complaint" had odds ratios greater than 1 (p < 0.001 and p < 0.01 respectively). Other indications including "altered mental status", "headache", "seizure", "nausea", "syncope/arrest", and "vascular concerns/complaints" had no significant correlation with positivity. The three most common order indications were trauma, altered mental status, and headache. Studies ordered during the day (7am - 7pm) had a significantly higher rate of positivity (p < 0.05) compared with studies ordered during the evening (7 pm - 7 am).*Conclusions Noncontrast head CTs ordered in the emergency department for the indications of trauma and vertigo/dizziness had lower odds of positivity, suggesting head CT may be overutilized in these settings. Older patients and patients with a history/concern for malignancy or focal neurologic deficits had a higher odds of a positive CT scan, suggesting that the clinical threshold to image such patients should be low. Studies ordered at night had lower odds of positivity, suggesting comparative over ordering during these hours.*Clinical Relevance/Application This work suggests there are certain clinical scenarios in which noncontrast head CT exams are being over-utilized. Ordering clinicians must be made aware of these trends in order to reduce costs and yield higher value care. In addition, when radiologists see higher risk indications and increasing patient age in the order requisition, they should consider triaging those exams ahead of other lower acuity studies and evaluate those exams rigorously for positive findings.

RESULTS

Patient age significantly correlated to CT positivity, increasing on a yearly basis (p < 0.001). Study indications of "trauma" and "vertigo/dizziness" were associated with an odds ratio less than 1 (p <0.001 and p < 0.05 respectively). Study indications of "malignancy" and any "focal neurologic complaint" had odds ratios greater than 1 (p < 0.001 and p < 0.01 respectively). Other indications including "altered mental status", "headache", "seizure", "nausea", "syncope/arrest", and "vascular concerns/complaints" had no significant correlation with positivity. The three most common order indications were trauma, altered mental status, and headache. Studies ordered during the day (7am - 7pm) had a significantly higher rate of positivity (p < 0.05) compared with studies ordered during the evening (7 pm - 7 am).

CLINICAL RELEVANCE/APPLICATION

This work suggests there are certain clinical scenarios in which noncontrast head CT exams are being over-utilized. Ordering clinicians must be made aware of these trends in order to reduce costs and yield higher value care. In addition, when radiologists see higher risk indications and increasing patient age in the order requisition, they should consider triaging those exams ahead of other lower acuity studies and evaluate those exams rigorously for positive findings.

MS02-A2   AI-CADt Algorithm For Pulmonary Embolism (PE) Detection In Single- And Dual-energy CT Pulmonary Angiography: Performance Based On PE Location

Participants
Fatemeh Homayounieh, MD, Bethesda, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To assess performance of AI-based triaging computer-aided detection algorithm (CADt, Aidoc) for detecting PE on single- (SECTPA) and dual (DECTPA)-energy CT pulmonary angiography and with variations in PE distribution.*Methods and Materials Our IRB-approved, HIPAA-compliant study included 356 patients who underwent CT (GE 750HD, Siemens Force/Flash) with SECTPA (n =112 patients; mean age 61±16 years; M:F 57:55) or DECTPA (n = 244 patients; 63±17 years; M:F 113:131) protocols for assessing PE. Data (previously unseen by the CADt) were enriched to include PE at different locations with matched controls. Subjects with suboptimal contrast enhancement or motion artifacts were excluded. Two radiologists independently evaluated each CTPA for presence and location (main, lobar, segmental and subsegmental) of PE to establish the ground truth. Separately, PE-CADt algorithm processed all CTPA exams after automatically selecting the image series. For each PE-positive CTPA exam, the algorithm produced a key image where the highest confidence PE finding was annotated. We estimated sensitivity, specificity, accuracy and area under the curve (AUC) with receiver operating characteristics along with 95% confidence interval.*Results Per the ground truth, 138 CTPA were positive for PE and 218 were PE negative. Overall, CADt was successful in ruling in or ruling out PE regardless

of scanners, scanning techniques and PE distribution (sensitivity 97%, specificity 89%, accuracy 92%, AUC 0.93, 95% CI 0.90-0.96). CADt had 100% sensitivity for detecting all 68 central PE up to lobar level and 93% sensitivity for 59 segmental PE. There was no significant difference in CADt accuracy in detecting PE on SECTPA (based on CT vendor 88-96%) and DECTPA (92-97%) (p>0.5). Most missed PEs were segmental and on CTPA with artifacts and/or suboptimal contrast-enhancement.*Conclusions The assessed CADt algorithm for PE retains high sensitivity, specificity and accuracy regardless of variations in acquisition technique (SECTPA vs DECTPA) and PE distribution (central vs peripheral down to subsegmental level).*Clinical Relevance/Application PE triaged algorithm based on machine learning can be applied with confidence regardless of scanners, scanning techniques and distribution of PE.

RESULTS

Per the ground truth, 138 CTPA were positive for PE and 218 were PE negative. Overall, CADt was successful in ruling in or ruling out PE regardless of scanners, scanning techniques and PE distribution (sensitivity 97%, specificity 89%, accuracy 92%, AUC 0.93, 95% CI 0.90-0.96). CADt had 100% sensitivity for detecting all 68 central PE up to lobar level and 93% sensitivity for 59 segmental PE. There was no significant difference in CADt accuracy in detecting PE on SECTPA (based on CT vendor 88-96%) and DECTPA (92-97%) (p>0.5). Most missed PEs were segmental and on CTPA with artifacts and/or suboptimal contrast-enhancement.

CLINICAL RELEVANCE/APPLICATION

PE triaged algorithm based on machine learning can be applied with confidence regardless of scanners, scanning techniques and distribution of PE.

MS02-A3   Infection Induced Tumors And Tumor-like Conditions Of The Abdomen And Pelvis: Multimodality Imaging Findings With Pathologic Correlation

Participants
Moataz Ahmed Sayed Mohammed Soliman, BMBCh, CHICAGO, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Different infectious causes that are can be associated with certain malignant conditions - Multimodality imaging findings of these tumors and tumor mimics with pathology correlation - Relevant differential considerations and management options - Potential pitfalls in imaging diagnosis

TABLE OF CONTENTS/OUTLINE

Introduction Mechanism of infection induced DNA mutation (oncogenic mutations) - Oncogenic effect - Chronic inflammation - Immune system suppression Infection induced tumors - Viral causes: EBV (Lymphoma, lymphoproliferative disease of transplant patients) HBV, HCV (Hepatocellular carcinoma) HPV 16, 18 (Anal, cervical, vaginal, vulval, and penile cancers)HTLV-1 (Lymphocytic leukemia and non-Hodgkin lymphoma) HIV:Kaposi sarcoma (HHV-8)Multicentric Castleman disease (HHV-8) - Bacterial causes: H. pylori infection (MALTOMA) - Parasitic causes - Opisthorchis viverrini and Clonorchis sinensis - Schistosomiasis (squamous cell carcinoma of the urinary bladder) - Tumor like conditions: - Infectious mononucleosis (IMN) - Adenovirus hepatic mass lesion (Inflammatory pseudotumor of the liver) - Liver abscess - TB Granuloma, abscess, milliary TB - Cholangitis - Chagas disease - Xanthogranulomatous inflammation - Disseminated fungal infection - Actinomycosis - Fitz-Hugh-Curtis syndrome Multimodality imaging findings of these pathologic entities and relevant differential considerations Potential pitfalls in imaging diagnosis Impact of imaging findings on management approach

Abstract Archives of the RSNA, 2021

Sub-Events

MK02-A1   Feasibility Study On Quantitative Assessment Osteoporosis By Virtual Noncontrast Scan Of Dual Energy Ct

Participants
Xin Wang, Heifei, China (*Presenter*) Nothing to Disclose

PURPOSE

Taking the bone mineral density (BMD) measured by QCT as the gold standard, explore the feasibility of virtual non-contrast scan(VNC) of dual -energy CT(DECT) to quantitatively evaluate bone mineral density(BMD) and the degree of osteoporosis without a phantom.*Methods and Materials A retrospective collection of 100 patients who underwent abdominal true non-contrast scan(TNC) and spectrum mode three-phase enhanced scan were randomly divided into test group and validation group with 50 cases each.To measure the BMD of L1 vertebral body by QCT Pro software. In the test group, the difference between the CT values of the L1 vertebral body in the TNC and the VNC was compared, the correlation between the vertebral body CT value of VNC and the BMD was determined, and the regression equation for predicting BMD was established. The validation group was used to evaluate the accuracy of the equation in diagnosing osteoporosis.*Results The CT value of the L1 vertebral body of the VNC is lower than that of TNC (CTTNC=133.57±48.42, CTVNC=71.24±26.38, P<0.001); after subtracting the TNC, the total radiation dose of the image is reduced by 21.94%; The multiple linear regression model of CT value of VNC to predict vertebral body BMD is: BMD=102.375+1.349×CT value-0.321×age-0.433×height (R2=0.979); The cut-off value of VNC vertebral body CT value quantitatively diagnoses osteoporosis and osteopenia are 64.5 HU and 54.3 HU, respectively.*Conclusions Without the body phantom, the CT attenuation of the lumbar spine vertebral body on VNC of DECT predict bone mineral density reliably, and can be used as a useful supplement to quantitative CT to evaluate bone mineral density.*Clinical Relevance/Application For patients undergoing DECT abdominal enhancement examinations in hospitals, in the absence of QCT phantoms, DECT virtual non-contrast scan can not only provide diagnostic information of abdominal diseases, but also provide bone health information such as bone mineral density without a Phantoms.And accurately diagnose osteoprosis and osteopenia are beneficial supplements to QCT and have certain clinical application value.

RESULTS

The CT value of the L1 vertebral body of the VNC is lower than that of TNC (CTTNC=133.57±48.42, CTVNC=71.24±26.38, P<0.001); after subtracting the TNC, the total radiation dose of the image is reduced by 21.94%; The multiple linear regression model of CT value of VNC to predict vertebral body BMD is: BMD=102.375+1.349×CT value-0.321×age-0.433×height (R2=0.979); The cut-off value of VNC vertebral body CT value quantitatively diagnoses osteoporosis and osteopenia are 64.5 HU and 54.3 HU, respectively.

CLINICAL RELEVANCE/APPLICATION

For patients undergoing DECT abdominal enhancement examinations in hospitals, in the absence of QCT phantoms, DECT virtual non-contrast scan can not only provide diagnostic information of abdominal diseases, but also provide bone health information such as bone mineral density without a Phantoms.And accurately diagnose osteoprosis and osteopenia are beneficial supplements to QCT and have certain clinical application value.

NPM01-A

Noninterpretative Sunday Poster Discussions

Sub-Events

NPM01-A1   **7-Tesla MRI Does Not Cause Increased Mercury Release From Dental Fillings**

Participants
Brian Burkett, MD, MPH, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

In recent years, 7-Tesla MRI has become an FDA-approved technology used in clinical practice. Elevated mercury (Hg) excretion from dental fillings following 7T MRI has been previously reported (Yilmaz, Radiology 288.3, 2018). Further investigation of the potential safety concern of toxic Hg release during 7T MRI is warranted. Additionally, Hg concentrations following 3T MRI of dental amalgam have not been investigated, which may impact a much larger number of patients. The purpose of this study is to further investigate the potential of Hg release from amalgam during 7T MRI, with technical improvements over previous research, as well as to evaluate Hg release during 3T MRI.*Methods and Materials Extracted human teeth with drilled caries were filled by a dentist using standard amalgam capsules containing 438 mg Hg. After 9-days storage in normal saline, 80 restored teeth were placed in 15 mL of artificial saliva solution for the following conditions: unscanned controls (n=20), MRI at 1.5T (n=20), 3.0T (n=20), and 7.0T (n=20). After 24-hours, Hg concentration was analyzed with inductively coupled plasma mass spectroscopy. Teeth were next tested under varied 9-day storage conditions in addition to the previous teeth using normal saline storage, including a dry sealed box (n=20) and immersion in artificial saliva (n=20) to ensure saline storage did not artificially decrease the Hg concentration. All teeth were transferred to new artificial saliva for scanning and/or Hg testing.*Results No significant difference in Hg concentration was observed between unscanned teeth and MRI at 1.5T, 3T, 7T (F=2.42, p=0.072), using one-way ANOVA with Holm post hoc test. Mean Hg concentrations were 13.72 ug/L for unscanned controls, 10.88 ug/L at 1.5T, 12.65 ug/L at 3T, and 8.88 ug/L at 7T. For teeth stored in artificial saliva or in a dry box, no significant difference in Hg concentration was observed with 7T MRI exposure (F=2.28, p=0.14) or by storage solution (F=1.55, p=0.22). With dry box storage, mean Hg concentrations were 12.49 ug/L after 7T MRI and 3.77 ug/L for unscanned controls. In artificial saliva storage, mean Hg concentrations were 4.72 ug/L after 7T MRI and 2.65 ug/L in controls.*Conclusions Hg release was not significantly increased after exposure to MRI at 1.5T, 3T, or 7T field strength. No significant increase in Hg concentration was associated with 7T MRI in any storage condition tested. The Hg concentration observed after 7T in various storage conditions, ranging from 4.72 to 12.49 ug/L, was markedly lower (between 53.9 and 142.6-fold) than previously reported (673 ug/L).*Clinical Relevance/Application Mercury excretion from dental fillings is not increased after exposure to 3T or 7T MRI. Dental amalgam should not create a barrier to obtaining clinical MRI examinations.

RESULTS

No significant difference in Hg concentration was observed between unscanned teeth and MRI at 1.5T, 3T, 7T (F=2.42, p=0.072), using one-way ANOVA with Holm post hoc test. Mean Hg concentrations were 13.72 ug/L for unscanned controls, 10.88 ug/L at 1.5T, 12.65 ug/L at 3T, and 8.88 ug/L at 7T. For teeth stored in artificial saliva or in a dry box, no significant difference in Hg concentration was observed with 7T MRI exposure (F=2.28, p=0.14) or by storage solution (F=1.55, p=0.22). With dry box storage, mean Hg concentrations were 12.49 ug/L after 7T MRI and 3.77 ug/L for unscanned controls. In artificial saliva storage, mean Hg concentrations were 4.72 ug/L after 7T MRI and 2.65 ug/L in controls.

CLINICAL RELEVANCE/APPLICATION

Mercury excretion from dental fillings is not increased after exposure to 3T or 7T MRI. Dental amalgam should not create a barrier to obtaining clinical MRI examinations.

NPM01-A2   **Faculty Development Effects Of A "resident Managed Peer-mentoring Program": Laddered Mentoring In Research Engages Academic Community From Students To Professors.**

Participants
Dhairya Lakhani, MD, Morgantown, West Virginia (*Presenter*) Nothing to Disclose

PURPOSE

Using a resident managed peer mentoring program that has increased resident participation in research, we reviewed the extent of change in faculty research productivity by academic rank in the two years before and the two years after implementing the intervention. Intervention consisted of identifying and extending to a resident interested in research and leadership substantial supervised autonomy to champion research and engage medical students and other residents in research projects. Briefly, novice researchers were given tasks and instruction for completing the tasks and in overall methods for bringing a research project to publication.*Methods and Materials This was an observational study designed to assess the faculty by rank outcomes of "Resident Managed Peer Mentoring Program". The program was implemented in November 2019. Primary outcomes were defined as peer-reviewed PubMed indexed publications and secondary outcomes were defined as number of abstracts and radiology physicians who published. The attendings where then classified based on their ranking for comparative analysis.*Results We report increased number of peer-reviewed PMID publications, reported by both residents and faculty members, following implementation of this program (50%, in year 1; 91.3% in year 2, as compared to pre-intervention years). Similar trends were obtained for number of abstracts presented, and number of physicians who authored PMID publications as compared to pre-intervention years. Faculty increases in participation and publications were more marked in the assistant professor and full professor ranks, and notably less in

the Associate Professor rank.*Conclusions The "Resident managed peer-mentoring program" was productive and engaging for students, residents, and for faculty physicians (particularly full professor and assistant professor ranks) in our training program. This intervention may help foster stronger departmental research culture.*Clinical Relevance/Application The "Resident managed peer-mentoring program" proved a successful method for residents, students, and faculty members. Its application may foster stronger departmental research culture in training programs.

RESULTS

We report increased number of peer-reviewed PMID publications, reported by both residents and faculty members, following implementation of this program (50%, in year 1; 91.3% in year 2, as compared to pre-intervention years). Similar trends were obtained for number of abstracts presented, and number of physicians who authored PMID publications as compared to pre-intervention years. Faculty increases in participation and publications were more marked in the assistant professor and full professor ranks, and notably less in the Associate Professor rank.

CLINICAL RELEVANCE/APPLICATION

The "Resident managed peer-mentoring program" proved a successful method for residents, students, and faculty members. Its application may foster stronger departmental research culture in training programs.

NPM01-A4   Embracing Diversity In Radiology: Understanding Cultural Competence And Cultural Humility

Participants
Shama Jaswal, MBBS, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

After reviewing this exhibit, the viewer will: 1) Understand the difference between cultural competence and cultural humility 2) Identify the importance of cultural competence and humility in radiology 3) Identify strategies for fostering cultural competence and practicing cultural humility.

TABLE OF CONTENTS/OUTLINE

1. Definitions: a. Culture: A body of knowledge, beliefs, and behaviors that are specific to ethnic, racial, religious, geographic, and social groups. b. Cultural Competence: The understanding, appreciation, and respect of different cultures; a process that requires ongoing training for providing quality care to diverse patients. c. Cultural Humility: A lifelong, learning-oriented process of self-exploration and assessment to address diverse cultures and recognition of power dynamics. 2. Key challenges faced within radiology in delivering care to diverse patient populations a. Power imbalance b. Stigmatizing patients c. Implicit and explicit biases 3. Role of cultural competence and humility in radiology a. Cultural competence improves the effectiveness of interactions with others; cultural humility enhances provider's capability to deliver patient-centered and culturally appropriate care while addressing systemic biases 4. Practical strategies for fostering cultural competence and practicing cultural humility a. Cultural competence and humility training tools b. Ongoing self-awareness and learning c. Partner with patients and communities: seek to understand cultural realities of diverse patients

GU04-A

Genitourinary Wednesday Poster Discussions

Sub-Events

GU04-A2   Prostate Biopsy In The Era Of MRI-targeting: Do All Men Require Additional Systematic Biopsy?

Participants
Dominik Deniffel, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The combination of MRI-targeted (TB) and systematic biopsy (SB) results in higher clinically significant prostate cancer (csPCa)-detection rates and is, therefore, routinely performed in many institutions. We aimed to identify patient groups which may forego concurrent SB in favor of MRI-TB alone to reduce the risk associated with additional biopsy cores.*Methods and Materials Retrospective study in 742 patients who underwent multiparametric MRI and combined biopsy (CB). Primary outcome was an upgrade to csPCa, defined as grade group (GG) =2 or =3, on CB versus MRI-TB alone. Logistic regression was used to estimate the association of variables (PI-RADS score, lesion size, location, number of lesions, number of targeted cores, Software-based versus cognitive Fusion, PSA density, prostate volume, history of previous biopsy, age) with outcomes. The clinical utility of biopsy optimization strategies was assessed by decision curve analysis. Among men who underwent radical prostatectomy (RP) within 1 year, upgrading of GG versus biopsy was recorded.*Results Compared to MRI-TB alone, CB resulted in the detection of additional GG =2 cancers in 6% (47/742) and GG =3 in 3% (21/742) of men. Adjusted odds ratios for upgrade to GG =2 were 0.31 (95% CI, 0.09- 0.91; p=0.033) and 0.34 (95% CI, 0.12-0.81; p=0.013) for PI-RADS 5 versus PI-RADS 3 and PI-RADS 4, respectively, 0.42 (95% CI, 0.20-0.82; p=0.01) for history of previous negative biopsy and 1.67 (95% CI, 1.11-2.52; p=0.013) for age (per 10-year increase). Decision curve analysis identified the omission of additional SB in all men with PI-RADS 5 and those with PI-RADS 5 aged <66 years as most clinically useful strategies, resulting in 27% (199/742) and 10% (77/742) fewer SB, whilst missing upgrades to GG =2/GG =3 in 3%/4% and 1%/3% of avoided SB, respectively. In 123 men undergoing RP, using CB versus MRI-TB alone resulted in fewer GG-upgrades on RP: -10% (12/123) for the entire cohort, -5% (2/42) for men with PI-RADS 5, -9% (7/74) for PI-RADS 4, -6% (2/35) for men with a history of previous negative biopsy, and -10% (8/82) for previous positive biopsy.*Conclusions Not all men benefit equally from the combination of SB and MRI-TB. The yield of additional csPCas on CB versus MRI-TB alone was lower in men with PI-RADS 5, previous negative biopsy and younger age, supporting the omission of additional SB in these patient groups.*Clinical Relevance/Application PI-RADS scores, biopsy history and age may help select men who can forego systematic biopsy in favor of MRI-targeted biopsy alone, thus minimizing the risks of excess biopsies.

RESULTS

Compared to MRI-TB alone, CB resulted in the detection of additional GG =2 cancers in 6% (47/742) and GG =3 in 3% (21/742) of men. Adjusted odds ratios for upgrade to GG =2 were 0.31 (95% CI, 0.09- 0.91; p=0.033) and 0.34 (95% CI, 0.12-0.81; p=0.013) for PI-RADS 5 versus PI-RADS 3 and PI-RADS 4, respectively, 0.42 (95% CI, 0.20-0.82; p=0.01) for history of previous negative biopsy and 1.67 (95% CI, 1.11-2.52; p=0.013) for age (per 10-year increase). Decision curve analysis identified the omission of additional SB in all men with PI-RADS 5 and those with PI-RADS 5 aged <66 years as most clinically useful strategies, resulting in 27% (199/742) and 10% (77/742) fewer SB, whilst missing upgrades to GG =2/GG =3 in 3%/4% and 1%/3% of avoided SB, respectively. In 123 men undergoing RP, using CB versus MRI-TB alone resulted in fewer GG-upgrades on RP: -10% (12/123) for the entire cohort, -5% (2/42) for men with PI-RADS 5, -9% (7/74) for PI-RADS 4, -6% (2/35) for men with a history of previous negative biopsy, and -10% (8/82) for previous positive biopsy.

CLINICAL RELEVANCE/APPLICATION

PI-RADS scores, biopsy history and age may help select men who can forego systematic biopsy in favor of MRI-targeted biopsy alone, thus minimizing the risks of excess biopsies.

Abstract Archives of the RSNA, 2021

Sub-Events

NR03-A1   Curriculum Learning With Deep Learning For Predicting Stroke Onset Within 4.5 Hours Using DWI-FLAIR Mismatch

Participants
Yujin Nam, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop curriculum learning based classifier using diffusion weighted imaging - fluid attenuated inversion recovery (DWI-FLAIR) mismatch to predict stroke onset time within 4.5 hours.*Methods and Materials A total of 355 stroke patients with DWI and FLAIR at Asan Medical Center who had clear stroke onset time were enrolled. The stroke onset time before or after 4.5 hours of each patient was classified. The input image is a combination of apparent diffusion coefficient (ADC), FLAIR, and b1000 axial slices. Since infarct region is an important factor in determining stroke onset time, only slices with an infarct area = 1 cm² or = 0.25 cm² were used as input images. Based on size selection, these images were divided into training (n=178, slices=808), tuning (n=19, slices=145), and validation sets (n=42, slice=228) and based on area, into training (n=238, slices=1231), tuning (n=60, slices=242), and validation (n=56, slices=333). The curriculum learning, in which fine-tuning a model was performed on the entire axial images after initial training a model with infarct-specified patch images, was performed. We compared the performances of the curriculum learning and the baseline models that was trained directly using entire images. The ResNet50 + CBAM networks were used as a backbone network and the area under curve (AUC), accuracy, specificity and sensitivity were evaluated.*Results In case of infarct area = 1 cm², and the largest infarct slice evaluation per patient sensitivity, specificity, accuracy, and AUC of our method were 0.84, 0.88, 0.85, and 0.95. In case of infarct area = 1 cm² or 0.25 cm², AUC of our method were 0.95 and 0.89, respectively, whereas AUC of the baseline is 0.83 and 0.78, respectively. In evaluation of the largest infarct slice, all ROCs of curriculum models show significantly better than those of the baseline models. (p < 0.05)*Conclusions Our curriculum learning based model with deep learning shows better and more robust performance for predicting stroke onset time based on 4.5 hours, which could be helpful in the actual clinical setting.*Clinical Relevance/Application Our model could be helpful in predicting the onset time of onset unclear stroke patient to perform thrombolysis in the actual clinical setting.

RESULTS

In case of infarct area = 1 cm², and the largest infarct slice evaluation per patient sensitivity, specificity, accuracy, and AUC of our method were 0.84, 0.88, 0.85, and 0.95. In case of infarct area = 1 cm² or 0.25 cm², AUC of our method were 0.95 and 0.89, respectively, whereas AUC of the baseline is 0.83 and 0.78, respectively. In evaluation of the largest infarct slice, all ROCs of curriculum models show significantly better than those of the baseline models. (p < 0.05)

CLINICAL RELEVANCE/APPLICATION

Our model could be helpful in predicting the onset time of onset unclear stroke patient to perform thrombolysis in the actual clinical setting.

NR03-A11   CNS HIV Infection: From Pathophysiology To Management With Emphasis On Advanced Neuroimaging

Awards
Certificate of Merit

Participants
Yoshiaki Ota, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To review the pathophysiology of CNS HIV infection and consequent brain injury 2. To demonstrate neuroimaging of CNS HIV infection, opportunistic infections, and malignancies3. To review treatment and treatment-related complications

TABLE OF CONTENTS/OUTLINE

1. Pathophysiology of CNS HIV infection- Neuronal damage- Neuroinflammation/demyelination- Breakdown of blood-brain barrier/vasculopathy/vasculitis2. Neuroimaging of HIV infection - Conventional CT, MRI: evaluation and characterization for brain lesions, gross brain structures, and brain atrophy- DWI: evaluation for cytotoxic/vasogenic edema and cellularity- PET-CT: evaluation for metabolic disturbances- Diffusion tensor image: neuroinflammation, microstructure assessment- DSC-MRI: blood-brain permeability- MRS: neuroinflammation3. Neuroimaging and pitfalls of CNS HIV infection, opportunistic infections and malignancies, and treatment-related complications- CNS HIV infection: brain atrophy, encephalopathy, vasculopathy- Opportunistic infections: progressive multifocal leukoencephalopathy, toxoplasmosis, Cryptococcus meningitis, CMV, VZV- Malignancy: primary central nervous system lymphoma (PCNSL) - Treatment-related complications: CD8 encephalitis, Immune reconstitution inflammatory syndrome (IRIS)

NR03-A4   Forecasting Demand For Image-guided Endovascular Thrombectomy In The United States

Participants
Cathy Yu, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

PURPOSE

Endovascular thrombectomy (EVT) has become life-saving for patients experiencing stroke due to large vessel occlusion. However, it is only available at specialized centers which are not uniformly distributed throughout the United States. The purpose of this study is to forecast how population and demographic changes will affect EVT accessibility at the national level in the future.*Methods and Materials Population data from 2009-2019 was obtained from the United States Census Bureau's American Community Survey 5-Year Estimates. Stroke incidence data from 2009-2017 was obtained from the Center for Disease Control based on stroke hospitalization rate. Linearized trends in total population, patient demographics, and stroke incidence were used to forecast future stroke events through 2024 in each census tract. EVT centers were identified from national and state organizations that certify stroke centers. Driving times between census tracts and their nearest EVT centers were calculated using real-world road networks. All analyses were done at the census tract level for census tracts within the contiguous United States.*Results In total, 371 EVT centers and 71,986 census tracts were included, encompassing a population of 322,521,2553 in 2019. In 2019, Americans lived a median of 26.4 minutes (IQR: 14.8, 54.9) from an EVT center; 55.0% lived within a 30-minute drive and 77.7% within a 60-minute drive. By 2024, Americans are forecast to live a median of 26.2 minutes (IQR: 14.9, 54.0) from an EVT center, a 1% decrease in time; 55.3% lived within a 30-minute drive and 78.2% within a 60-minute drive. Among stroke patients, the median time to an EVT center was 30.2 minutes (16.2, 61.7) in 2019; 49.7% were within a 30-minute drive and 74.2% were within a 60-minute drive. By 2024, likely stroke patients are forecast to live a median 30.7 minutes (16.2, 64.7) from an EVT center, a 2% increase; 49.3% will live within a 30-minute drive and 72.9% within a 60-minute drive.*Conclusions Population and stroke incidence changes between 2019 and 2024 are forecast to result in a 2% increase in median travel time to an EVT center. Future planning for stroke systems of care must anticipate these changes in order to preserve access to EVT.*Clinical Relevance/Application A comprehensive understanding of both current and future demand for thrombectomy access is necessary not only for clinical decision-making regarding treatment modality, but also hospital and resource planning to improve treatment availability.

RESULTS

In total, 371 EVT centers and 71,986 census tracts were included, encompassing a population of 322,521,2553 in 2019. In 2019, Americans lived a median of 26.4 minutes (IQR: 14.8, 54.9) from an EVT center; 55.0% lived within a 30-minute drive and 77.7% within a 60-minute drive. By 2024, Americans are forecast to live a median of 26.2 minutes (IQR: 14.9, 54.0) from an EVT center, a 1% decrease in time; 55.3% lived within a 30-minute drive and 78.2% within a 60-minute drive. Among stroke patients, the median time to an EVT center was 30.2 minutes (16.2, 61.7) in 2019; 49.7% were within a 30-minute drive and 74.2% were within a 60-minute drive. By 2024, likely stroke patients are forecast to live a median 30.7 minutes (16.2, 64.7) from an EVT center, a 2% increase; 49.3% will live within a 30-minute drive and 72.9% within a 60-minute drive.

CLINICAL RELEVANCE/APPLICATION

A comprehensive understanding of both current and future demand for thrombectomy access is necessary not only for clinical decision-making regarding treatment modality, but also hospital and resource planning to improve treatment availability.

NR03-A5   Early Intervention With Multiple CT-guided Pudendal Nerve Blocks Offers Hope For Controlling Pudendal Neuralgia

Participants
Dennis Phan, Rochester, New York (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed toevaluate the benefit of multiple regularly spaced computed tomography (CT) guided nerve blocks (>3) with a combination of anesthetics and steroids for the treatment of pudendal neuralgia. The accuracy of localization of the pudendal nerve during blockade, demographics, and social factors were analyzed to determine their influence on CT-guided pudendal nerve blocks.*Methods and Materials 217 patients diagnosed with pudendal neuralgia per the NANTES criteria underwent CT-guided pudendal nerve block and were assessed for outcome and response rate. The patients' demographics, inciting events, initial pain criteria, treatment data, and follow-up data were collected. Non-responders to treatment were compared to responders using unpaired t-test for continuous variables, Fisher's exact test for binary variables and chi squared test for categorical variables. Univariate logistic regression was used to examine prediction of response to the nerve block. A p value <0.05 was indicative of a significant difference.*Results The most common chief complaint was pain during sitting or squatting and most common areas of pain involved the vulva, labia, perineum, and vagina (44.2%). Treatment response rates increased with the number of blocks with a maximum response rate of 92.2% after the 4th dose. Responders underwent more nerve blocks in the first year when compared to treatment non-responders (3.1±1.5 vs. 2.6±1.6, p=0.026). 29.4% of treatment non-responders were on disability compared to 9.7% of responders (p=0.043). History of preadolescent sexual abuse was present in 41.7% of non-responders versus 15.7% in responders (p=0.046) and was a significant predictor of response to treatment (odds ratio = 0.27, p=0.04).*Conclusions CT guided pudendal nerve block improves pain in patients meeting NANTES criteria. A significant predictor of response included the number of blocks administered within the first year. Other predictors included history of preadolescent sexual abuse and being on disability at the time of treatment.*Clinical Relevance/Application Approaches to managing pudendal neuralgia are varied with mixed outcomes. Improving and standardizing treatment necessitates further investigation of current practices.

RESULTS

The most common chief complaint was pain during sitting or squatting and most common areas of pain involved the vulva, labia, perineum, and vagina (44.2%). Treatment response rates increased with the number of blocks with a maximum response rate of 92.2% after the 4th dose. Responders underwent more nerve blocks in the first year when compared to treatment non-responders (3.1±1.5 vs. 2.6±1.6, p=0.026). 29.4% of treatment non-responders were on disability compared to 9.7% of responders (p=0.043). History of preadolescent sexual abuse was present in 41.7% of non-responders versus 15.7% in responders (p=0.046) and was a significant predictor of response to treatment (odds ratio = 0.27, p=0.04).

CLINICAL RELEVANCE/APPLICATION

Approaches to managing pudendal neuralgia are varied with mixed outcomes. Improving and standardizing treatment necessitates further investigation of current practices.

NR03-A6   Inaccuracies Of AI-based Intracranial Hemorrhage Detection On CTs

Participants
Muhannad Seyam, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To classify inaccurately flagged findings (false positives) of a deep learning algorithm for detecting intracranial hemorrhage on CT.*Methods and Materials We classified false-positive findings of a deep learning algorithm for detecting intracranial hemorrhage on emergent cranial NCCTs obtained at our university hospital between November 2019 and October 2020. The radiology report, generated by at least two radiologists (at least one board-certified neuroradiologist), served as the ground-truth for our analysis. As per the report, indeterminate reasons for incorrectly flagged findings were reviewed by two radiologists for classification or remained indeterminate if the review was inconclusive. The deep learning algorithm evaluated emergent cranial CTs prospectively and prompted a window alert with the critical findings if applicable.*Results The study included 3215 emergent cranial CT examinations, of which 5.3% (169/3215) were classified as false-positive findings per radiology report. The majority comprised of post-operative and post-ischemic defects (24.9%, 42/169), followed by other artifacts (20.1%, 34/169), tumors (14.8%, 25/169), calcifications (9.5%, 16/169), and fluids (edema, hygroma, seroma, irrigation, subdural and subcutaneous fluid) (6.5%, 11/169). Other findings included arteriovenous malformations, arteriovenous fistulas, cavernomas, contrast agent, cerebral venous thrombosis, cysts, hyperdense vessels, a hyperdense media sign, or remained indeterminate (2.4%, 4/169). Notably, six previously unreported but flagged intracranial hemorrhages (3.6%) were detected in this review and consisted of two intracerebral hemorrhages, three subdural hematomas, and one intraventricular hemorrhage.*Conclusions Relatively common secondary findings may compromise the accuracy of AI-based tools for detecting intracranial hemorrhage on CT.*Clinical Relevance/Application Awareness of various false-positive imaging findings may assist in optimizing future deep learning algorithms.

RESULTS

The study included 3215 emergent cranial CT examinations, of which 5.3% (169/3215) were classified as false-positive findings per radiology report. The majority comprised of post-operative and post-ischemic defects (24.9%, 42/169), followed by other artifacts (20.1%, 34/169), tumors (14.8%, 25/169), calcifications (9.5%, 16/169), and fluids (edema, hygroma, seroma, irrigation, subdural and subcutaneous fluid) (6.5%, 11/169). Other findings included arteriovenous malformations, arteriovenous fistulas, cavernomas, contrast agent, cerebral venous thrombosis, cysts, hyperdense vessels, a hyperdense media sign, or remained indeterminate (2.4%, 4/169). Notably, six previously unreported but flagged intracranial hemorrhages (3.6%) were detected in this review and consisted of two intracerebral hemorrhages, three subdural hematomas, and one intraventricular hemorrhage.

CLINICAL RELEVANCE/APPLICATION

Awareness of various false-positive imaging findings may assist in optimizing future deep learning algorithms.

NR03-A7   Anatomical Variants Of The Circle Of Willis Do Not Determine Cerebral Collateral Circulation In Ischemic Stroke Due To M1 Occlusion

Participants
Karolina Brzegowy, Krakow, Poland (*Presenter*) Nothing to Disclose

PURPOSE

In acute ischemic stroke, tissue fate and treatment results are dependent on collateral circulation. The purpose of this study was to determine whether variations in the anatomy of the Circle of Willis (CoW) affect collateral blood flow in acute M1 occlusion.*Methods and Materials We performed a retrospective assessment of radiological examinations of patients with stroke due to middle cerebral artery M1 segment occlusion. All patients underwent mechanical thrombectomy from January 2015 until March 2021. The anatomy of the CoW was assessed on initial CT-angiography and DSA. Cranial collateral vasculature status and cortical vein opacification score (COVES) were graded on CTA. Non-contrast CT scans and ASPECTS scores (using RAPID software) were used to determine the ischemic area.*Results A total of 100 patients were included in the analysis (58 females and 42 males, mean age: 71.6 +/- 13.9). Patients with fully continuous CoW had worse COVES scores than those with CoW incomplete at both anterior and posterior portion (89% vs 68% with COVES 0-2, p=0.179). No statistically significant results were found when comparing the enhancement of collaterals between these two groups (p=0.390). The COVES scores were similar for patients with complete and incomplete anterior portions of CoW (77% vs 80% with COVES 0-2, p=0.812). Patients with incomplete posterior portions of CoW had lower COVES scores than those with complete (80% vs 67% with COVES 0-2, p=0.206). No statistically significant differences were discovered when comparing different types of posterior communicating artery (adult, transitional and fetal). Analysis of ischemic areas determined as ASPECTS scores pre- and post-thrombectomy yielded no significant differences between any of the groups.*Conclusions Although certain variants of the CoW have been reported to increase the risk of ischemic stroke, our results show that the anatomy of CoW has no large effect on collateral blood flow during acute M1 occlusion. Pial arterioles may play a more important role in determining cerebral collateral circulation than anatomical variants of major cerebral arteries.*Clinical Relevance/Application Detailed knowledge about factors that influence collateral blood flow is crucial as may aid in identification of patients prone to worse outcomes of ischemic stroke. Anatomical variants of CoW do not play a major role in formation of cerebral collaterals.

RESULTS

A total of 100 patients were included in the analysis (58 females and 42 males, mean age: 71.6 +/- 13.9). Patients with fully continuous CoW had worse COVES scores than those with CoW incomplete at both anterior and posterior portion (89% vs 68% with COVES 0-2, p=0.179). No statistically significant results were found when comparing the enhancement of collaterals between these two groups (p=0.390). The COVES scores were similar for patients with complete and incomplete anterior portions of CoW (77% vs 80% with COVES 0-2, p=0.812). Patients with incomplete posterior portions of CoW had lower COVES scores than those with complete (80% vs 67% with COVES 0-2, p=0.206). No statistically significant differences were discovered when comparing different types of posterior communicating artery (adult, transitional and fetal). Analysis of ischemic areas determined as ASPECTS scores pre- and post-thrombectomy yielded no significant differences between any of the groups.

CLINICAL RELEVANCE/APPLICATION

Detailed knowledge about factors that influence collateral blood flow is crucial as may aid in identification of patients prone to worse outcomes of ischemic stroke. Anatomical variants of CoW do not play a major role in formation of cerebral collaterals.

NR03-A8   Effect Of Quantitative Collateral-core Ratio On Predicting Functional Independence In Patients With Acute Ischemic Stroke

Participants

Jinhao Lyu, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

The study was to test the hypothesis that a collateral perfusion - core ratio as measured by quantitative arterial spin labeling (ASL) and diffusion-weighted imaging (DWI) is predictable for clinical outcome in acute ischemic large vessel occlusive stroke.*Methods and Materials A prospective, observational cohort study was conducted at 12 academic hospital-based centers in China. Participants with acute ischemic stroke caused by anterior circulation large vessel occlusion underwent two post-labeling delays (PLD, 1.5s, and 2.5s) ASL and DWI. Quantitative collateral - core ratio was calculated by (volume of collateral perfusion / volume of DWI hyperintensity). The volume of collateral perfusion was obtained by volumetric measurement of residual signal on 2 PLD cerebral blood flow subtraction map by in-house software. 90 day modified Rankin Scale (mRS) was followed and recorded. Enrollment took place from January 1, 2019. Data was central reviewed and analyzed.*Results 149 patients remained eligible after exclusion in the study. There were 84 patients with mRS = 2 (favorable outcome) and 65 patients with mRS > 2 (unfavorable outcome). The optimal collateral-core ratio for predictive for 90 day mRS >2 was 0.7. 57 (38.2%) patients were classified as low collateral-core ratio (<0.7) and 92 (61.8%) patients were high collateral-core ratio (=0.7). Figure 1 shows scatter plots for all enrolled patients according to infarct core volume and collateral-core ratio stratified by clinical outcome. The NIHSS, infarct core volume, was significantly higher in patients with unfavorable outcome than those with favorable outcome, whereas collateral perfusion volume showed no significantly different. Collateral-core ratio were significantly lower in patients with unfavorable outcome. After adjusted for baseline characteristics, risk factors, treatment, lesion location, infarct core volume, and collateral perfusion volume, NIHSS (OR 1.1996, 95%CI 1.0842 - 1.3272) and collateral-core ratio (OR 0.7563, 95%CI 0.5779 to 0.9897) were independently significantly associated with unfavorable outcome. Predictive models showed significant improvement after recruiting collateral-core ratio in the model than NIHSS alone (Figure 2).*Conclusions Collateral - core ratio determined using 2 PLD ASL is robustly associated with clinical outcome in patients with acute ischemic anterior circulation large vessel occlusive stroke.*Clinical Relevance/Application We introduce collateral - core ratio, a novel imaging marker determined using arterial spin labeling perfusion, to evaluate the interaction effect of collateral circulation and volume of infarct core on clinical outcome in patients with acute ischemic anterior circulation large vessel occlusive stroke.

RESULTS

149 patients remained eligible after exclusion in the study. There were 84 patients with mRS = 2 (favorable outcome) and 65 patients with mRS > 2 (unfavorable outcome). The optimal collateral-core ratio for predictive for 90 day mRS >2 was 0.7. 57 (38.2%) patients were classified as low collateral-core ratio (<0.7) and 92 (61.8%) patients were high collateral-core ratio (=0.7). Figure 1 shows scatter plots for all enrolled patients according to infarct core volume and collateral-core ratio stratified by clinical outcome. The NIHSS, infarct core volume, was significantly higher in patients with unfavorable outcome than those with favorable outcome, whereas collateral perfusion volume showed no significantly different. Collateral-core ratio were significantly lower in patients with unfavorable outcome. After adjusted for baseline characteristics, risk factors, treatment, lesion location, infarct core volume, and collateral perfusion volume, NIHSS (OR 1.1996, 95%CI 1.0842 - 1.3272) and collateral-core ratio (OR 0.7563, 95%CI 0.5779 to 0.9897) were independently significantly associated with unfavorable outcome. Predictive models showed significant improvement after recruiting collateral-core ratio in the model than NIHSS alone (Figure 2).

CLINICAL RELEVANCE/APPLICATION

We introduce collateral - core ratio, a novel imaging marker determined using arterial spin labeling perfusion, to evaluate the interaction effect of collateral circulation and volume of infarct core on clinical outcome in patients with acute ischemic anterior circulation large vessel occlusive stroke.

NR03-A9   Comparative Costs Of Direct To Angiography Suite Vs. Standard-Of-Care CT Pathway For Stroke Patients With Suspected Large Vessel Occlusion Using Time-driven Activity-based Costing

Participants

Kinpritma Sangha, PhD,MPH, Malvern, Pennsylvania (*Presenter*) Employee, Siemens AG

PURPOSE

Direct to angiography (DTA) is a new care pathway for treatment of patients with stroke due to large vessel occlusion. While DTA pathway has the potential to lower time to treatment and improve clinical outcomes for acute ischemic stroke (AIS), the costs of implementing a DTA care pathway have not been studied. The purpose of this study is to measure and compare the relative cost differences between the DTA and standard-of-care CT suite pathways based on four treatment scenarios using IV-tPA and EVT.*Methods and Materials We apply the Time Driven Activity Based Costing (TDABC) model to assess the costs of both DTA and standard-of-care CT pathways from the healthcare institution perspective. Four scenarios were considered based on patient eligibility for treatment with IV-tPA and EVT: a) IV-tPA+ EVT, b) IV-tPA+ no EVT, c) No IV-tPA+ EVT, d) No IV-tPA+ no EVT. We utilize process mapping to outline all activities, materials, and equipment for each step needed to perform in each pathway for AIS patients with suspected large vessel occlusion. TDABC uses time equations to estimate the time spent on each activity within a pathway and the associated costs. The outcomes measured in this study include total costs and cost per patient for both pathways.*Results Total costs to manage an acute ischemic stroke patient with LVO using the DTA and the CT suite pathway were: IV-tPA+EVT= $26,004.65 and $26,077.80, IV-tPA but no EVT= $8,694.52 and $8,649.43, no IV-tPA+EVT= $17,595.03 and $17,668.18, no IV-tPA and no EVT= $284.90 and $228.79 per patient. Material costs (IV-tPA and EVT), with a total amount of $24,656.45, were the highest cost driver in both pathways, comprising nearly 95% of the total costs in the IV-tPA+EVT group. However, in the no IV-tPA+no EVT group with no treatment, personnel costs become the highest cost driver, comprising 92% and 91% of the total costs in the DTA and CT pathways.*Conclusions While the DTA approach will incur similar per-patient costs to the CT pathway, the costs vary based on treatment. Costs of IV-tPA and EVT are the highest cost drivers in both pathways, while, in the absence of any treatment, personnel costs become the highest cost driver. Figure 1: DTA and standard-of-care CT costs class="MsoNormal">*Clinical Relevance/Application Implementation of DTA pathway can allow for lower time to treatment and improve clinical outcomes for Acute ischemic stroke patients with suspected LVO at similar costs as the standard-of-care CT pathway.

RESULTS

Total costs to manage an acute ischemic stroke patient with LVO using the DTA and the CT suite pathway were: IV-tPA+EVT= $26,004.65 and $26,077.80, IV-tPA but no EVT= $8,694.52 and $8,649.43, no IV-tPA+EVT= $17,595.03 and $17,668.18, no IV-tPA and no EVT= $284.90 and $228.79 per patient. Material costs (IV-tPA and EVT), with a total amount of $24,656.45, were the highest cost driver in both pathways, comprising nearly 95% of the total costs in the IV-tPA+EVT group. However, in the no IV-tPA+no EVT group with no treatment, personnel costs become the highest cost driver, comprising 92% and 91% of the total costs

in the DTA and CT pathways.

CLINICAL RELEVANCE/APPLICATION

Implementation of DTA pathway can allow for lower time to treatment and improve clinical outcomes for Acute ischemic stroke patients with suspected LVO at similar costs as the standard-of-care CT pathway.

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Abstract Archives of the RSNA, 2021

Sub-Events

BR01-A10   Comparison Of Hyperplasic Axillary Lymph Nodes Reaction After COVID-19 M-RNA Vaccine Between Different Age Groups.

Participants
Alba Cristina Igual Rouilleault, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To study axillary lymph node response to the COVID-19 mRNA vaccination between young and middle-aged patients.*Methods and Materials Ninety-one volunteer employees from our center were prospectively ruled-out between February to April 2021. The study was conducted with the approval of our IRB and all participants provided written consent to participate. Patients recruited were Pfizer-BioNTech COVID-19 vaccine recipients and each one underwent a total of three axillary ultrasound (US) evaluations of the ipsilateral vaccinated arm. The first axillar US exam was obtained within the week before vaccine administration (basal control), the second one the week after the first dose (control 1) and the last one, the week after the second dose (control 2). Findings recorded in our study included: the total number of visible nodes, the maximum measurements of the long-axis size and cortical thickness (mm), Bedi's classification (grade 1 to 6) and color Doppler evaluation (grade 0 to 3, being 0 no color signal and 3 high intense color signal). Patients were classified in two age groups using 45 years of age as a cut-off. Data collected were compared between both groups in the follow-up evaluations using unpaired-sample Student's t-test for quantitative continuous variables and Mann-Whitney U test for ordinal variables.*Results The mean age of patients included was 44 y/o with 43 patients younger than 45 y/o and 48 older than 45 y/o. In basal US examination, a higher cortical thickness (mean 1.8 vs 1.4 mm; p=0.037), a higher grade of Bedi's classification (90.6% vs 77.1% of grade 2; p=0.024) and a greater grade of color Doppler (60% of grade 1 vs 56% of grade 0; p=0.009) were identified in younger group vs middle-age group. In control 1 and 2, statistically significant differences were also found comparing these three parameters between younger and middle-age patients. However, total visible nodes and maximum long-axis measurement didn't' show statistically significant differences between both age groups in any of the three US examinations.*Conclusions Comparative analyses between younger and middle-age patients showed more cortical thickness, Bedi's grade and Doppler scale in the first group among the three US examinations. *Clinical Relevance/Application Hyperplasic axillary lymphadenopathy can be consider a normal response to COVID-19 vaccine, showing higher morphological changes in younger patients.

RESULTS

The mean age of patients included was 44 y/o with 43 patients younger than 45 y/o and 48 older than 45 y/o. In basal US examination, a higher cortical thickness (mean 1.8 vs 1.4 mm; p=0.037), a higher grade of Bedi's classification (90.6% vs 77.1% of grade 2; p=0.024) and a greater grade of color Doppler (60% of grade 1 vs 56% of grade 0; p=0.009) were identified in younger group vs middle-age group. In control 1 and 2, statistically significant differences were also found comparing these three parameters between younger and middle-age patients. However, total visible nodes and maximum long-axis measurement didn't' show statistically significant differences between both age groups in any of the three US examinations.

CLINICAL RELEVANCE/APPLICATION

Hyperplasic axillary lymphadenopathy can be consider a normal response to COVID-19 vaccine, showing higher morphological changes in younger patients.

BR01-A2   Synthetic Post-contrast Breast MRI For Imaging Malignant Lesions Using Deep Learning

Participants
Maggie Chung, MD, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of simulating post-contrast T1 breast MR images from pre-contrast MR images using a 3D fully convolutional neural network and to evaluate its diagnostic quality through a multi-reader study.*Methods and Materials A 3D fully convolutional deep neural network based on the U-net architecture was used to generate synthetic post-contrast T1 breast MRs (syMR) from 5 pre-contrast series: T1 with and without fat saturation (FS), T2 FS, DWI, and ADC. The dataset consisted of 101 breast MRs performed from 1/2015-1/2019 in women with newly diagnosed invasive breast cancer. The first post-contrast phase of the conventional dynamic contrast-enhanced T1 MR (cMR) was used as the ground-truth. Independent training and testing sets were used with training/test ratio of 85/15. Ten cMRs from the test set demonstrating a measurable index malignancy were included in the reader study. cMRs with only non-mass enhancement without detectable enhancing mass were excluded. The 10 pairs of cMR and syMR were randomized between two sessions separated by a 2-week washout period. Three blinded breast radiologists independently assessed whether each case looked like a cMR, image quality (5-point Likert-type scale), presence of tumor enhancement, and maximum index mass measurement. Quality scores of "excellent," "good," and "acceptable" were considered acceptable for diagnostic use. Paired t-test assessed difference in the mean tumor size between cMR and syMR. Wilcoxon signed-rank test evaluated difference in image quality scores.*Results All syMRs were assessed by the three readers as having the appearance of a cMR and demonstrating tumor enhancement. Mean tumor sizes for cMR and syMR were 23mm (range 12-39mm) and 22mm (range 12-41 mm), respectively; mean difference was 1.0 mm (95% CI -0.9, 3.0)(p=0.3). Image quality of the

MR was statistically lower for syMR compared to cMR (p<0.0001). The majority of cMRs (53%) were assessed as "excellent", while most syMRs (77%) were assessed as "good" or "acceptable." Of the 10 syMRIs, the majority were considered acceptable for diagnostic use by each of the three readers (10/10, 9/10, and 7/10, respectively).*Conclusions This pilot feasibility study demonstrates that syMR generated using a 3D deep fully convolutional neural network has the appearance of cMR with comparable tumor enhancement and similar lesion size. Image quality of syMR was slightly less than cMR, but the majority were of acceptable diagnostic quality.*Clinical Relevance/Application Simulated post-contrast breast MR is a promising deep learning technique that has the potential to extend the benefits and accessibility of contrast-enhanced breast MR to patients while reducing the necessity of gadolinium contrast administration.

RESULTS

All syMRs were assessed by the three readers as having the appearance of a cMR and demonstrating tumor enhancement. Mean tumor sizes for cMR and syMR were 23mm (range 12-39mm) and 22mm (range 12-41 mm), respectively; mean difference was 1.0 mm (95% CI -0.9, 3.0)(p=0.3). Image quality of the MR was statistically lower for syMR compared to cMR (p<0.0001). The majority of cMRs (53%) were assessed as "excellent", while most syMRs (77%) were assessed as "good" or "acceptable." Of the 10 syMRIs, the majority were considered acceptable for diagnostic use by each of the three readers (10/10, 9/10, and 7/10, respectively).

CLINICAL RELEVANCE/APPLICATION

Simulated post-contrast breast MR is a promising deep learning technique that has the potential to extend the benefits and accessibility of contrast-enhanced breast MR to patients while reducing the necessity of gadolinium contrast administration.

BR01-A4   Consistent Breast Density Calculation In Screening Breast MRI

Participants
Riccardo Samperna, MSc, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Personalized breast cancer screening allows for more accurate and cost-effective women care. Breast density is a well-known risk factor for future development of breast cancer and may be used to stratify women to alternative screening modalities (e.g. breast MRI). Automatic breast density calculation in breast MRI is thus required to be able to re-adjust screening recommendations and provide further screening personalization. It is essential that measured density in MRI is consistent over time, in order to only change the screening advice in women who have a significant decrease in density.*Methods and Materials 197 patients with a total of 611 studies (on average 3 per patient, with an average time-interval of 1 year between scans) were selected from the breast screening MRI database available at our institution based on the availability of two or more studies with T1 weighted Dixon acquisitions (in phase, opposed phase and reconstructed water and fat images). Breast volume was automatically calculated by using a deep-learning based segmentation solution. Fibroglandular tissue volume was calculated via subtraction of T1 fat-suppressed images and T1 water-suppressed images following Otsu thresholding. Density classes were defined using the thresholds applied by Volpara Density Grade (VDG) and {non-dense, dense} categorization based on calculated volumetric breast density. Per-patient consistency of density over sequential studies was evaluated.*Results The distribution over the density classes at baseline was a = 24%, b = 23%, c = 28%, d =25%. VDG classes had an average of 76.8% consistency between follow-up studies. In non-consistent classes: 16.4% of studies changed to a lower class and 6.8% of studies changed to a higher class. The categorization {non-dense, dense} showed 91.5% consistency between follow-up studies. In non-consistent categories: 6.3% of studies changed from dense to non-dense and 2.2% changed from non-dense to dense.*Conclusions The automatic VDG class assignment and the {non-dense, dense} categorization of intra-patient breast screening MRI proved to be highly consistent over two or multiple studies. Non-consistent results are at expected levels, due to the known decrease of breast density in ageing women and changes in body composition.*Clinical Relevance/Application Reliable automatic breast density calculation over time for MRI eliminates interobserver human variability and may be used to provide patients with a personalized screening advice.

RESULTS

The distribution over the density classes at baseline was a = 24%, b = 23%, c = 28%, d =25%. VDG classes had an average of 76.8% consistency between follow-up studies. In non-consistent classes: 16.4% of studies changed to a lower class and 6.8% of studies changed to a higher class. The categorization {non-dense, dense} showed 91.5% consistency between follow-up studies. In non-consistent categories: 6.3% of studies changed from dense to non-dense and 2.2% changed from non-dense to dense.

CLINICAL RELEVANCE/APPLICATION

Reliable automatic breast density calculation over time for MRI eliminates interobserver human variability and may be used to provide patients with a personalized screening advice.

BR01-A5   Outcomes Of Benign Concordant Mri-guided Breast Biopsy And Follow-up Recommendations

Participants
Lonie Salkowski, MD,PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

MRI-guided vacuum assisted breast biopsies (MR VABB) are increasingly used for histologic diagnosis of suspicious lesions on screening/diagnostic MRI. Currently there are no standard guidelines for imaging follow-up after a benign concordant biopsy. The purpose of this study was to determine imaging follow-up recommendations and outcomes of benign, concordant MR VABB.*Methods and Materials An IRB approved, HIPAA compliant retrospective review was performed of 9-gauge MR VABB with clip placement, performed at a single academic institution from 2013 through 2019, with prospective radiology-pathology concordance assessment. We collected lesion/clip location, histology, radiology-pathology concordance, and timing of follow-up MRI recommendations. Follow-up intervals after MR VABB were defined as 6 months (5-9 months), 12 month (=9-15 months) and long-term (>15 months). The cancer detection rates (CDR) were compared with a two-tailed Fischer exact test.*Results Of 444 MR VABB, 258 were benign and concordant with 46 lost to follow-up. Of the remaining 212 biopsies (193 patients), 145 biopsies satisfied our inclusion criteria based on the timing of the first follow-up breast MRI. 100 biopsies had MRI follow-up at 6-months, 23 at 12-months, and 22 long term. The CDR were 2% (2/100), 0% (0/23), and 0% (0/22) (P=1), respectively. At 6-months, 2 cases were recommended for biopsy and 3 assessed for short interval follow-up (BI-RADS 3). The cancers were Stage 0 (DCIS) and Stage IA (invasive ductal carcinoma). The overall false-negative rate of the benign concordant MR VABB was 1.38% (2/145). A 6-month follow-up breast MRI was recommended for 90% (190/212) of the benign concordant MR VABB; however, only 50.5% (96/190) obtained MRI follow-up at 6 months.*Conclusions Follow-up breast MRI should be performed after benign concordant MR VABB given the 1.38% overall false negative rate. However, the timing of the first follow-up (6 versus 12 months) may not be clinically

significant as the two cancers detected at 6-month MRI follow-up were small size and lymph node negative. Although the majority of benign concordant MR VABB were recommended for a 6-month follow-up breast MRI, only half were performed at that interval.*Clinical Relevance/Application Given the relatively low CDR (2%) and favorable pathologic features of the cancers detected at 6-month follow-up MRI, it may be clinically acceptable to perform the initial follow-up MRI at 12 months.

RESULTS

Of 444 MR VABB, 258 were benign and concordant with 46 lost to follow-up. Of the remaining 212 biopsies (193 patients), 145 biopsies satisfied our inclusion criteria based on the timing of the first follow-up breast MRI. 100 biopsies had MRI follow-up at 6-months, 23 at 12-months, and 22 long term. The CDR were 2% (2/100), 0% (0/23), and 0% (0/22) (P=1), respectively. At 6-months, 2 cases were recommended for biopsy and 3 assessed for short interval follow-up (BI-RADS 3). The cancers were Stage 0 (DCIS) and Stage IA (invasive ductal carcinoma). The overall false-negative rate of the benign concordant MR VABB was 1.38% (2/145). A 6-month follow-up breast MRI was recommended for 90% (190/212) of the benign concordant MR VABB; however, only 50.5% (96/190) obtained MRI follow-up at 6 months.

CLINICAL RELEVANCE/APPLICATION

Given the relatively low CDR (2%) and favorable pathologic features of the cancers detected at 6-month follow-up MRI, it may be clinically acceptable to perform the initial follow-up MRI at 12 months.

BR01-A7   Breast US/MRI Fusion Technology Helps Reduce The Need For MRI Guided Biopsies

Participants
Adrian K. Lim, MD, FRCR, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Breast US/MRI fusion has been challenging particularly requiring a supine MRI sequence, not possible on all scanners. Advancing fusion technology on a new system has significantly improved image synchronization working with any MRI scan and patient position. The feasibility of this scanner in characterizing incidental MRI detected breast lesions was assessed.*Methods and Materials Patients requiring a second look breast US following an incidentally MRI detected lesion were recruited prospectively. All MRI studies were performed in the prone position using a 3T Verio scanner (Siemens) and the US/MRI fusion was performed with an Aplio i800 scanner (Canon). All US/MRI fusion studies were performed by A.L. who initially undertook a baseline US survey and documented if the lesion could be confidently identified. Subsequently, the US was then fused with MRI sequences depicting the hypervascular lesion and again noted if a lesion was present. US guided biopsies were then undertaken as per routine clinical protocol. Where there was no defined lesion, the operator biopsied the area corresponding to that seen on the MRI study as indicated by the fusion system. The results were correlated with histology.*Results 30 patients have been recruited to date. All patients had a known newly diagnosed breast cancer requiring a second look ultrasound following an incidental MRI detected lesion. These were performed within 1 week. 11 lesions could be detected with US alone. In 17 cases, US/MRI fusion was needed to identify the lesion/area; 14 of which were biopsied influencing clinical management; the 3 lesions not biopsied were normal lymph nodes. In 2 cases, the lesion could not be seen with US or fusion and thus had MRI guided biopsies. These results were statistically significant (Fisher's exact test: p<0.001). The US/fusion system obviated the need for MRI guided biopsy in a significant number of cases. The US/MRI fusion was quick and easy to use with improved image registration when there was another identifiable lesion (e.g., a cyst), in addition to the nipple to provide accurate synchronization. The system allows fusion with up to three sequences at once and a color coded option to help denote the lesion of interest.*Conclusions Breast US/MRI Fusion significantly improves localization of incidentally detected MRI lesions which are occult on an initial US survey alone, thus reducing the need for MRI guided biopsies.*Clinical Relevance/Application The US/MRI fusion technology will reduce the need for MRI guided biopsies and improve patients experience and save costs.

RESULTS

30 patients have been recruited to date. All patients had a known newly diagnosed breast cancer requiring a second look ultrasound following an incidental MRI detected lesion. These were performed within 1 week. 11 lesions could be detected with US alone. In 17 cases, US/MRI fusion was needed to identify the lesion/area; 14 of which were biopsied influencing clinical management; the 3 lesions not biopsied were normal lymph nodes. In 2 cases, the lesion could not be seen with US or fusion and thus had MRI guided biopsies. These results were statistically significant (Fisher's exact test: p<0.001). The US/fusion system obviated the need for MRI guided biopsy in a significant number of cases. The US/MRI fusion was quick and easy to use with improved image registration when there was another identifiable lesion (e.g., a cyst), in addition to the nipple to provide accurate synchronization. The system allows fusion with up to three sequences at once and a color coded option to help denote the lesion of interest.

CLINICAL RELEVANCE/APPLICATION

The US/MRI fusion technology will reduce the need for MRI guided biopsies and improve patients experience and save costs.

BR01-A9   A Comprehensive AI Platform To Identify Women At Risk Of Interval Breast Cancer After Negative Mammography Screening - Enabling Supplemental MRI

Participants
Fredrik Strand, MD,PhD, Stockholm, Sweden (*Presenter*) Speaker, Lunit Inc

PURPOSE

Studies using extremely high mammographic density to select women for supplemental MRI have shown a dramatic reduction in interval cancer rates. In our retrospective study, we examine the ability of an AI platform to identify women at risk of interval cancer.*Methods and Materials A comprehensive platform was designed based on combining the scores from three AI networks trained for different purposes: masking assessment, risk prediction and cancer detection. The networks were a mix of in-house and commercial (Lunit Inc., South Korea). For comparison, quantitative mammographic percent density was calculated by validated software. Performance was evaluated in a held-back test set of negative mammograms from a previously published case-control dataset in population-based screening. All mammography equipment were from the same vendor (Hologic Inc., USA).*Results Within 23 months of a normal screening, 2023 women remained healthy and 113 women were diagnosed with interval breast cancer. After oversampling healthy observations to attain a population-level 0.2% interval cancer rate, the following number of interval cancers were observed when selecting the top 8% scores: 15 (13%) for mammographic density, 36 (32%) for AI, 34 (30%) for AI without masking assessment, 31 (27%) for AI without risk prediction, and 32 (28%) for AI without cancer detection. Selection by mammographic density had to be expanded to the top 25% scores to achieve inclusion of 36 interval cancers.*Conclusions Nearly

one in three interval cancers were included by the top 8% of AI score. Removing any of the three AI networks from the comprehensive model reduced this number. For mammographic density, 25% of women had to be included to obtain the same number of interval cancers.*Clinical Relevance/Application Using a combination of AI networks to triage women after negative screening holds promise to markedly increase the number of interval cancers preempted by a realistic proportion of supplemental MRI. We have recently implemented a similar approach in a randomized controlled trial of screening MRI at our institution.

RESULTS

Within 23 months of a normal screening, 2023 women remained healthy and 113 women were diagnosed with interval breast cancer. After oversampling healthy observations to attain a population-level 0.2% interval cancer rate, the following number of interval cancers were observed when selecting the top 8% scores: 15 (13%) for mammographic density, 36 (32%) for AI, 34 (30%) for AI without masking assessment, 31 (27%) for AI without risk prediction, and 32 (28%) for AI without cancer detection. Selection by mammographic density had to be expanded to the top 25% scores to achieve inclusion of 36 interval cancers.

CLINICAL RELEVANCE/APPLICATION

Using a combination of AI networks to triage women after negative screening holds promise to markedly increase the number of interval cancers preempted by a realistic proportion of supplemental MRI. We have recently implemented a similar approach in a randomized controlled trial of screening MRI at our institution.

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Sub-Events

SDP-PD-1 **Neurovascular Coupling Alteration Of The Cingulate Cortex In Children With Idiopathic Generalized Epilepsy**

Participants
Jie Hu, Zunyi, China (*Presenter*) Nothing to Disclose

PURPOSE

Idiopathic generalized epilepsy (IGE) is associated with increased risk of cognitive impairment, for which altered neuronal activity and cerebral vascular hemodynamics are important etiologies. However, their coupling alterations and its effects on cognitive in IGE remain unknown. Thus, the aim of this study is to investigate neurovascular coupling alterations and its potential contribution to cognitive function in IGE by using functional connectivity strength (FCS) and cerebral blood flow (CBF).*Methods and Materials A total of 25 children with IGE and 26 sex- and age-matched healthy controls (Table 1) were included in this study. All subjects exhibited normal radiologic presentations in routine neuroimaging examination and underwent resting-state functional MRI (rs-fMRI) and arterial spin labeling imaging (ASL). FCS and CBF were calculated from rs-fMRI and ASL, respectively. The CBF/FCS ratio (the amount of blood supply per unit of connectivity strength), CBF and FCS of each voxel were compared between the 2 groups. Multiple comparisons were corrected using a voxel-wise Gaussian random field method (voxel P < 0.005, cluster P < 0.05, two tailed). The mean CBF/FCS ratio, CBF and FCS of each cluster with significant group differences was extracted and was correlated with clinical variables in IGE group by using partial correlation analysis (age, sex and education as covariates). Multiple comparisons were corrected using the Bonferroni method (P < 0.05/4 = 0.0125).*Results Compared with healthy controls, IGE patients showed increased CBF/FCS ratio in the left median cingulate gyrus (Table 2, Figure 1A), decreased FCS in the left putamen (Table 3, Figure 1B). IGE patients also showed increased CBF in the right superior parietal gyrus, middle occipital gyrus and decreased CBF in the left postcentral gyrus (Table 4, Figure 1C). In IGE group, the increased CBF/FCS ratio was negatively correlated with full-scale intelligence quotient (FIQ) and verbal intelligence quotient (VIQ) of Wechsler Intelligence Scale in the left median cingulate gyrus (r=-5.39, P=0.010; r=-5.55, P=0.007; Bonferroni corrected) (Figure 2). FIQ was also negatively correlated with CBF in the left postcentral gyrus, and positively correlated with FCS in the left putamen in IGE patients (r=-0.424, P=0.049; r=0.424, P=0.049; uncorrected) (Table 5).*Conclusions The results suggest that children with IGE show abnormal neurovascular coupling in the left median cingulate cortex, which is associated cognitive impairments.*Clinical Relevance/Application The results may contribute to the monitoring of IGE progression and provide insight into the pathophysiology of the cognitive impairment in these children.

RESULTS

Compared with healthy controls, IGE patients showed increased CBF/FCS ratio in the left median cingulate gyrus (Table 2, Figure 1A), decreased FCS in the left putamen (Table 3, Figure 1B). IGE patients also showed increased CBF in the right superior parietal gyrus, middle occipital gyrus and decreased CBF in the left postcentral gyrus (Table 4, Figure 1C). In IGE group, the increased CBF/FCS ratio was negatively correlated with full-scale intelligence quotient (FIQ) and verbal intelligence quotient (VIQ) of Wechsler Intelligence Scale in the left median cingulate gyrus (r=-5.39, P=0.010; r=-5.55, P=0.007; Bonferroni corrected) (Figure 2). FIQ was also negatively correlated with CBF in the left postcentral gyrus, and positively correlated with FCS in the left putamen in IGE patients (r=-0.424, P=0.049; r=0.424, P=0.049; uncorrected) (Table 5).

CLINICAL RELEVANCE/APPLICATION

The results may contribute to the monitoring of IGE progression and provide insight into the pathophysiology of the cognitive impairment in these children.

SDP-PD-10 **Application Of 70kvp In Abdominal CT Angiography To Reduce Both Radiation And Contrast Dosage And Improve Patient Comfort For Children**

Participants
Jianying Li, Beijing, China (*Presenter*) Employee, General Electric Company

PURPOSE

To evaluate the application of 70kVp in pediatric abdominal CT angiography (CTA) to reduce radiation and contrast dose and improve patient comfort.*Methods and Materials Forty-six children needing abdominal CTA were enrolled in the study group using low-dose scanning protocol with 70kVp and 0.7-1.1ml/kg contrast dose, and reconstructed with 50%ASIR-V. They were compared with another 46 children (control group) with matching body weight who underwent conventional CT scans with 100kVp, 1.2-1.8ml/kg contrast dose and reconstructed using 50%ASIR. The image quality of large vessels was evaluated using a 5-point scale, and the number of superior mesenteric artery branches identifiable by a computer-aided detection (CAD) system was recorded. The CT value and standard deviation of descending aorta (Ao) was measured, and signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) calculated. Radiation dose, contrast dose and the maximum injection pressure were compared between the two groups.*Results The score for displaying large vessels using 70kVp images was 3.91±0.28, and up to 3 superior mesenteric artery branches could be identified, all of which met the diagnostic requirements. The CT value of Ao was 390.87±86.79HU in the study group, higher than the 343.93±49.94HU in the control group, while there was no difference in SNR and CNR between the two groups. The radiation dose, contrast dose and injection pressure of the study group was 1.23±0.39mGy, 12.67±7.27ml and

43.83±17.16psi, respectively, significantly lower than the 1.95±0.37mGy, 22.67±7.39ml, and 77.59±19.68psi of the control group.*Conclusions 70kVp scanning meets the diagnostic requirements in pediatric abdominal CTA while providing significant radiation dose, contrast dose and injection pressure reduction.*Clinical Relevance/Application 70kVp scanning could reduce the requirement for radiation dose, contrast medium dose, and improve patient comfort for children.

RESULTS

The score for displaying large vessels using 70kVp images was 3.91±0.28, and up to 3 superior mesenteric artery branches could be identified, all of which met the diagnostic requirements. The CT value of Ao was 390.87±86.79HU in the study group, higher than the 343.93±49.94HU in the control group, while there was no difference in SNR and CNR between the two groups. The radiation dose, contrast dose and injection pressure of the study group was 1.23±0.39mGy, 12.67±7.27ml and 43.83±17.16psi, respectively, significantly lower than the 1.95±0.37mGy, 22.67±7.39ml, and 77.59±19.68psi of the control group.

CLINICAL RELEVANCE/APPLICATION

70kVp scanning could reduce the requirement for radiation dose, contrast medium dose, and improve patient comfort for children.

SDP-PD-11 Feasibility Of Performing Chest CT In Children With An X-ray Film Dosage (0.04msv) By Using A Deep Learning Image Reconstruction (dlir)

Participants
Jianying Li, Beijing, China (*Presenter*) Employee, General Electric Company

PURPOSE

To assess feasibility of performing chest CT in children with radiation dose level of x-ray films by using a Deep Learning Image Reconstruction (DLIR) algorithm.*Methods and Materials 26 children (age range 3-12y, average 7.3±3.0 years) underwent ultra-low-dose plain chest CT in a follow-up scan with 80kV (for 3-6 years) or 100kV (for 7-12 years), 10mA, 0.5s rotation time. Images were reconstructed with 50% and 100% Adaptive Statistical Iterative Reconstruction-V (ASIR-V) with standard kernel and DLIR with low (DL-L), medium (DL-M) and high (DL-H) settings at slice thickness of 5mm. Two radiologists in consensus evaluated images for lung opacity, lung markings, large airways, small airways and mediastinum on a 5-point scale (5, excellent, 4, good, 3, measurable and acceptable, 2, detectable and 1, not acceptable), and recorded abnormal CT findings. Image noise of left ventricle (LV), muscle, and lung were measured for objective image quality and statistically compared between the 5 reconstruction groups and calculated the number of lesion (consolidation, air bronchogram sign). Finally, radiation dose was recorded based on the report of ICRP103.*Results The average CTDIvol and effective dose was 0.07±0.03mGy and 0.04±0.01mSv, respectively. The image noise (in HU) of LV was 21.1±2.0 with 50%ASIR-V, 12.9±1.8 with 100%ASIR-V, 28.2±5.0 with DL-L, 23.4±4.8 with DL-M and 18.5±4.7 with DL-H images. The image quality scores for lung opacity and large airways were all higher than 3 points with DL-H being the highest at 3.6±0.4 and 4.7±0.3, respectively. However, only DL-H provided acceptable image quality for small airways with score of 3.2±0.3, and none of the images at such low dose level had acceptable image quality for mediastinum. 33 consolidations and occupations were identified on all image groups, but DL-M and DL-H images detected more small airway lesions than ASIR-V images (5 lesions on DL-M and DL-H vs. 4 on 50%ASIR-V and 2 on 100%ASIR-V).*Conclusions It is feasible to provide acceptable CT images using a DL-H algorithm for evaluating lungs for children at dose level similar to X-ray films.*Clinical Relevance/Application Ultra-low-dose chest CT has radiation dose level of plan X-Ray films, and together with DLIR may provide clinically relevant details.

RESULTS

The average CTDIvol and effective dose was 0.07±0.03mGy and 0.04±0.01mSv, respectively. The image noise (in HU) of LV was 21.1±2.0 with 50%ASIR-V, 12.9±1.8 with 100%ASIR-V, 28.2±5.0 with DL-L, 23.4±4.8 with DL-M and 18.5±4.7 with DL-H images. The image quality scores for lung opacity and large airways were all higher than 3 points with DL-H being the highest at 3.6±0.4 and 4.7±0.3, respectively. However, only DL-H provided acceptable image quality for small airways with score of 3.2±0.3, and none of the images at such low dose level had acceptable image quality for mediastinum. 33 consolidations and occupations were identified on all image groups, but DL-M and DL-H images detected more small airway lesions than ASIR-V images (5 lesions on DL-M and DL-H vs. 4 on 50%ASIR-V and 2 on 100%ASIR-V).

CLINICAL RELEVANCE/APPLICATION

Ultra-low-dose chest CT has radiation dose level of plan X-Ray films, and together with DLIR may provide clinically relevant details.

SDP-PD-12 Gadopiclenol Pharmacokinetics, Safety And Efficacy In Pediatric Patients Aged 2 To 17 Years

Participants
Silvia Tsvetkova, Plovdiv, Bulgaria (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the pharmacokinetic (PK) profile, safety and efficacy of gadopiclenol, a new high-relaxivity gadolinium-based contrast agent, in children aged 2 to17 years.*Methods and Materials Children scheduled to undergo contrast-enhanced MRI of the Central Nervous System (CNS cohort) or other organs (Body cohort) were included into 3 age groups (12-17, 7-11 and 2-6 years). Gadopiclenol was administered at the dose of 0.05 mmol/kg. A sparse sampling approach was applied, four blood samples per child were collected (up to 8h post-injection). Population PK modeling was used for the analysis, including the CNS cohort and adult subjects from a previous study. Adverse events (AEs) were recorded, and efficacy was assessed for all children.*Results Eighty children were included (male: 51.3%): 60 in the CNS cohort and 20 in the Body cohort. The two-compartment model with linear elimination from the central compartment developed in adults was also suitable for children. PK parameters were very similar between adults and children. Terminal half-life was 1.82 h for adults and 1.77 to 1.29 h for age classes 12-17 to 2-6 years. Median clearance ranged from 0.08 L/h/kg in adults and 12-17 years to 0.12 L/h/kg in 2-6 years. Median central and peripheral volume of distribution were 0.11-0.12 L/kg and 0.06 L/kg, respectively, for both adults and children. Simulations of plasma concentrations showed minor differences and median area under the curve was 590 mg.h/L for adults and 403 to 582 mg.h/L for children. Two patients (2.5%) experienced AEs considered related to gadopiclenol (none serious): a mild QT interval prolongation and a moderate maculopapular rash. As for diagnostic efficacy in this population, there was no difference among the pediatric age groups.*Conclusions Gadopiclenol PK in children aged 2 to17 years seems similar to that observed in adults. Gadopiclenol had a good safety profile in these patients and positive efficacy results were obtained.*Clinical Relevance/Application There is no indication for dose adaptation based on age, and comparable plasma gadopiclenol concentrations are predicted to be achieved with body weight-based dosing in children aged 2 to17 years.

RESULTS

Eighty children were included (male: 51.3%): 60 in the CNS cohort and 20 in the Body cohort. The two-compartment model with linear elimination from the central compartment developed in adults was also suitable for children. PK parameters were very similar between adults and children. Terminal half-life was 1.82 h for adults and 1.77 to 1.29 h for age classes 12-17 to 2-6 years. Median clearance ranged from 0.08 L/h/kg in adults and 12-17 years to 0.12 L/h/kg in 2-6 years. Median central and peripheral volume of distribution were 0.11-0.12 L/kg and 0.06 L/kg, respectively, for both adults and children. Simulations of plasma concentrations showed minor differences and median area under the curve was 590 mg.h/L for adults and 403 to 582 mg.h/L for children. Two patients (2.5%) experienced AEs considered related to gadopiclenol (none serious): a mild QT interval prolongation and a moderate maculopapular rash. As for diagnostic efficacy in this population, there was no difference among the pediatric age groups.

CLINICAL RELEVANCE/APPLICATION

There is no indication for dose adaptation based on age, and comparable plasma gadopiclenol concentrations are predicted to be achieved with body weight-based dosing in children aged 2 to17 years.

SDP-PD-13 An Audit Of The Yield Of MRI In Adolescent Idiopathic Scoliosis

Participants
Ann Foran, MBBCh, Dublin, Ireland (*Presenter*) Nothing to Disclose

PURPOSE

Adolescent Idiopathic Scoliosis (AIS) is the most common type of scoliosis, with a prevalence of 1-5.4%. Currently, there are no established guidelines for the use of MRI in AIS. Some literature proposes that all children with AIS should have MRI with a yield of significant findings up to 15%, others recommend MRI for specific indications only such as an atypical curve or those with clinical neurological findings on examination. This study assessed the indications for MRI in our institution and the yield of the MRI with the view of comparing with the generally accepted indications to develop a protocol.*Methods and Materials This is a retrospective review of patients undergoing an initial MRI for AIS over a 4 year period to assess the yield of performing MRI. Patients aged 12-16, referred through the National Scoliosis referral pathway to our service were included. We also identified clinical findings or risk factors that may be associated with a positive finding and categorized patients by the King-Moe and the Lenke Classifications.*Results 158 patients were identified, 128 were female with a median age of 14. 43% was referred for adolescent idiopathic scoliosis, not otherwise specified. Overall 11% had MRI findings. Only 4% had findings which could potentially change management, all of whom were referred for specific indications that are considered generally acceptable.*Conclusions The yield of MRI for adolescent idiopathic scoliosis was low, prioritisation for MRI should be given to patients who have generally acceptable indications such as neurological findings, atypical or severe curve and pain.*Clinical Relevance/Application From the findings of this audit we plan on developing a protocol for doing MRI Spine on patients with presumed AIS, to ensure patient selection is appropriate as well as guiding prioritisation of these scans.

RESULTS

158 patients were identified, 128 were female with a median age of 14. 43% was referred for adolescent idiopathic scoliosis, not otherwise specified. Overall 11% had MRI findings. Only 4% had findings which could potentially change management, all of whom were referred for specific indications that are considered generally acceptable.

CLINICAL RELEVANCE/APPLICATION

From the findings of this audit we plan on developing a protocol for doing MRI Spine on patients with presumed AIS, to ensure patient selection is appropriate as well as guiding prioritisation of these scans.

SDP-PD-14 Intravoxel Incoherent Motion MRI In Pediatric Patients With Synovitis Of The Knee Joint: A Prospective Pilot Study

Participants
Britta Huch, MD, Ulm, Germany (*Presenter*) Nothing to Disclose

PURPOSE

We investigated diagnostic accuracy of diffusion-weighted (DWI) MRI with intravoxel incoherent motion (IVIM) imaging compared to contrast-enhanced MRI for detecting synovitis of the knee joint in a pediatric population. Further we compared quantitative measures of synovial diffusion and perfusion to a group of healthy volunteers.*Methods and Materials In this prospective study, 8 pediatric patients (6 girls, median age 13 years) with known or suspected synovitis underwent pre- and post-contrast 3.0 T MRI of the knee and additional DWI sequences between October 2016 and July 2019. For comparison we enrolled 5 healthy young adults (2 women, median age 27 years) with contrast-free MRI of both knees. Post-contrast T1w images and DWI images at b = 1000s/mm2 with apparent diffusion coefficient (ADC) maps of patients were separately rated by two independent and blinded readers with different levels of experience for the presence or absence and degree of synovitis along with the level of confidence. We measured signal intensity on DWI of synovium, joint effusion and muscle with regions of interests and calculated the IVIM-parameters tissue diffusion coefficient (D) and perfusion fraction (f) for patients and volunteers.*Results All patients showed at least some synovial contrast enhancement, 8 (80%) children were diagnosed with synovitis on ce-T1w, the diagnostic standard. Ratings by the 1st and 2nd reader on ce-T1w and DWI showed full agreement (kappa=1) in diagnosing synovitis and substantial agreement (k=0.655) for the degree of synovial enhancement. Interobserver agreement on DWI showed fair agreement (k=0.220) between both readers. Diagnostic confidence was lower on DWI. Mean D- and f-values of muscle was comparable between patients and volunteers. Effusion mean D was higher, mean f was lower, synovial mean D was lower, mean f higher in patients than in volunteers (all p<0.05).*Conclusions Diffusion-weighted MRI with IVIM imaging remains a promising, though reader-dependent alternative to intravenous contrast-enhanced imaging in pediatric patients to reliably diagnose, or rule out, synovitis of the knee joint. We detected significantly restricted synovial diffusion and increased synovial perfusion in patients compared to healthy volunteers.*Clinical Relevance/Application Diagnosing synovial inflammation by administration of gadolinium-based contrast agents is limited by invasiveness and possible side effects, especially in children and adolescents.

RESULTS

All patients showed at least some synovial contrast enhancement, 8 (80%) children were diagnosed with synovitis on ce-T1w, the diagnostic standard. Ratings by the 1st and 2nd reader on ce-T1w and DWI showed full agreement (kappa=1) in diagnosing synovitis and substantial agreement (k=0.655) for the degree of synovial enhancement. Interobserver agreement on DWI showed fair agreement (k=0.220) between both readers. Diagnostic confidence was lower on DWI. Mean D- and f-values of muscle was comparable between patients and volunteers. Effusion mean D was higher, mean f was lower, synovial mean D was lower, mean f

higher in patients than in volunteers (all p<0.05).

CLINICAL RELEVANCE/APPLICATION

Diagnosing synovial inflammation by administration of gadolinium-based contrast agents is limited by invasiveness and possible side effects, especially in children and adolescents.

SDP-PD-2   Can We Use Adult-Oriented Artificial Intelligence-based Lesion Detection Software On Pediatric Chest Radiographs?

Participants
Hyun-joo Shin, MD, Gyeonggi-do, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate whether artificial intelligence (AI)-based lesion detection software developed and approved for adults' chest radiographs could be used for pediatric chest radiographs.*Methods and Materials Pediatric patients who underwent chest radiographs in March 2021 were included in this retrospective study. Radiographs on lateral, decubitus views or infantogram were excluded for the analysis. AI-based lesion detection software on chest radiographs were applied and presence of nodule, consolidation, fibrosis, atelectasis, cardiomegaly, mediastinal widening, pleural effusion, pneumothorax, and pneumoperitoneum were analyzed. The results were presented with region-of-interest and its abnormality scores. A board-certified pediatric radiologist evaluated the presence of lesions in each chest radiograph. Considering the result by radiologist as a standard reference, diagnostic performance of the software was assessed.*Results Among total 777 chest radiographs, 691 radiographs had analyzed results using the software. Among them, 142 radiographs had positive result by software and 95 radiographs had positive result by radiologist. The sensitivity, specificity, positive predictive value (PPV), negative predictive values (NPV), and accuracy of the software were 82%, 88.55%, 51.4%, 97.1%, and 87.7%, respectively. When we exclude cardiomegaly and mediastinal widening results, the specificity, PPV and accuracy were significantly increased (94.7%, 69.5%, and 92.8%, respectively, all p<0.001), while sensitivity and NPV showed no statistical significant differences (80.2%, 96.9%, p>0.15).*Conclusions AI-based lesion detection software developed with adult chest radiographs could be used on pediatric chest radiographs with high accuracy. The specificity, PPV, and accuracy were improved when excluding mediastinal widening and cardiomegaly results on pediatric chest radiographs.*Clinical Relevance/Application Artificial intelligence (AI)-based lesion detection software was developed and approved for adults' chest radiographs for commercial use. However, there is no study assessed diagnostic performance of this software on pediatric population. This study evaluated accuracy of the software on pediatric chest radiographs and according to the specific lung lesions.

RESULTS

Among total 777 chest radiographs, 691 radiographs had analyzed results using the software. Among them, 142 radiographs had positive result by software and 95 radiographs had positive result by radiologist. The sensitivity, specificity, positive predictive value (PPV), negative predictive values (NPV), and accuracy of the software were 82%, 88.55%, 51.4%, 97.1%, and 87.7%, respectively. When we exclude cardiomegaly and mediastinal widening results, the specificity, PPV and accuracy were significantly increased (94.7%, 69.5%, and 92.8%, respectively, all p<0.001), while sensitivity and NPV showed no statistical significant differences (80.2%, 96.9%, p>0.15).

CLINICAL RELEVANCE/APPLICATION

Artificial intelligence (AI)-based lesion detection software was developed and approved for adults' chest radiographs for commercial use. However, there is no study assessed diagnostic performance of this software on pediatric population. This study evaluated accuracy of the software on pediatric chest radiographs and according to the specific lung lesions.

SDP-PD-3   Motor Function Is Associated With Structural Alterations Of Gray Matter In Children With Spastic Cerebral Palsy

Participants
Jie Hu, Zunyi, China (*Presenter*) Nothing to Disclose

PURPOSE

Periventricular leukomalacia (PVL) has been investigated as the major neuropathological substrate of the motor deficits of spastic cerebral palsy (SCP), but the relationship between gray matter changes and motor function in these children has been unknown. The aim of this study was to characterize the relationship between the structural alterations of gray matter and motor function in children with PVL and SCP.*Methods and Materials A total of 30 children with PVL and SCP, and 24 age-sex-paired health controls (HCs) were included in this study (Table1). 3D-MPRAGE T1WIs were performed in a 3T scanner (GE, Signa HDxt) with 8-channel head coil. All SCP children accepted Gross Motor Function Classification System (GMFCS) and Manual Ability Classification System (MACS) assessment. Voxel-based morphometry (VBM) was used to quantify differences in gray matter volume between SCP children and the control group using SPM12 (Statistical Parametric Mapping) and CAT12 (Computational Anatomy Toolbox). Significance threshold was set at P < 0.05, false discovery rate (FDR) corrected for multiple comparisons. The regions showing significant differences were defined as regions of interest (ROIs). We extracted the mean gray matter volume in each ROI and used partial correlation analysis (controlling for age) to examine the correlation between gray matter volume and motor function (GMFCS, MACS) in SCP group.*Results The gray matter volume of the bilateral Parietal lobe, Thalamus, Cerebellum, and right Frontal lobe, Putamen was significantly higher in the HC group as compared to the SCP group (Table 2 and Figure 1). Negative correlations were found between the gray matter volume of bilateral Thalamus, right Cerebelum_6, left Median cingulate, paracingulate gyri and GMFCS level in SCP group (r were -0.668, -0.397, -0.414, and P were <0.001, 0.033, 0.025, respectively). Similarly, there were also negative correlations between the gray matter volume of bilateral Thalamus, right Putamen and MACS level in the SCP group (r were -0.557, -0.630,and P were 0.002, <0.001, respectively) (Figure 2).*Conclusions Gray matter changes are observed and several of these changes are associated with motor impairment in children with PVL and SCP.*Clinical Relevance/Application Understanding of structure-function relationships will be helpful in the clinical context and also as a basis for investigation of causal pathways in motor impairment of these children.

RESULTS

The gray matter volume of the bilateral Parietal lobe, Thalamus, Cerebellum, and right Frontal lobe, Putamen was significantly higher in the HC group as compared to the SCP group (Table 2 and Figure 1). Negative correlations were found between the gray matter volume of bilateral Thalamus, right Cerebelum_6, left Median cingulate, paracingulate gyri and GMFCS level in SCP group (r were -0.668, -0.397, -0.414, and P were <0.001, 0.033, 0.025, respectively). Similarly, there were also negative correlations between the

gray matter volume of bilateral Thalamus, right Putamen and MACS level in the SCP group (r were -0.557, -0.630,and P were 0.002, <0.001, respectively) (Figure 2).

CLINICAL RELEVANCE/APPLICATION

Understanding of structure-function relationships will be helpful in the clinical context and also as a basis for investigation of causal pathways in motor impairment of these children.

SDP-PD-4   To Evaluate The Diagnostic Role Of 18 F FDG PET-CT In Children With Fever Of Unknown Origin Or Unexplained Signs Of Inflammation

Participants
Sikandar Shaikh, DMRD, Hyderabad, India (*Presenter*) Nothing to Disclose

PURPOSE

As we all know that Fever of unknown origin (FUO) and various unexplained signs of inflammation are challenging medical problems especially in children and most of them are predominantly caused by infections, malignancies or non infectious inflammatory diseases. The basic aim of this study was to assess the diagnostic value of (18)F-FDG PET and PET/CT in the diagnostic work-up in paediatric patients of the above mentioned conditions.*Methods and Materials This was the retrospective study, comprising of the 96 FDG PET and 60 PET/CT scans from 138 children (median age 8.1 years, range 0.2-18.1 years, 36 male, 33 female) were analysed. The whole body study was done from the vertex of skull to the feet in most of the pediatric patients after injecting the FDG contrast.The diagnostic efficacy of PET in evaluation of the paediatric patients presenting with Fever of unknown origin (88 whole body scans) or unexplained various signs of inflammation without fever (66 scans) were analysed*Results Based on the SUV max values of various lesions in various parts of the body the diagnosis in paediatric patients with FUO or unexplained signs of inflammation could be established in 64 patients (54%). Of all scans, 126 (82%) were abnormal, and of the total number of 144 PET and PET/CT scans 70 (45%) were clinically helpful. In patients with a final diagnosis, after the PET-CT scans were found to have contributed to the diagnosis in 73%. Laboratory, demographic or clinical parameters of the children did not predict the usefulness of FDG PET scans*Conclusions Thus FDG PET and PET/CT are valuable tools for the evaluation of children with FUO and unexplained signs of inflammation. By evaluation of the above mentioned criterias it is of more useful at a times . Thus the combination of PET with CT is significantly superior and can evaluate site of inflammation more accurately.*Clinical Relevance/Application Thus FDG PET-CT is the important imaging modality for the evaluation of the FUO and inflammations

RESULTS

Based on the SUV max values of various lesions in various parts of the body the diagnosis in paediatric patients with FUO or unexplained signs of inflammation could be established in 64 patients (54%). Of all scans, 126 (82%) were abnormal, and of the total number of 144 PET and PET/CT scans 70 (45%) were clinically helpful. In patients with a final diagnosis, after the PET-CT scans were found to have contributed to the diagnosis in 73%. Laboratory, demographic or clinical parameters of the children did not predict the usefulness of FDG PET scans

CLINICAL RELEVANCE/APPLICATION

Thus FDG PET-CT is the important imaging modality for the evaluation of the FUO and inflammations

SDP-PD-5   Post-lymphangiographic CT (plct) In Protein-losing Enteropathy (PLE): A Retrospective Study

Participants
Xingpeng Li, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the imaging features and clinical value of post lymphangiographic CT (PLCT) in diagnosis and differential diagnosis in protein-losing enteropathy (PLE).*Methods and Materials Forty-two patients diagnosed as PLE were recruited in this retrospective study from Jan of 2011 to June of 2017, including 42 primary intestinal lymphangiectasia (PIL), and 15 other kinds of PLE. All patients underwent PLCT, endoscopy and pathological examinations. All the imaging data were blinded reviewed by two radiologists respectively, with the imaging features of intestinal wall thickening, dilation of intestinal lumen, edematous lesions, abnormal distribution of contrast agents, reflux, lymph nodes and fistula. Statistical analyses were performed with P < 0.05.*Results Compared with other kinds of PLE, patients with PIL demonstrated lower onset age (14.7 ± 10.6 Vs. 38.8 ± 10.7,P<0.01). For imaging features, the proportion of abnormal distribution of contrast media in intestinal wall and mesentery and lymph reflux are higher in PIL than other PLE. While no statistical difference was found in intestinal wall dilatation, edematous lesions, abnormal distribution of contrast media in other abdominal cavity, fistula and lymph node (all P>0.05).*Conclusions PLCT demonstrates capability in detection of location, distribution and range of abnormal lymphatics, which is useful for differential diagnosis and therapeutic adoptions for PLE.*Clinical Relevance/Application It is necessary to evaluate the systematic lymphatic circulation abnormality for with PLCT in patients with PLE, which is very important for therapeutic options

RESULTS

Compared with other kinds of PLE, patients with PIL demonstrated lower onset age (14.7 ± 10.6 Vs. 38.8 ± 10.7,P<0.01). For imaging features, the proportion of abnormal distribution of contrast media in intestinal wall and mesentery and lymph reflux are higher in PIL than other PLE. While no statistical difference was found in intestinal wall dilatation, edematous lesions, abnormal distribution of contrast media in other abdominal cavity, fistula and lymph node (all P>0.05).

CLINICAL RELEVANCE/APPLICATION

It is necessary to evaluate the systematic lymphatic circulation abnormality for with PLCT in patients with PLE, which is very important for therapeutic options

SDP-PD-6   Pleuroparenchymal Fibroelastosis-like Lesions After Hematopoietic Cell Transplantation In Children: A Propensity Score-matched Analysis

Participants
Tae Yeon Jeon, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the incidence of, risk factors for, and clinical outcomes of PPFE-like lesions in pediatric HCT recipients.*Methods and Materials In this single-center, retrospective, case-control study, 738 consecutive patients who underwent chest CT 3 months after HCT between January 2000 and June 2018 were reviewed. We identified patients who fulfilled radiologic criteria of PPFE-like lesions and assessed clinical characteristics and radiologic findings of PPFE-like lesions in these patients. Propensity score matching was performed using 4 covariates (age, sex, HCT type, and primary disease). The risk factors and clinical outcomes of PPFE-like lesions were analyzed using Fine and Gray regression model and stratified log rank test in the matched groups.*Results PPFE-like lesions were identified in 4% (31/738) pediatric HCT recipients with a median time of 3 years after HCT, and it occurred following allogeneic (5%, 15/317), autologous (4%, 15/379), or both (2%, 1/42). Matching yielded 30 cases in the PPFE group and 130 in control. The late-onset noninfectious pulmonary complications (LONIPCs) and respiratory infection 3 months after HCT were more frequent in the PPFE group (P<0.05). Multivariable analysis showed a significantly higher risk of PPFE-like lesions in HCT recipients who had respiratory infection 3 months after HCT (hazard ratio=10.8, P<0.001). PPFE group showed poorer overall survival with 73% of mortality rate and 6.8 years of median survival time than that of the control group (P<0.001).*Conclusions PPFE-like lesions can represent LONIPCs after HCT with high mortality. HCT recipients who had respiratory infection after HCT may have an increased risk of PPFE-like lesions.*Clinical Relevance/Application Early recognition of the clinical and radiologic characteristic of PPFE-like lesions in HCT recipients is pivotal in establishing a presumptive diagnosis and referral for lung transplantation.

RESULTS

PPFE-like lesions were identified in 4% (31/738) pediatric HCT recipients with a median time of 3 years after HCT, and it occurred following allogeneic (5%, 15/317), autologous (4%, 15/379), or both (2%, 1/42). Matching yielded 30 cases in the PPFE group and 130 in control. The late-onset noninfectious pulmonary complications (LONIPCs) and respiratory infection 3 months after HCT were more frequent in the PPFE group (P<0.05). Multivariable analysis showed a significantly higher risk of PPFE-like lesions in HCT recipients who had respiratory infection 3 months after HCT (hazard ratio=10.8, P<0.001). PPFE group showed poorer overall survival with 73% of mortality rate and 6.8 years of median survival time than that of the control group (P<0.001).

CLINICAL RELEVANCE/APPLICATION

Early recognition of the clinical and radiologic characteristic of PPFE-like lesions in HCT recipients is pivotal in establishing a presumptive diagnosis and referral for lung transplantation.

SDP-PD-7   Could We Better Detect Pars Interarticularis Defects In Teens Before Completion?

Participants
Riti Kanesa-Thasan, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To identify predictive factors of osseous stress response in the lumbar pars interarticularis in pediatric patients with low back pain.*Methods and Materials A PACS database was retrospectively searched for noncontrast lumbar spine MRIs from performed between 2006-2021 on patients 10 to 18 years old. Patients with evidence of unrelated trauma including vertebral body fractures were excluded. MRIs were reviewed to identify subjects with bone marrow edema at the pars interarticularis or pedicle, with or without incomplete fracture. Pediatric patients undergoing noncontrast lumbar spine for low back pain without pars osseous stress response were randomly selected as controls. Demographics, transitional lumbosacral anatomy, scoliosis, and disc pathology at MRI were recorded. BMI and sports participation was recorded for those with available electronic medical records. Radiology report addendums and follow up imaging findings were noted. Mann-Whiney U, Chi-square, and Fisher's exact tests were used for comparisons.*Results Mean subject group age 15.3±1.6 years without significant difference compared to controls (p=.858). Subjects had significantly lower incidence of disc bulges and scoliosis compared to controls (39% vs 60%, p=.002; and 6.4% vs 16%, p=.026), with similar incidence of transitional lumbosacral anatomy (12% vs 9%, p=0.533). Subjects were more likely than controls to be male (68% vs 40%, p=001), play sports (71% vs 41%, p=0.001), and have a lower BMI (21.7 vs 23.9, p=0.021). 71% (68/96) of athletes were involved in contact sports. 90% (35/39) of female subjects participated in sports, and 23% (8/35) of female athletes were gymnasts. In 5.6% (7/126) of subjects, pars edema/stress response was not mentioned in the original radiology report, which was later addended. On follow up imaging for 14 patients (1-92 months apart, average 20 months), 29% resolved, 50% improved, 14% were stable, and 7% completed pars fracture. New areas of osseous stress were noted on follow up in 21% (3/14).*Conclusions Osseous stress response at the pars interarticularis can be a source of pain leading to lumbar spine MRI in young patients, and should be reported. Patients with osseous stress response in the lumbar pars interarticularis are more likely to be athletes, particularly in contact sports and in gymnasts, and have a lower BMI. 5% of pars stress lesions were missed on initial imaging review.*Clinical Relevance/Application Osseous stress response at the pars interarticularis should be included in the search pattern for young, athletic patients undergoing MRI of the lumbar spine for back pain, given the opportunity for patients to heal from these lesions when detected.

RESULTS

Mean subject group age 15.3±1.6 years without significant difference compared to controls (p=.858). Subjects had significantly lower incidence of disc bulges and scoliosis compared to controls (39% vs 60%, p=.002; and 6.4% vs 16%, p=.026), with similar incidence of transitional lumbosacral anatomy (12% vs 9%, p=0.533). Subjects were more likely than controls to be male (68% vs 40%, p=001), play sports (71% vs 41%, p=0.001), and have a lower BMI (21.7 vs 23.9, p=0.021). 71% (68/96) of athletes were involved in contact sports. 90% (35/39) of female subjects participated in sports, and 23% (8/35) of female athletes were gymnasts. In 5.6% (7/126) of subjects, pars edema/stress response was not mentioned in the original radiology report, which was later addended. On follow up imaging for 14 patients (1-92 months apart, average 20 months), 29% resolved, 50% improved, 14% were stable, and 7% completed pars fracture. New areas of osseous stress were noted on follow up in 21% (3/14).

CLINICAL RELEVANCE/APPLICATION

Osseous stress response at the pars interarticularis should be included in the search pattern for young, athletic patients undergoing MRI of the lumbar spine for back pain, given the opportunity for patients to heal from these lesions when detected.

SDP-PD-8   Comparison Of CTA Image Quality Between Adaptive Statistical Repeated Reconstruction-V (ASIR-V) And Deep Learning Reconstruction "TrueFidelity" (TF) In Children With Congenital Heart Disease (CHD)

Participants
Kun Hee Kim, MD, Yangsan, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To determine the best CT angiography image set among "Adapted Statistical Repeated Reconstruction-V" (ASIR-V) and Deep Learning Reconstruction "TrueFidelity" (TF) in children with congenital heart disease (CHD)*Methods and Materials Fifty children (3.1±3.11 months; 28 men) with CHD who underwent CTA were enrolled between June and September 2020. Images were reconstructed by two ASIR-V (blending factor of 80% (AV-80) and 100% (AV-100)) and three TF (low-, medium-, and high-strength-level (TF-L-M-H) settings). For quantitative analyses, three objective image qualities (attenuation, noise, signal to noise ratio (SNR)) were measured in the great vessels and heart chambers. The contrast to noise ratio (CNR) was also evaluated between left ventricle and the myocardial wall. For qualitative analyses, the degree of quantum mottle and blurring at the upper level to the first branch of the main pulmonary artery were assessed by independent two radiologists.*Results When the level or strength of the ASIR-V blending factor and TF is higher, the noise is lower and the SNR is higher. The image noise and SNR of TF-H was significantly lower and higher than that of AV-100 except right atrium (p<0.01). For CNR comparison between AV 100 and TF-H, TF-H was significantly better than AV 100 (p<0.01). In addition, when subjectively assessing the degree of quantum mottle and blurring, TF-H scored the highest among all the image sets examined. (p<0.01).*Conclusions TF-H is superior to AV-100 when comparing objective and subjective image quality. Consequently, TF-H was the best image set for CTA in children with CHD.*Clinical Relevance/Application Because CT angiography was performed using a very low tube voltage of 70kVP for pediatric patients under 1 year of age, increase in noise is inevitably expected. So our aim is to determine which reconstruction method will maintain image attenuation or image texture while reducing noise.

RESULTS

When the level or strength of the ASIR-V blending factor and TF is higher, the noise is lower and the SNR is higher. The image noise and SNR of TF-H was significantly lower and higher than that of AV-100 except right atrium (p<0.01). For CNR comparison between AV 100 and TF-H, TF-H was significantly better than AV 100 (p<0.01). In addition, when subjectively assessing the degree of quantum mottle and blurring, TF-H scored the highest among all the image sets examined. (p<0.01).

CLINICAL RELEVANCE/APPLICATION

Because CT angiography was performed using a very low tube voltage of 70kVP for pediatric patients under 1 year of age, increase in noise is inevitably expected. So our aim is to determine which reconstruction method will maintain image attenuation or image texture while reducing noise.

SDP-PD-9   Assessment Of Mediastinal Shift Angle In Congenital Pulmonary Airway Malformation; A New Fetal MRI Indicator Of Congenital Lung Disease

Participants
Jun Tsukamoto, Kitakyushu, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this research was to establish the normal range of the mediastinal shift angle (MSA) on fetal MRI in a control group, to evaluate the MSA of fetuses with congenital pulmonary airway malformation (CPAM), to compare the MSA with an established index, and to assess how MR image characteristics and the MSA vary.*Methods and Materials To establish normal range, measurement of bilateral MSA was obtained in 125 fetuses without any lung abnormality (control group). Subsequently, measurement of the MSA was carried out in 32 fetuses who had a pathological diagnosis of CPAM. We compared MSA between CPAM and control group for both hemithoraces with statistical analysis. Also, comparison between MSA and the CPAM volume ratio (CVR) as an established index was carried out. The relationship between MSA and image characteristics whether typically cystic or atypically solid was evaluated. A receiver-operating characteristics (ROC) curve was constructed to assess the predictive value of MSA on the time to surgery.*Results In the right hemithorax, the mean value for a normal MSA was 19.1° (range 10.9-34.5°) and was 26.2° (13.4-38.4°) in the left hemithorax. The MSA of left side CPAM (mean 38.7°, range 17.4-61.4°) was larger than right side CPAM (mean 35.9°, range 25.2-51°). Using the Student t-test, statistical analysis revealed a significant difference of MSA between CPAM and control group in both hemithoraces(P value <.0001). There was a positive statistical correlation between the MSA and the CVR determined by ultrasound (right: r = 0.76, left: r = 0.61) and MRI (right: r = 0.81, left: r = 0.61). The MSA of patients with atypical solid type CPAM (n=4) were larger than in other patients. Based on the point estimate of ROC-Area Under the Curve (AUC), MSA showed higher discriminatory ability. in terms of whether the time of surgery was within 24 hours or 1 month after birth compared with CVR of MRI .*Conclusions The MSA might be a new, easy and useful tool for evaluating the severity of CPAM during the fetal period. It correlates well with the CVR and may predict urgent surgical treatment.*Clinical Relevance/Application Mediastinal shift angle (MSA) is a new and simple indicator for CPAM patients, it may replace CPAM volume ratio (CVR) to predict time to surgery.

RESULTS

In the right hemithorax, the mean value for a normal MSA was 19.1° (range 10.9-34.5°) and was 26.2° (13.4-38.4°) in the left hemithorax. The MSA of left side CPAM (mean 38.7°, range 17.4-61.4°) was larger than right side CPAM (mean 35.9°, range 25.2-51°). Using the Student t-test, statistical analysis revealed a significant difference of MSA between CPAM and control group in both hemithoraces(P value <.0001). There was a positive statistical correlation between the MSA and the CVR determined by ultrasound (right: r = 0.76, left: r = 0.61) and MRI (right: r = 0.81, left: r = 0.61). The MSA of patients with atypical solid type CPAM (n=4) were larger than in other patients. Based on the point estimate of ROC-Area Under the Curve (AUC), MSA showed higher discriminatory ability. in terms of whether the time of surgery was within 24 hours or 1 month after birth compared with CVR of MRI .

CLINICAL RELEVANCE/APPLICATION

Mediastinal shift angle (MSA) is a new and simple indicator for CPAM patients, it may replace CPAM volume ratio (CVR) to predict time to surgery.

Abstract Archives of the RSNA, 2021

Sub-Events

IN03-C2   **Tracking Results And Utilization Of Artificial Intelligence (tru-AI) In Radiology: Early-stage COVID-19 Pandemic Observations On Intracranial Hemorrhage**

Participants
Axel Wismueller, MD,PhD, Pittsford, New York (*Presenter*) Research Grant, Aidoc Medical Ltd;Advisory Board Member, Aidoc Medical Ltd

PURPOSE

To introduce a method for tracking results and utilization of Artificial Intelligence (tru-AI) in radiology. By tracking both large-scale utilization and AI results data, the tru-AI approach aims at calculating surrogates for important disease-related observational quantities over time, such as the prevalence of intracranial hemorrhage during the early COVID-19 pandemic outbreak.*Methods and Materials To quantitatively investigate the clinical applicability of the tru-AI approach, we tracked service requests and AI-based image analysis results for automatically identifying intracranial hemorrhage (ICH) on non-contrast head CT using a commercial AI solution (Aidoc, Tel Aviv, Israel). This software is typically used for AI-based prioritization of radiologists' reading lists for reducing turnaround times in patients with emergent clinical findings, such as ICH. We analyzed data of N=9,421 emergency-setting non-contrast head CT studies at a major US healthcare system acquired from November 1, 2019 through June 2, 2020, and compared two observation periods, namely (i) a pre-pandemic epoch from November 1, 2019 through February 29, 2020, and (ii) a period during the early COVID-19 pandemic outbreak, April 1-30, 2020. A chi-square test of independence was performed to examine the relation between AI-based ICH detection and observation during one of the two tracking periods defined above, namely prior to and after the COVID-19 pandemic outbreak.*Results Although daily CT scan counts were significantly lower during (40.1±7.9) than before (44.4±7.6) the early phase of the COVID-19 outbreak, we found that ICH was more likely to be observed by AI during than before the COVID-19 outbreak (p<0.05), with approximately one daily ICH+ case more than statistically expected.*Conclusions Our results suggest an increased prevalence of ICH on head CT studies in the scanned patient population during the pandemic outbreak. We conclude that by tracking both large-scale utilization and AI image analysis results data, the tru-AI approach can help identify temporal changes in observed disease prevalence under unusual conditions, such as for ICH during the early phase of the COVID-19 outbreak.*Clinical Relevance/Application Automated tracking of both AI image analysis and service utilization data can provide useful contributions to monitoring the prevalence of clinically relevant disease entities, such as intracranial hemorrhage observed during the early COVID-19 pandemic outbreak.

RESULTS

Although daily CT scan counts were significantly lower during (40.1±7.9) than before (44.4±7.6) the early phase of the COVID-19 outbreak, we found that ICH was more likely to be observed by AI during than before the COVID-19 outbreak (p<0.05), with approximately one daily ICH+ case more than statistically expected.

CLINICAL RELEVANCE/APPLICATION

Automated tracking of both AI image analysis and service utilization data can provide useful contributions to monitoring the prevalence of clinically relevant disease entities, such as intracranial hemorrhage observed during the early COVID-19 pandemic outbreak.

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PH03-D

Physics Tuesday Poster Discussions

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Sub-Events

PH03-D10   Deep Learning-based Effective Atomic Number Conversion From Single Energy Computed Tomography

Participants
Jimin Lee, Ulsan, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To investigate a Deep Learning-based effective atomic number conversion technique from single energy computed tomography (CT) for accurate dose calculation in radiation therapy*Methods and Materials The whole dataset consisted of 120 kVp CT images and effective atomic number (Zeff) maps of 66 patients acquired by dual-layer dual energy CT scanner (IQon Spectral CT, Philips, Best, The Netherlands) from 2019 to 2020. Among the patients, 19 patients underwent chest examinations, 23 patients underwent abdomen-pelvic examinations, and 24 patients underwent head and brain CT. The dataset was randomly divided into 56 patients' data for training stage and the other 10 patients' data for test stage.To develop a Deep Learning-based Zeff conversion technique, a convolutional neural network (CNN) with encoder-decoder structure was implemented. In the training stage, the CNN model was trained to translate the 120 kVp CT images (input) to Zeff maps (target). The model was trained with the summation of mean squared error and structural similarity losses for parameter updating. In the test stage, to evaluate the conversion performance of the trained CNN, pearson correlation coefficient (PCC), structural similarity (SSIM), and peak signal-to-noise ratio (PSNR) between the outputs from the model and the targets were calculated.*Results The trained CNN model showed superior Zeff conversion performance for the test dataset. Average PCC, SSIM, and PSNR scores from the test data were 0.959, 0.926, and 28.638, respectively. Referring to the difference maps between the targets and outputs in the figure, discrepancy occurred in some areas outside the body. However, it doesn't matter since only the area inside the body is used for radiation therapy planning. These results can assist to differentiate benign and malignant lesions and improve the diagnostic performance. Furthermore, the results can be used for further accurate dose calculation in radiation therapy.*Conclusions The Deep Learning-based Zeff conversion technique from single energy CT has been successfully developed and shown superior conversion performance.*Clinical Relevance/Application The proposed Zeff conversion technique from single energy CT can be used for further accurate dose calculation in radiation therapy planning.

RESULTS

The trained CNN model showed superior Zeff conversion performance for the test dataset. Average PCC, SSIM, and PSNR scores from the test data were 0.959, 0.926, and 28.638, respectively. Referring to the difference maps between the targets and outputs in the figure, discrepancy occurred in some areas outside the body. However, it doesn't matter since only the area inside the body is used for radiation therapy planning. These results can assist to differentiate benign and malignant lesions and improve the diagnostic performance. Furthermore, the results can be used for further accurate dose calculation in radiation therapy.

CLINICAL RELEVANCE/APPLICATION

The proposed Zeff conversion technique from single energy CT can be used for further accurate dose calculation in radiation therapy planning.

PH03-D3   MRI For Evaluating Renal Metabolism In A Rat Model Of Hypertension

Participants
El-Sayed Ibrahim, PhD, Milwaukee, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

Enhanced sensitivity of blood pressure to salt diet in animal models is associated with abnormal mitochondrial function and substrate utilization in the kidney. In this study, we used blood oxygenation level dependent (BOLD) MRI to investigate renal metabolism in a rat model of salt-sensitive hypertension.*Methods and Materials Nine rats were imaged on a 9.4T small-animal Bruker scanner using T2*-based BOLD MRI. Three normal Sprague Dawley (SD) rats were fed a normal 1% NaCl diet and compared to three 12-weeks old Dahl salt-sensitive (SS) rats and three salt-resistant SS.BN13 consomic rats of the same age (SS rats with chromosome 13 inherited from Brown Norway rats) maintained on a 0.4% NaCl diet since weaning. The effects of a high salt diet (4% NaCl) on tissue oxygenation was studied by sequentially determining changes in response to switching to the high salt at days 7 and 21 post initiation of the high-salt diet.*Results The BOLD images showed gradual decreases in the oxygenation level between the cortex and outer medulla in the SD rats when fed the high salt diet. The SS rats exhibited heterogenous regions of poorly oxygenation of the kidney (deoxygenated hemoglobin). The results showed that the kidney of the SS rats became increasingly deoxygenated as seen by increasing heterogeneity in the BOLD maps, first with greater regions of decreased T2* at day 7 leading to even greater heterogeneity by day 21 in both the renal cortex and medulla, indicating a chronically hypoxic kidney. In contrast, the average T2* values in the kidney of the SD and SS.BN13 rats were significantly higher compared to SS rats and maintained relatively unchanged at the different imaging timepoints in response to the high salt diet.*Conclusions MRI BOLD imaging provides a method to non-invasively and sequentially determine the progressive effects of a high salt diet on tissue oxygenation in rats with a strong potential for making similar determinations in hypertensive human subjects before and following antihypertensive therapy.*Clinical Relevance/Application The proposed approaches provide opportunities to gain greater understanding of metabolic

stress and oxygenation of salt-sensitive and salt-resistant hypertensive human subjects pre and post therapy.

RESULTS

The BOLD images showed gradual decreases in the oxygenation level between the cortex and outer medulla in the SD rats when fed the high salt diet. The SS rats exhibited heterogenous regions of poorly oxygenation of the kidney (deoxygenated hemoglobin). The results showed that the kidney of the SS rats became increasingly deoxygenated as seen by increasing heterogeneity in the BOLD maps, first with greater regions of decreased T2* at day 7 leading to even greater heterogeneity by day 21 in both the renal cortex and medulla, indicating a chronically hypoxic kidney. In contrast, the average T2* values in the kidney of the SD and SS.BN13 rats were significantly higher compared to SS rats and maintained relatively unchanged at the different imaging timepoints in response to the high salt diet.

CLINICAL RELEVANCE/APPLICATION

The proposed approaches provide opportunities to gain greater understanding of metabolic stress and oxygenation of salt-sensitive and salt-resistant hypertensive human subjects pre and post therapy.

PH03-D6 Proposed Approach For Assessing The Performance Of Ultrasound Imaging Systems: Statistics-based Analyses Of Simulated Random Spherical Void Phantoms

Participants
Mark Holland, PHD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

To explore the potential of using statistics-based, quantitative measurements of images obtained from random spherical void (RSV) phantoms as an approach for assessing the performance of ultrasound imaging systems.*Methods and Materials Ten computer-simulated RSV phantoms with a RSV volume fraction of 0.15 were generated. Simulated ultrasound images were produced and degradation of imaging system performance was modeled by averaging 1 to 9 neighboring planes to represent increasing elevation plane thicknesses. Quantification of the performance of the imaging system was determined by measuring the: 1) mean number of observed circle cross sections per frame; 2) mean fractional area of circle cross-sections per frame; and 3) agreement of observed circle cross section radii histograms with the theoretical distribution (Chi-square statistic).*Results For 150 image plane analyses, the degraded RSV phantom images show decreasing: mean number of circle cross sections detected per frame (31.5±0.3, 28.4±0.3, 28.2±0.3, 26.3±0.3 and 25.3±0.3); mean fractional area of circle cross-section per frame (0.157±0.002, 0.133±0.001, 0.133±0.001, 0.111±0.001 and 0.108±0.001); and agreement with theoretical radii histogram distribution (chi-square: 0.070±0.004, 0.140±0.005, 0.149±0.007, 0.379±0.011 and 0.518±0.010) for 1, 3, 5, 7 and 9 neighboring plane averages, respectively.*Conclusions This simulation study suggests that statistics-based analyses of images from RSV phantoms may represent an approach for providing quantitative assessment of ultrasound system performance in a quantitative, reproducible fashion.*Clinical Relevance/Application Quantitative, statistics-based analyses of images from random spherical void phantoms may provide a useful approach for assessing and predicting the clinical performance of ultrasound imaging systems.

RESULTS

For 150 image plane analyses, the degraded RSV phantom images show decreasing: mean number of circle cross sections detected per frame (31.5±0.3, 28.4±0.3, 28.2±0.3, 26.3±0.3 and 25.3±0.3); mean fractional area of circle cross-section per frame (0.157±0.002, 0.133±0.001, 0.133±0.001, 0.111±0.001 and 0.108±0.001); and agreement with theoretical radii histogram distribution (chi-square: 0.070±0.004, 0.140±0.005, 0.149±0.007, 0.379±0.011 and 0.518±0.010) for 1, 3, 5, 7 and 9 neighboring plane averages, respectively.

CLINICAL RELEVANCE/APPLICATION

Quantitative, statistics-based analyses of images from random spherical void phantoms may provide a useful approach for assessing and predicting the clinical performance of ultrasound imaging systems.

PH03-D7 Study On Hepatic Alveolar Echinococcosis In Mice Based On 7T Small Animal MRI

Participants
Hai Hua Bao, Xining, China (*Presenter*) Nothing to Disclose

PURPOSE

Hepatic alveolar echinococcosis(HAE) slowly infiltrates and grows outwards by means of exophytic spores. The growth characteristics are complex and diverse. In the study, 7T small animal MR was used to analyze and study the MRI characteristics of secondary mouse hepatic alveolar echinococcus animal models.*Methods and Materials The secondary mouse HAE animal model was prepared by intraperitoneal injection of HAE tissue suspension, and 10 mice that had been successfully inoculated with HAE were selected through ultrasound screening. the mice were examined by 7T small animal MR at 15 weeks after inoculation, and the performance of the mouse HAE lesions on T1WI, T2WI, and DWI was analyzed.*Results (1) 10 mice were inoculated with the suspension of HAE tissue for 15 weeks. 10 mice were successfully inoculated with HAE tissue suspension by ultrasound screening, with a success rate of 100%.(2) There were a total of 63 lesions in the liver of 10 mouse HAE models, including 47.62% (30/63) lesions in the right lobe, 25.40% (16/63) lesions in the left lobe, 1.58% (1/63) lesions in the left and right lobe, and 25.40% (16/63) lesions in the hilar. No obvious portal vein invasion was observed in 84.13% (53/63) cases.Compression and narrowing of portal vein and its branches were observed in 15.87% (10/63) of the lesions. The main portal vein and left branch were invaded in 80.00% (8/10) of the lesions, and the main portal vein and right branch were invaded in 20.00% (2/10) of the lesions. In the liver, 76.20% (48/63) of the lesions were mainly cystic, 23.80% (15/63) of the lesions were mainly cystic. (3) HAE lesions showed low signal intensity on T1WI and varied in size. the lesion showed multilocular cystic hyperintensity On T2WI. On DWI , the lesion showed hyperintensity with perifocal low-signal shadow surrounding. Some lesions were complex in composition. Small vesicle structures of different sizes were observed with solid components. The solid components showed isosignal on T1WI , and isosignal or slightly lower on T2WI .On DWI , there were isosignal and low signal. (4) In the liver, the lesions were mainly distributed along the main portal vein and the left and right branches. Some lesions grew around the portal vein, showing thickening and compression of the main portal vein and branches. And some lesions were not clearly separated from the lesions.(5) In the abdominal cavity, the lesions were diffusely distributed with different sizes. The MR manifestations were similar to those of liver lesions.*Conclusions HAE lesions in mice showed characteristic manifestations on 7T small animal MR.*Clinical Relevance/Application The basic research based on the model of HAE in small animals under 7T MR can well transfer the current basic research results to clinical practice.

RESULTS

(1) 10 mice were inoculated with the suspension of HAE tissue for 15 weeks. 10 mice were successfully inoculated with HAE tissue suspension by ultrasound screening, with a success rate of 100%.(2) There were a total of 63 lesions in the liver of 10 mouse HAE models, including 47.62% (30/63) lesions in the right lobe, 25.40% (16/63) lesions in the left lobe, 1.58% (1/63) lesions in the left and right lobe, and 25.40% (16/63) lesions in the hilar. No obvious portal vein invasion was observed in 84.13% (53/63) cases.Compression and narrowing of portal vein and its branches were observed in 15.87% (10/63) of the lesions. The main portal vein and left branch were invaded in 80.00% (8/10) of the lesions, and the main portal vein and right branch were invaded in 20.00% (2/10) of the lesions. In the liver, 76.20% (48/63) of the lesions were mainly cystic, 23.80% (15/63) of the lesions were mainly cystic. (3) HAE lesions showed low signal intensity on T1WI and varied in size. the lesion showed multilocular cystic hyperintensity On T2WI. On DWI , the lesion showed hyperintensity with perifocal low-signal shadow surrounding. Some lesions were complex in composition. Small vesicle structures of different sizes were observed with solid components. The solid components showed isosignal on T1WI , and isosignal or slightly lower on T2WI .On DWI , there were isosignal and low signal. (4) In the liver, the lesions were mainly distributed along the main portal vein and the left and right branches. Some lesions grew around the portal vein, showing thickening and compression of the main portal vein and branches. And some lesions were not clearly separated from the lesions.(5) In the abdominal cavity, the lesions were diffusely distributed with different sizes. The MR manifestations were similar to those of liver lesions.

CLINICAL RELEVANCE/APPLICATION

The basic research based on the model of HAE in small animals under 7T MR can well transfer the current basic research results to clinical practice.

PH03-D8 **Performance Testing And Capability Of Carbon Nanotube Based X-ray Tubes**

Participants
Brian Gonzales, PhD, SeaTac, Washington (*Presenter*) Scientist, Micro-X Ltd

PURPOSE

Cold cathode electronically controlled x-ray tubes are emerging as a new and potentially disruptive x-ray technology that enables lighter and most cost-effective x-ray imaging along with new fixed gantry tomography imaging. Historically, this technology has been limited by low electron current and short lifetime performance that prevented the application of the technology into medical imaging. We have developed a unique approach to delivering a stable long-life high current carbon nanotube (CNT) based x-ray tube. In this presentation we present our unique approach along with test data demonstrating current and life performance of the CNT electron emitter.*Methods and Materials We will present an overview of the unique physics of our CNT x-ray tube, focused on our unique approach to creating a stable long life high current electron emitter. Our testing consisted of testing different sized CNT emitters, all created using the same method, to demonstrate size versus peak current; testing emitters under varying pulse lengths and currents to demonstrate are variety of electric field stress on the CNT; and accelerated life testing to show long term performance of CNT electron emitters. The tests CNT emitters were tested both individually in a vacuum chamber and integrated into an x-ray tube.*Results We have demonstrated a variety of large area CNT emitter sizes ranging from 1mm2 to 100mm2. We show that a peak stable current of the emitter is partially dependent on the size of the emitter, but even our very small emitters achieve at least 100mA of current. We show that the lifetime stability of our CNT emitter depends on the combination of the current and size of the emitter, the larger emitters deliver stable long-life up to at least 200mA. We demonstrate that when an emitter begins to degrade, due to high current over stressing, our emitter will recover and re-stabilize when current is lower.*Conclusions Our unique CNT emitter provides a stable long life electron source, providing up to 200mA of current that can be used for 5+ years in an x-ray tube. We show that our unique approach allows for an adaptable emitter design for a variety of applications.*Clinical Relevance/Application Our unique CNT x-ray tube and CNT electron emitter are already deployed in two FDA certified medical devices, the Carestream DRX Revolution Nano and the Micro-X Rover. Additionally, the flexibility, reliability, and performance demonstrated in this data provides the bases for future x-ray tube designs that could increase the application of the technology to lightweight deployable fixed gantry tomosynthesis and CT applications, bringing three-dimensional imaging to patients bedside and outside the hospital.

RESULTS

We have demonstrated a variety of large area CNT emitter sizes ranging from 1mm2 to 100mm2. We show that a peak stable current of the emitter is partially dependent on the size of the emitter, but even our very small emitters achieve at least 100mA of current. We show that the lifetime stability of our CNT emitter depends on the combination of the current and size of the emitter, the larger emitters deliver stable long-life up to at least 200mA. We demonstrate that when an emitter begins to degrade, due to high current over stressing, our emitter will recover and re-stabilize when current is lower.

CLINICAL RELEVANCE/APPLICATION

Our unique CNT x-ray tube and CNT electron emitter are already deployed in two FDA certified medical devices, the Carestream DRX Revolution Nano and the Micro-X Rover. Additionally, the flexibility, reliability, and performance demonstrated in this data provides the bases for future x-ray tube designs that could increase the application of the technology to lightweight deployable fixed gantry tomosynthesis and CT applications, bringing three-dimensional imaging to patients bedside and outside the hospital.

PH03-D9 **Comparison Of Digital Variance Angiography And Digital Subtraction Angiography In Selective Lower Limb Interventions**

Participants
Istvan Gog, Budapest, Hungary (*Presenter*) Researcher, Kinepict Health Ltd

PURPOSE

The evaluation of potential benefits of Digital Variance Angiography (DVA) in selective lower limb angiography and to compare the performance of the conventional DVA1 versus the recently developed DVA2 algorithm.*Methods and Materials 112 iodine contrast media (ICM) angiograms from 15 peripheral artery disease (PAD) patients and 42 CO2 angiograms from 13 PAD patients were collected from November 2019 to May 2020. DVA files were retrospectively generated from the same source files as Digital Subtraction Angiography (DSA) images. The contrast-to-noise ratio (CNR) and image quality (IQ) of DSA, DVA1 and DVA2 images were compared. The visual evaluation was performed by 6 radiologists from two different institutions using a 5-grade Likert scale.*Results Irrespective of the contrast media (CM) used, a significant 2-fold increase in CNR values and significant higher IQ scores were generated by both DVA algorithms in comparison to DSA. Overall IQ scores for DSA, DVA1 and DVA2 using ICM were 3.61±0.05, 4.30±0.05 and 4.33±0.04. Using CO2, scores were 3.09±0.13, 3.61±0.13 and 3.34±0.13, respectively.*Conclusions Regardless of the CM used, a higher CNR and significant better IQ can be provided by DVA for selective lower limb interventions.

DVA1 is the first choice in the direct comparison of the DVA algorithms. It provides identical or better IQ than DVA2, whilst requiring shorter processing time (DVA1 1-2 sec, DVA2 up to 7 sec). A possible daily clinical implementation could be beneficial by assisting the intra-operative decision-making process.*Clinical Relevance/Application For selective lower limb angiography DVA can provide higher IQ and greater CNR compared to DSA, with either ICM or CO2 as contrast.

RESULTS

Irrespective of the contrast media (CM) used, a significant 2-fold increase in CNR values and significant higher IQ scores were generated by both DVA algorithms in comparison to DSA. Overall IQ scores for DSA, DVA1 and DVA2 using ICM were 3.61±0.05, 4.30±0.05 and 4.33±0.04. Using CO2, scores were 3.09±0.13, 3.61±0.13 and 3.34±0.13, respectively.

CLINICAL RELEVANCE/APPLICATION

For selective lower limb angiography DVA can provide higher IQ and greater CNR compared to DSA, with either ICM or CO2 as contrast.

CH04-C

Chest Wednesday Poster Discussions

Sub-Events

CH04-C4   **Effect Of Beta-blocker Therapy On Aortic Hemodynamics In Patients With Bicuspid Aortic Valve**

Participants
Ashitha Pathrose, MBBS, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Beta-blockers (BB) are hypothesized to delay ascending aortic (AAo) dilation in bicuspid aortic valve (BAV) patients by decreasing the rate of increase in central arterial pressure. This is thought to reduce forces of flowing blood on the aortic wall (wall shear stress, WSS) and aortic stiffness (measured as pulse wave velocity, PWV). This longitudinal study investigated changes in 4D flow-derived aortic hemodynamics in BAV patients before and after BB initiation.*Methods and Materials Our institutional database with ~2500 4D flow BL exams was queried for adult BAV patients with follow-up (FU) 4D flow MRI. After excluding patients with a history of dissections, genetic syndromes, or surgical interventions, n=25 patients who initiated BB between their BL and FU were identified (BBc: 48±12 years; 17 males). Age, sex-matched BAV control groups were also identified, including a group receiving BB at both BL and FU (BB+: n=25; 49±14 years; 16 males) and a BB naïve group (BB-: n=25; 46±15 years; 19 males). Velocity maximal intensity projections were used to measure the peak-systolic velocity (Vmax) at the AAo. 3D aortic peak-systolic WSS was calculated at the AAo. Aortic PWV was quantified using a cross-correlation approach.*Results There were no significant differences in AAo Vmax (2.26±0.85m/s vs. 2.30±0.94m/s, p=0.514), AAo WSS (1.99±0.69Pa vs. 2.00±0.65Pa, p=0.962), or aortic PWV (6.55±1.43m/s vs. 6.67±1.48m/s, p=0.636) in BBc patients before and after the onset of BB therapy. However, in BB+ and BB- groups, Vmax, WSS, and PWV were significantly higher at FU than at BL. Comparison of the longitudinal AAo Vmax, WSS, and PWV between the BBc, BB+, and BB- groups using mixed-model ANOVA showed no significant effect due to BB treatment (Vmax: F=0.132, p=0.876; WSS: F=0.464, p=0.630; PVW: F=0.387, p=0.680).*Conclusions In BAV patients, the initiation of BB therapy did not significantly change 4D flow-derived aortic hemodynamics. However, significant increase in AAo Vmax, WSS, and PWV on FU among matched BB+ patients may be due to a more severe disease requiring medical therapy. While in BB- patients this significant increase may indicate the natural progression of the disease.*Clinical Relevance/Application The benefits of BB treatment in BAV has not been proven in clinical trials. Our longitudinal study using 4D flow MRI-derived aortic hemodynamics in a cohort of BAV patients found no significant benefits. 4D flow MRI is a useful tool to investigate drugs that affect hemodynamics.

RESULTS

There were no significant differences in AAo Vmax (2.26±0.85m/s vs. 2.30±0.94m/s, p=0.514), AAo WSS (1.99±0.69Pa vs. 2.00±0.65Pa, p=0.962), or aortic PWV (6.55±1.43m/s vs. 6.67±1.48m/s, p=0.636) in BBc patients before and after the onset of BB therapy. However, in BB+ and BB- groups, Vmax, WSS, and PWV were significantly higher at FU than at BL. Comparison of the longitudinal AAo Vmax, WSS, and PWV between the BBc, BB+, and BB- groups using mixed-model ANOVA showed no significant effect due to BB treatment (Vmax: F=0.132, p=0.876; WSS: F=0.464, p=0.630; PVW: F=0.387, p=0.680).

CLINICAL RELEVANCE/APPLICATION

The benefits of BB treatment in BAV has not been proven in clinical trials. Our longitudinal study using 4D flow MRI-derived aortic hemodynamics in a cohort of BAV patients found no significant benefits. 4D flow MRI is a useful tool to investigate drugs that affect hemodynamics.

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Abstract Archives of the RSNA, 2021

Sub-Events

IR04-C3   Feasibility Of Velocity Quantification In A Stenotic Iliac Artery Phantom Model Using Quantitative DSA

Participants
Ece Meram, MD, Madison, Wisconsin (*Presenter*) Research Grant, Koninklijke Philips NV

PURPOSE

For patients with peripheral arterial disease, there is no direct objective and standardized intra-procedural method for determining a successful endovascular revascularization endpoint. Quantitative 2D digital subtraction angiography (qDSA) is a recently introduced postprocessing technique that leverages the inherent pulsatility in arterial blood to quantify blood velocity. qDSA has been correlated with intravascular Doppler and 4D Flow MRI, but not yet been evaluated in a stenosis model. This study aimed to assess the feasibility of using qDSA to quantify arterial velocity in a stenotic iliac artery phantom model.*Methods and Materials A silicon-based flexible iliac artery phantom was used with varying degrees of stenosis (based on luminal diameter reduction: no stenosis, mild, <50%; moderate, 50-70%; severe, >70%). A pulsatile pump was used to mimic physiologic arterial flow. DSAs (30 fps) were acquired by injecting 50% contrast at 2.5 mL/s injection rate for 8 seconds via a 5 Fr angled Glidecatheter positioned at the proximal left common iliac artery. 12-second 3D-DSAs were obtained for evaluation of vessel caliber. Downstream flow was measured in the iliac artery using an ultrasonic flow sensor. Velocities were calculated just distal to the stenosis and the results were evaluated with descriptive statistics. The change in flow was correlated with the change in velocities.*Results Average baseline arterial flow without a stenosis was 5.6 mL/s. Diameter reductions were 30% with mild, 60% with moderate and 85% with severe stenosis. The degree of stenosis corresponded to the following changes (i.e. decrease) in flow: 2% in mild (5.5 mL/s), 8% in moderate (5.2 mL/s) and 42% in severe (3.3 mL/s) stenosis. Average blood velocities were 12.2 ± 0.6 cm/s (no stenosis), 13.1 ± 0.6 cm/s (mild), 29.8 ± 1.1 cm/s (moderate), and 34.8 ± 4.6 cm/s (severe). These corresponded to 7% (mild), 145% (moderate) and 186% (severe) increases in local blood velocity. The change in blood velocity inversely correlated with the change in downstream flow with a Pearson r of -0.80 (p<0.001).*Conclusions qDSA was able to successfully characterize changes in blood velocity with varying degrees of stenosis despite turbulent flow conditions observed with moderate and severe stenoses. Further studies are indicated to investigate the accuracy of qDSA velocity quantification in stenotic iliac arteries in animal models and patients.*Clinical Relevance/Application After further validation, qDSA could be implemented into the clinical workflow to calculate arterial velocity changes during lower extremity revascularization, which in turn may help establish objective, reproducible quantitative endpoints to improve patient outcomes.

RESULTS

Average baseline arterial flow without a stenosis was 5.6 mL/s. Diameter reductions were 30% with mild, 60% with moderate and 85% with severe stenosis. The degree of stenosis corresponded to the following changes (i.e. decrease) in flow: 2% in mild (5.5 mL/s), 8% in moderate (5.2 mL/s) and 42% in severe (3.3 mL/s) stenosis. Average blood velocities were 12.2 ± 0.6 cm/s (no stenosis), 13.1 ± 0.6 cm/s (mild), 29.8 ± 1.1 cm/s (moderate), and 34.8 ± 4.6 cm/s (severe). These corresponded to 7% (mild), 145% (moderate) and 186% (severe) increases in local blood velocity. The change in blood velocity inversely correlated with the change in downstream flow with a Pearson r of -0.80 (p<0.001).

CLINICAL RELEVANCE/APPLICATION

After further validation, qDSA could be implemented into the clinical workflow to calculate arterial velocity changes during lower extremity revascularization, which in turn may help establish objective, reproducible quantitative endpoints to improve patient outcomes.

IR04-C4   Motion Correction In Digital Subtraction Angiography Using Generative Adversarial Networks: An Implementation And Evaluation Of The Gradient-Consistency Loss Function

Participants
Brendan Crabb, BS, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

PURPOSE

Digital subtraction angiography (DSA) is a commonly used method for the visualization of vasculature throughout the human body. However, artifacts due to patient motion limit the diagnostic utility of this technique. Generative adversarial networks (GAN) represent a viable solution to the significant problem of motion artifacts in DSA. In this study, we investigated the use of a gradient-consistency (GC) loss function to enhance the anatomical accuracy and diagnostic capabilities of this promising approach.*Methods and Materials An IRB approved dataset containing 29,656 cerebral DSA images with minimal artifacts due to patient motion was collected and split into training, validation, and testing datasets. Using these images as ground truth, the pix2pix GAN was trained to produce DSAs directly from the post-contrast fluoroscopic image, without the use of a pre-contrast mask. Training was performed with both an L1 + adversarial loss and an L1 + GC + adversarial loss. Progress was tracked using the L1 loss and a visual review of generated DSAs. Following training, the algorithm was evaluated on the testing dataset and generated DSAs were assessed for diagnostic quality with a quantitative structural similarity index (SSIM) metric and a visual review.*Results The pix2pix GAN trained with an L1 + GC + adversarial loss had a statistically significant improvement in SSIM on the testing dataset when compared to an L1 + adversarial loss alone (SSIM 0.837 (95% CI 0.835 to 0.839) vs. 0.833 (95% CI

0.831 to 0.835), p-value 0.004). Visual review of the images demonstrated notable instances where the addition of the GC loss improved the vessel demarcation and anatomical accuracy of the resultant DSA images.*Conclusions The inclusion of a GC loss during training improves the ability of the algorithm to accurately demarcate the vasculature of interest when performing motion correction in DSA with a GAN. This iterative improvement brings GANs one step closer to providing a reliable and diagnostic solution to the significant problem of motion artifacts in DSA.*Clinical Relevance/Application DSA is a commonly used technique for imaging vasculature that can be limited by artifacts due to patient motion. Elimination of motion artifacts in real time with a GAN that is enhanced by a GC loss function may improve the diagnostic utility of this approach.

RESULTS

The pix2pix GAN trained with an L1 + GC + adversarial loss had a statistically significant improvement in SSIM on the testing dataset when compared to an L1 + adversarial loss alone (SSIM 0.837 (95% CI 0.835 to 0.839) vs. 0.833 (95% CI 0.831 to 0.835), p-value 0.004). Visual review of the images demonstrated notable instances where the addition of the GC loss improved the vessel demarcation and anatomical accuracy of the resultant DSA images.

CLINICAL RELEVANCE/APPLICATION

DSA is a commonly used technique for imaging vasculature that can be limited by artifacts due to patient motion. Elimination of motion artifacts in real time with a GAN that is enhanced by a GC loss function may improve the diagnostic utility of this approach.

IR04-C5   Clinical Predictors Of Active Arterial Extravasation On CT Angiography (CTA) In Patients With Suspected GI Bleed: A Multi-hospital Retrospective Case-control Study With Risk Modeling

Participants
Brett Marinelli, MD,MS, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to identify clinical predictors of active arterial extravasation on CTA in patients with suspected GI bleeding.*Methods and Materials Review of CTA reports (4,342) across multiple hospitals from January 1, 2011 to July 30, 2019 yielded 1,763 studies performed for suspected GI bleeding. Curation of images by faculty revealed 231 studies with active arterial extravasation and accessible medical charts. 1:1 matching by age, gender, site, and time period was performed. Clinical variables extracted included patient characteristics (demographics, hospital, inpatients versus emergency department, shift and time period), history of recent bleeding events, past medical history, presenting symptoms, medications, vitals, and laboratory values. Univariate analysis was performed using Chi-square and t-tests for binary and continuous variables, respectively. Clinical variables significantly correlated (p<0.05) with extravasation on univariate analysis were entered into a multivariate logistic regression (MLR) risk model yielding adjusted odds-ratios (ORs) and area under the receiver operating curve (AUROC) statistics.*Results Univariate testing demonstrated significant unadjusted ORs (95%CI) of 3.6 (2.3-5.8) for bleeding event within the last 7 days, 1.9 (1.2-2.9) for diverticulosis, 2.8 (1.1-6.5) for diverticulitis, 2.1 (1.3-3.3) for varices/hemorrhoids, 2.0 (1.4-2.9) for hematochezia, 2.6 (1.4-5.0) for syncope, 1.6 (1.1-2.3) for NSAID use, 1.9 (1.3-2.8) for PPIs, 2.9 (1.7-4.8) for any anticoagulation, 3.8 (1.7-9.4) for coumadin, 2.2 (1.4-3.2) for recent transfusion in last 24 hours, 2.2 (2.2-4.0) for active pressors, and 1.5 (1.0-2.3) for hemoglobin less than 7.5 mg/dL. On MLR significant adjusted ORs were 3.4 (1.3-10.0) for diverticulitis, 2.3 (1.5-3.7) for hematochezia, 2.2 (1.1-4.7) for syncope, 2.2 (1.1-4.6) for any anticoagulation, 1.9 (1.2-3.1) for transfusion in last 24 hours and 2.1 (1.0-4.3) for active pressors. The AUROC for the MLR risk model was 0.74 (95%CI: 0.70-0.79).*Conclusions In patients with suspected GI bleeding several clinical variables predict extravasation on CTA. Risk models incorporating these clinical variables may guide mobilization of resources for emergent embolization by interventional radiology.*Clinical Relevance/Application GI bleeding is a life-threatening condition that can be emergently treated with transarterial embolization by interventional radiology. Successful embolization is more likely if extravasation is visualized on CTA prior to intervention. Recognizing clinical predictors of high (or low) likelihood of active arterial extravasation on CTA can guide mobilization of technical and staffing resources for emergent intervention.

RESULTS

Univariate testing demonstrated significant unadjusted ORs (95%CI) of 3.6 (2.3-5.8) for bleeding event within the last 7 days, 1.9 (1.2-2.9) for diverticulosis, 2.8 (1.1-6.5) for diverticulitis, 2.1 (1.3-3.3) for varices/hemorrhoids, 2.0 (1.4-2.9) for hematochezia, 2.6 (1.4-5.0) for syncope, 1.6 (1.1-2.3) for NSAID use, 1.9 (1.3-2.8) for PPIs, 2.9 (1.7-4.8) for any anticoagulation, 3.8 (1.7-9.4) for coumadin, 2.2 (1.4-3.2) for recent transfusion in last 24 hours, 2.2 (2.2-4.0) for active pressors, and 1.5 (1.0-2.3) for hemoglobin less than 7.5 mg/dL. On MLR significant adjusted ORs were 3.4 (1.3-10.0) for diverticulitis, 2.3 (1.5-3.7) for hematochezia, 2.2 (1.1-4.7) for syncope, 2.2 (1.1-4.6) for any anticoagulation, 1.9 (1.2-3.1) for transfusion in last 24 hours and 2.1 (1.0-4.3) for active pressors. The AUROC for the MLR risk model was 0.74 (95%CI: 0.70-0.79).

CLINICAL RELEVANCE/APPLICATION

GI bleeding is a life-threatening condition that can be emergently treated with transarterial embolization by interventional radiology. Successful embolization is more likely if extravasation is visualized on CTA prior to intervention. Recognizing clinical predictors of high (or low) likelihood of active arterial extravasation on CTA can guide mobilization of technical and staffing resources for emergent intervention.

Abstract Archives of the RSNA, 2021

Sub-Events

IN01-A2   Racial Diversity In Deep Learning Chest X-ray Interpretation

Participants

Brandon Price, Tallahassee, Florida (*Presenter*) Nothing to Disclose

PURPOSE

A common misconception of deep learning systems is that due to their seemingly objective interpretation of data, they are incapable of bias. However, this has been demonstrated to be false in multiple studies. Often, bias is introduced into the training data unknowingly or a group is under sampled causing susceptible models to develop bias. As the rapid development of deep learning in medicine continues, there are concerns of potential bias when interpreting radiological images. In this study, we investigate how a model trained on a dataset without racial diversity could hinder detection of pathology in underrepresented minority patients.*Methods and Materials In this study, we used the MIMIC-CXR dataset with over 300,000 images. This dataset consists of 14 labeled findings. Lateral images were excluded and due to the low sample size of other races/ethnicities, only images of "Black" and "White" patients were included. One training dataset was composed entirely of "White" patients, while the other training dataset included both "Black" and "White" patients, creating a mixed dataset of 26% "Black" and 74% "White" patients. Datasets were filtered so an equal distribution of labeled findings was shared between them. A DenseNet model was trained on each dataset 25 times. The ROC-AUC and sensitivity, with a specificity threshold of 0.75, were compared for each of the 14 labeled findings with subsequent confidence intervals.*Results Models trained with a diverse training dataset had a significantly better ROC-AUC performance at identifying 6 of the 14 labeled findings in a test dataset of only black patients compared to a model trained on only white patients (p<0.05). In addition, the models trained with a diverse dataset found a significant increase in sensitivity performance for 6 of the 14 labeled findings on a test dataset of only black patients compared to the model trained with only white patients (p<0.05).*Conclusions As more AI systems are developed, it is imperative that they are fair and perform equally well with groups that have been historically underserved. This study demonstrates the importance of using diverse datasets while training models in order to ensure fair outcomes.*Clinical Relevance/Application As future medical AI systems are approved by regulators, it is crucial that model performance on different racial/ethnic groups is shared to ensure that safe and fair systems are being implemented.

RESULTS

Models trained with a diverse training dataset had a significantly better ROC-AUC performance at identifying 6 of the 14 labeled findings in a test dataset of only black patients compared to a model trained on only white patients (p<0.05). In addition, the models trained with a diverse dataset found a significant increase in sensitivity performance for 6 of the 14 labeled findings on a test dataset of only black patients compared to the model trained with only white patients (p<0.05).

CLINICAL RELEVANCE/APPLICATION

As future medical AI systems are approved by regulators, it is crucial that model performance on different racial/ethnic groups is shared to ensure that safe and fair systems are being implemented.

IN01-A3   Automated Kidney Segmentation In Magnetic Resonance Imaging In Patients With Autosomal-dominant Polycystic Kidney Disease: A Multicenter Study.

Participants

Piotr Woznicki, Warszawa, Poland (*Presenter*) Smart Reporting, working student

PURPOSE

Imaging-based total kidney volume (TKV) is a major prognostic factor in autosomal-dominant polycystic kidney disease (ADPKD). However, manual or semi-automated kidney segmentation is extremely time-consuming. Therefore, the purpose of this study was to develop a fully automated method for kidney segmentation in magnetic resonance imaging (MRI) in patients with ADPKD and to evaluate its purpose in a multimodal, multicentric setting.*Methods and Materials Deep convolutional neural network based on the U-Net architecture was trained on a dataset consisting of 406 abdominal MRI scans of 101 patients, including different MRI sequences (T2 TSE, T2 SPIR, T2 mapping). Manual segmentation of both kidneys delivered the ground-truth labels. The model's performance was evaluated on a test dataset of 25 patients, 17 of whom had longitudinal follow-up data, as well as an external dataset of 324 patients (485 MRI scans, acquired from multiple MRI scanners). Standard similarity metrics were calculated, including Dice score as well as correlation and agreement between TKV derived from automated segmentation and from manual segmentation and between TKV growth over time.*Results The segmentation model yielded excellent performance on the segmentation task, achieving a mean per-study Dice score of 0.93±0.04 on the test dataset. The automatically computed TKV was highly correlated with manually measured TKV (intraclass correlation coefficient: 0.996) with low bias and high precision (0.2±4.3%). For longitudinal analysis of TKV growth, bias and precision were -0.6±1.7% and there was no significant difference between automated and manual estimations. In the external dataset, the model achieved a mean bias and precision of -3.5±8.8%.*Conclusions Our deep learning model enabled accurate segmentation of the kidneys and objective assessment of TKV in patients with ADPKD. This approach could aid the clinicians in the precise and rapid assessment of disease progression.Importantly, this approach was shown to work in scans obtained using MRIs from 40 different MR scanners as well as longitudinal monitoring, making implementation in clinical routine care

possible.*Clinical Relevance/Application Our method is a robust tool for estimation of TKV and TKV growth over time. It was extensively validated in longitudinal as well as external datasets, which proves its applicability in the clinical setting.

RESULTS

The segmentation model yielded excellent performance on the segmentation task, achieving a mean per-study Dice score of 0.93±0.04 on the test dataset. The automatically computed TKV was highly correlated with manually measured TKV (intraclass correlation coefficient: 0.996) with low bias and high precision (0.2±4.3%). For longitudinal analysis of TKV growth, bias and precision were -0.6±1.7% and there was no significant difference between automated and manual estimations. In the external dataset, the model achieved a mean bias and precision of -3.5±8.8%.

CLINICAL RELEVANCE/APPLICATION

Our method is a robust tool for estimation of TKV and TKV growth over time. It was extensively validated in longitudinal as well as external datasets, which proves its applicability in the clinical setting.

Sub-Events

GU05-A1   Neoadjuvant Chemotherapy In Ovarian Cancer: Response Assessment And Predictors Of Survival

Participants
Molly Roseland, MD, Northville, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

Neoadjuvant chemotherapy is often administered for advanced high grade serous ovarian carcinoma (HGSC) prior to definitive cytoreductive surgery, and accurate response assessment is necessary for guiding treatment and prognosis. Goal of study was to compare response evaluated by CT (simplified peritoneal carcinomatosis index; S-PCI), pathology (chemotherapy response score; CRS), laboratory markers (CA-125), and surgical outcomes, and to examine which factors were predictive of disease-free survival.*Methods and Materials For this retrospective, HIPAA-compliant, IRB-approved study, we identified 396 women with HGSC receiving neoadjuvant chemotherapy between 2010-2019. Patients were excluded if debulking surgery was not performed or if imaging and histologic specimens were unavailable for review, leaving 97 patients for analysis. Radiologists blinded to outcome rated pre- and post-treatment abdominopelvic CTs with S-PCI scores of 0-24 (higher score indicating more visible tumor). One pathologist assigned surgical specimens a CRS of 1-3 (ranging from minimal to complete treatment response). Clinical data were obtained via chart review. Univariate and multivariate analysis was performed using R 3.6.3 and survival analysis was performed using SAS 9.4.*Results Interreader agreement was good for CT readers' pre-treatment S-PCI scores (ICC 0.64) and excellent for post-treatment S-PCI scores (ICC 0.82). Although there was a significant decrease in S-PCI scores after treatment (single paired t-test, p<0.001), the mean percentage decrease in S-PCI did not differ significantly among the three CRS categories (one-way ANOVA test; p=0.51) or between patients who were optimally vs. suboptimally debulked (two sample t-test; p=0.29). In a survival analysis incorporating time to disease progression, log-rank test demonstrated lower CRS score to be a significant predictor of progression (p<0.001). Cox proportional-hazards models demonstrated that, while both CRS score (HR 4.3, p<0.0001) and change in CA-125 (HR 1.8; p=0.01) were significantly associated with progression, change in S-PCI score was not (HR 0.99, p=0.80).*Conclusions HGSC response to neoadjuvant therapy evaluated by CT S-PCI was not associated with pathologic CRS score, surgical success, or clinical progression, revealing discordance between imaging and pathologic, biochemical, and surgical assessments of disease response.*Clinical Relevance/Application The role of imaging in determining response and guiding management for HGSC remains uncertain. Further studies are needed to clarify if macroscopic disease truly does not predict microscopic findings, or if alternative methods to quantify burden of disease by CT would better correlate with clinical outcomes.

RESULTS

Interreader agreement was good for CT readers' pre-treatment S-PCI scores (ICC 0.64) and excellent for post-treatment S-PCI scores (ICC 0.82). Although there was a significant decrease in S-PCI scores after treatment (single paired t-test, p<0.001), the mean percentage decrease in S-PCI did not differ significantly among the three CRS categories (one-way ANOVA test; p=0.51) or between patients who were optimally vs. suboptimally debulked (two sample t-test; p=0.29). In a survival analysis incorporating time to disease progression, log-rank test demonstrated lower CRS score to be a significant predictor of progression (p<0.001). Cox proportional-hazards models demonstrated that, while both CRS score (HR 4.3, p<0.0001) and change in CA-125 (HR 1.8; p=0.01) were significantly associated with progression, change in S-PCI score was not (HR 0.99, p=0.80).

CLINICAL RELEVANCE/APPLICATION

The role of imaging in determining response and guiding management for HGSC remains uncertain. Further studies are needed to clarify if macroscopic disease truly does not predict microscopic findings, or if alternative methods to quantify burden of disease by CT would better correlate with clinical outcomes.

GU05-A2   Toward Reliable Predictors Of Stress Urinary Incontinence Surgery Success Based On Quantitative Dynamic And Static Pelvic MRI Parameters

Participants
Mohamed A. El-Ghar, MSc, MD, Mansoura, Egypt (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to analyze preoperative 3T quantitative static and dynamic pelvic MRI parameters in a trial to detect the parameters predicting the successful surgical correction of stress urinary incontinence.*Methods and Materials 42 female patients with stress urinary incontinence were recruited in our study, their age ranged from 35 to 65 years. 3T pelvic MRI examination was conducted at rest and during straining, preoperative and 6 months post-operative. Logistic regression of the MRI parameters was done to determine their ability to predict the success of the surgery. Also, ROC curve analysis was performed to detect the cut off value, sensitivity and specificity of the different MRI variables.*Results Logistic regression revealed that the pubovaginal space was the most significant parameter with p value (0.03) followed by H line during straining (p value=0.05). According to ROC curve, the cut off value of pubovaginal space was (2.65 cm) demonstrating sensitivity and specificity of (77.1%& 62.5%) respectively with AUC of (0.741) which represents the highest AUC value compared to other MRI parameters. The cut off value of H line during straining was (7.45 cm) demonstrating sensitivity and specificity of (74.3%& 62.5%) respectively with AUC of (0.720).*Conclusions The specific MRI parameters that predict the success of SUI surgery should be looked thoroughly preoperatively during pelvic floor

MRI evaluation.*Clinical Relevance/Application Preoperative pelvic floor MRI parameters that can predict the success of stress urinary incontinence surgery can help to avoid the unnecessary surgery

RESULTS

Logistic regression revealed that the pubovaginal space was the most significant parameter with p value (0.03) followed by H line during straining (p value=0.05). According to ROC curve, the cut off value of pubovaginal space was (2.65 cm) demonstrating sensitivity and specificity of (77.1%& 62.5%) respectively with AUC of (0.741) which represents the highest AUC value compared to other MRI parameters. The cut off value of H line during straining was (7.45 cm) demonstrating sensitivity and specificity of (74.3%& 62.5%) respectively with AUC of (0.720).

CLINICAL RELEVANCE/APPLICATION

Preoperative pelvic floor MRI parameters that can predict the success of stress urinary incontinence surgery can help to avoid the unnecessary surgery

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SDP-GI

Gastrointestinal Pre-recorded Scientific Posters

Sub-Events

SDP-GI-1   Esophageal Wall Thickness On CT Scans: Can It Predict The T Stage Of Primary Thoracic Esophageal Squamous Cell Carcinoma?

Participants
Yue Wang, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

To determine and validate the optimal esophageal wall thickness (EWT) threshold on CT to distinguish lesions with different T stages in esophageal squamous cell carcinoma (ESCC) patients.*Methods and Materials 1102 consecutive patients with histopathologically verified ESCC between July 2014 and April 2020 were retrospectively reviewed. All patients underwent preoperative CT examination and surgical treatment.The maximal EWT of the lesions on CT was measured. Patients were divided into pT1, pT2, pT3 and pT4 subgroups according to pathologic stage. We employed the support vector machine, where linear kernels were leveraged to determine the optimal threshold to classify samples with different T stages. 90% of samples for each subgroup were selected randomly as the training set, while the remainder comprised the test set.*Results The mean EWTs of the pT1, pT2, pT3 and pT4 subgroups were 4.9±2.6mm, 8.1±2.3mm, 12.4±3.6mm, and 18.6±4.4mm, respectively. Differences in the EWT between four subgroups or between adjacent subgroups were significant (p=0.000), and esophageal wall became thicker with increasing pT. Multivariate logistic regression analysis indicated that the EWT was a predictor of pathologic T stage in ESCC (p=0.000). We utilized MATLAB 2020a to implement the SVM model and ran the code 10 times. The accuracy of the model was 60.29±2.33%. The thresholds between samples from pT1/pT2, pT2/pT3 and pT3/pT4 lesions were 5.5±0.3mm, 10.8±0.8mm and 15.9±0.5mm, respectively.*Conclusions EWT correlates closely with pathologic T stage and demonstrates acceptable accuracy for T-staging prediction of ESCC.*Clinical Relevance/Application This study can provide a reference for pre-treatment T-staging evaluation of esophageal cancer based on CT.

RESULTS

The mean EWTs of the pT1, pT2, pT3 and pT4 subgroups were 4.9±2.6mm, 8.1±2.3mm, 12.4±3.6mm, and 18.6±4.4mm, respectively. Differences in the EWT between four subgroups or between adjacent subgroups were significant (p=0.000), and esophageal wall became thicker with increasing pT. Multivariate logistic regression analysis indicated that the EWT was a predictor of pathologic T stage in ESCC (p=0.000). We utilized MATLAB 2020a to implement the SVM model and ran the code 10 times. The accuracy of the model was 60.29±2.33%. The thresholds between samples from pT1/pT2, pT2/pT3 and pT3/pT4 lesions were 5.5±0.3mm, 10.8±0.8mm and 15.9±0.5mm, respectively.

CLINICAL RELEVANCE/APPLICATION

This study can provide a reference for pre-treatment T-staging evaluation of esophageal cancer based on CT.

SDP-GI-10   Assessment Of Lymph Node Status And Tumor Response After Chemoradiation Therapy In Locally Advanced Rectal Cancer: Comparison Of Three Methods Of Region Of Interest For Intravoxel Incoherent Motion Parameters

Participants
Yi Yuan, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To assess the diagnostic performance of region of interest (ROI) methods of intravoxel incoherent motion (IVIM) for determining lymph node metastases (LNM) and tumor response after chemoradiation therapy (CRT) in locally advanced rectal cancer and which risk factors related to early recurrence.*Methods and Materials 79 patients underwent preoperative IVIM and diffusion-weighted imaging before and after CRT. Slow diffusion coefficient (D), fast diffusion coefficient (D*), perfusion-related diffusion fraction (f), apparent diffusion coefficient (ADC) value and their percentage changes (?%) were obtained according to three ROI methods: whole-volume, single-slice and small samples. Risk factors were evaluated through multivariate logistic regression analyses. Areas under the receiver operating characteristic curves (AUCs) and prescision-recall curves were calculated to evaluate diagnostic performance. 2-year recurrence-free survival was estimated using Kaplan-Meier survival curves.*Results Interobserver agreement were good for pre- and post-CRT whole-volume ROI and single-slice ROI (intraclass correlation coefficient [ICC], 0.775-0.953), and moderate for small samples ROI (ICC, 0.581-0.905). At multivariate analysis, whole-volume ROI-derived ?%D values was an independent risk factor for discriminating LNM, non-pathological complete response (non-pCR) and poor response (odds ratio,0.947,0.952,0.805; p=0.001,<0.001,<0.001, respectively). AUC for whole-volume ROI-derived ?%D values showed the best AUC of 0.810, 0.851 and 0.903 for identifying LNM, non-pCR and poor response. After CRT, only patients with LNM showed earlier recurrence (hazard ratio, 3.253; 95% confidence interval, 1.229-8.608; p=0.018).*Conclusions Whole-volume ROI-derived ?%D values provided high diagnostic performance for evaluating LNM and tumor response. Furthermore, only patients with LNM after CRT was associated with early recurrence.*Clinical Relevance/Application Whole-volume ROI-derived ?%D values was an independent risk factor and provided higher diagnostic performance for determining LNM and tumor response, and those patients with LNM were associated with early recurrence.

RESULTS

Interobserver agreement were good for pre- and post-CRT whole-volume ROI and single-slice ROI (intraclass correlation coefficient [ICC], 0.775-0.953), and moderate for small samples ROI (ICC, 0.581-0.905). At multivariate analysis, whole-volume ROI-derived ? %D values was an independent risk factor for discriminating LNM, non-pathological complete response (non-pCR) and poor response (odds ratio,0.947,0.952,0.805; p=0.001,<0.001,<0.001, respectively). AUC for whole-volume ROI-derived ?%D values showed the best AUC of 0.810, 0.851 and 0.903 for identifying LNM, non-pCR and poor response. After CRT, only patients with LNM showed earlier recurrence (hazard ratio, 3.253; 95% confidence interval, 1.229-8.608; p=0.018).

CLINICAL RELEVANCE/APPLICATION

Whole-volume ROI-derived ?%D values was an independent risk factor and provided higher diagnostic performance for determining LNM and tumor response, and those patients with LNM were associated with early recurrence.

SDP-GI-100 Prediction Of High-risk Esophageal Varices With Liver Multifrequency MR Elastography In Cirrhotic Patients

Participants
Jin Wang, MD, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

High-risk esophageal varices (HREVs) pose a greater threat to life than low-risk esophageal varices (LREVs) in patients with liver cirrhosis. Non-invasive prediction of HREVs among cirrhotic patients is of utmost importance. The aim of this study was to assess the value of multifrequency MR elastography (MRE) to predict HREVs in patients with cirrhosis.*Methods and Materials This retrospective study received institutional review board approval, and informed consent was waived. From March 2018 to August 2020, 97 patients with liver cirrhosis who performed multifrequency MRE within 6 months before or after gastroscopy were retrospective included. The liver shear stiffness (G*), storage modulus (G'), shear loss modulus (G?) and damping ratio (?) were measured by multifrequency MRE at 30Hz, 40Hz and 60Hz. The presence of esophageal varices grade II and III were classified as HREVs while no varices and grade I were classified as LREVs. Logistic regression analysis was used to identify independent risk factors for predicting HREVs in cirrhotic patients by using clinical and multi-parametric information.*Results According to gastroscopy, forty-five (46.39%, 45/97) patients were classified HREVs and fifty-two (53.61%, 52/97) patients were classified as LREVs. Low platelet count(PLT)(P=0.011; odds ratio=0.979, 95% CI, 0.963-0.995), 60Hz G?(P=0.018; odds ratio=2.369, 95% CI, 1.162-4.828) and 40Hz G?(P=0.029; odds ratio=2.970, 95% CI, 1.116-7.904) were independent risk factors for predicting HREVs. Combination of PLT and 40Hz G? had sensitivity of 59.3% and specificity of 82.8% with AUC of 0.762, combination of PLT and 60Hz G? had sensitivity of 78.8% and specificity of 69.0% with AUC of 0.766, combination of PLT, 40Hz G? and 60Hz G? had sensitivity of 77.8% and specificity of 69.0% with AUC of 0.770 for prediction of HREVs.*Conclusions Combination of platelet count, 60Hz G? and 40Hz G? can perform well in the prediction of HREV in cirrhotic patients.*Clinical Relevance/Application The combination of laboratory biomarkers and quantitative measurements from multifrequency MRE may be a useful method to identify cirrhotic patients with HREVs, helpful for clinical management and follow-up strategies.

RESULTS

According to gastroscopy, forty-five (46.39%, 45/97) patients were classified HREVs and fifty-two (53.61%, 52/97) patients were classified as LREVs. Low platelet count(PLT)(P=0.011; odds ratio=0.979, 95% CI, 0.963-0.995), 60Hz G?(P=0.018; odds ratio=2.369, 95% CI, 1.162-4.828) and 40Hz G?(P=0.029; odds ratio=2.970, 95% CI, 1.116-7.904) were independent risk factors for predicting HREVs. Combination of PLT and 40Hz G? had sensitivity of 59.3% and specificity of 82.8% with AUC of 0.762, combination of PLT and 60Hz G? had sensitivity of 78.8% and specificity of 69.0% with AUC of 0.766, combination of PLT, 40Hz G? and 60Hz G? had sensitivity of 77.8% and specificity of 69.0% with AUC of 0.770 for prediction of HREVs.

CLINICAL RELEVANCE/APPLICATION

The combination of laboratory biomarkers and quantitative measurements from multifrequency MRE may be a useful method to identify cirrhotic patients with HREVs, helpful for clinical management and follow-up strategies.

SDP-GI-101 Assessment Of Two Quantification Techniques For Measuring Small Bowel Motility With Cine-MRI

Participants
Kyra Van Rijn, MD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Cine-MRI motility measurements are increasingly used in different populations, some with dilated small bowel loops. Usually, this automated technique calculates an average motility score within a region of interest (ROI). In subjects with dilated bowel loops, the lumen may cover a large part of the ROI and may therefore have a disproportionate influence on the motility score. Our aim was to evaluate the effect of bowel dilation on cine-MRI small bowel motility measurements, by comparing a MRI motility score that includes both bowel walls and luminal content with a bowel wall-specific motility score in healthy and diseased populations.*Methods and Materials Four populations were included: 10 Crohn's patients with a stricture and pre stricture dilation for segmental motility analysis, and 14 mannitol-prepared healthy volunteers, 15 fasted healthy volunteers and 8 chronic intestinal pseudo-obstruction (CIPO) patients (characterized by dilated bowel loops) for global small bowel motility analysis. All subjects underwent a cine-MRI scan from which two motility scores were calculated: a conventional score that included both bowel walls and luminal content and a small bowel wall-specific motility score. The difference between the two scores was calculated per population and was compared between the populations with an ANOVA and Tukey-Kramer post hoc analysis.*Results In Crohn's patients the median (IQR) change between the conventional and wall-specific motility score was 0% (-2 to +4%) in the stricture and 0% (-1 to +7%) for the pre stricture dilation. For the global small bowel, in mannitol-prepared healthy volunteers this was -1% (-5 to 0%), in healthy fasted subjects -2% (-6 to +2%) and in CIPO patients +14% (+6 to +20%). The ANOVA showed a significant difference between the populations (P<0.001*), post hoc analysis showed that CIPO patients were different from the other populations.*Conclusions The conventional small bowel motility score appears to be robust in Crohn's patients and healthy subjects. In CIPO patients with globally and grossly dilated bowel loops a clear difference was detected, therefore a bowel-wall specific motility score may give a better representation of small bowel motility.*Clinical Relevance/Application Cine-MRI small bowel motility measurements appear to be robust in Crohn's patients and healthy subjects, but globally dilated bowel loops affect motility measurements, needing a tailored approach.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Cine-MRI small bowel motility measurements appear to be robust in Crohn's patients and healthy subjects, but globally dilated bowel loops affect motility measurements, needing a tailored approach.

SDP-GI-102 Impact Of Spleen Volume On Prediction Of Clinical Outcome After Open Abdominal Aortic Repair In Elderly Patients

Participants
Hiroki Horinouchi, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Spleen volume is reported to be an independent prognostic factor for patients with cancer or infectious diseases. However, the relationship between spleen volume and clinical outcomes in patients with cardiovascular diseases has rarely been studied or addressed. In elderly patients, open abdominal aortic repair (OAR) carries a significantly higher risk of operative mortality and perioperative complications. The purpose of this study was to investigate whether preoperative spleen volume was associated with clinical outcomes in elderly patients undergoing elective OAR.*Methods and Materials We retrospectively reviewed our institutional data to identify all elderly patients (age = 80 years) who underwent elective OAR between 2007 and 2020. Patients with emergency procedure or insufficient data were excluded. Clinical outcomes were hospital length of stay (LOS) and overall survival (OS) after OAR. Spleen volume was measured on preoperative computed tomography scans. Patient characteristics, intraprocedural variables, and imaging findings including spleen volume were analyzed using stepwise multiple regression and multivariable analysis to determine predictors of LOS and OS.*Results We identified 90 elderly patients (median age, 82 years) who underwent OAR. The median preoperative spleen volume was 95.9 (interquartile range (IQR): 72.0-129.5) mL. The median LOS was 14 (IQR: 12-17) days. The overall survival rate was 82% at five years. Pneumonia, heart disease, cancer, and stroke were the most common causes of death, and no deaths occurred due to aneurysm rupture. Stepwise multiple regression analysis demonstrated that preoperative spleen volume (B coefficient, 0.213; 95% confidence interval (CI), 0.000348-0.0443; p = 0.047) and age (B coefficient, 0.381; 95% CI, 0.385-1.207; p = 0.0002) were associated with prolonged postoperative LOS. There was no association between OS and the spleen volume (p = 0.17).*Conclusions Preoperative spleen volume can be an independent prognostic factor for prolonged postoperative LOS after elective OAR in elderly patients.*Clinical Relevance/Application Spleen volume was associated with prolonged hospital length of stay after open abdominal aortic repair in elderly patients. Spleen volume may predict outcomes in patients with cardiovascular diseases.

RESULTS

We identified 90 elderly patients (median age, 82 years) who underwent OAR. The median preoperative spleen volume was 95.9 (interquartile range (IQR): 72.0-129.5) mL. The median LOS was 14 (IQR: 12-17) days. The overall survival rate was 82% at five years. Pneumonia, heart disease, cancer, and stroke were the most common causes of death, and no deaths occurred due to aneurysm rupture. Stepwise multiple regression analysis demonstrated that preoperative spleen volume (B coefficient, 0.213; 95% confidence interval (CI), 0.000348-0.0443; p = 0.047) and age (B coefficient, 0.381; 95% CI, 0.385-1.207; p = 0.0002) were associated with prolonged postoperative LOS. There was no association between OS and the spleen volume (p = 0.17).

CLINICAL RELEVANCE/APPLICATION

Spleen volume was associated with prolonged hospital length of stay after open abdominal aortic repair in elderly patients. Spleen volume may predict outcomes in patients with cardiovascular diseases.

SDP-GI-103 Inter-reader Agreement Of Adequacy And Visualization Scores Of Gadoxetate-enhanced Abbreviated Mri (amri) And Liver Ultrasound (us) For Hepatocellular Carcinoma (hcc) Screening/surveillance

Participants
Guilherme M. Cunha, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

Abbreviated MRI (AMRI) protocols for HCC surveillance have been proposed as more sensitive alternatives to ultrasound (US) in high-risk patients (1, 2). Both AMRI and US may be limited in some patients due to factors such as body habitus, severity of cirrhosis, and suboptimal contrast uptake (2, 3). A standardized approach to communicating limitations is needed to allow for adaptive alternative surveillance strategies. We aimed to assess and compare inter-reader agreement for LI-RADS US visualization score and novel US and AMRI adequacy scoring systems.*Methods and Materials Data from a prospective study of gadoxetate-AMRI/US surveillance was available for analysis in 62 patients, reviewed and scored by 3 independent readers according to the LI-RADS visualization score, as well as additional adequacy scoring indices on both US and AMRI. Inter-reader agreement was computed using intra-class correlation (ICC). Bootstrap comparison was performed between AMRI and US visualization scores*Results 27 (44%) patients were men (age: 60±10, BMI: 30 ±7) and 40 (64.5%) had liver cirrhosis. The ICC for US LI-RADS visualization score was 0.19 (95%CI: 0.02 - 0.38), and ranged from 0.08 (0.08 - 0.30), 0.11 (0.04 - 0.29), 0.36 (0.19 - 0.53), 0.64 (0.51, 0.76) and 0.51 (0.35 - 0.66) for the other US metrics. The ICC for AMRI visualization score was 0.721 (95% CI: 0.598, 0.82), significantly higher than US visualization score (p<0.001), and 0.749 (0.631, 0.842) and 0.578 (0.419, 0.716) for contrast uptake and parenchymal heterogeneity indexes, respectively.*Conclusions The ICC for assessment of adequacy of HBP-AMRI was high, while the US LI-RADS visualization score and other indices showed poor agreement.*Clinical Relevance/Application Further refinements in the US adequacy metrics are needed to standardize communication in a reliable way. AMRI adequacy scores may direct potential need for alternative surveillance imaging.

RESULTS

27 (44%) patients were men (age: 60±10, BMI: 30 ±7) and 40 (64.5%) had liver cirrhosis. The ICC for US LI-RADS visualization score was 0.19 (95%CI: 0.02 - 0.38), and ranged from 0.08 (0.08 - 0.30), 0.11 (0.04 - 0.29), 0.36 (0.19 - 0.53), 0.64 (0.51, 0.76) and 0.51 (0.35 - 0.66) for the other US metrics. The ICC for AMRI visualization score was 0.721 (95% CI: 0.598, 0.82), significantly higher than US visualization score (p<0.001), and 0.749 (0.631, 0.842) and 0.578 (0.419, 0.716) for contrast uptake and parenchymal heterogeneity indexes, respectively.

Further refinements in the US adequacy metrics are needed to standardize communication in a reliable way. AMRI adequacy scores may direct potential need for alternative surveillance imaging.

SDP-GI-104 Correlating Quantitative Para-aortic Node CT Parameters With FDG PET For Cervical Cancer Staging: Possible Solution For Resource Constrained Countries

Participants
Paul D'Cunha, BS, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To determine the most accurate quantitative morphological parameters on CT that correlate with FDG-avid PANs in patients with cervical cancer.*Methods and Materials A single institution retrospective evaluation was preformed of women with cervical cancer who underwent pretreatment PET/CT and radiotherapy therapy planning CT between 2009 and 2020. A node-by-node correlation between pretreatment CT and PET/CT was performed for the reference standard of FDG-avidity for short and long axes diameters, volume, and long/short-axes ratio (L/S). Nodal volume was manually contoured and calculated using the radiation treatment program. FDG-avid PANs were defined as PET positive and non FDG-avid PANs from patients without PET determined PAN metastasis were defined as PET negative. Area under the receiver operator curve (AUC) was calculated to access diagnostic accuracy of the different quantitative parameters. Three specificity set points of 0.85, 0.90, and 0.95 were used to calculate various cutoffs and compare sensitivity between parameters.*Results A total of 94 women (mean age ± standard deviation, 52 years ± 13) with cervical cancer were included. Forty-seven patients had PET positive PANs (181 PET positive PANs) and 47 patients had no PET positive PANs (141 PET negative PANs). The AUC for PAN volume (0.945) was significantly greater (P < 0.001) than that of short-axis diameter (0.895), long-axis diameter (0.885), and L/S (0.583). For all three specificity set points, 0.85, 0.90, and 0.95, nodal volume sensitivity was significantly higher than that of short-axis diameter (P < 0.001, P = 0.001, and P = 0.005, respectively), long-axis diameter (P < 0.001, P = 0.002, P < 0.001, respectively), and L/S ratio (P < 0.001 for all specificity set points). At a specificity set point of 0.90 (127/141 PANs), the cutoff for volume was = 0.443 cm3 (0.85 sensitivity [154/181 PAN]) and for short-axis diameter was = 5.9 mm (0.75 sensitivity [135/181 PAN]).*Conclusions Para-aortic lymph node volume demonstrated improved node-by-node correlation between CT and PET/CT compared to short-axis diameter, long-axis diameter, and L/S and is an alternative to improve detection of PAN suspicious for metastatic disease for cervical cancer patients in locations without access to PET/CT.*Clinical Relevance/Application Our CT quantitative parameter cutoffs provide improved sensitivity, without much compromise in specificity, compared to literature CT criteria for detection of para-aortic nodes suspicious for metastatic disease in cervical cancer patients, which is useful for sites without access to PET/CT.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Our CT quantitative parameter cutoffs provide improved sensitivity, without much compromise in specificity, compared to literature CT criteria for detection of para-aortic nodes suspicious for metastatic disease in cervical cancer patients, which is useful for sites without access to PET/CT.

SDP-GI-11 Evaluation Of Dual-energy CT Derived Radiomics Signatures In Predicting Outcomes In Patients With Advanced Gastric Cancer After Neoadjuvant Chemotherapy

Participants
Yong Chen, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the prognostic value of dual-energy CT (DECT) based radiomics to predict disease-free survival (DFS) and overall survival (OS) for patients with advanced gastric cancer (AGC) after neoadjuvant chemotherapy (NAC).*Methods and Materials From January 2014 to December 2018, a total of 156 AGC patients were enrolled and randomly allocated into a training cohort and a testing cohort at a ratio of 2:1. Volume of interest of primary tumor was delineated on eight image series. Four feature sets derived from pre-NAC and delta radiomics were generated for each survival arm. Random survival forest was used for generating the optimal radiomics signature (RS). Statistical metrics for model evaluation included Harrell's concordance index (C-index) and the average cumulative/dynamic AUC throughout follow-up. A clinical model and a combined Rad-clinical model were built for comparison.*Results The pre-IU (derived from iodine uptake images before NAC) RS performed best for DFS and OS in the testing cohort (C-indices, 0.784 and 0.698; the average cumulative/dynamic AUCs, 0.80 and 0.77). When compared with the clinical model, the radiomics model had significantly higher C-indices to predict DFS in both cohorts (0.822 vs. 0.651, p < 0.001; 0.784 vs. 0.635, p < 0.001), but no statistical significance was found for OS prediction in either the training or the testing cohorts (0.724 vs. 0.728, p = 0.899; 0.698 vs. 0.680, p = 0.473).*Conclusions The DECT radiomics model serves as a promising non-invasive biomarker to predict survival for AGC patients after NAC, providing an opportunity of transforming proper treatment.*Clinical Relevance/Application Compared with conventional CT images, iodine uptake maps before neoadjuvant chemotherapy may provide more insight into heterogeneity of gastric cancer to predict survival.

RESULTS

The pre-IU (derived from iodine uptake images before NAC) RS performed best for DFS and OS in the testing cohort (C-indices, 0.784 and 0.698; the average cumulative/dynamic AUCs, 0.80 and 0.77). When compared with the clinical model, the radiomics model had significantly higher C-indices to predict DFS in both cohorts (0.822 vs. 0.651, p < 0.001; 0.784 vs. 0.635, p < 0.001), but no statistical significance was found for OS prediction in either the training or the testing cohorts (0.724 vs. 0.728, p = 0.899; 0.698 vs. 0.680, p = 0.473).

CLINICAL RELEVANCE/APPLICATION

Compared with conventional CT images, iodine uptake maps before neoadjuvant chemotherapy may provide more insight into heterogeneity of gastric cancer to predict survival.

SDP-GI-13 Application Of Basis Material Decomposition Technique With Spectral CT In Quantitatively Evaluating The Staging Of Chronic Hepatitis B Liver Fibrosis Using Histopathology As The Reference Standard

Participants
Liu Xianwang, Lanzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the application value of basis material decomposition technique with spectral CT in the quantitative assessment of chronic hepatitis B liver fibrosis staging.*Methods and Materials This prospective study included patients with chronic liver disease who were scheduled to undergo multiphase abdominal CT(including portal phase dual-energy scanning) and liver biopsy from January 2018 to December 2020. The area of interest (ROI) was drawn in the area that approximately matched the area of biopsy on the right lobe, and another ROI was placed on the abdominal aorta at the level of the celiac trunk to calculate the normalized iodine concentration of liver (LNIC). One-way analysis of variance (ANOVA) and least significant difference method (LSD) were used to compare the differences of LNIC with the METAVIR fibrosis stage (ranging from F0 to F4). Spearman correlation analysis was used to evaluate the correlation between chronic hepatitis B liver fibrosis stage and LNIC. Diagnostic performance of the LNIC was assessed by using areas under the receiver operating characteristic curve (AUCs).*Results A total of 36 participants (mean age, 45.61 years ± 9.03 ; 16 women) and 20 control subjects (mean age, 38.30 years ±11.02; 11 men) were evaluated. There are differences in LNIC among different stages of chronic hepatitis B liver fibrosis (F=39.778, P<0.001). The RNIC showed strong nagative correlation with METAVIR stage (Spearman r=-0.830, P<0.001). The AUC values of LNIC in the diagnosis of chronic hepatitis B liver fibrosis staging are all >0.9, which has high diagnostic value. The AUC, sensitivity, specificity of LNIC distinguishes ?F1, ?F2, and ?F3+4 were 0.926, 86.11%, 95%; 0.922, 91.62%, 81.25%; 0.982, 100%, 90.7%, respectively.*Conclusions Basis material decomposition technique with spectral CT can be used to quantitatively assess the staging of chronic hepatitis B hepatic fibrosis and provide more evidence for the early diagnosis of chronic hepatitis B liver fibrosis staging.*Clinical Relevance/Application The basis material decomposition technique with energy spectral CT is helpful for the evaluation of chronic hepatitis B hepatic fibrosis.

RESULTS

A total of 36 participants (mean age, 45.61 years ± 9.03 ; 16 women) and 20 control subjects (mean age, 38.30 years ±11.02; 11 men) were evaluated. There are differences in LNIC among different stages of chronic hepatitis B liver fibrosis (F=39.778, P<0.001). The RNIC showed strong nagative correlation with METAVIR stage (Spearman r=-0.830, P<0.001). The AUC values of LNIC in the diagnosis of chronic hepatitis B liver fibrosis staging are all >0.9, which has high diagnostic value. The AUC, sensitivity, specificity of LNIC distinguishes ?F1, ?F2, and ?F3+4 were 0.926, 86.11%, 95%; 0.922, 91.62%, 81.25%; 0.982, 100%, 90.7%, respectively.

CLINICAL RELEVANCE/APPLICATION

The basis material decomposition technique with energy spectral CT is helpful for the evaluation of chronic hepatitis B hepatic fibrosis.

SDP-GI-14 In Vivo Quantitative Proton MR Spectroscopy For Predicting The Presence Of Esophageal Varices Needing Treatment In Patients With Liver Cirrhosis

Participants
Sang Soo Shin, MD, Gwangju, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the metabolic change and its correlation with clinical characteristics to predict the presence of esophageal varices needing treatment (VNT) in patients with liver cirrhosis using in vivo quantitative proton magnetic resonance spectroscopy (1H-MRS).*Methods and Materials This prospective study consisted of 40 cirrhotic patients (M:F = 20:20, 59±21.45 years of age) without VNT including negative red color sign and 40 cirrhotic patients (M:F = 20:20, 63±22.9 years of age) with VNT including positive red color sign, which were classified by conventional endoscopy. 1H-MRS with single-voxel localization was performed in cirrhotic liver parenchyma at a 3-T MR scanner (Magnetom TimTrio). Blood cell counts and liver function were measured as blood-based biomarkers using a routine clinical chemistry analyzer. Also, the spleen diameter was measured on MR images as an imaging biomarker. Data were statistically analyzed using independent two-sample t-tests to compare clinical variables and analysis of covariance (ANCOVA) with adjustments for age and sex to compare the metabolic levels between the two groups. A multiple linear regression analysis was used to analyze the significant factors affecting cellular alterations of hepatic metabolism.*Results Cirrhotic patients with VNT had lower platelet counts, lower levels of serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT), higher total bilirubin, lower serum albumin levels, longer spleen diameters, and lower ratios of platelet count to spleen diameter than those without VNT. Except for AST and ALT levels, these clinical variables were all significantly different between the two groups (P < 0.05). Also, the metabolite levels of lactate+triglyceride (TG) and choline in cirrhotic patients with VNT were significantly higher as compared to those of cirrhotic patients without VNT (P < 0.05). Additionally, in cirrhotic patients with VNT, older age, longer spleen diameter, lower platelet counts, and lower ratios of platelet count/spleen diameter were significantly and independently associated with an increase in both lactate+TG and choline metabolites in the presence of esophageal VNT (except age, which was not significantly associated with choline).*Conclusions The higher values of lactate+TG and choline at 1H-MRS were associated with the presence of esophageal VNT. Those metabolic changes were correlated with longer spleen diameters, lower platelet counts, and lower ratios of platelet count to spleen diameter.*Clinical Relevance/Application 1H-MRS could be effectively used for predicting the presence of esophageal varices needing treatment in cirrhotic patients.

RESULTS

Cirrhotic patients with VNT had lower platelet counts, lower levels of serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT), higher total bilirubin, lower serum albumin levels, longer spleen diameters, and lower ratios of platelet count to spleen diameter than those without VNT. Except for AST and ALT levels, these clinical variables were all significantly different between the two groups (P < 0.05). Also, the metabolite levels of lactate+triglyceride (TG) and choline in cirrhotic patients with VNT were significantly higher as compared to those of cirrhotic patients without VNT (P < 0.05). Additionally, in cirrhotic patients with VNT, older age, longer spleen diameter, lower platelet counts, and lower ratios of platelet count/spleen diameter were significantly and independently associated with an increase in both lactate+TG and choline metabolites in the presence of esophageal VNT (except age, which was not significantly associated with choline).

SDP-GI-15   Confounders Of Liver Ultrasound Positive Predictive Value In Hepatocellular Carcinoma Screening

Participants
Nadine Zeidan, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Liver ultrasound (US) is recommended for hepatocellular carcinoma (HCC) surveillance by professional society guidelines including the American Association for the Study of Liver Disease (AASLD). Prior studies suggest patient-related factors, such as obesity and non-viral liver disease, are associated with worse visualization; however, their impact on diagnostic performance has not been reported. Therefore, we evaluated whether patient-related factors are associated with US exam-level specificity for HCC detection.*Methods and Materials This retrospective cohort study at two academic centers included patients with chronic liver disease, at risk for HCC, who had a screen-positive US exam per US LI-RADS (US-3) during 01/2016-06/2019. Patients were categorized as True Positive (TP) or False Positive (FP) by a composite reference standard of histology or diagnostic CT/MRI demonstrating HCC, or no clinical diagnosis of HCC =2 years after index US, respectively. Patients who were lost to follow-up prior to 2 years and duplicate US exams were excluded. We used logistic regression analysis to evaluate associations between US positivity and Visualization Score (A; B; C), Body Mass Index (BMI) >30 kg/m2, and viral vs. nonviral liver disease etiology.*Results Of 310 patients with US-3 exams, 37 patients (12%) were lost to follow-up. Of the remaining 273, 34% were TP and 66% were FP. Factors associated with FPR are summarized in Table 1. Higher FPR was significantly associated with BMI >30 kg/m2 (OR 2.17, p=0.004), nonviral cirrhosis (OR 2.38, p<0.001), and age younger than 60 years (OR 0.38, p<0.001). Notably, US Visualization Score was not significantly associated with FPR.*Conclusions Our results show a higher false positive rate in screening US liver exams in obese patients, and in those with nonviral cirrhosis, independent of Visualization Score. This suggests alternative surveillance strategies may be needed in these populations to reduce unnecessary harms associated with a false positive screen.*Clinical Relevance/Application We found two-thirds of screen-positive liver US (i.e., US-3) are false positive results, with a higher FPR in obese patients and in those with nonviral cirrhosis. False positive US results can lead to unnecessary invasive biopsies, additional costly and inconvenient follow-up imaging, and patient anxiety. This is concerning given the increasing prevalence of obesity and nonviral cirrhosis due to nonalcoholic steatohepatitis (NASH), suggesting this will become more problematic in the future. Our data highlight a clear need for alternative surveillance modalities, with increased diagnostic performance, for these patients.

RESULTS

Of 310 patients with US-3 exams, 37 patients (12%) were lost to follow-up. Of the remaining 273, 34% were TP and 66% were FP. Factors associated with FPR are summarized in Table 1. Higher FPR was significantly associated with BMI >30 kg/m2 (OR 2.17, p=0.004), nonviral cirrhosis (OR 2.38, p<0.001), and age younger than 60 years (OR 0.38, p<0.001). Notably, US Visualization Score was not significantly associated with FPR.

CLINICAL RELEVANCE/APPLICATION

We found two-thirds of screen-positive liver US (i.e., US-3) are false positive results, with a higher FPR in obese patients and in those with nonviral cirrhosis. False positive US results can lead to unnecessary invasive biopsies, additional costly and inconvenient follow-up imaging, and patient anxiety. This is concerning given the increasing prevalence of obesity and nonviral cirrhosis due to nonalcoholic steatohepatitis (NASH), suggesting this will become more problematic in the future. Our data highlight a clear need for alternative surveillance modalities, with increased diagnostic performance, for these patients.

SDP-GI-16   Two-section Formula Based On Axial+Coronal CT In The Discrimination Of Siewert Types Of Adenocarcinoma Of Esophagogastric Junction

Participants
Yiting Liu, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To build an easy-handled formula to judge the Siewert type of AEG on CT images, through the comparison with the pathological findings.*Methods and Materials A total of 62 patients with AEG were enrolled. All patients underwent preoperative enhancement CT and had postoperative Siewert type. Siewert type on CT was performed by two radiologists on venous phase. On the coronal CT image, find the angular notch (the anatomical junction of the esophagus and the greater curvature of stomach, A in the figure) and the counterpart point on the lesser curvature (B in the figure). Connect the two points with a smooth arc to get the EGJ line. The midpoint of the line on axial image equals to EGJ layer. Then we judge Siewert type using the layer numbers on axial images with two-section formula (TSF): formula 1. Positive values signified as Siewert III, and negative ones will use formula 2 to further discriminate Siewert I and II, the positive values will be determined as Siewert II, and negative as Siewert I. (The formula will be shown in PDF attachment.)*Results The interobserver agreement was good (kappa value=0.737). TSF method and pathological findings reached consensus in 56 patients: type I 11 in 15, type II 43 in 44, and type III 2 in 3. The Siewert type difference between pathology and TSF was not statistically significant different (p >0.05), and the agreement was good (kappa value=0.759).*Conclusions Two-section formula using axial combing with coronal CT information provided a potential method in the preoperative judgement of the Siewert type of AEG.*Clinical Relevance/Application Two-section formula might be applied to gastric cancer structured report for more convenient calculation in daily report writing.

RESULTS

The interobserver agreement was good (kappa value=0.737). TSF method and pathological findings reached consensus in 56 patients: type I 11 in 15, type II 43 in 44, and type III 2 in 3. The Siewert type difference between pathology and TSF was not statistically significant different (p >0.05), and the agreement was good (kappa value=0.759).

CLINICAL RELEVANCE/APPLICATION

Two-section formula might be applied to gastric cancer structured report for more convenient calculation in daily report writing.

SDP-GI-17   **The Role Of Preoperational Imaging Traits In Selecting Surgical Resection Or Radiofrequency Ablation For Single <= 5cm Hepatocellular Carcinoma**

Participants
Mengchao Wei, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Current treatment selection method for single = 5 cm hepatocellular carcinoma (HCC) gives inadequate attention on inter-tumor biological heterogeneity. Imaging traits including non-smooth tumor margins, internal arteries, peritumoral enhancement and absence of hypodense halos can reflect tumor aggressiveness preoperatively and may affect treatment selection. Therefore, our study aimed to explore the role of these four imaging traits in treatment selection between surgical resection (SR) and radiofrequency ablation (RFA) for patients with single = 5 cm HCC.*Methods and Materials 381 patients with single = 5 cm HCC who underwent SR (n=202) or RFA (n=179) in our hospital from April 2010 to December 2019 were retrospectively enrolled. The efficacy of SR and RFA in patients with the imaging traits that significantly influenced recurrence-free survival (RFS) or overall survival (OS) was compared and analyzed.*Results 381 patients with a median age of 56 years (interquartile range: 47-64 years) were evaluated. There were 330 men and 51 women. Multivariable Cox regression analysis identified albumin (P = 0.02), platelet (P = 0.02) and internal arteries (P = 0.001) were independent influencing factors for RFS, while prothrombin time (P < 0.001), internal arteries (P = 0.005) and peritumoral enhancement (P = 0.001) were independent influencing factors for OS. In patients with internal arteries, subgroup analysis based on tumor size demonstrated that both RFS and OS of SR were superior to those of RFA in patients with 3-5 cm HCC (RFS, P = 0.02; OS, P = 0.02). In patients with peritumoral enhancement, both RFS and OS of SR were superior to those of RFA (RFS, P = 0.02; OS, P = 0.04).*Conclusions Surgical resection might be the first choice for patients with single 3-5 cm hepatocellular carcinoma having internal arteries and patients with single = 5 cm hepatocellular carcinoma having peritumoral enhancement.*Clinical Relevance/Application Current treatment selection method gives inadequate attention on inter-tumor biological heterogeneity. As a consequence, doctors are unable to differentiate tumors with distinct aggressiveness. To tackle the challenge, our study adopted preoperative imaging traits as a surrogate of biological heterogeneity to illustrate its role in treatment selection of HCC and we successfully found a non-invasive, maneuverable and repeatable therapeutic selection method based on internal arteries and peritumoral enhancement. These traits are usually easily acquired and it would be convenient for doctors to apply the method in clinical practice.

RESULTS

381 patients with a median age of 56 years (interquartile range: 47-64 years) were evaluated. There were 330 men and 51 women. Multivariable Cox regression analysis identified albumin (P = 0.02), platelet (P = 0.02) and internal arteries (P = 0.001) were independent influencing factors for RFS, while prothrombin time (P < 0.001), internal arteries (P = 0.005) and peritumoral enhancement (P = 0.001) were independent influencing factors for OS. In patients with internal arteries, subgroup analysis based on tumor size demonstrated that both RFS and OS of SR were superior to those of RFA in patients with 3-5 cm HCC (RFS, P = 0.02; OS, P = 0.02). In patients with peritumoral enhancement, both RFS and OS of SR were superior to those of RFA (RFS, P = 0.02; OS, P = 0.04).

CLINICAL RELEVANCE/APPLICATION

Current treatment selection method gives inadequate attention on inter-tumor biological heterogeneity. As a consequence, doctors are unable to differentiate tumors with distinct aggressiveness. To tackle the challenge, our study adopted preoperative imaging traits as a surrogate of biological heterogeneity to illustrate its role in treatment selection of HCC and we successfully found a non-invasive, maneuverable and repeatable therapeutic selection method based on internal arteries and peritumoral enhancement. These traits are usually easily acquired and it would be convenient for doctors to apply the method in clinical practice.

SDP-GI-18   **Delta Radiomics On Dual-energy CT For Gastric Cancer With Neoadjuvant Chemotherapy: A Preliminary Study**

Participants
Yong Chen, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate a radiomics signature to evaluate tumor regression grade (TRG) for locally advanced gastric cancer (GC) after neoadjuvant chemotherapy (NAC) and assess prognostic value.*Methods and Materials One hundred and three GC patients treated with NAC were retrospectively recruited from April 2018 to December 2019 and were randomly allocated into a training cohort (n = 69) and a validation cohort (n = 34). Delineation was performed on both mix and iodine uptake images on portal venous and delayed phases based on dual-energy CT (DECT). A total of 4094 radiomics features were extracted from pre-NAC, post-NAC and delta feature sets. Spearman correlation and the least absolute shrinkage and selection operator were used for robust analysis and dimensionality reduction. Multivariable logistic regression was used for TRG evaluation and generated the optimal radiomics signature. Kaplan-Meier survival analysis with log-rank test was implemented in an independent cohort of 40 patients for validating the prognostic value of the optimal radiomics signature.*Results Three, five and six radiomics features were finally selected for pre-NAC, post-NAC and delta feature sets. The delta model was demonstrated best performance assessing TRG both in the training and the validation cohorts (AUCs, 0.91 and 0.76, respectively, p > 0.1). The optimal radiomics signature from the delta model showed significant capability to predict DFS and OS in the independent cohort (p =0.027 and 0.014, respectively).*Conclusions Delta radiomics based on DECT images serves as a potential biomarker of TRG evaluation and shows potential prognostic values for GC patients with NAC.*Clinical Relevance/Application Delta radiomics based on dual-energy CT can serve as an alternative noninvasive tool for evaluating tumor regression grade for locally advanced gastric cancer after neoadjuvant chemotherapy.

RESULTS

Three, five and six radiomics features were finally selected for pre-NAC, post-NAC and delta feature sets. The delta model was demonstrated best performance assessing TRG both in the training and the validation cohorts (AUCs, 0.91 and 0.76, respectively, p > 0.1). The optimal radiomics signature from the delta model showed significant capability to predict DFS and OS in the independent cohort (p =0.027 and 0.014, respectively).

CLINICAL RELEVANCE/APPLICATION

Delta radiomics based on dual-energy CT can serve as an alternative noninvasive tool for evaluating tumor regression grade for locally advanced gastric cancer after neoadjuvant chemotherapy.

SDP-GI-19   Participants

Predictive Value Of Gd-eob-dtpa Enhanced MRI With Adc : Microvaseular Invasion In Hepatocellular

Min Du, Xuzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Microvascular invasion (MVI) is one of the factors related to the prognosis of HCC. This study aims to explore the diagnostic value of clinical factors and Gd-EOB-DTPA enhanced MRI combined with ADC for HCC MVI.*Methods and Materials From September 2018 to December 2020, a total of 94 patients with 117 tumor were enrolled, who had complete information and didn't underwent any preoperative treatment. However, patients with recurrent HCC or other malignant tumors were excluded. Finally, the imaging of the patients were collected, including the peritumoral enhancement, peritumoral hypointensity, tumor maximum diameter, and tumor apparent diffusion coefficient (ADC) value, ADC ratio (the ratio of tumor ADC value to normal liver parenchymal ADC value), mismatch between diffusion-weighted imaging (DWI) and T2-weighted image (T2WI). Gender, age, alpha- fetoprotein (AFP), Protein induced by vitamin K absence or antagonist-II (PIVKA-II). These factors are divided into two groups: MVI positive (+) and MVI negative (-). Univariate analyses are performed in clinical and imaging factors and also logistic regression analyses. The receiver operating characteristic (ROC) curve is used to evaluate the diagnostic value of various factors for HCC MVI.*Results In the clinical factors, PIVKA-II was an independent predictor for HCC MVI The area of under the ROC curve (AUC) is 0.853, the sensitivity and specificity are 80.0% and 78.3%respectively, and the cut-off value is = 255 mAu/ml. AFP, gender, number of lesions and age groups are not correlated with HCC MVI. In the imaging factors, logistic regression analyses revealed peritumoral enhancement, peritumor hypointensity are independent predictors for MVI ,but largest tumor diameter and mismatch between DWI and T2WI are not independent predictors for MVI. However, the difference of the largest tumor diameter and mismatch between DWI and T2WI in groups are statistically significant. ROC curve analysis showed that the AUC of the peritumoral enhancement is the largest.However, these four factors united has highest AUC of 0.824, and has good sensitivity (79.4%) and specificity (77.1%).*Conclusions PIVKA-II is an independent predictor for HCC MVI with high diagnostic value. At the same time, peritumoral enhancement in the artery phase and peritumor hypointensity in the hepatobiliary phase are independent risk factors for HCC MVI. The maximum diameter of the tumor and the shape of the tumor are related to HCC MVI. The combination of the four factors has the highest value in the diagnose of HCC MVI. ADC value and ADC ratio and mismatch between DWI and T2WI have limited value in the diagnose of HCC MVI.*Clinical Relevance/Application Helping predict HCC MVI in advance and helping doctors choose appropriate treatments to improve prognosis

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Helping predict HCC MVI in advance and helping doctors choose appropriate treatments to improve prognosis

SDP-GI-2   Dynamic CT and Gadoxetic Acid-Enhanced MR Imaging Characteristics of P53-Mutated Hepatocellular Carcinoma

Participants
Azusa Kitao, MD, Kanazawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To clarify the imaging characteristics of P53-mutated hepatocellular carcinoma (HCC) correlated with clinical features, pathology, and prognosis.*Methods and Materials Institutional review board approval was obtained, and informed consent was waived. One hundred forty-nine patients with 175 HCCs who were diagnosed by surgical resection at our institution from January 2015 to May 2018 were enrolled. Cases were classified as HCC with P53 mutation (n=28) and HCC without P53 mutation (n=147) by immunostaining. Dynamic CT and gadoxetic acid-enhanced MR imaging (MRI) findings, clinical features, pathological findings, and prognosis were compared. P53 and organic anion-transporting polypeptide (OATP) 1B3 expression detected by immunochemistry was semiquantitatively evaluated.*Results P53-mutated HCC showed significantly higher serum alpha fetoprotein (AFP) (median 34 ng/ml vs 6 ng/ml; P=0.0001) and AFP-L3 fraction (7.15% vs 0.5%; P=0.001). P53-mutated HCC was often poorly differentiated (75.0% vs 17.0%; P<0.0001). In the arterial phase of dynamic CT, P53-mutated HCC showed poorly enhanced areas (57.1% vs 32.0%; P=0.003) and dilated arteries (35.7% vs 10.2%; P=0.002). In the hepatobiliary phase of gadoxetic acid-enhanced MRI, irregular tumor margin (39.3% vs 18.4%; P=0.05), peritumoral hypointensity (28.6% vs 9.5%; P=0.01), relative enhancement ratio (1.34 vs 1.70; P=0.04), and lower tumor/liver signal intensity ratio (0.46 vs 0.60; P=0.004) were common in P53-mutated HCC. In multivariate regression analysis, low signal intensity ratio in the hepatobiliary phase was an independent predictor of P53-mutated HCC (P=0.008, OR=0.02). Area under the curve of receiver operating characteristic curve was 0.68 and the cut-off value was 0.50. There was a significantly positive correlation between OATP1B3 expression and signal intensity ratio in the hepatobiliary phase (P<0.0001, R=0.41), and an inverse correlation between OATP1B3 expression and P53 expression (P=0.002, R=-0.23). Overall survival was worse in P53-mutated HCC than in HCC without P53 mutation (P=0.02).*Conclusions P53-mutated HCC is a biologically aggressive subtype with higher serum tumor marker expression, poorer differentiation grade, and worse survival. A lower signal intensity ratio in the hepatobiliary phase is useful for predicting P53-mutated HCC.*Clinical Relevance/Application Imaging findings, especially lower signal intensity ratio in the hepatobiliary phase, will help to predict P53-mutated HCC with aggressive features.

RESULTS

P53-mutated HCC showed significantly higher serum alpha fetoprotein (AFP) (median 34 ng/ml vs 6 ng/ml; P=0.0001) and AFP-L3 fraction (7.15% vs 0.5%; P=0.001). P53-mutated HCC was often poorly differentiated (75.0% vs 17.0%; P<0.0001). In the arterial phase of dynamic CT, P53-mutated HCC showed poorly enhanced areas (57.1% vs 32.0%; P=0.003) and dilated arteries (35.7% vs 10.2%; P=0.002). In the hepatobiliary phase of gadoxetic acid-enhanced MRI, irregular tumor margin (39.3% vs 18.4%; P=0.05), peritumoral hypointensity (28.6% vs 9.5%; P=0.01), relative enhancement ratio (1.34 vs 1.70; P=0.04), and lower tumor/liver signal intensity ratio (0.46 vs 0.60; P=0.004) were common in P53-mutated HCC. In multivariate regression analysis, low signal intensity ratio in the hepatobiliary phase was an independent predictor of P53-mutated HCC (P=0.008, OR=0.02). Area under the curve of receiver operating characteristic curve was 0.68 and the cut-off value was 0.50. There was a significantly positive correlation between OATP1B3 expression and signal intensity ratio in the hepatobiliary phase (P<0.0001, R=0.41), and an inverse correlation

between OATP1B3 expression and P53 expression (P=0.002, R=-0.23). Overall survival was worse in P53-mutated HCC than in HCC without P53 mutation (P=0.02).

CLINICAL RELEVANCE/APPLICATION

Imaging findings, especially lower signal intensity ratio in the hepatobiliary phase, will help to predict P53-mutated HCC with aggressive features.

SDP-GI-20 Usefulness Of Contrast-enhanced Ultrasound LI-RADS Version 2017: Diagnostic Accuracy And Inter-reader Agreement For Differentiating Hepatocellular Carcinoma From Other Malignancies

Participants
Rushuang Mao, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to explore the diagnostic accuracy of contrast-enhanced ultrasound (CEUS) Liver Imaging Reporting and Data System (LI-RADS) version 2017 for differentiating hepatocellular carcinoma (HCC) from non-HCC malignancies in high-risk patients, and to determine the inter-reader agreement (IRA) between the expert and novice reader for CEUS features and the final categories.*Methods and Materials Patients with chronic hepatitis B virus infection and at least one US-detected liver observation between 2006 and 2019 were enrolled in this retrospective study. Eventually, 517 patients with 517 pathologically proven observations (384 HCC, 78 intrahepatic cholangiocarcinoma, 50 combined hepatocellular cholangiocarcinoma, 5 metastases) evaluated at CEUS were included. A novice reader (R1) and an experienced reader (R2) independently assessed CEUS features and assigned an LI-RADS category for each observation.*Results The LR-5 category yielded a high specificity (R1, 92.48%; R2, 93.98%) and high PPV (R1, 96.48%; R2, 97.18%) for diagnosing HCC. For identifying non-HCC malignancies, the LR-M category had high sensitivity and high NPV for both readers (R1, 92.48%, and 96.63%; R2, 93.98%, and 97.30%). The inter-reader agreement for individual features and the overall LI-RADS algorithm were substantial to almost perfect (enhancement, ?=0.829; onset of washout, ?=0.835; degree of washout, ?=0.857; overall LI-RADS algorithm, ?=0.828).*Conclusions The CEUS LI-RADS had brilliant diagnostic accuracy for distinguishing HCC from non-HCC malignancies, and substantial to almost perfect inter-reader agreement was obtained between the expert and novice radiologists for both individual features and LI-RADS categories.*Clinical Relevance/Application Applying CEUS LI-RADS in clinical practice can effectively distinguish the HCC from non-HCC malignancies, and can help improve the diagnostic performance of novice radiologists.

RESULTS

The LR-5 category yielded a high specificity (R1, 92.48%; R2, 93.98%) and high PPV (R1, 96.48%; R2, 97.18%) for diagnosing HCC. For identifying non-HCC malignancies, the LR-M category had high sensitivity and high NPV for both readers (R1, 92.48%, and 96.63%; R2, 93.98%, and 97.30%). The inter-reader agreement for individual features and the overall LI-RADS algorithm were substantial to almost perfect (enhancement, ?=0.829; onset of washout, ?=0.835; degree of washout, ?=0.857; overall LI-RADS algorithm, ?=0.828).

CLINICAL RELEVANCE/APPLICATION

Applying CEUS LI-RADS in clinical practice can effectively distinguish the HCC from non-HCC malignancies, and can help improve the diagnostic performance of novice radiologists.

SDP-GI-21 A CT-based Radiomics Nomogram For Prediction Of Preoperative Pathological Grading Of Advanced Gastric Cancer

Participants
xiaolei wang I, BS,BS, BengBu, China (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to establish and validate the the radiomics nomogram constructed based on the radiomics signature of enhanced CT images combined with clinical features in the preoperative pathological grading of advanced gastric cancer.*Methods and Materials A retrospective analysis of 260 patients with pathologically confirmed gastric cancer obtained from two centers (176 in the training cohort, 44 in the internal testing cohort, and 40 in the external testing cohort) was performed to outline the region of interests (ROIs) and extract radiomics signature on arterial phase and venous phase CT images, respectively. The least absolute shrinkage and selection operator regression and iterative screening features were applied for feature selection and radiomics signature construction. An external testing cohort was used to verify the stability of arterial model, and finally the arterial phase radiomics signature were combined with clinical independent risk factors to establish the combined model and radiomics nomogram using support vector machine (SVM) and multiple logistic regression, respectively. The utility of the proposed model was evaluated using the ROC, area under ROC curve (AUC), calibration curve, and decision curve analysis (DCA).*Results Arterial model with 8 feature combinations (training cohort: AUC = 0.827; testing cohort: AUC = 0.827), The efficacy was higher than that of the venous model (Training cohort: AUC = 0.803; Testing cohort: AUC = 0.799). External validation demonstrated the stability of the arterial model (Training cohort: AUC = 0.809; Testing cohort: AUC = 0.792), and after single-factor and multi-factor logistic regression screening, the independent clinical correlates were used to contracted a clinical model (Training cohort: AUC = 0.639; Testing cohort: AUC = 0.659). Three independent predictors of radiomics signature, gender and enhancement degree were finally selected to construct the combined model (Training cohort: AUC = 0.869; Testing cohort: AUC = 0.851) and the radiomics nomogram model (Training cohort: AUC = 0.877; Testing cohort: AUC = 0.854) were constructed respectively. The efficacy of the radiomics nomogram was higher than that of the combined model. The calibration curve and DCA demonstrated the clinical usefulness of the radiomics nomogram.*Conclusions The radiomics nomogram model constructed in this study is more effective than other models and can be useful in predicting the preoperative pathological grading of advanced gastric cancer.*Clinical Relevance/Application The application of AI method such as radiomics nomogram constructed based on the radiomics signature of CT images combined can provide higher level.

RESULTS

Arterial model with 8 feature combinations (training cohort: AUC = 0.827; testing cohort: AUC = 0.827), The efficacy was higher than that of the venous model (Training cohort: AUC = 0.803; Testing cohort: AUC = 0.799). External validation demonstrated the stability of the arterial model (Training cohort: AUC = 0.809; Testing cohort: AUC = 0.792), and after single-factor and multi-factor logistic regression screening, the independent clinical correlates were used to contracted a clinical model (Training cohort: AUC = 0.639; Testing cohort: AUC = 0.659). Three independent predictors of radiomics signature, gender and enhancement degree were finally selected to construct the combined model (Training cohort: AUC = 0.869; Testing cohort: AUC = 0.851) and the radiomics

nomogram model (Training cohort: AUC = 0.877; Testing cohort: AUC = 0.854) were constructed respectively. The efficacy of the radiomics nomogram was higher than that of the combined model. The calibration curve and DCA demonstrated the clinical usefulness of the radiomics nomogram.

CLINICAL RELEVANCE/APPLICATION

The application of AI method such as radiomics nomogram constructed based on the radiomics signature of CT images combined can provide higher level.

SDP-GI-22   A Deep Learning Risk Prediction Model Based On Residual CNN For Overall Survival In Patients With Advanced Gastric Cancer

Participants
Wenjuan Zhang, Lanzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Gastric cancer is one of the most common malignant tumors of the digestive tract. Predicting the probability of survival accurately before surgery, stratifying the risk, are the key steps to individualized treatment of gastric cancer. This study aimed to construct and validate a survival risk prediction deep learning (DL) model based on the widely recognized residual convolutional neural network (Residual CNN).*Methods and Materials We retrospectively collected 337 patients from Lanzhou University Second Hospital, which were divided into a training cohort (n=237) and an external validation cohort (n=100). We developed an end-to-end DL model based on the architecture of Residual CNN, and augmented the size of training dataset by image transformations to avoid overfitting. Cox regression for univariable and multivariable analysis were used to develop a clinical model. Meanwhile, a comprehensive prediction model was constructed by combining the DL model and the clinical model, and then, nomogram was constructed. We calculated the Harrell's concordance index (C-index) and hazard ratio (HR) to evaluate the performance of the three models. Calibration curves and decision curve analysis (DCA) was also applied to verify the prognostic value of these prediction models.*Results Totally 5688 CT images were prepared by data augmentation and fed into DL model. The DL model significantly classified patients into high-risk and low-risk groups in training cohort (C-index: 0.70, HR: 2.88, P<0.002) and validation cohort (C-index:0.64, HR: 4.32, P<0.002,). The clinical model was developed with three significant clinical variables (P <0.05). The comparison illustrated the combined model (DL+ Clinical) had the best performance for risk prediction of OS according to the C-index (training: combined model vs DL vs Clinical =0.74 vs 0.72 vs 0.70, validation: 0.67 vs 066 vs 0.64). The DL model also had the highest HR both in training and validation cohort. The calibration curve analysis shows that the predicted 1, 2 and 3 year survival probability based on the integrated prediction model is in good agreement with the actual OS. The DCA also proved that the comprehensive prediction model had the best net benefit than other models for the patients.*Conclusions The DL model constructed based on the Residual CNN in this study is a good survival risk assessment model and has good application value for the early prediction of OS in AGC patients.*Clinical Relevance/Application The new AI technology is expected to effectively supplement the existing prognostic evaluation system and may become a potential tool to guide the personalized treatment of AGC.

RESULTS

Totally 5688 CT images were prepared by data augmentation and fed into DL model. The DL model significantly classified patients into high-risk and low-risk groups in training cohort (C-index: 0.70, HR: 2.88, P<0.002) and validation cohort (C-index:0.64, HR: 4.32, P<0.002,). The clinical model was developed with three significant clinical variables (P <0.05). The comparison illustrated the combined model (DL+ Clinical) had the best performance for risk prediction of OS according to the C-index (training: combined model vs DL vs Clinical =0.74 vs 0.72 vs 0.70, validation: 0.67 vs 066 vs 0.64). The DL model also had the highest HR both in training and validation cohort. The calibration curve analysis shows that the predicted 1, 2 and 3 year survival probability based on the integrated prediction model is in good agreement with the actual OS. The DCA also proved that the comprehensive prediction model had the best net benefit than other models for the patients.

CLINICAL RELEVANCE/APPLICATION

The new AI technology is expected to effectively supplement the existing prognostic evaluation system and may become a potential tool to guide the personalized treatment of AGC.

SDP-GI-23   Comparison Of Volumetric Liver Fat Measurement Method And Conventional Method Of Drawing Of Region Of Interest

Participants
Hyun Ji Lee, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of volumetric liver fat measurement methods (Fvol) compared to conventional multiple region of interest drawing methods (Froi)*Methods and Materials Sixty-seven patients who underwent liver MRI with fat quantification from August to September 2020 were included in this retrospective study. Two experienced radiologists measured proton density fat fraction (PDFF) of the liver twice in the mDIXON-Quant sequence using two methods: Fvol, PDFF was measured volumetrically using dedicated program and Vroi, 3 ROIs were drawn on each segment (total of 24) and the averaged value was calculated. PDFF measurement was performed twice with each method with at least 4 weeks interval to avoid recall bias. Measurement times were recorded for the comparison between the two methods. The intra-class correlation coefficient (ICC) were calculated between the observer and method. Inter-observer variability was also evaluated between the two measurements of the same method. P values less than 0.05 were considered as statistically significant.*Results The measurement times were significantly shorter in Fvol (127±46s and 64±18s for reviewer 1 and 2) compared to Froi (209±55s and 191±31s, P<0.05). ICC for the same methods in each reviewer were excellent (R1: 0.998, 95% confidence interval 0.998-0.999 and R2: 0.999, 0.999-1.000 for Froi; R1: 0.999, 0.999-1.000 and R2: 1.000, 1.000-1.000 for Fvol). ICC between reviewers (0.999, 0.998~0.999 for Froi and 1.000, 0.999~1.000 for Fvol) and between measurement methods (0.998, 0.996-0.999) for reviewer 1 and 0.995, 0.991-0.997 for reviewer 2) were also excellent.*Conclusions The measurement time of PDFF could be significantly reduced using Fvol compared to Froi, while maintaining the consistency of the measurement values.*Clinical Relevance/Application Volumetric measurement method of PDFF can reduce the measurement time with maintaining the consistency of the measured value

RESULTS

The measurement times were significantly shorter in Fvol (127±46s and 64±18s for reviewer 1 and 2) compared to Froi (209±55s and 191±31s, P<0.05). ICC for the same methods in each reviewer were excellent (R1: 0.998, 95% confidence interval 0.998-0.999 and R2: 0.999, 0.999-1.000 for Froi; R1: 0.999, 0.999-1.000 and R2: 1.000, 1.000-1.000 for Fvol). ICC between reviewers (0.999,

0.998~0.999 for Froi and 1.000, 0.999~1.000 for Fvol) and between measurement methods (0.998, 0.996-0.999) for reviewer 1 and 0.995, 0.991-0.997 for reviewer 2) were also excellent.

CLINICAL RELEVANCE/APPLICATION

Volumetric measurement method of PDFF can reduce the measurement time with maintaining the consistency of the measured value

SDP-GI-25   Application Of Iodine Concentration Quantitative Analysis Based On Energy Spectrum CT In Evaluating The Degree Of Differentiation Of Gastric Adenocarcinoma

Participants
Lu Ye, Tianjin, China (*Presenter*) Nothing to Disclose

PURPOSE

To determine the application value of iodine concentration (IC) for the pathological differentiation degree of gastric adenocarcinoma, and to compare their diagnostic efficacy.*Methods and Materials A retrospective analysis of 64 patients' clinical and imaging data with pathologically confirmed gastric adenocarcinoma was conducted by measuring the IC of arterial phase and portal venous phase of contrast-enhanced CT, including 21 patients with moderate/highly differentiated adenocarcinoma, 21 patients with moderately poorly differentiated adenocarcinoma, and 22 patients with poorly differentiated adenocarcinoma. The correlation with gastric adenocarcinoma differentiation were performed, receiver operating characteristic (ROC) curve analysis was further performed to explore their diagnostic efficiency for the values with statistical significance.*Results ICAP values of moderate/highly differentiated, moderately poorly differentiated and poorly differentiated gastric adenocarcinoma were 1.06±0.44 mg/mL, 1.48±0.51 mg/mL, 1.72±0.54 mg/mL, respectively,nICAP values was 0.15±0.05, 0.18±0.05, 0.22±0.09, and ICPP values were 2.81±0.59 mg/mL, 3.17±0.80 mg/mL, 3.64±0.79 mg/mL, respectively. The values of nICPP were 0.43±0.13, 0.55±0.13, 0.65±0.17, among which the nICPP value of poorly differentiation and moderately poorly differentiation group, the ICAP, nICAP, nICPP value of moderate/highly differentiation and moderately poorly differentiation group, the ICAP, nICAP, ICPP and nICPP values of moderate/highly differentiation and poorly differentiation group were statistically significant(p<0.05). Classified moderately poorly and poorly differentiation as poorly differentiation, the values of ICAP, nICAP, ICPP, nICPP were 1.61±0.53 mg/mL, 0.20±0.07, 3.41±0.82 mg/mL, 0.60±0.16 respectively. The AUC was 0.791, 0.749, 0.721, and 0.814 respectively. When the diagnostic threshold was 0.507, nICPP had the highest diagnostic efficiency for poorly differentiated gastric adenocarcinoma, with a sensitivity of 69.8% and a specificity of 81.0%.*Conclusions The quantitative analysis of IC of energy spectrum CT can determine the pathological differentiation degree of advanced gastric adenocarcinoma, and the nICPP value was most effective.*Clinical Relevance/Application IC and nIC of energy spectrum CT in arterial and venous phases have great potential in predicting the differentiation of gastric adenocarcinoma, and can provide a new index for preoperative evaluation.

RESULTS

ICAP values of moderate/highly differentiated, moderately poorly differentiated and poorly differentiated gastric adenocarcinoma were 1.06±0.44 mg/mL, 1.48±0.51 mg/mL, 1.72±0.54 mg/mL, respectively,nICAP values was 0.15±0.05, 0.18±0.05, 0.22±0.09, and ICPP values were 2.81±0.59 mg/mL, 3.17±0.80 mg/mL, 3.64±0.79 mg/mL, respectively. The values of nICPP were 0.43±0.13, 0.55±0.13, 0.65±0.17, among which the nICPP value of poorly differentiation and moderately poorly differentiation group, the ICAP, nICAP, nICPP value of moderate/highly differentiation and moderately poorly differentiation group, the ICAP, nICAP, ICPP and nICPP values of moderate/highly differentiation and poorly differentiation group were statistically significant(p<0.05). Classified moderately poorly and poorly differentiation as poorly differentiation, the values of ICAP, nICAP, ICPP, nICPP were 1.61±0.53 mg/mL, 0.20±0.07, 3.41±0.82 mg/mL, 0.60±0.16 respectively. The AUC was 0.791, 0.749, 0.721, and 0.814 respectively. When the diagnostic threshold was 0.507, nICPP had the highest diagnostic efficiency for poorly differentiated gastric adenocarcinoma, with a sensitivity of 69.8% and a specificity of 81.0%.

CLINICAL RELEVANCE/APPLICATION

IC and nIC of energy spectrum CT in arterial and venous phases have great potential in predicting the differentiation of gastric adenocarcinoma, and can provide a new index for preoperative evaluation.

SDP-GI-26   CT Texture Features In The Prediction Of Overall Survival In Patients With Her2+ Stage IV Gastric Cancer

Participants
Lei Tang, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Non-invasive evaluation of target therapy for gastric cancer remains an urgent clinical need. We intend to determine whether CT texture features (CTTA) could become potential biomarkers for the prognosis in HER2+ stage IV gastric cancer patients treated by trastuzumab.*Methods and Materials 71 HER2+ stage IV gastric cancer patients were retrospectively enrolled into this study. 107 quantitative features, including histogram features, fractal features and high-level texture features, were extracted from each of the regions of interest (ROI) on arterial and venous phases, respectively. After intra-class correlation coe&9;cient (ICC) calculation and consistency test evaluating the reader agreement on feature extraction, Cox proportional hazard analysis and Kaplan-Meier analysis were used to determine the association of texture features and clinicopathological factors with overall survival (OS).*Results The median overall survival was 16.95 months. On multivariate Cox analysis, diffuse or mixed Lauren type (hazard ratio [HR]=8.074, 95 % confidence interval [CI]=3.335-19.574), BMI (HR=1.145, CI=1.027-1.276), CEA level (HR=1.002, CI=1.001-1.003) and two of key texture features, Arterial_GrayLevelDependenceMatrix_DependenceNonUniformityNormalized (A_GLDM_DNUN) (HR=1.953, CI=1.281-2.976) and V_GLDM_DNUN(HR=1.775, CI=1.148-2.744), were independently and significantly potential prognostic factors for overall survival. On Kaplan-Meier survival analysis of CT texture features parameters, A_GLDM_DNUN of more than -0.43 and V_GLDM_DNUN of more than -1.04 show more adverse overall survival (p<0.001 and p=0.002, log-rank test)*Conclusions For HER2+ stage IV gastric cancer patients treated with trastuzumab, the CT-guided radiomics signatures have the potential to be the non-invasive surrogates for the prediction of OS.*Clinical Relevance/Application We intend to expand the sample size and establish an external validation cohort to further explore the potential connection between prognosis and imaging biomarkers, for future applying it in clinical decision-making as soon as possible.

RESULTS

The median overall survival was 16.95 months. On multivariate Cox analysis, diffuse or mixed Lauren type (hazard ratio [HR]=8.074, 95 % confidence interval [CI]=3.335-19.574), BMI (HR=1.145, CI=1.027-1.276), CEA level (HR=1.002, CI=1.001-1.003) and two of key texture features, Arterial_GrayLevelDependenceMatrix_DependenceNonUniformityNormalized (A_GLDM_DNUN) (HR=1.953,

CI=1.281-2.976) and V_GLDM_DNUN(HR=1.775, CI=1.148-2.744), were independently and significantly potential prognostic factors for overall survival. On Kaplan-Meier survival analysis of CT texture features parameters, A_GLDM_DNUN of more than -0.43 and V_GLDM_DNUN of more than -1.04 show more adverse overall survival (p<0.001 and p=0.002, log-rank test)

CLINICAL RELEVANCE/APPLICATION

We intend to expand the sample size and establish an external validation cohort to further explore the potential connection between prognosis and imaging biomarkers, for future applying it in clinical decision-making as soon as possible.

SDP-GI-27 The Effect Of Deep Learning-based CT Image Reconstruction On The Image Quality Of The Biliary System

Participants
Jia Xu, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the effects of a deep learning reconstruction (DLR) method on the clear visibility of biliary system in patients with biliary system disease on abdominal CT images, in comparison with different iterative reconstruction (IR) algorithms (hybrid IR [AIDR3D], forward projected model-based IR [FIRST]) and conventional filtered back projection (FBP).*Methods and Materials This retrospective study included the imaging data of all the 30 consecutive patients who underwent clinically indicated contrast-enhanced abdominal imaging at our hospital between March and April 2021 with bile-duct dilatation caused by different biliary diseases (such as bile ducted stone, cholangitis, bile duct wall thickening). The portal phases were reconstructed using four different algorithms (DLR, FBP, AIDR3D and FIRST) separately. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) of the biliary system, as well as image noise (which was calculated as the SD of the CT values for anterior subcutaneous fat) were compared among the four datasets. In subjective analyses, two radiologists independently ordered images (1, poor; 4, excellent) based on the visual image quality of the biliary system. Numerical data are expressed as means ± standard deviations. Qualitative variables were expressed as mean (minimum; maximum). The Friedman and the Dunn-Bonferroni post-hoc tests were used for comparison.*Results DLR images yielded significant higher CNR (4.4±0.87) than FBP (2.2±1.0), AIDR3D (2.8±0.91) and FIRST (2.5±1.2) images (all P<0.05), higher SNR (1.39±0.85) than FBP (0.86±0.63) and FIRST (1.0±0.61) images (all P<0.05), and showed lower image noise (10.5±3.5) than FBP (24.1±3.9), AIDR3D (15.7±2.4) and FIRST (21.5±19.6) images (all P<0.05). AIDR3D showed significant higher SNR (1.17±0.74), CNR (2.8±0.91) and lower image noise (15.7±2.4) than FBP (0.86±0.63, 2.2±1.0, 24.1±3.9, SNR, CNR and image noise respectively) images (all P<0.05). There were no significant differences in SNR and CNR between FIRST and AIDR3D images (all P>0.05). DLR images obtained higher score (4) than FPB (4), AIDR3D [2.85 (2;3)]and FIRST [2.15 (2;3)] (all P<0.05).*Conclusions DLR images yield significant lower the image noise, higher CNR compared to FBP, AIDR3D and FIRST images. DLR images showed the best visual image quality of the biliary system.*Clinical Relevance/Application DLR method can improve the image quality, resulted in a better observation of the structure of the biliary system.

RESULTS

DLR images yielded significant higher CNR (4.4±0.87) than FBP (2.2±1.0), AIDR3D (2.8±0.91) and FIRST (2.5±1.2) images (all P<0.05), higher SNR (1.39±0.85) than FBP (0.86±0.63) and FIRST (1.0±0.61) images (all P<0.05), and showed lower image noise (10.5±3.5) than FBP (24.1±3.9), AIDR3D (15.7±2.4) and FIRST (21.5±19.6) images (all P<0.05). AIDR3D showed significant higher SNR (1.17±0.74), CNR (2.8±0.91) and lower image noise (15.7±2.4) than FBP (0.86±0.63, 2.2±1.0, 24.1±3.9, SNR, CNR and image noise respectively) images (all P<0.05). There were no significant differences in SNR and CNR between FIRST and AIDR3D images (all P>0.05). DLR images obtained higher score (4) than FPB (4), AIDR3D [2.85 (2;3)]and FIRST [2.15 (2;3)] (all P<0.05).

CLINICAL RELEVANCE/APPLICATION

DLR method can improve the image quality, resulted in a better observation of the structure of the biliary system.

SDP-GI-28 Deep Learning Based Spectral CT Imaging For Quantifying Contrast Medium Enhancement And Washout In Hepatocellular Carcinomas: Comparison Of Iodine Maps And Virtual Monochromatic Images

Participants
Keigo Narita, Hiroshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The typical characteristics of hepatocellular carcinoma (HCC) images include arterial-phase hyperenhancement and washout in the portal venous- and equilibrium phases. Deep learning (DL) based spectral CT imaging (DL-SCTI), a novel rapid kV-switching dual-energy technique, facilitates robust material decomposition analysis because the exact spatial and temporal alignment of high and low kV views yielded by the DL technique results in good energy separation. We compared iodine maps generated from hepatic arterial- and equilibrium phase DL-SCTI scans with virtual monochromatic images at 70 keV to assess their clinical applicability for the quantification of the contrast uptake and washout in HCC.*Methods and Materials Fifty-two patients with 61 hypervascular HCCs which vascularity was confirmed with CT during hepatic arteriography were evaluated with dynamic DL-SCTI scans. Virtual monochromatic images at 70 keV served as the conventional images. Iodine maps were reconstructed using three-material decomposition (fat, healthy liver tissue, iodine). A radiologist measured the image noise represented by the standard deviation of the attenuation measured in the paraspinal muscle and calculated the contrast-to-noise ratio (CNR) using the equation CNR = (ROIT- ROIL)/N, where ROIL is the mean attenuation of the liver parenchyma, ROIT the mean tumor attenuation, and N the noise.*Results In the arterial phase, the CNR for HCCs was significantly higher on iodine maps (3.34) than on 70 keV images (2.39) (p = 0.03). While only one HCC had a negative CNR on iodine maps, 6 had a negative CNR on 70 keV images. In the equilibrium phase, the CNR for HCCs was significantly lower on 70 keV images (-0.71) than on iodine maps (-0.05) (p < 0.01). Fewer HCCs had a negative CNR (washout) on iodine maps than on 70 keV images (32 vs 47).*Conclusions Iodine maps generated from DL-SCTI scans help in the assessment of HCCs for their arterial vascularity but not for washout in the equilibrium phase.*Clinical Relevance/Application Iodine maps generated from DL-SCTI scans were useful for evaluating the arterial hypervascularity of HCCs but not for evaluating washout in the equilibrium phase.

RESULTS

In the arterial phase, the CNR for HCCs was significantly higher on iodine maps (3.34) than on 70 keV images (2.39) (p = 0.03). While only one HCC had a negative CNR on iodine maps, 6 had a negative CNR on 70 keV images. In the equilibrium phase, the CNR for HCCs was significantly lower on 70 keV images (-0.71) than on iodine maps (-0.05) (p < 0.01). Fewer HCCs had a negative CNR

(washout) on iodine maps than on 70 keV images (32 vs 47).

CLINICAL RELEVANCE/APPLICATION

Iodine maps generated from DL-SCTI scans were useful for evaluating the arterial hypervascularity of HCCs but not for evaluating washout in the equilibrium phase.

SDP-GI-29 Evaluation Of Pancreatic Fibrosis: Extracellular Volume Fraction (ECV) Measurements Using Contrast-enhanced CT And Its Relation To Pancreatic Cancer

Participants
Hideyuki Fukui, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Pancreatic cancer is one of the fatal neoplasms, which is challenging to diagnose at an early stage. Recent studies show pancreatic fibrosis plays a pivotal role in pancreatic carcinogenesis. However, the clinically relevant methods have not yet to be derived for pancreatic fibrosis detection. This study aimed to assess the relationship between pancreatic fibrosis measured by extracellular volume fraction (ECV) using contrast-enhanced CT and histological pancreatic fibrosis and investigate the relationship between pancreatic fibrosis and pancreatic cancer presence.*Methods and Materials The study included 96 consecutive patients (54 males and 42 females; median age, 69 years; range, 17-89 years). Among these patients, 53 had pancreatic cancer, 43 had other diseases. Fifty-two cases were evaluated pathologically for pancreatic fibrosis to assess whether CT could be used to detect pancreatic fibrosis. The histological pancreatic fibrosis was quantified by using image analysis software (BZ-X analyzer; Keyence, Osaka, Japan) in nontumorous pancreatic tissue at the resection stump using 2-μm thick Azan-stained slides. A board-certified radiologist measured ECV by generating the largest possible spherical region of interest in the pancreatic parenchyma at an estimated transaction line to match the measurement point on CT with the area of pathological assessment. We investigated the correlation between histological pancreatic fibrosis and ECV and determined the optimal ECV cutoff value for detecting pancreatic cancer. We then investigated whether the ECV value could be used as a biomarker for pancreatic cancer.*Results The histological pancreatic fibrosis, ranged from 4.0% to 78.0% (median, 16.0%; interquartile range, 11.0%-30.8%), were significantly correlated with the ECV, ranged from 22.4% to 57.5% (median, 34.0%; interquartile range, 11.2%- 39.7%) (r=0.689, P<0.01). The pancreatic fibrosis evaluated by ECV was higher in the pancreatic cancer patients than other disease patients (P<0.01). Receiver operating characteristics analysis indicated that the ECV had good diagnostic accuracy for pancreatic cancer diagnosis (cutoff value 36.0; sensitivity 0.81, specificity 0.69). The pancreatic fibrosis evaluated by ECV was identified in the multivariate analysis as an independent risk factor for pancreatic cancer (odds ratio 0.82; P<0.01).*Conclusions Pancreatic fibrosis, which was associated with pancreatic cancer, could be accurately quantified by ECV.*Clinical Relevance/Application ECV can be an imaging predictor for estimating the probability of developing pancreatic cancer.

RESULTS

The histological pancreatic fibrosis, ranged from 4.0% to 78.0% (median, 16.0%; interquartile range, 11.0%-30.8%), were significantly correlated with the ECV, ranged from 22.4% to 57.5% (median, 34.0%; interquartile range, 11.2%- 39.7%) (r=0.689, P<0.01). The pancreatic fibrosis evaluated by ECV was higher in the pancreatic cancer patients than other disease patients (P<0.01). Receiver operating characteristics analysis indicated that the ECV had good diagnostic accuracy for pancreatic cancer diagnosis (cutoff value 36.0; sensitivity 0.81, specificity 0.69). The pancreatic fibrosis evaluated by ECV was identified in the multivariate analysis as an independent risk factor for pancreatic cancer (odds ratio 0.82; P<0.01).

CLINICAL RELEVANCE/APPLICATION

ECV can be an imaging predictor for estimating the probability of developing pancreatic cancer.

SDP-GI-3 Classification Of Malignant Features Of IPMNs: Interobserver Agreement Of CT Diagnosis

Participants
Eisuke Mukaida, MD, Morioka, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the interobserver agreement of malignant predictors and subtypes of intraductal papillary mucinous neoplasm (IPMN) on preoperative CT, and determine whether the radiologist's experience level affects evaluation.*Methods and Materials This retrospective study included patients who were pathologically diagnosed with IPMN postoperatively, from September 2007 to June 2020, and had undergone dynamic contrast-enhanced CT preoperatively. Four radiologists (more experienced, n=2; less experienced, n=2) reviewed the CT images and malignant factors of IPMN presented in the international guidelines, "high risk stigmata: HRS," and "worrisome features: WFs" on a three-point scale. Interobserver agreements were determined for all reviewers and their subgroups, stratified according to experience (more vs. less) using Fleiss and weighted k statistics. We then assigned a score to each malignant prognostic factor (each WF =1 point, each HRS=5 point), calculated the sensitivity and specificity of each reader's results for the pathological diagnosis, and performed a ROC analysis.*Results A total of 61 patients (mean age, 68.5±8.4; 40 males) were evaluated. Overall, interobserver agreements were poor to moderate for HRS and WFs (k for HRS = 0.37-0.68, k for WFs = 0.14-0.59). The k value of "enhancing mural nodule < 5 mm" was low for both more experienced and less experienced reviewers (k=0.21 vs. 0.11, respectively). As opposed to less experienced reviewers, more experienced reviewers demonstrated higher agreement in "thickened/enhancing cyst walls" (k=0.10 vs. 0.51, respectively). In the more experienced reviewers, the highest AUC was obtained with a total score of four (AUC=0.668). In the less experienced reviewers, the highest AUC was obtained with a total score of 3-4 (AUC=0.582).*Conclusions "Thickened/enhancing cyst walls" on dynamic contrast-enhanced CT may be dependent on the years of clinician experience. The "enhancing mural nodule < 5 mm" criteria is less consistently reproducible.*Clinical Relevance/Application IPMNs, one of the most common pancreatic cystic diseases, are easily detected incidentally due to advances in diagnostic imaging. CT is the primary imaging modality for cystic pancreatic lesions in the guideline. There are many predictors of malignancy listed in the guidelines, and the ability to identify malignant predictors will affect the treatment strategy. However, the interobserver agreement for malignant predictors varies among reports. We thought that the reason for this was related to the number of years of experience of the observer, and by clarifying this, we could re-examine the clinical significance of malignant prognostic factors.

RESULTS

A total of 61 patients (mean age, 68.5±8.4; 40 males) were evaluated. Overall, interobserver agreements were poor to moderate for HRS and WFs (k for HRS = 0.37-0.68, k for WFs = 0.14-0.59). The k value of "enhancing mural nodule < 5 mm" was low for both more experienced and less experienced reviewers (k=0.21 vs. 0.11, respectively). As opposed to less experienced reviewers, more

experienced reviewers demonstrated higher agreement in "thickened/enhancing cyst walls" (k=0.10 vs. 0.51, respectively). In the more experienced reviewers, the highest AUC was obtained with a total score of four (AUC=0.668). In the less experienced reviewers, the highest AUC was obtained with a total score of 3-4 (AUC=0.582).

CLINICAL RELEVANCE/APPLICATION

IPMNs, one of the most common pancreatic cystic diseases, are easily detected incidentally due to advances in diagnostic imaging. CT is the primary imaging modality for cystic pancreatic lesions in the guideline. There are many predictors of malignancy listed in the guidelines, and the ability to identify malignant predictors will affect the treatment strategy. However, the interobserver agreement for malignant predictors varies among reports. We thought that the reason for this was related to the number of years of experience of the observer, and by clarifying this, we could re-examine the clinical significance of malignant prognostic factors.

SDP-GI-30   Enhanced CT Radiomics For The Prediction Of Kit Exon 11 Mutations In Gastrointestinal Stromal Tumors

Participants
Xiaofei Yue, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To construct and evaluate radiomics models based on enhanced CT for preoperative prediction of KIT exon 11 mutations in gastrointestinal stromal tumors (GIST).*Methods and Materials 122 patients with GIST (66 patients with KIT exon 11 mutations and 60 patients without KIT exon 11 mutations) who performed preoperative enhanced CT and postoperative pathologically confirmed were involved in this study. GISTs were segmented manually using ITK-SNAP (www.itksnap.org) in the artery phase (AP) and the portal venous phase (PVP) images of enhanced CT. 1218 radiomics features were extracted using Anaconda Prompt (version 4.2.0) importing the feature package of pyradiomics (github.com/Radiomics/pyradiomics). Patients were randomized to training and test sets in a 5:5 ratio. The algorithms of mRMR and LASSO were used to select the feature. Then, Radiomics models were constructed based on AP, PVP, and AP+PVP by LASSO. Statistics were carried out using R 3.6.1 (http://www.Rproject.org). The ROC curve was used to compare the predictive capabilities between three radiomics (AP, PVP, and AP+PVP) and pure clinical models, and the differences between them were compared by using the DeLong test. The DCA curve was used to compare the clinical benefits between four models.*Results All the radiomics signatures (Radscores) showed favorable abilities to predict KIT exon 11 mutations. The area under the curves (AUCs) of the three Radscores (AP, PVP, and AP+PVP) were 1.00, 1.00, and1.00 in training sets, and 0.99, 1.00, and1.00 in test sets, respectively. The clinical features were also analyzed, and the poor predictive performance was found in the training and test cohorts (with the AUCs of 0.87 and 0.63, respectively). The predictabilities among the three Radscores showed no significant differences (P > 0.05), but there were significant differences (P < 0.05) between the clinical model and either of the Radscores. The results of DCA indicated the clinical benefits of Radscores were far better than the clinical results.*Conclusions The Radiomics models based on enhanced CT achieve a good predictive performance to predict KIT exon 11 mutations and are not affected by phases. Compared to two-phases, a single-phase (either AP or PVP could be selected) is recommended for the reasons of the same good predictability and time- and labor-savings.*Clinical Relevance/Application KIT exon 11 mutations in gastrointestinal stromal tumors (GIST) often indicate a poor prognosis. The Radiomics analysis can help clinicians to develop better personalized treatment plans.

RESULTS

All the radiomics signatures (Radscores) showed favorable abilities to predict KIT exon 11 mutations. The area under the curves (AUCs) of the three Radscores (AP, PVP, and AP+PVP) were 1.00, 1.00, and1.00 in training sets, and 0.99, 1.00, and1.00 in test sets, respectively. The clinical features were also analyzed, and the poor predictive performance was found in the training and test cohorts (with the AUCs of 0.87 and 0.63, respectively). The predictabilities among the three Radscores showed no difference (P > 0.05), but there were significant differences (P < 0.05) between the clinical model and either of the Radscores. The results of DCA indicated the clinical benefits of Radscores were far better than the clinical results.

CLINICAL RELEVANCE/APPLICATION

KIT exon 11 mutations in gastrointestinal stromal tumors (GIST) often indicate a poor prognosis. The Radiomics analysis can help clinicians to develop better personalized treatment plans.

SDP-GI-31   Iodine Density Calculation Based On The Double Probe Spectrum Ct Of Ecv Research To The Diagnosis Of Colorectal Cancer Nerve Vascular Infiltration

Participants
Wenxia zheng, Lanzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the feasibility and diagnostic efficacy of the extracellular volume (ECV) in the assessment of neurovascular infiltration in colorectal cancer based on dual detector spectral CT iodine density measurement.*Methods and Materials The basic data of 64 patients diagnosed with colorectal cancer in Gansu Provincial People's Hospital from July 20 to February 21 were collected, including 10 cases of colorectal cancer and 54 cases of colorectal cancer.All patients underwent dual-layerspectral CT (DLCT) enhanced examination. Before examination, hematocrit was collected. Iodine density (IC) in venous phase and delayed phase and IC values in abdominal aorta or iliac vessels of the same plane were measured after scanning, and extracellularvolume (ECV) score was calculated.To analyze the feasibility of ECV in evaluating neurovascular infiltration in colorectal cancer, and to analyze the diagnostic efficacy by ROC curve.*Results There was no significant difference in ECV value between CD31, D2-40 and S100 positive and negative immunohistochemical groups based on spectral CT during venous phase (all P > 0.05).There were significant differences between delayed ECV and immunohistochemical CD31, D240, S100 positive and negative groups (all P < 0.001).Comparison of two stages of ECV between colorectal cancer and normal intestinal wall indicated that ECV of colorectal cancer was significantly increased.*Conclusions ECV score based on delayed iodine density measurement of spectral CT can reflect the neurovascular infiltration in patients with colorectal cancer, which provides a new preoperative evaluation method for clinical practice.*Clinical Relevance/Application Preliminary studies have shown that ECV can reflect the infiltration of nerve vessels in colorectal cancer, and can distinguish cancer tissue from normal intestinal wall.It is hoped that ECV will provide more value in the diagnosis and differential diagnosis of colorectal diseases, lymphatic metastasis and prognosis with the continuous follow-up of studies.

RESULTS

There was no significant difference in ECV value between CD31, D2-40 and S100 positive and negative immunohistochemical groups

based on spectral CT during venous phase (all P > 0.05).There were significant differences between delayed ECV and immunohistochemical CD31, D240, S100 positive and negative groups (all P < 0.001).Comparison of two stages of ECV between colorectal cancer and normal intestinal wall indicated that ECV of colorectal cancer was significantly increased.

CLINICAL RELEVANCE/APPLICATION

Preliminary studies have shown that ECV can reflect the infiltration of nerve vessels in colorectal cancer, and can distinguish cancer tissue from normal intestinal wall.It is hoped that ECV will provide more value in the diagnosis and differential diagnosis of colorectal diseases, lymphatic metastasis and prognosis with the continuous follow-up of studies.

SDP-GI-32 Preoperative CT Imaging Findings Of Arterial Invasion In Patients With Pancreatic Ductal Adenocarcinoma: What Is The Best Diagnostic Finding?

Participants
Yoshihumi Noda, MD,PhD, Gifu, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the diagnostic performance of preoperative computed tomographic (CT) imaging findings for diagnosing arterial invasion in pancreatic ductal adenocarcinoma (PDAC) and to determine the best imaging criterion.*Methods and Materials This retrospective study was composed of patients with PDAC who underwent preoperative contrast-enhanced CT from January 2008 to July 2020. Five board-certified radiologists (7-13 years of experience [more experienced]) and four fellows (3-5 years of experience [less experienced]) independently assessed arterial invasions for celiac, superior mesenteric, splenic, and common hepatic arteries using a 6-point score: 1, no tumor contact; 2, hazy attenuation =180°; 3, hazy attenuation >180°; 4, soft-tissue contact =180°; 5, soft-tissue contact >180°; and 6, contour irregularity. Receiver-operating-characteristic (ROC) analysis was conducted to evaluate the diagnostic performances of each score and to determine the best criterion for diagnosing arterial invasion which was confirmed by pathological or intraoperative findings. Interobserver agreements between more and less experienced reviewers were determined by Fleiss ? statistics.*Results In 128 patients (71 ± 9 years, 73 men) who were evaluated, 45 had been received neoadjuvant treatment. For both patients treated with and without neoadjuvant treatment, soft-tissue contact =180° demonstrated the highest diagnostic performance for arterial invasion (sensitivity, 100% and 100%; specificity, 90% and 93%; and area under the ROC curve, 0.96 and 0.98 in patients treated with and without neoadjuvant treatment, respectively). Interobserver agreements in less experienced reviewers were not inferior to more experienced reviewers (? = 0.61 vs 0.61; P = .39 and ? = 0.59 vs 0.51; P < .001 in patients treated with and without neoadjuvant treatment, respectively).*Conclusions Presence of soft-tissue contact =180° demonstrated the highest performance for diagnosing arterial invasion in pancreatic ductal adenocarcinoma.*Clinical Relevance/Application We revealed the best imaging criterion of soft-tissue contact =180° for diagnosing arterial invasion in pancreatic ductal adenocarcinoma. This imaging finding is useful to determine the candidate for surgical resection.

RESULTS

In 128 patients (71 ± 9 years, 73 men) who were evaluated, 45 had been received neoadjuvant treatment. For both patients treated with and without neoadjuvant treatment, soft-tissue contact =180° demonstrated the highest diagnostic performance for arterial invasion (sensitivity, 100% and 100%; specificity, 90% and 93%; and area under the ROC curve, 0.96 and 0.98 in patients treated with and without neoadjuvant treatment, respectively). Interobserver agreements in less experienced reviewers were not inferior to more experienced reviewers (? = 0.61 vs 0.61; P = .39 and ? = 0.59 vs 0.51; P < .001 in patients treated with and without neoadjuvant treatment, respectively).

CLINICAL RELEVANCE/APPLICATION

We revealed the best imaging criterion of soft-tissue contact =180° for diagnosing arterial invasion in pancreatic ductal adenocarcinoma. This imaging finding is useful to determine the candidate for surgical resection.

SDP-GI-34 The Contrast-enhanced Portal Vein-to-liver Ratio: A New, Simple, And Accurate Parameter For Diagnosis Of Fatty Liver On Contrast-enhanced Computed Tomography.

Participants
Hadeer Al-Ali, MBBS, Doha, Qatar (*Presenter*) Nothing to Disclose

PURPOSE

To assess the value of contrast-enhanced portal vein-to-liver ratio as a new, simple, and accurate parameter for diagnosis of fatty liver on contrast-enhanced computed tomography.*Methods and Materials Three hundred ninety-one consecutive unenhanced and portal-phase contrast enhanced CT from the daily work have been included in the study after exclusion of patients with focal liver lesions, cirrhosis, heart failure, and diseases of the bile ducts, pancreas, and spleen and patients with poor technical quality examination and poorly timed portal-phase contrast enhanced CT. Attenuation value of the liver parenchyma, portal vein, aorta, and spleen were measured by manually placed region-of-interest on the unenhanced and contrast-enhanced CT. On the contrast-enhanced CT, two parameters were calculated: the portal vein/liver (P/L) ratio and the blood-subtracted liver attenuation, defined as [L - 0.3 x (0.75 x P + 0.25 x A)]/0.7, where L, P and A represent the attenuation of the liver, main portal vein and abdominal aorta, respectively. Area under the Receiver-Operator Characteristic Curve (AUCROC) was calculated for the two parameters at different cut-off values.*Results In comparison to the gold standard of an attenuation value ratio between the liver and the spleen of 0.8 or less on the unenhanced CT for the diagnosis of fatty liver. P/L ratio was found to have specificity, sensitivity, and accuracy of 96%, 69%, and 92% respectively at a cut-off value of 2, while the blood-subtracted attenuation of the liver had corresponding values of 96%, 73%, and 93% at the cut-off value of 55. AUC-ROC has been 0.93 for P/L ratio and 0.92 for the blood-subtracted attenuation parameter.*Conclusions A portal vein-to-liver ratio of 2 or more is accurate for the diagnosis of fatty liver on contrast-enhanced CT. This newly described parameter is easier to use compared to the previously described blood-subtracted attenuation which is also accurate but needs more sophisticated calculations.*Clinical Relevance/Application On direct contrast-enhanced CT of the liver not preceded by an unenhanced CT, diagnosis of fatty liver can still be made if the attenuation value of the portal vein is double (or more than double) that of the liver. This can be done during the reporting session without the need of sophisticated calculations.

RESULTS

In comparison to the gold standard of an attenuation value ratio between the liver and the spleen of 0.8 or less on the unenhanced CT for the diagnosis of fatty liver. P/L ratio was found to have specificity, sensitivity, and accuracy of 96%, 69%, and 92% respectively at a cut-off value of 2, while the blood-subtracted attenuation of the liver had corresponding values of 96%, 73%, and 93% at the cut-off value of 55. AUC-ROC has been 0.93 for P/L ratio and 0.92 for the blood-subtracted attenuation parameter.

CLINICAL RELEVANCE/APPLICATION

On direct contrast-enhanced CT of the liver not preceded by an unenhanced CT, diagnosis of fatty liver can still be made if the attenuation value of the portal vein is double (or more than double) that of the liver. This can be done during the reporting session without the need of sophisticated calculations.

SDP-GI-35   Conventional And Volumetric Response Assessment In Chemotherapy For Patients With Pancreatic Adenocarcinoma

Participants
Azarakhsh Baghdadi, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

RECIST 1.1 and WHO are the most commonly used response assessment criteria for systemic therapies in PDAC, however response to treatment may not be fully reflected through conventional response assessment criteria. We aimed to compare the performance of RECIST, WHO, total and viable tumor volume for evaluation of response to systemic chemotherapy in patients with PDAC.*Methods and Materials This retrospective study was HIPAA compliant and approved by the IRB, waiver of consent was granted. We conducted a retrospective review of patients receiving systemic chemotherapy for PDAC at the Johns Hopkins Hospital from 2017-2021. Patients were included if they had received systemic chemotherapy as standard of care and at least 6 months of follow-up, with corresponding contrast enhanced CT at baseline and at the end of treatment. Manual contouring of tumor volume was performed. Thresholds for tumor viability on venous CT scans were identified based on pathologic correlation. The above-mentioned threshold was used to derive viable tumor volume from total tumor volume which was reported as percentage of total tumor volume. Percent change in total and viable tumor volume for all patients was calculated. Reduction of 66% in viability and 50% in total tumor volume were deemed as response to treatment. Anatomic (RECIST, and WHO) and functional (total and viable tumor volume) imaging parameters were evaluated at baseline and at the end of treatment.*Results Twenty-seven patients with the mean age of 67 years old, fulfilled our inclusion criteria and were included in our imaging assessment. Mean change in the sum of bidimensional measurements based on WHO criteria was 28%. Fifteen patients went into surgery. Overall mean change in RECIST was 15.5%. On imaging assessment of post-treatment scans, viable volume assessment yielded higher response rates (42%), than RECIST (25%) and WHO(25%).*Conclusions Viable tumor volume identifies more responders with chemotherapy in PDAC than conventional imaging modalities. Further prospective studies are needed to validate viable tumor volume as a predictor of response in chemotherapy for PDAC.*Clinical Relevance/Application Our data is useful to lay the groundwork for future larger prospective studies to assess response in patients with PDAC.

RESULTS

Twenty-seven patients with the mean age of 67 years old, fulfilled our inclusion criteria and were included in our imaging assessment. Mean change in the sum of bidimensional measurements based on WHO criteria was 28%. Fifteen patients went into surgery. Overall mean change in RECIST was 15.5%. On imaging assessment of post-treatment scans, viable volume assessment yielded higher response rates (42%), than RECIST (25%) and WHO(25%).

CLINICAL RELEVANCE/APPLICATION

Our data is useful to lay the groundwork for future larger prospective studies to assess response in patients with PDAC.

SDP-GI-36   Impact Of COVID-19 Pandemic On Liver Multidisciplinary Cancer Clinic In A Tertiary Referral Center

Participants
Azarakhsh Baghdadi, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

In 2020, the COVID-19 pandemic upended the delivery of medical care across all specialties, but the impact of the COVID-19 pandemic on the delivery of cancer care has not been comprehensively assessed. We performed a retrospective review of patient care in the Johns Hopkins Multidisciplinary Liver Cancer Clinic (MDLC) in 2020, as compared to 2019, to determine how the pandemic influenced the presentation and management of multidisciplinary liver cancer care for biliary tract cancers (BTC) or hepatocellular carcinoma (HCC).*Methods and Materials A retrospective review was conducted using data from JHH between January 2019 and December 2020. The inclusion criteria for the study were as follows: (1) new patients who were evaluated at the MDLC, (2) HCC diagnosed by radiographic or histologic confirmation or BTC (CCA, gallbladder cancer) by histologic confirmation, and (3) age = 18 years. The study protocol was approved by the Johns Hopkins Institutional Review Boards (IRB00231803).*Results Patient consultations took place exclusively over telemedicine for 17 weeks beginning on 3/25/2020 and a mix of in person and telemedicine for most of the remaining year. A total of 188 patients were evaluated in MDLC in 2019 and 189 patients were evaluated in MDLC in 2020. As compared to 2019 when patient consultations took place in person, there was no significant change in the median number of specialties that patients met with during in MDLC (median of 2 specialties in 2019, 2 specialties in 2020). The percentage of BTC patients presenting with disease that was determined in MDLC to be resectable decreased from 8% in 2019 to 4% in 2020. The percentage of HCC patients presenting with resectable disease decreased from 4.8% in 2019 to 1% in 2020.*Conclusions Coordinated expert multidisciplinary care was feasible during the COVID19 pandemic, but a significantly lower number of patients presenting to MDLC had resectable disease potentially reflecting delays in cancer diagnosis.*Clinical Relevance/Application The implications of these changes on the clinical outcomes of patients with primary liver cancers warrants further investigation.

RESULTS

Patient consultations took place exclusively over telemedicine for 17 weeks beginning on 3/25/2020 and a mix of in person and telemedicine for most of the remaining year. A total of 188 patients were evaluated in MDLC in 2019 and 189 patients were evaluated in MDLC in 2020. As compared to 2019 when patient consultations took place in person, there was no significant change in the median number of specialties that patients met with during in MDLC (median of 2 specialties in 2019, 2 specialties in 2020). The percentage of BTC patients presenting with disease that was determined in MDLC to be resectable decreased from 8% in 2019 to 4% in 2020. The percentage of HCC patients presenting with resectable disease decreased from 4.8% in 2019 to 1% in 2020.

CLINICAL RELEVANCE/APPLICATION

The implications of these changes on the clinical outcomes of patients with primary liver cancers warrants further investigation.

SDP-GI-37   Baseline Imaging Features Associated With Progression In Patients With Hepatocellular Carcinoma Listed For Liver Transplantion

Participants
Azarakhsh Baghdadi, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to assess baseline imaging features that are associated with waitlist dropout due to progression of disease in patients with hepatocellular carcinoma (HCC) who are listed for liver transplantation.*Methods and Materials This retrospective study was HIPAA compliant and approved by the IRB. 102 patients who were listed for liver transplant with HCC between 2013-2018 were reviewed. Patients with HCC with adequate baseline MRI, who were able to receive liver transplantation or those who were delisted due to HCC progression beyond transplant criteria were included in the study (n=91). HCC treatment history, transplant listing date, waitlist dropout or transplantation dates were retrieved from electronic medical records. All baseline scans were independently reviewed and analyzed by a radiologist. Tumor margin (well- vs ill-defined), presence of capsule bulging, lesion size and number of lesions were included in the analysis. Volumetric analysis was performed using MR Multiparametric Tool (Siemens Healthineers) software. Logistic regression and ROC analyses were used to predict disease progression and to investigate the difference in waitlist time between categories. P<0.05 was considered significant.*Results 87 patients met our inclusion criteria and were included in the analysis. In univariate analysis, following variables were significantly associated with disease progression; number of lesions, diameter of the dominant lesion, sum of diameters of all lesions, lesion bulging outside of liver capsule, tumor volume at baseline and AFP level. The final logistic model was developed based on the clusters of patients who were either within or outside Milan criteria. In multivariable analysis, having >1 HCC lesion (OR=2.34, p=0.005), tumor bulging outside of liver capsule (OR=1.20, p = 0.038), ill-defined margin (OR=4.86, p = <0.001) and larger tumor diameter (OR=3.24 per 1 cm, p<0.001) were independent predictors of disease progression while on transplant waitlist. This model had a predictive performance of 83%.*Conclusions In HCC patients who were listed for liver transplant, baseline imaging parameters that are predictors of waitlist dropout are as follows, >1 HCC lesion, ill-defined tumor margin, tumor causing liver capsule bulging, and lesion diameter =3.24 cm. These imaging features correlated with earlier progression of disease. Volumetric evaluations show a positive trend and may also be prognostic in larger studies.*Clinical Relevance/Application Imaging findings such as tumor margin and bulging of liver capsule can augment current liver transplant criteria such as Milan and improve their performance.

RESULTS

87 patients met our inclusion criteria and were included in the analysis. In univariate analysis, following variables were significantly associated with disease progression; number of lesions, diameter of the dominant lesion, sum of diameters of all lesions, lesion bulging outside of liver capsule, tumor volume at baseline and AFP level. The final logistic model was developed based on the clusters of patients who were either within or outside Milan criteria. In multivariable analysis, having >1 HCC lesion (OR=2.34, p=0.005), tumor bulging outside of liver capsule (OR=1.20, p = 0.038), ill-defined margin (OR=4.86, p = <0.001) and larger tumor diameter (OR=3.24 per 1 cm, p<0.001) were independent predictors of disease progression while on transplant waitlist. This model had a predictive performance of 83%.

CLINICAL RELEVANCE/APPLICATION

Imaging findings such as tumor margin and bulging of liver capsule can augment current liver transplant criteria such as Milan and improve their performance.

SDP-GI-38   **Motion Compensation Method For Non-periodic In-plane And Out-of-plane Motion In 2d Contrast-enhanced Ultrasound Of Focal Liver Lesions**

Participants
Thodsawit Tiyarattanachai, Bangkok, Thailand (*Presenter*) Nothing to Disclose

PURPOSE

While the use of contrast-enhanced ultrasound (CEUS) in hepatic applications is increasing, quantification of perfusion remains a challenge due to motion artifacts during the dynamic contrast enhanced cine. Thus, development of advanced motion compensation (MC) algorithms is necessary to advance quantification of perfusion parameters in the clinic. Motion can result from periodic respiration, or from non-periodic movements, such as probe movement, large diaphragm movement after long breath holding, patient movement and talking. Previous reports have described MC methods for periodic motion. In this study, we proposed a novel MC method that works for both periodic and non-periodic motion in 2D CEUS of focal liver lesions.*Methods and Materials We developed a MC algorithm based on iterative local search. The algorithm receives as input a user-defined reference region of interest (ROI) on the lesion in B-mode window in only 1 frame. The algorithm then tracks the lesion on B-mode and translates the corresponding coordinates to the contrast-enhanced window. The in-plane tracking works by iteratively searching for the area with maximum normalized correlation coefficient with the reference ROI. The search is confined within a local region, which updates based on prior information from previously tracked frames. Finally, frames with out-of-plane motion are eliminated by applying a correlation threshold, which is automatically determined during the iterative tracking process. We applied the MC algorithm on 20 CEUS videos of focal liver lesions, collected at Stanford University. Performance of the algorithm was evaluated by fitting time-intensity curve (TIC) using the lognormal model. The root mean square error (RMSE) and coefficient of determination (R2) of pre-MC and post-MC TICs were compared.*Results The MC algorithm significantly improved TICs. Median RMSE significantly decreased from 0.031 to 0.025 (p=0.037). Median R2 significantly increased from 0.83 to 0.93 (p=0.037). Overall, we found that the MC algorithm worked well on lesions with various characteristics, and on cases with either periodic or non-periodic motion.*Conclusions The MC algorithm can compensate for both periodic and non-periodic, in-plane and out-of-plane motion, ultimately improving quality of perfusion analysis of focal liver lesions by CEUS.*Clinical Relevance/Application Motion during acquisition of CEUS negatively impacts quality of perfusion analysis of focal liver lesions. Our novel MC algorithm can compensate for both periodic and non-periodic motion in CEUS cine.

RESULTS

The MC algorithm significantly improved TICs. Median RMSE significantly decreased from 0.031 to 0.025 (p=0.037). Median R2 significantly increased from 0.83 to 0.93 (p=0.037). Overall, we found that the MC algorithm worked well on lesions with various characteristics, and on cases with either periodic or non-periodic motion.

CLINICAL RELEVANCE/APPLICATION

Motion during acquisition of CEUS negatively impacts quality of perfusion analysis of focal liver lesions. Our novel MC algorithm can compensate for both periodic and non-periodic motion in CEUS cine.

SDP-GI-39   **Ultrasound Liver Imaging Reporting And Data System (US LI-RADS) Visualization Score: Stability Of**

Visualization Score Over Time

Participants
Thodsawit Tiyarattanachai, Bangkok, Thailand (*Presenter*) Nothing to Disclose

PURPOSE

The Ultrasound Liver Imaging Reporting and Data System (US LI-RADS) Visualization Score conveys the expected level of sensitivity of the screening/surveillance examination in patients at risk for hepatocellular carcinoma (HCC). The Visualization Score depends on patient's liver condition, body habitus and radiologist's interpretation. We sought to determine how often the Visualization Score changes during repeated evaluation.*Methods and Materials 6998 consecutive ultrasound HCC screening and surveillance studies in 3115 patients from 2017 to 2020 were retrospectively reviewed. Of these, 6154 (87.9%) studies were Visualization A (No or minimal limitations), 709 (10.1%) were Visualization B (Moderate limitations), and 135 (1.9%) were Visualization C (Severe limitations). Conditional probabilities of Visualization Score transition, given preceding examination(s), were calculated, along with 95% confidence intervals (CI).*Results The median time interval between examinations in patients with Visualization A, B and C were 191 (interquartile range, IQR 69), 199 (IQR 131.5) and 203 (IQR 111) days, respectively. Visualization A remained stable with high probability of 0.95 (1349/1426, CI 0.93-0.96) and 0.96 (865/898, CI 0.95-0.98) after 1 and 2 consecutive Visualization A's, respectively.For Visualization B, the probability of remaining stable increased from 0.51 (122/240, CI 0.45-0.57) after 1 examination, to 0.61 (37/61, CI 0.48-0.73) after 2 consecutive Visualization B examinations. The probabilities of transition from Visualization B to A were 0.45 (108/240, CI 0.39-0.51) and 0.34 (21/61, CI 0.23-0.46); B to C were 0.04 (10/240, CI 0.02-0.07) and 0.05 (3/61, CI 0-0.10) after 1 and 2 consecutive Visualization B's, respectively.For Visualization C, the probability of remaining stable increased from 0.49 (17/35, CI 0.32-0.65) after 1 examination, to 0.67 (6/9, CI 0.36-0.98) after 2 consecutive Visualization C examinations. The probabilities of transition from Visualization C to A were 0.17 (6/35, CI 0.05-0.30) and 0 (0/9, CI 0-0.34); C to B were 0.34 (12/35, CI 0.19-0.50) and 0.33 (3/9, CI 0.03-0.64) after 1 and 2 consecutive Visualization C's, respectively.*Conclusions Patients with Visualization B or C may benefit from repeated evaluation as Visualization Scores may change in approximately 50% of patients on subsequent examination(s). After 2 consecutive B or C Visualization Scores, change is less likely and at that point the decision for alternative imaging may be made on a case-by-case basis.*Clinical Relevance/Application Our findings of Visualization Score dynamics helps support rationale in choosing an appropriate imaging modality for HCC screening and surveillance in each patient.

RESULTS

The median time interval between examinations in patients with Visualization A, B and C were 191 (interquartile range, IQR 69), 199 (IQR 131.5) and 203 (IQR 111) days, respectively. Visualization A remained stable with high probability of 0.95 (1349/1426, CI 0.93-0.96) and 0.96 (865/898, CI 0.95-0.98) after 1 and 2 consecutive Visualization A's, respectively.For Visualization B, the probability of remaining stable increased from 0.51 (122/240, CI 0.45-0.57) after 1 examination, to 0.61 (37/61, CI 0.48-0.73) after 2 consecutive Visualization B examinations. The probabilities of transition from Visualization B to A were 0.45 (108/240, CI 0.39-0.51) and 0.34 (21/61, CI 0.23-0.46); B to C were 0.04 (10/240, CI 0.02-0.07) and 0.05 (3/61, CI 0-0.10) after 1 and 2 consecutive Visualization B's, respectively.For Visualization C, the probability of remaining stable increased from 0.49 (17/35, CI 0.32-0.65) after 1 examination, to 0.67 (6/9, CI 0.36-0.98) after 2 consecutive Visualization C examinations. The probabilities of transition from Visualization C to A were 0.17 (6/35, CI 0.05-0.30) and 0 (0/9, CI 0-0.34); C to B were 0.34 (12/35, CI 0.19-0.50) and 0.33 (3/9, CI 0.03-0.64) after 1 and 2 consecutive Visualization C's, respectively.

CLINICAL RELEVANCE/APPLICATION

Our findings of Visualization Score dynamics helps support rationale in choosing an appropriate imaging modality for HCC screening and surveillance in each patient.

SDP-GI-40 **Pancreatic MRI For Surveillance Of Cystic Neoplasms: Comparison Of The Diagnostic Value Of Breath Hold Versus Respiratory-gated T2-weighted Coronal Sequences**

Participants
Tom Gibson, MBBCHIR, Romsey, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

A limited pancreatic cyst surveillance protocol has been advocated using respiratory-gated (RG) T2-weighted axial and coronal imaging. The objective was to assess whether breath hold (BH) coronal T2-weighted imaging instead of RG could be used to further reduce scanning time.*Methods and Materials This retrospective study included 55 consecutive patients with working-diagnosis of PCN and available MRI/MRCP. 10 patients were excluded due to absence of the necessary sequences (5), recent lesion resection/resolution (3), or extensive pancreatic cystic disease precluding reliable re-evaluation (2). The images were anonymised. Two radiologists independently evaluated axial HASTE, BH, and RG T2-weighted sequences for each patient at spaced intervals and with randomisation. The baseline PCN surveillance protocol included: unenhanced T1-weighted imaging, axial T2 HASTE, RG PACE, and BH and RG T2 coronal [total acquisition time (AT)?~?10 min]. For RG vs BH T2-weighted coronal sequences specifically, AT ~ 3 min 20 s vs 1 min 4 s, respectively. Intra- and inter-observer reliability were determined. Mean values of largest cyst/main pancreatic duct diameter (DC/DMPD) were compared. The presence/absence of pancreatic parenchymal or extra-pancreatic abnormalities was also assessed.*Results Both intra- and inter-observer reliability were high (intraclass correlation coefficient (ICC) = 0.97-0.99 and ICC = 0.96, respectively). For DC and DMPD, mean values with BH/RG were 19.76/20.0 mm and 3.62/3.54 mm, while mean differences BH-RG were 0.2 mm (p?=?0.75) and 0.08 mm (p?=?0.14), respectively. Additional pancreatic parenchymal or extra-pancreatic findings in 10/45 (22.2%) patients were all visible on both RG and BH sequences.*Conclusions For PCN surveillance, a non-gated breath hold coronal T2-weighted sequence demonstrates no statistically significant difference to a respiratory-gated version in the measurement of cystic and MPD dimensions and in the identification of additional local and distant abnormalities, with the advantage of being more time efficient.*Clinical Relevance/Application MRI surveillance of pancreatic cystic lesions is increasingly utilised due to incidental diagnosis. Cumulatively, this becomes burdensome in time and cost. Refining scan acquisition time (and hence cost) whilst maintaining diagnostic capability is therefore key.

RESULTS

Both intra- and inter-observer reliability were high (intraclass correlation coefficient (ICC) = 0.97-0.99 and ICC = 0.96, respectively). For DC and DMPD, mean values with BH/RG were 19.76/20.0 mm and 3.62/3.54 mm, while mean differences BH-RG were 0.2 mm (p?=?0.75) and 0.08 mm (p?=?0.14), respectively. Additional pancreatic parenchymal or extra-pancreatic findings in 10/45 (22.2%) patients were all visible on both RG and BH sequences.

CLINICAL RELEVANCE/APPLICATION

MRI surveillance of pancreatic cystic lesions is increasingly utilised due to incidental diagnosis. Cumulatively, this becomes

burdensome in time and cost. Refining scan acquisition time (and hence cost) whilst maintaining diagnostic capability is therefore key.

SDP-GI-41   Discrepancies Of On-call Radiology Residents' Interpretations In Abdominal Imaging: Risk Factor Evaluation

Participants
Su Jeong Yang, MD, Incheon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To report discrepancy for examinations interpreted by on-call residents, and to investigate risk factors for discrepancies and characteristics of major finding discrepancies in abdominal radiology*Methods and Materials A total of 1132 consecutive patients for examinations interpreted by on-call residents from February 2016 to September 2019 in abdominal radiology. The images were initially interpreted by on-call residents, compared with final interpretations including abdominal radiologists and clinical data. Interpreted data were analyzed regarding specific organs, examination types, resident grade, discrepancy rates, and major discrepancies. Multiple logistic regression analysis was used to evaluate specific features for risk factors of discrepancy interpretations by on-call residents.*Results Of 1132, bowel (564, 49.8%) was the most common organ interpreted by on-call residents, and followed by gallbladder/bile duct/pancreas (139, 12.3%) and liver (118, 10.4%). Sixty-four (5.6%) showed discrepancies and 26 (2.3%) major finding discrepancies consisted of 14 active bleeding, 6 bowel obstruction, 4 rupture of organ, and 2 etc. Resident grade 2 (odd ratio [OR]; 2.23, 95% confidence interval [CI]: 1.34-3.72, P =.002) and bowel obstruction (OR; 2.89, 95% CI: 1.17-7.13, P =.02) revealed significant risk factors for discrepancy on-call interpretations.*Conclusions The overall discrepancy rate between interpretations by on-call residents and final decisions showed low in abdominal radiology. However, residents should be aware of the relatively high rate of missed bowel obstruction and one of the most on-call interpretations was bowel section.*Clinical Relevance/Application We suggest that abdominal radiology staff inform residents about the relatively high rate of missed bowel obstructions and instruct them to interpret carefully bowel obstruction cases. Before starting night duty, additional education for residents must be needed about the higher rate of previous missing cases among the major discrepancies in abdominal radiology.

RESULTS

Of 1132, bowel (564, 49.8%) was the most common organ interpreted by on-call residents, and followed by gallbladder/bile duct/pancreas (139, 12.3%) and liver (118, 10.4%). Sixty-four (5.6%) showed discrepancies and 26 (2.3%) major finding discrepancies consisted of 14 active bleeding, 6 bowel obstruction, 4 rupture of organ, and 2 etc. Resident grade 2 (odd ratio [OR]; 2.23, 95% confidence interval [CI]: 1.34-3.72, P =.002) and bowel obstruction (OR; 2.89, 95% CI: 1.17-7.13, P =.02) revealed significant risk factors for discrepancy on-call interpretations.

CLINICAL RELEVANCE/APPLICATION

We suggest that abdominal radiology staff inform residents about the relatively high rate of missed bowel obstructions and instruct them to interpret carefully bowel obstruction cases. Before starting night duty, additional education for residents must be needed about the higher rate of previous missing cases among the major discrepancies in abdominal radiology.

SDP-GI-42   Using Machine Learning Methods To Detect Imaging Features In Crohn's Disease

Participants
Ashish Wasnik, MD, Ann Arbor, Michigan (*Presenter*) Royalties, Reed Elsevier;Research Grant, Sequana Medical NV;Royalties, Applied Morphomics Inc;Patent agreement, Applied Morphomics Inc

PURPOSE

Explore machine learning methods for detecting and localizing qualitative CT imaging features of Crohn's disease (CD)*Methods and Materials In this retrospective, IRB approved study, CD patients with CT enterography between 2014-2018 identified. Inclusion criteria: at least 5 cm of terminal ileal disease, Age > 18 years. Exclusion criteria: only colonic disease, penetrating disease, or ileostomy. Two body radiologists localized CD features on CT using a customized electronic interface: mural hyperenhancement, bowel wall thickening, mural stratification, stenosis, and mesenteric fat stranding. Two models were generated to predict presence and location of CD findings (1) random forest (RF) model using automatically extracted radiologist-defined features, 2) unassisted convolution neural network (CNN) using self-generated source CTE features. Model area under the curve (AUC), accuracy, sensitivity, and specificity used to describe model performance. Agreement between radiologists and between models and adjudicated radiologist ground truth was assessed using Cohen's kappa statistic.*Results 165 patients included. Median length of segmented bowel was 25.9 cm with 5,979 points evaluated for each of the 5 qualitative features rendering 29,895 individual annotations. Agreement between radiologists on presence and localization of findings was very good (k=0.72, 95% CI 0.70-0.74). Reviewer agreement on individual qualitative CD findings: very good for degree of mural enhancement (k=0.73) and presence of bowel wall thickening (k=0.71), good for stricture localization (k=0.66) and mural stratification (k=0.67), and poor for mesenteric fat stranding (k=0.47). RF model performance was excellent with an average AUROC of 0.905 across all qualitative findings, with an accuracy, sensitivity, and specificity of 84.2%, 0.81 and 0.85, respectively. Agreement between RF prediction and localization of findings with radiologists nearly matched the agreement between paired radiologists (Table 1). CNN model performed equally well with an average AUROC, accuracy, sensitivity, and specificity across all qualitative findings of 0.906, 0.83%, 0.79, and 0.85, respectively. Time spent on image analysis: Radiologist (25-30 min) versus machine learning models (near instantaneous).*Conclusions ML methods can detect and localize qualitative findings of CD with performance similar to experienced radiologist and the potential to improve reproducibility, objectivity and efficiency.*Clinical Relevance/Application ML approaches to image analysis in CD have the ability to standardize and reproduce reporting for traditional imaging feature, with capability to extract quantifiable features that can potentially impact clinical decision making.

RESULTS

165 patients included. Median length of segmented bowel was 25.9 cm with 5,979 points evaluated for each of the 5 qualitative features rendering 29,895 individual annotations. Agreement between radiologists on presence and localization of findings was very good (k=0.72, 95% CI 0.70-0.74). Reviewer agreement on individual qualitative CD findings: very good for degree of mural enhancement (k=0.73) and presence of bowel wall thickening (k=0.71), good for stricture localization (k=0.66) and mural stratification (k=0.67), and poor for mesenteric fat stranding (k=0.47). RF model performance was excellent with an average AUROC of 0.905 across all qualitative findings, with an accuracy, sensitivity, and specificity of 84.2%, 0.81 and 0.85, respectively. Agreement between RF prediction and localization of findings with radiologists nearly matched the agreement between paired radiologists (Table 1). CNN model performed equally well with an average AUROC, accuracy, sensitivity, and specificity across all

qualitative findings of 0.906, 0.83%, 0.79, and 0.85, respectively. Time spent on image analysis: Radiologist (25-30 min) versus machine learning models (near instantaneous).

CLINICAL RELEVANCE/APPLICATION

ML approaches to image analysis in CD have the ability to standardize and reproduce reporting for traditional imaging feature, with capability to extract quantifiable features that can potentially impact clinical decision making.

SDP-GI-43   Multiparametric Magnetic Resonance Imaging Improves The Prognostic Outcomes In Patients With Intrahepatic Cholangiocarcinoma After Curative-intent Resection

Participants
Qian Li, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To characterise patients with intrahepatic cholangiocarcinoma (ICC) into different clinical phenotypes using multiomics-based clustering analysis, and to further identify the clinical phenotypes associated with the prognostic outcomes.*Methods and Materials A retrospective study comprised of 256 patients undergoing only dynamic enhanced CT scan (CT group) and 31 patient undergoing both mpMRI and CT (CT+MR group) scan. Inverse probability treatment weighting (IPTW) and propensity score matching (PSM) were used to minimize potential selection bias and confounding effects. The rates of overall survival (OS) and recurrence-free survival (RFS) of the two groups were compared.*Results More nodules (n=6), additional biliary dilation (n=4) and peritumoral parenchymal arterial phase hyperenhancement (n=18) were found with the additional mpMRI scan, and led to the treatment modification. Multivariate analysis revealed a survival advantage of additional mpMRI imaging (OS: HR 0.390, 95%CI 0.236-0.646, P<0.001, IPTW HR 0.465, 95%CI 0.263-0.823, P=0.008, PSM HR 0.415, 95%CI 0.216-0.800, P=0.009; RFS: HR 0.545, 95%CI 0.344-0.863, P=0.010, IPTW HR 0.486, 95%CI 0.279 -0.849, P=0.011, PSM HR 0.686, 95%CI 0.301-0.939, P=0.048).*Conclusions Additional mpMRI has the potential to select better treatment options and lower the risk of tumor recurrence, and improve overall survival.*Clinical Relevance/Application The prognosis of patients with intrahepatic cholangiocarcinoma (ICC) is dismal. The additional multi-parametric magnetic resonance imaging (mpMRI) enabled to find more tumor lesions, biliary dilation and peritumoral parenchymal arterial phase hyperenhancement. Consequently, it would help ICC patients to receive additional treatment in time. and patients undergoing both CT and mpMRI scan achieved better overall survival and recurrence-free survival than those undergoing CT scan only.

RESULTS

More nodules (n=6), additional biliary dilation (n=4) and peritumoral parenchymal arterial phase hyperenhancement (n=18) were found with the additional mpMRI scan, and led to the treatment modification. Multivariate analysis revealed a survival advantage of additional mpMRI imaging (OS: HR 0.390, 95%CI 0.236-0.646, P<0.001, IPTW HR 0.465, 95%CI 0.263-0.823, P=0.008, PSM HR 0.415, 95%CI 0.216-0.800, P=0.009; RFS: HR 0.545, 95%CI 0.344-0.863, P=0.010, IPTW HR 0.486, 95%CI 0.279 -0.849, P=0.011, PSM HR 0.686, 95%CI 0.301-0.939, P=0.048).

CLINICAL RELEVANCE/APPLICATION

The prognosis of patients with intrahepatic cholangiocarcinoma (ICC) is dismal. The additional multi-parametric magnetic resonance imaging (mpMRI) enabled to find more tumor lesions, biliary dilation and peritumoral parenchymal arterial phase hyperenhancement. Consequently, it would help ICC patients to receive additional treatment in time. and patients undergoing both CT and mpMRI scan achieved better overall survival and recurrence-free survival than those undergoing CT scan only.

SDP-GI-44   Multiparametric MRI-based Radiomics Signature For Predicting Overall Survival In Intrahepatic Cholangiocarcinomaafter Partial Hepatectomy

Participants
Yang Yang, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop radiomics signature using multiparametric MRI images to predict overall survival in patients with intrahepatic cholangiocarcinoma (ICC) and to investigate its incremental value for disease stratification.*Methods and Materials In this retrospective study, quantitative radiomics features (n=4998) were extracted from the multiparametric MRI of 163 patients with ICC (allocated to a training and validation set, 7:3 ratio). Radiomics model was built based on LASSO algorithm. The clinicopathologic-radiologic (CPR) model and the combined model integrating the radiomics signature with the CPR risk factors were developed with multivariate cox regression model. The Kaplan-Meier method and log-rank test were used to estimate the efficacy of risk stratification of the above models. Net Reclassification Index (NRI) and Integrate Discrimination Improvement (IDI) were used to analyze the reclassification ability of the combined model compared with CPR model.*Results The radiomics signature achieved significant stratification of overall survival (OS) and disease-free survival (DFS) in both training (p<0.0001, p<0.001, respectively) and validation set (p<0.001,p=0.0036, respectively). The C-index of the radiomics signature for predicting OS in training and validation sets were 0.680 (95%CI 0.618-0.742) and 0.698 (95%CI 0.583-0.814), which was comparable to CPR model (training set: 0.705, 95%CI: 0.634-0.777; validation set: 0.674, 95%CI: 0.555-0.792) (p=0.486, p=0.752, respectively). The C-index of the combined model integrating radiomics signature and CPR risk factors were 0.750 (95%CI 0.680-0.819) and 0.723 (95%CI 0.624-0.822), with no improvement in prognostic performance compared with that of CPR model in both sets (p=0.109, p=0.214; respectively). The combined model showed increased ability to stratify prognosis over the CPR model (validation set: p=0.028 vs p=0.058). In reclassification analyses, incorporating radiomics signature into CPR model significantly improved the prognostic accuracy(validation set: NRI and IDI of 1-year OS were 0.325, and 0.081;NRI and IDI of 2-year OS were 0.343 and 0.129;NRI and IDI of 3-year OS were 0.414 and 0.162).*Conclusions Multiparametric MRI-based radiomics signature is a potential biomarker for preoperative prognostic stratification.*Clinical Relevance/Application Multiparametric MRI-based radiomics signature is a powerful tool for prognostic assessment, and potentially serves as an individualized recommender for decision-making in ICC patients.

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CLINICAL RELEVANCE/APPLICATION

Multiparametric MRI-based radiomics signature is a powerful tool for prognostic assessment, and potentially serves as an individualized recommender for decision-making in ICC patients.

SDP-GI-45 Clinical Validation Of Ultrasound Backscatter Statistics For Assessment Of Liver Steatosis With Possible Concomitant Hepatitis

Participants
Chih Hao Lin, MD, Taoyuan, Taiwan (*Presenter*) Nothing to Disclose

PURPOSE

Hepatic steatosis is becoming the leading cause for hepatitis and liver fibrosis. Ultrasonography is widely used to grade hepatic steatosis. However, concomitant hepatitis may reduce the accuracy of grayscale evaluation of steatosis. This study compared backscatter statistics and echogenicity in ultrasound grading of hepatic steatosis in case of co-existing hepatitis.*Methods and Materials A total of 236 surgical patients were prospectively enrolled. Surgical specimen was used to determine the histologic diagnosis of hepatic steatosis. Ultrasound radio-frequency (RF) data of right side of liver were collected using the Terason t3000 ™ (convex array) system pre-operatively. An FDA-cleared backscatter analysis tool (AmCAD-US) was used to analyze the echogenicity and backscatter signals. The median of the echogenicity level (env), the median Nakagami (m) and the median histogram (h) backscatter statistics were calculated. ANOVA and Receiver Operating Characteristic (ROC) curve analysis were performed to compare ultrasonic and histologic severity of steatosis.*Results There were 93 grade 0 (<5%), 100 grade 1 (5~33%), 30 grade 2 (34~66%), and 13 grade 3 (>66%) steatosis cases and 70 had hepatitis with an elevated serum alanine aminotransferase level (>41 U/L). The area under ROC curve (AUC) showed a significant discriminant power of the liver steatosis by each of the three ultrasound statistics env, m and h: grade 0 versus grade 1-3, AUC= 0.643, 0.817, 0.817 (p-value<0.001); grade 0-1 versus grade 2-3, AUC= 0.837, 0.855, 0.863 (p-value<0.001); and grade 0-2 versus grade 3, AUC=0.899, 0.897, 0.907 (p-value<0.001), respectively. The two-way ANOVA showed that the steatosis grade was severely confounded by hepatitis in the echogenicity level with significant inflammation (p-value=0.003) as well as interaction effects (p-value=0.028). Whereas the backscatter statistics' discriminant power of the steatosis severity was not affected by hepatitis*Conclusions Given the highly variable echogenicity in liver parenchyma with concomitant liver disease, the use of backscatter statistics may improve the current ultrasonic capacity in diagnosis and staging of fatty liver disease.*Clinical Relevance/Application Fatty liver disease may cause hepatitis and further evolve into fibrosis. However, with conventional gray-scale image, co-existing hepatitis may largely compromise the accuracy of ultrasonic estimation of fatty liver disease. This study demonstrated backscatter signal analysis and its statistics may be a better clinical tool in assessing fatty liver disease, particularly when there were concomitant hepatitis and liver fibrosis.

RESULTS

There were 93 grade 0 (<5%), 100 grade 1 (5~33%), 30 grade 2 (34~66%), and 13 grade 3 (>66%) steatosis cases and 70 had hepatitis with an elevated serum alanine aminotransferase level (>41 U/L). The area under ROC curve (AUC) showed a significant discriminant power of the liver steatosis by each of the three ultrasound statistics env, m and h: grade 0 versus grade 1-3, AUC= 0.643, 0.817, 0.817 (p-value<0.001); grade 0-1 versus grade 2-3, AUC= 0.837, 0.855, 0.863 (p-value<0.001); and grade 0-2 versus grade 3, AUC=0.899, 0.897, 0.907 (p-value<0.001), respectively. The two-way ANOVA showed that the steatosis grade was severely confounded by hepatitis in the echogenicity level with significant inflammation (p-value=0.003) as well as interaction effects (p-value=0.028). Whereas the backscatter statistics' discriminant power of the steatosis severity was not affected by hepatitis

CLINICAL RELEVANCE/APPLICATION

Fatty liver disease may cause hepatitis and further evolve into fibrosis. However, with conventional gray-scale image, co-existing hepatitis may largely compromise the accuracy of ultrasonic estimation of fatty liver disease. This study demonstrated backscatter signal analysis and its statistics may be a better clinical tool in assessing fatty liver disease, particularly when there were concomitant hepatitis and liver fibrosis.

SDP-GI-46 Risk Prediction Models For Screening High-risk Esophageal Varices With MR-Elastography In Patients With Advanced Liver Disease

Participants
Safa Hoodeshenas, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To explore the role of MR elastography (MRE) in stratifying portal hypertension (PHTN) severity and predicting high-risk varices (HRV) by using esophagogastroduodenoscopy (EGD) as the reference standard.*Methods and Materials We retrospectively identified 1,167 patients who had MRE-assessed liver stiffness measurement (LSM) =5 kPa; 457 of them had EGD within one year of the MRE exam. LSM, spleen stiffness measurement (SSM), spleen size and platelet count (PLT) were identified as four predictors to assess PHTN severity. Data for all four predictors were available in 211 patients. The severity of esophageal varices was classified into four grades based on the EGD findings and variceal bleeding history: Grade 0 (No varices), Grade1 (small varices), Grade 2 (large varices or high-risk small varices), Grade 3 (active or prior variceal bleeding). Grades 0 and 1 were considered as a low-risk group, while grades 2 and 3 as a high-risk group .The models were constructed with Logistic regression analyses and trained with Leave-one-out cross-validation. To facilitate predicting the chance of having HRV for each patient, we designed a nomogram based on the most predictive model.*Results The model using all four predictors showed significantly higher performance compared to the model based on LSM plus PLT alone in predicting HRV (P-value=0.002) or stratifying variceal severity grades (P-value <0.05). SSM showed the most significant role among four predictors in predicting HRV (|odds ratio - 1| = 30.96%) .It had almost a doubled effect than LSM (|odds ratio - 1| =16.79%) and sixty times than PLT (|odds ratio - 1|=0.52%). We found weak correlation (Spearman ? =0.11; P < 0.06) between LSM and SSM in our study cohort. As all patients in our cohort had LSM=5.0 kPa, we extended our evaluation to a larger range of LSM in our database. We found strong correlation between LSM and SSM (0.51 < ? = 0.69 < 0.82 at 99.5% confidence) for LSM < 5kPa and weak correlation (-0.02 < ? = 0.15 < 0.31 at 99.5% confidence) for LSM = 5kPa. The correlation in all patients was also significant (0.31 < ? = 0.43 < 0.55 at 99.5% confidence).*Conclusions MRE-based

assessment of the shear stiffness of the spleen shows promise for predicting the absence of HRV in patients with advanced liver disease and is more accurate than measurement of liver stiffness and platelet count alone, allowing for use of fewer endoscopies in management of these patients.*Clinical Relevance/Application The multiparametric predictive model developed in this study has potential to reduce unnecessary endoscopy procedures and improve longitudinal management of patients with portal hypertension.

RESULTS

The model using all four predictors showed significantly higher performance compared to the model based on LSM plus PLT alone in predicting HRV (P-value=0.002) or stratifying variceal severity grades (P-value <0.05). SSM showed the most significant role among four predictors in predicting HRV (|odds ratio - 1| = 30.96%) .It had almost a doubled effect than LSM (|odds ratio - 1| =16.79%) and sixty times than PLT (|odds ratio - 1|=0.52%). We found weak correlation (Spearman ? =0.11; P < 0.06) between LSM and SSM in our study cohort. As all patients in our cohort had LSM=5.0 kPa, we extended our evaluation to a larger range of LSM in our database. We found strong correlation between LSM and SSM (0.51 < ? = 0.69 < 0.82 at 99.5% confidence) for LSM < 5kPa and weak correlation (-0.02 < ? = 0.15 < 0.31 at 99.5% confidence) for LSM = 5kPa. The correlation in all patients was also significant (0.31 < ? = 0.43 < 0.55 at 99.5% confidence).

CLINICAL RELEVANCE/APPLICATION

The multiparametric predictive model developed in this study has potential to reduce unnecessary endoscopy procedures and improve longitudinal management of patients with portal hypertension.

SDP-GI-47 Preliminary Application Of Spectral CT In Preoperative Evaluation Of Esophageal High-grade Intraepithelial Neoplasia And Pathological Grades Of The Squamous Cell Carcinoma

Participants
Yi Wang, Taizhou, China (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study is to investigate the value of spectral CT in the quantitative assessment of esophageal high-grade intraepithelial neoplasia (EHGIEN) and esophageal squamous cell carcinoma (ESCC) with different degrees of differentiation.*Methods and Materials There were 221 patients with proven EHGIEN or ESCC who underwent enhanced spectral CT from July 2017 to March 2021 retrospectively enrolled. These patients were divided into four groups based on pathological results: HGIEN, well differentiated ESCC, moderately differentiated ESCC and poorly differentiated ESCC. Iodine concentration (IC), water concentration (WC), effective atomic number (Eff-Z) and the slope of the spectral curve (?HU) of the arterial phase (AP) and venous phase (VP) were measured or calculated. The quantitative parameters of four groups were compared by using one-way ANOVA and pairwise comparison were performed with LSD. Receiver operating characteristic (ROC) analysis was used to evaluate the diagnostic performance of these parameters on EHGIEN and ESCC.*Results There were significant differences in IC, WC, Eff-Z, and ?HU in AP and VP among the four groups (all p < 0.001). The IC and Eff-Z in the poorly differentiated group were significantly higher than those in other three groups in VP (all p < 0.001), while the IC and Eff-Z in the HGIEN group were significantly lower than those in other three groups in VP (all p<0.05). In the ROC analysis, IC performed the best in the identification of EHGIEN group and ESCC group (AUC = 0.828, Sensitivity = 0.628 and Specificity = 0.933 under the threshold of 20.745).*Conclusions The quantitative parameters of spectral CT performed decently in the differential diagnosis between EHGIEN and ESCC with different degrees of differentiation before operation.*Clinical Relevance/Application Quantitative parameters of spectral CT, especially IC and Eff-Z in venous phase, could be helpful in the differential diagnosis of EHGIEN and ESCC with different degrees of differentiation.

RESULTS

There were significant differences in IC, WC, Eff-Z, and ?HU in AP and VP among the four groups (all p < 0.001). The IC and Eff-Z in the poorly differentiated group were significantly higher than those in other three groups in VP (all p < 0.001), while the IC and Eff-Z in the HGIEN group were significantly lower than those in other three groups in VP (all p<0.05). In the ROC analysis, IC performed the best in the identification of EHGIEN group and ESCC group (AUC = 0.828, Sensitivity = 0.628 and Specificity = 0.933 under the threshold of 20.745).

CLINICAL RELEVANCE/APPLICATION

Quantitative parameters of spectral CT, especially IC and Eff-Z in venous phase, could be helpful in the differential diagnosis of EHGIEN and ESCC with different degrees of differentiation.

SDP-GI-48 Dynamic Enhanced Computed Tomography Features Predict Pancreatic Neuroendocrine Neoplasm With Ki-67 Index Less Than 5%

Participants
Haopeng Yu, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

Patients with Ki67 index less than 5% had better prognosis after curative surgery. Based on preoperative dynamic enhanced computed tomography (CT), this study aimed to investigate imaging characteristics eligible to discriminate Ki67of =5% group from Ki67 of >5% group of nonmetastatic pancreatic neuroendocrine neoplasm (PanNEN).*Methods and Materials Patients with pathologically diagnosed PanNEN and preoperative multiphase CT were enrolled. Their Ki67 index was calculated and grouped according to the 5% cutoff value. Various CT imaging characteristics and some serum biomarkers were assessed between the two groups: the diameter, location, tumor margin, calcification, pancreatic atrophy, distal pancreatic duct dilation, vessel involvement, and enhancement pattern characteristics of both arterial phase (AP) and portal vein phase (PVP).*Results A total of 142 patients with PanNEN were enrolled in this study, comprising 104 in the long (Ki67, 1%-5%) and 38 in the high index group (Ki67, >5%). Alpha fetoprotein (AFP) and cancer antigen 125 (CA125) were significant between the two groups (P-values, 0.030 and 0.049, respectively). The diameter (P=0.000), margin (P=0.003), distal main ductal dilation (P=0.021), vessel involvement (P=0.002), AP hypoenhancement (P=0.000), PVP hypoenhancement (P=0.003), AP ratio (P=0.000), and PVP ratio (P=0.000) manifested significant difference between low and high index groups. The area under the curve of multivariate logistic regression model is 0.853.*Conclusions This study found several radiological differences in nonmetastatic PanNENs between the Ki67 index >5% group and lower Ki67 index group with preoperative enhanced CT.*Clinical Relevance/Application The findings of this study may affect the decision on PanNEN patients as to whether surgery is more beneficial or if postoperative surveillance should be more intensive.

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A total of 142 patients with PanNEN were enrolled in this study, comprising 104 in the long (Ki67, 1%-5%) and 38 in the high index group (Ki67, >5%). Alpha fetoprotein (AFP) and cancer antigen 125 (CA125) were significant between the two groups (P-values, 0.030 and 0.049, respectively). The diameter (P=0.000), margin (P=0.003), distal main ductal dilation (P=0.021), vessel involvement (P=0.002), AP hypoenhancement (P=0.000), PVP hypoenhancement (P=0.003), AP ratio (P=0.000), and PVP ratio (P=0.000) manifested significant difference between low and high index groups. The area under the curve of multivariate logistic regression model is 0.853.

CLINICAL RELEVANCE/APPLICATION

The findings of this study may affect the decision on PanNEN patients as to whether surgery is more beneficial or if postoperative surveillance should be more intensive.

SDP-GI-49 Visceral Adiposity As A Risk Factor For Lean Nonalcoholic Fatty Liver Disease In Potential Living Liver Donors

Participants
Sunyoung Lee, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to investigate the relationship between hepatic steatosis (HS) evaluated by biopsy and visceral adiposity assessed by CT in lean living liver donor candidates and to determine the risk factors for lean nonalcoholic fatty liver disease (NAFLD).*Methods and Materials This retrospective study included 250 lean (body mass index, <23 kg/m2) potential living liver donors (mean age, 31.1±8.6 years; 141 men) who had undergone liver biopsy and abdominal CT between 2017 and 2018. Anthropometry, laboratory parameters, body composition, and the degree of HS were evaluated. Logistic regression was used to identify independent predictors of lean NAFLD.*Results The visceral fat area (VFA) was significantly correlated with the degree of HS in men (r=0.408; P<0.001) and women (r=0.360; P<0.001). The subcutaneous fat area (SFA) was significantly correlated with the degree of HS in men (r=0.398; P<0.001), but not in women. The skeletal muscle area did not correlate with the degree of HS in either men or women. In the multivariable logistic regression analysis, the VFA (odds ratio [OR], 1.028; 95% confidence interval [CI], 1.013-1.004; P<0.001) and SFA (OR, 1.016; 95% CI, 1.004-1.028; P=0.009) were independent risk factors for lean NAFLD in men, and the VFA (OR, 1.036; 95% CI, 1.013-1.059; P=0.002) was an independent risk factor for lean NAFLD in women.*Conclusions The severity of nonalcoholic fatty liver was positively correlated with visceral fat accumulation in a lean Asian population. Visceral adiposity may be a risk factor for lean NAFLD in potential living liver donors.*Clinical Relevance/Application Visceral adiposity may be a risk factor for lean NAFLD in potential living liver donors.

RESULTS

The visceral fat area (VFA) was significantly correlated with the degree of HS in men (r=0.408; P<0.001) and women (r=0.360; P<0.001). The subcutaneous fat area (SFA) was significantly correlated with the degree of HS in men (r=0.398; P<0.001), but not in women. The skeletal muscle area did not correlate with the degree of HS in either men or women. In the multivariable logistic regression analysis, the VFA (odds ratio [OR], 1.028; 95% confidence interval [CI], 1.013-1.004; P<0.001) and SFA (OR, 1.016; 95% CI, 1.004-1.028; P=0.009) were independent risk factors for lean NAFLD in men, and the VFA (OR, 1.036; 95% CI, 1.013-1.059; P=0.002) was an independent risk factor for lean NAFLD in women.

CLINICAL RELEVANCE/APPLICATION

Visceral adiposity may be a risk factor for lean NAFLD in potential living liver donors.

SDP-GI-5 Relationship Between Pancreatic Parenchyma Loss And Medium-and Long-term Blood Glucose In Patients With Benign Pancreatic Diseases

Participants
Wen Kan, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the relationship between pancreatic parenchyma loss and type 3c diabetes mellitus (T3cDM).*Methods and Materials A total of 105 patients with benign pancreatic tumors or chronic pancreatitis, whose preoperative fasting blood glucose (FBG) was normal and who underwent partial pancreatectomy were included. The pancreatic resection volume ratios (PRV) was measured by CT imaging. The patients were followed up for 18 months (3 months, 6 months, 9 months, 12 months and 18 months after operation). The content of the follow-up was the FBG value of the patients. According to WHO criteria, patients were divided into diabetes mellitus group (DM group), impaired fasting blood glucose group (IFG group) and normal blood glucose group (NG group). The differences of blood glucose at different time points after operation in the three groups were compared. The sex, age, BMI, hypertension, hyperlipidemia, surgery type were compared between non-diabetic group (IFG+NG) and DM group. Exploring the best cutoff value of resection volume ratio to predict new-onset diabetes after operation.*Results (1) A total of 13 patients with new-onset diabetes mellitus were found during the 18-month observation period, and the incidence was 12.38% (13/105). (2) The blood glucose of NG group returned to normal 3 months after operation. The blood glucose of the IFG group and the DM group also decreased 3 months after operation, but it was still higher than normal value. There was no significant difference between the FBG at 6, 9, 12 and 18 months postoperatively and those at 3 months postoperatively in the three groups (P > 0.05). (3) There was significant difference in age and PRV between non-DM group and DM group (P<0.05), and there was no significant difference in sex, hypertension, hyperlipidemia, BMI, surgery type between the two groups (P > 0.05). (4) ROC curve analysis showed the best cutoff value of the PRV between the DM group and non-DM group was 52.60%, AUC = 0.727, the sensitivity was 76.92%, and the specificity was 77.27%.*Conclusions Patients with PRV = 52.60% have a higher risk of developing T3cDM after operation. In addition, age are also associated with postoperative diabetes mellitus. The occurrence of T3cDM may be a multifactor process. Therefore, it is necessary to follow up the patients who have undergone partial pancreatectomy for a long time, especially the elderly patients whose PRV is greater than 52.60%.*Clinical Relevance/Application After partial pancreatectomy, the loss of pancreatic parenchyma must mean the loss of endocrine cells and function, but the compensatory ability of pancreas has not been reached. The purpose of this study was to explore the relationship between pancreatic parenchyma loss and type 3c diabetes mellitus (T3cDM).

RESULTS

(1) A total of 13 patients with new-onset diabetes mellitus were found during the 18-month observation period, and the incidence was 12.38% (13/105). (2) The blood glucose of NG group returned to normal 3 months after operation. The blood glucose of the IFG group and the DM group also decreased 3 months after operation, but it was still higher than normal value. There was no

significant difference between the FBG at 6, 9, 12 and 18 months postoperatively and those at 3 months postoperatively in the three groups (P > 0.05). (3) There was significant difference in age and PRV between non-DM group and DM group (P<0.05), and there was no significant difference in sex, hypertension, hyperlipidemia, BMI, surgery type between the two groups (P > 0.05). (4) ROC curve analysis showed the best cutoff value of the PRV between the DM group and non-DM group was 52.60%, AUC = 0.727, the sensitivity was 76.92%, and the specificity was 77.27%.

CLINICAL RELEVANCE/APPLICATION

After partial pancreatectomy, the loss of pancreatic parenchyma must mean the loss of endocrine cells and function, but the compensatory ability of pancreas has not been reached. The purpose of this study was to explore the relationship between pancreatic parenchyma loss and type 3c diabetes mellitus (T3cDM).

SDP-GI-50   Is There Clinically Significant Liver Injury In Acute COVID-19 And Post-COVID Period: Multimodal Imaging Approach

Participants
Maija Radzina, MD,PhD, Riga, Latvia (*Presenter*) Speakers Bureau, Canon Medical Systems Corporation;Speakers Bureau, Bayer AG;Speakers Bureau, Medtronic plc;Speakers Bureau, Bracco Group

PURPOSE

This study takes a multimodal imaging approach to evaluate liver injury during and after Covid-19 in the setting of a varying patient population and clinical outcomes.*Methods and Materials 1117 patients were enrolled: 1027 with acute Covid-19 had a thoracic computed tomography (CT) scan performed, in which liver density and abdominal ratio (AR) was measured. 56 patients with previous Covid-19 infection had a multiparametric ultrasound (mpUS) examination performed to evaluate liver elasticity, viscosity and attenuation, with same-day thoracic CT and abdominal magnetic resonance (MR) scans. The remaining 34 patients were a clinically healthy control group. Imaging findings were correlated with markers of liver injury and inflammation, the clinical course and outcomes of Covid-19.*Results 76% of acute patients had diffusely decreased liver density, corresponding to increased liver markers (p<0.001). Increased liver fattiness was more common among hospitalised patients (p=0.001, F=10.5) and in mild-moderate cases (p<0.001, F=13.8), but did not influence ICU admission or mortality. Increased AR correlated with steatosis on CT (r = 0.4, p<0.01), however, AR was slightly decreased in cases of lethal outcome when compared to survivors (p=0.002). Patients after Covid-19 had significantly different fibrosis, steatosis and viscosity scores on mpUS compared to the control group (p<0.001). Increased liver stiffness correlated with increased liver markers, but CT and MR did not (p>0.05). Patients with higher BMI had more severe disease (p<0.001) and had higher stiffness and steatosis values (p=0.016). Hospitalised patients were 9 times more likely to have increased steatosis values (p<0.01). Patients who had indicators of steatosis on MR were more likely to have had experienced moderate or severe disease (p=0.01).*Conclusions Biochemical and imaging signs of liver injury were observed in patients during and after Covid-19. Diffusely decreased liver density on CT predicted hospitalisation rates and moderate disease but did not influence lethality. Reduced AR possibly signified increased risk of a lethal outcome. Biochemically evident liver injury was more common 3-9 months after Covid-19 when compared to a control group: this was mirrored by altered mpUS findings, especially increased liver stiffness. MpUS findings were more sensitive to altered biochemical markers of liver injury than CT or MR.*Clinical Relevance/Application Easy measurements on thoracic CT scans such as liver density or the abdominal ratio could aid predicting the need for hospitalisation, development of severe disease, or indicate risk of a lethal outcome. In clinical practice, lasting effect on the liver from Covid-19 could be evaluated by mpUS, which is sensitive to liver injury.

RESULTS

76% of acute patients had diffusely decreased liver density, corresponding to increased liver markers (p<0.001). Increased liver fattiness was more common among hospitalised patients (p=0.001, F=10.5) and in mild-moderate cases (p<0.001, F=13.8), but did not influence ICU admission or mortality. Increased AR correlated with steatosis on CT (r = 0.4, p<0.01), however, AR was slightly decreased in cases of lethal outcome when compared to survivors (p=0.002). Patients after Covid-19 had significantly different fibrosis, steatosis and viscosity scores on mpUS compared to the control group (p<0.001). Increased liver stiffness correlated with increased liver markers, but CT and MR did not (p>0.05). Patients with higher BMI had more severe disease (p<0.001) and had higher stiffness and steatosis values (p=0.016). Hospitalised patients were 9 times more likely to have increased steatosis values (p<0.01). Patients who had indicators of steatosis on MR were more likely to have had experienced moderate or severe disease (p=0.01).

CLINICAL RELEVANCE/APPLICATION

Easy measurements on thoracic CT scans such as liver density or the abdominal ratio could aid predicting the need for hospitalisation, development of severe disease, or indicate risk of a lethal outcome. In clinical practice, lasting effect on the liver from Covid-19 could be evaluated by mpUS, which is sensitive to liver injury.

SDP-GI-51   Screening Of Radiotracer For Diagnosis Of Colorectal Cancer Liver Metastasis Based On Macc1Spon2

Participants
Huijie Jiang, PhD, MS, Harbin, China (*Presenter*) Nothing to Disclose

PURPOSE

Metastasis-associated in colon cancer 1 (MACC1) and Spondin2 (SPON2) are newly discovered oncogenes,but little is known about their role in colorectal cancer(CRC) liver metastases. PET has become an important molecularimaging technology due to its high sensitivity and quantifability. In particular, its targeted, specifc molecular probes can detect biological behaviors. This study was designed to evaluate the diferent biological properties of 18F-FDG, 18F-FLT, and 18F-FMISO PET. The value of the CRC liver metastasis model explores the correlation and potential mechanisms of three tracers uptakes with tumor-related biological characteristics.*Methods and Materials Human CRC cell lines(LoVo and HCT8), were cultured for in vitro radionuclide uptake experiments to compare the molecular imaging features of colorectal cancer cells with diferent metastatic potentials. Two kinds of cells wereinjected into the spleen of nude mice to establish a liver metastasis model. After the tumor formation, three kinds of tracer PET images were performed to evaluate the characteristics of live PET imaging of high and low liver metastasis colorectal cancer models. The expression levels of MACC1 and SPON2 in tissues were detected by immunohistochemistry and Westernblot. Correlation between tracer uptake and expression of MACC1 and SPON2 in liver metastases was assessed by linear regression analysis.*Results The uptake rate of in vitro three tracers uptake experiments was LoVo>HCT8. Micro-PET scan showed no significant diference between the 18F-FDG SUV values of the two cells (P>0.05); there was signifcant diference between the18F-FLT and 18F-FMISO SUV values (P<0.05). All in vivo FLT and FMISO SUV values were signifcantly higher in LoVo tumors than in HCT8 tumors. The results of Western blot and immunohistochemistry showed that the expression levels of MACC1 and SPON2 in

LoVo liver metastasis were higher than those in HCT8 (P<0.05). The 18F-FLT SUVmax ratio was signifcantly correlated with the expression of MACC1 and SPON2 in hepatic metastases (r=0.737, P=0.0026; r=0.842,P=0.0002). The 18F-FMISO SUVmax ratio was only signifcantly correlated with the expression of MACC1 in hepatic metastasis (r=0.770, P=0.0013).*Conclusions Early screening with 18F-FLT and 18F-FMISO tracers has important clinical value for the efcient diagnosis and treatment of colorectal cancer liver metastases.*Clinical Relevance/Application a

RESULTS

The uptake rate of in vitro three tracers uptake experiments was LoVo>HCT8. Micro-PET scan showed no significant diference between the 18F-FDG SUV values of the two cells (P>0.05); there was signifcant diference between the18F-FLT and 18F-FMISO SUV values (P<0.05). All in vivo FLT and FMISO SUV values were signifcantly higher in LoVo tumors than in HCT8 tumors. The results of Western blot and immunohistochemistry showed that the expression levels of MACC1 and SPON2 in LoVo liver metastasis were higher than those in HCT8 (P<0.05). The 18F-FLT SUVmax ratio was signifcantly correlated with the expression of MACC1 and SPON2 in hepatic metastases (r=0.737, P=0.0026; r=0.842,P=0.0002). The 18F-FMISO SUVmax ratio was only signifcantly correlated with the expression of MACC1 in hepatic metastasis (r=0.770, P=0.0013).

CLINICAL RELEVANCE/APPLICATION

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SDP-GI-52 Non-enhanced CT Images Based Deep Learning Analysis For The Severity Prediction Of Acute Pancreatitis At The Early Stage: A Pilot Study

Participants
Yi Wang, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to develop a lightweight network-structured deep learning (DL) model based on non-enhanced CT (NECT) images for the severity prediction of acute pancreatitis (AP) at the early stage.*Methods and Materials A total of 978 AP patients in a single center from July 2016 to August 2019 were retrospectively recruited, and the severity of AP was determined according to the Revised Atlanta Classification. The NECT images within 72 hours of onset were collected, and clinical factors selected by multivariate logistic regression were used to develop the clinical model via decision tree method. Two MobileNetV2-backbone based DL models were constructed by using CT images (image model) or both CT images and clinical factors (combined model), respectively. All models were trained and fine-tuned in the development cohort (n = 783) and their performance were evaluated in the independent testing dataset (n = 195). Confusion matrix was used to evaluate the efficacy of the models in the classification of AP severity.*Results Clinical factors including WBC, NLR, CRP, Ca2+, LDH, Cr, 24h SIRS and 48h SIRS were significantly related to the severity of AP (all p values less than 0.05) and used for model development. In the independent testing dataset, the accuracy in predicting severe AP (SAP) of clinical model was only 29.0%, while those of image model and combined model were 64.5% and 74.2%, respectively. The accuracy of clinical model, image model and combined model for moderately severe AP (MSAP) prediction were 43.2%, 27.0% and 32.4%, respectively, and for mild AP (MAP) prediction were 80.0%, 76.7% and 90.0%, respectively. The overall prediction accuracy of the combined model was 65.6%, which was higher than those of the clinical model (57.9%, p = 0.118) and the imaging model (55.9%, p = 0.049). The combined model had achieved AUCs of 0.820 (95% CI, 0.759~0.871) and 0.920 (95% CI, 0.873~0.954) in diagnosing MAP and SAP, separately.*Conclusions The combined deep learning model which integrated clinical and image information achieved favorable performance for early prediction of AP severity, providing a basis for risk stratification of patients in early clinical stage.*Clinical Relevance/Application Early and accurate assessment of the severity of AP is of great significance in guiding timely clinical intervention, so as to improve the therapeutic effect and reduce the mortality.The clinical and image information-based deep learning model predicts AP severity with an overall accuracy of 65.6%, which might help risk stratification of patients in early clinical stage.

RESULTS

Clinical factors including WBC, NLR, CRP, Ca2+, LDH, Cr, 24h SIRS and 48h SIRS were significantly related to the severity of AP (all p values less than 0.05) and used for model development. In the independent testing dataset, the accuracy in predicting severe AP (SAP) of clinical model was only 29.0%, while those of image model and combined model were 64.5% and 74.2%, respectively. The accuracy of clinical model, image model and combined model for moderately severe AP (MSAP) prediction were 43.2%, 27.0% and 32.4%, respectively, and for mild AP (MAP) prediction were 80.0%, 76.7% and 90.0%, respectively. The overall prediction accuracy of the combined model was 65.6%, which was higher than those of the clinical model (57.9%, p = 0.118) and the imaging model (55.9%, p = 0.049). The combined model had achieved AUCs of 0.820 (95% CI, 0.759~0.871) and 0.920 (95% CI, 0.873~0.954) in diagnosing MAP and SAP, separately.

CLINICAL RELEVANCE/APPLICATION

Early and accurate assessment of the severity of AP is of great significance in guiding timely clinical intervention, so as to improve the therapeutic effect and reduce the mortality.The clinical and image information-based deep learning model predicts AP severity with an overall accuracy of 65.6%, which might help risk stratification of patients in early clinical stage.

SDP-GI-53 Evaluation Of Pancreatic Ductal Adenocarcinoma Resectability Using 80 Kvp 1mm Thickness CT: A Prospective Multicenter Study

Participants
Dong Ho Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Low kVp CT can provide better iodine contrast than 120 kVp standard CT, and 1mm thin-section CT provides high spatial resolution which would be helpful for the evaluation of vascular invasion by pancreatic ductal adenocarcinoma (PDAC). In this multicenter prospective study, we aimed to evaluate the diagnostic accuracy of 80 kVp 1mm section CT in assessing resectability of pancreatic cancer*Methods and Materials From April 2019 to October 2020, we prospectively enrolled patients who were candidates of surgical resection for PDAC at six-tertiary referral hospitals in South Korea. All participants underwent contrast enhanced pancreas protocol CT. Both late arterial phase and portal venous phase images were obtained using 80kVp with reference mAs of 325 mAs, and reconstructed every 1mm with iterative reconstruction algorithm (i.e., ADMIRE level 2). The PDAC resectability was evaluated using NCCN guideline at each center. The PDAC resectability was also assessed using 5-point scale: 1, definitely resectable; 2, probably resectable; 3, indeterminate; 4, probably unresectable; and 5, definitely unresectable. After pancreatic resection, the rate of R0 resection was assessed using histopathologic analysis as well as operative findings. To evaluate the diagnostic accuracy of 80 kVp

1mm thickness CT in assessing PDAC resectability, ROC analysis was used.*Results During the study period, 124 patients were enrolled in this study. Pancreatic resection was done in 115 patients, and R0 resection was achieved in 92 patients (74.2%, 92/124). According to the 80 kVp 1mm thickness CT and NCCN guideline, 69 patients were classified as having resectable PDC, 43 patients as having borderline resectable, and 12 patients as having unresectable, The R0 resection rate was 89.9% (62/69) for 69 patients with resectable, 65.1% (28/43) for borderline resectable, and 16.7% (2/12) for unresectable PDAC. The area-under-ROC curve of 80 kVp 1mm thickness CT in predicting R0 resection was 0.800 (P<0.001). When categories 1, 2, and 3 were considered to indicate R0 resection, the sensitivity, specificity, and accuracy of 80 kVp 1mm thickness CT in predicting R0 resection was 90.2% (83/92), 53.1% (17/32), and 80.6% (100/124), respectively.*Conclusions The 80 kVp 1mm thickness pancreas protocol CT provided good diagnostic performance in assessing PDAC resectability with accuracy of 80.6%, particularly in predicting R0 resection for resectable PDAC patients (89.9%, 62/69).*Clinical Relevance/Application The 80 kVp 1mm thickness pancreas protocol CT is useful for the evaluation of pancreatic cancer resectability with good diagnostic accuracy.

RESULTS

During the study period, 124 patients were enrolled in this study. Pancreatic resection was done in 115 patients, and R0 resection was achieved in 92 patients (74.2%, 92/124). According to the 80 kVp 1mm thickness CT and NCCN guideline, 69 patients were classified as having resectable PDC, 43 patients as having borderline resectable, and 12 patients as having unresectable, The R0 resection rate was 89.9% (62/69) for 69 patients with resectable, 65.1% (28/43) for borderline resectable, and 16.7% (2/12) for unresectable PDAC. The area-under-ROC curve of 80 kVp 1mm thickness CT in predicting R0 resection was 0.800 (P<0.001). When categories 1, 2, and 3 were considered to indicate R0 resection, the sensitivity, specificity, and accuracy of 80 kVp 1mm thickness CT in predicting R0 resection was 90.2% (83/92), 53.1% (17/32), and 80.6% (100/124), respectively.

CLINICAL RELEVANCE/APPLICATION

The 80 kVp 1mm thickness pancreas protocol CT is useful for the evaluation of pancreatic cancer resectability with good diagnostic accuracy.

SDP-GI-54 Predicting T And N Staging Of Resectable Gastric Cancer According Towhole Tumor Histogram Analysisabout A Non-cartesian K-space Acquisitiondce-mri: Afeasibility Study

Participants
Yan Liangliang, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the feasibility of the whole tumor histogram analysis parameters derived from dynamic contrast-enhanced MRI (DCE-MRI) based on stack-of stars (StarVIBE) to predict T and N staging of resectable gastric cancer(GC).*Methods and Materials Eighty-seven patients confirmed as GC by histopathology were enrolled in this prospective study. DCE-MRI were performed before surgery, and quantitative DCE parameters (Ktrans, Kep, Ve) and histogram metrics (Skewness, Kurtosis and Entropy) were measured by Omni-Kinetics software. Intraclass correlation coefficient (ICC) testing was used to determine the consistency of Ktrans, Kep and Ve values and histogram metrics values between two radiologists using Bland-Altman analysis. The quantitative DCE parameters or histogram metrics values between T stage or N stage were compared using ANOVA or Kruskal-Wallis testing. Receiver operating characteristic (ROC) analyses was performed to find out the best parameters for identifying T and N staging.*Results There were statistically difference in Ktrans, Kep, Ve and entropy to identify T staging (P=0.015, 0.033, <0.001, and 0.007, respectively), and in pairwise comparisons of Ve values showed statistically difference between T1+2 and T3 group (P<0.001), T1+2 and T4 group (P<0.001) . There were statistically differences in Ve to identify N staging (P=0.041). In ROC analysis, Ve was the best parameter for identifying T staging (AUC: 0.788, the sensitivity and specificity was 0.929 and 0.578, respectively) and N staging (AUC: 0.590, the sensitivity and specificity was 0.714 and 0.899, respectively).*Conclusions The whole tumor histogram analysis parameters derived from StarVIBE DCE-MRI may be able to quantitatively evaluate T and N staging of GC.*Clinical Relevance/Application The whole tumor histogram analysis parameters derived from DCE-MRI may be able to quantitatively evaluate T and N staging of GC, so as to help clinical treatment decision optimization.

RESULTS

There were statistically difference in Ktrans, Kep, Ve and entropy to identify T staging (P=0.015, 0.033, <0.001, and 0.007, respectively), and in pairwise comparisons of Ve values showed statistically difference between T1+2 and T3 group (P<0.001), T1+2 and T4 group (P<0.001) . There were statistically differences in Ve to identify N staging (P=0.041). In ROC analysis, Ve was the best parameter for identifying T staging (AUC: 0.788, the sensitivity and specificity was 0.929 and 0.578, respectively) and N staging (AUC: 0.590, the sensitivity and specificity was 0.714 and 0.899, respectively).

CLINICAL RELEVANCE/APPLICATION

The whole tumor histogram analysis parameters derived from DCE-MRI may be able to quantitatively evaluate T and N staging of GC, so as to help clinical treatment decision optimization.

SDP-GI-55 Qualitative Assessment Of Fontan Associated Liver Disease Using Gd-EOB-DTPA-MRI: Correlation With Serum Liver Fibrosis Markers

Participants
Reiko Sakai, Tokyo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

In patients undergoing Fontan procedure for congenital single ventricle, Fontan-associated liver disease (FALD) has been reported as a sequela in approximately 40% of patients, which leads to a fatal outcome. The present study aims to quantify FALD using uptake analysis of Gd-EOB-DTPA MRI with 1.5T and 3T scanners, and verify its association with serum hepatic fibrosis markers.*Methods and Materials 60 examinations of Gd-EOB-DTPA MRI for 31 patients (mean age; 28 years) after Fontan procedure was retrospectively analyzed. Of these, 44 examinations of 27 patients were scanned with a 1.5 tesla scanner, and 16 examinations of 13 patients were scanned with a 3 tesla MR scanner. The increase rate of liver-to-spleen signal intensity ratio (LSR-increasing-ratio) on the hepatobiliary phase after 15 minutes of Gd-EOB-DTPA administration was used as an assessment of FALD, and the correlation with serum liver fibrosis markers hyaluronic acid and Fib-4 index was examined. When liver fibrosis was defined as Fib-4 index 2.67 or higher, the diagnostic ability was examined by ROC curved analysis.*Results LSR-increasing-ratio was decreased significantly as hyaluronic acid (1.5 tesla and 3 tesla; Pearson r -0.57 and -0.59, p<0.05) and Fib-4 index (1.5 tesla and 3 tesla; Pearson r -0.71 and -0.83, p<0.0001) increased. Using the optimal threshold for LSR-increasing-ratio, the diagnostic performance of liver fibrosis at 1.5 tesla and 3 tesla was threshholds 0.14 and 0.29, areas under the curve 0.89 and 0.93,

sensitivity 80% and 100%, and specificity 91% and 91%.*Conclusions LSR-increasing-ratio as a quantitative index of FALD correlated significantly with serum liver fibrosis markers and could be used to detect liver fibrosis noninvasively.*Clinical Relevance/Application Gd-EOB-DTPA MRI can simultaneously evaluate liver fibrosis and the presence or absence of tumors, and it is a helpful tool for FALD management.

RESULTS

LSR-increasing-ratio was decreased significantly as hyaluronic acid (1.5 tesla and 3 tesla; Pearson r -0.57 and -0.59, p<0.05) and Fib-4 index (1.5 tesla and 3 tesla; Pearson r -0.71 and -0.83, p<0.0001) increased. Using the optimal threshold for LSR-increasing-ratio, the diagnostic performance of liver fibrosis at 1.5 tesla and 3 tesla was threshholds 0.14 and 0.29, areas under the curve 0.89 and 0.93, sensitivity 80% and 100%, and specificity 91% and 91%.

CLINICAL RELEVANCE/APPLICATION

Gd-EOB-DTPA MRI can simultaneously evaluate liver fibrosis and the presence or absence of tumors, and it is a helpful tool for FALD management.

SDP-GI-56   Deep Learning 3D Convolutional Neural Network For Noninvasive Evaluation Of Pathologic Grade Of Hepatocellular Carcinoma Using Contrast-enhanced Magnetic Resonance Imaging

Participants
Ying Zhao JR, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the diagnostic performance of three-dimensional convolutional neural network (3D-CNN) model for the differentiation of the pathologic grade of hepatocellular carcinoma (HCC) based on contrast-enhanced (CE)-MR images.*Methods and Materials This retrospective study enrolled 113 patients who underwent preoperative CE-MR examinations and were pathologically confirmed as HCC, including 60 poorly-differentied (PD) HCCs and 53 non-PD (well-differentied (WD) and moderately-differentied (MD)) HCCs. The samples were randomly divided into the training set (n = 90) and the testing set (n = 23) at ratio of 8:2. Figure 1 shows the flowchart of the multimodal fusion model. On the arterial (A), venous (V) and delayed (D) phase images, two radiologists manually outlined the regions of interest (ROIs) which enclosed the boundary of the lesions. We set the size of the normalized HCC slice as 224 × 224 to input into the network. ResNet-50 was used to extract senior semantic features based on each phase images. Figure 2 shows the feature extraction process of ResNet-50. We used the parameters of ResNet-50 model trained on ImageNet dataset to initialize our three ResNet-50 model. In order to make the ResNet-50 network on different phase images to better learn to express the characteristics of HCC differentiation, we deleted the last full connected layer of each ResNet-50, and then added two fully connected layers with 2048 and two neurons respectively. Finally, we added two fully connected layers followed by the three models (A, V and D). These two fully connected layers were used to fuse the senior semantic features of different phase MR images for the HCC classification task. ROC analysis was used to evaluate the diagnostic performance for differentiation of pathologic grade of HCC.*Results The multimodal fusion model showed prior performance (AUC = 0.889) compared with the single-modal model (A model: AUC = 0.579; V model: AUC: 0.793; D model: AUC = 0.681), were shown in Table 1.*Conclusions 3D-CNN model may be valuable for the noninvasive evaluation of the pathologic grade of HCC.*Clinical Relevance/Application In this study, we proposed a 3D-CNN model to preoperatively identify HCC grading, which will provide more prognostic information and facilitate clinical management.

RESULTS

The multimodal fusion model showed prior performance (AUC = 0.889) compared with the single-modal model (A model: AUC = 0.579; V model: AUC: 0.793; D model: AUC = 0.681), were shown in Table 1.

CLINICAL RELEVANCE/APPLICATION

In this study, we proposed a 3D-CNN model to preoperatively identify HCC grading, which will provide more prognostic information and facilitate clinical management.

SDP-GI-57   MRI-based Radiomic Model For Predicting Treatment Response To First Transarterial Chemoembolization In Intermediate-stage Hepatocellular Carcinoma

Participants
huanyi zhu, Nanjing, China (*Presenter*) Nothing to Disclose

PURPOSE

This article aims to construct and validate a radiomic model to predict the first-month objective treatment response of patients with intermediate-stage hepatocellular carcinoma (HCC) who received first transarterial chemoembolization (TACE), on the basis of preoperative MRI image data and clinic data.*Methods and Materials All subjects enrolled in a single-arm multicentre prospective clinical trial 'A Study of Tandem Microspheres in Localized Hepatocellular Carcinoma' were analyzed in this study. The patients were all diagnosed with intermediate-stage HCC and accepted Tandem Microspheres TACE as the first-line therapy. The demographics and laboratory test results of the subjects were collected. All patients received Tandem Microspheres TACE within 14 days after the acquisition of baseline contrast-enhanced abdominal MRI. Follow-up MRI were performed one month after the treatment. Region of interests (ROIs) were drew at the central level of the tumor on the fat-saturated T2-weighted sequence, late arterial and portal venous phase images. All lesions were separated into training and testing group randomly in the ratio of 7:3. High-throughput extraction of image features were performed with python. According to the modified Response Evaluation Criteria in Solid Tumors (mRECIST), all lesions were divided into CR group (complete response) and non-CR group (partial response / stable disease / progressive disease). Lasso regression were performed to build radiomic model, and receiver operating characteristic curve (ROC) was used to evaluate the performance of the model.*Results 109 subjects (mean age, 60.3 ± 14.7 years old) from 10 centres were included in the study and 160 lesions were analyzed. A total of 3218 radiomic features were extracted for each lesion. After dimension reduction, 10 image features were selected for radiomic model construction. The areas under the curve (AUCs) of the model were 0.748 and 0.675 in the training and the testing group, respectively. Among all features, Wavelet-LLL GLRLM Long Run Low Gray Level Emphasis from portal venous phase MR image demonstrated the greatest contribution in the model.*Conclusions The MRI-based radiomic model had a good performance in predicting the objective response after the initial TACE in patients with intermediate-stage HCC.*Clinical Relevance/Application The MRI-based radiomic model may have potential in guiding personalized TACE treatment in patients with intermediate-stage HCC.

RESULTS

109 subjects (mean age, 60.3 ± 14.7 years old) from 10 centres were included in the study and 160 lesions were analyzed. A total of 3218 radiomic features were extracted for each lesion. After dimension reduction, 10 image features were selected for radiomic model construction. The areas under the curve (AUCs) of the model were 0.748 and 0.675 in the training and the testing group, respectively. Among all features, Wavelet-LLL GLRLM Long Run Low Gray Level Emphasis from portal venous phase MR image demonstrated the greatest contribution in the model.

CLINICAL RELEVANCE/APPLICATION

The MRI-based radiomic model may have potential in guiding personalized TACE treatment in patients with intermediate-stage HCC.

SDP-GI-58 Development Of A CT-based Binary Radiological Prediction Model For Lauren Classification Of Gastric Adenocarcinoma

Participants
Jiejin Yang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to develop and compare different radiomics models (with/without clinical information) for differentiating the Lauren classification of gastric adenocarcinoma.*Methods and Materials A total of 259 portal-venous-phase CT images with Lauren classification confirmed gastric adenocarcinoma was retrospectively collected and were randomly assigned to the training set (intestinal type/non-intestinal type = 59/123) and test set (intestinal type/non-intestinal type=25/52) at a ratio of 7:3. Three kinds of clinical information were used to participate in the construction of the model, including the patient's gender, age, and tumor location. The manually segmented 3D gastric cancer label in portal venous phase CT images was used as the region of interest. After extracting features of the ROI, normalization, feature reduction, and feature selection, a simple radiomics model of Lauren classification with radiomics features and a radiomics model combining clinical information were established respectively. 5-fold cross-validation were both used in the training sets of the two models. Receiver operating characteristic (ROC) curves, accuracy, sensitivity, and specificity were used to validate the capability of the radiomics models on both the training and test cohorts. Furthermore, the decision curve analysis (DCA) was used to compare the predictive performance of the two models.*Results The DCA showed that the radiomics model combined with clinical information had better performance in predicting the Lauren classification of gastric cancer. In the test set, the model had an AUC of 0.808, and accuracy, sensitivity, and specificity of 77.9%, 84.0%, and 75.0%, respectively.*Conclusions The radiomics model combined with clinical information had better performance in predicting the Lauren classification of gastric cancer than the simple radiomics model. The patient's age, gender, and tumor location information were potentially helpful to improve the predictive performance of the Lauren classification binary radiomics model.*Clinical Relevance/Application The Lauren classification of gastric adenocarcinoma is a simple and powerful histological classification method and is widely accepted and adopted by pathologists and clinicians. Preoperative prediction of Lauren classification of gastric adenocarcinoma is of great significance for tumor treatment and prognostic evaluation. Establishing the radiomics model of differentiating Lauren classification of gastric adenocarcinoma by deeply explore CT image characteristics, could provide more information for tumor treatment, and improve the value of imaging reports.

RESULTS

The DCA showed that the radiomics model combined with clinical information had better performance in predicting the Lauren classification of gastric cancer. In the test set, the model had an AUC of 0.808, and accuracy, sensitivity, and specificity of 77.9%, 84.0%, and 75.0%, respectively.

CLINICAL RELEVANCE/APPLICATION

The Lauren classification of gastric adenocarcinoma is a simple and powerful histological classification method and is widely accepted and adopted by pathologists and clinicians. Preoperative prediction of Lauren classification of gastric adenocarcinoma is of great significance for tumor treatment and prognostic evaluation. Establishing the radiomics model of differentiating Lauren classification of gastric adenocarcinoma by deeply explore CT image characteristics, could provide more information for tumor treatment, and improve the value of imaging reports.

SDP-GI-59 Differentiation Of T2- And T3-stage Rectal Cancer Using Whole-tumor CT Radiomics Signatures

Participants
Takeshi Nakaura, MD, Kumamoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Diagnosis of the depth of rectal cancer is important in deciding the indication for preoperative chemotherapy and surgery, but it is often difficult to perform, even with endoscopy and CT. Radiomics analysis using contrast-enhanced CT has recently been found useful for tumor differentiation, malignant diagnosis, and prediction of various parameters such as gene expression. In this study, we evaluated the usefulness of CT radiomics analysis in the differentiation of T2- and T3-stage rectal cancer.*Methods and Materials Total 166 rectal cancer resections performed at our hospital from April 2019 to March 2021 were included in the study, with 87 patients placed in the training group and 29 patients in the test group. Volumes of interest of the whole tumors were manually contoured in preoperative portal-phase CT examinations, and total 115 radiomics features (14 shape features, 18 &7;rst-order intensity statistics features, and 73 texture features) were extracted. Signi&7;cant features for the differentiation of T2- and T3-stage rectal cancer were selected using the Random Forest and Boruta algorithms. Radiomics signatures were built and validated with the selected features in the training group using five-fold cross-validation. The performance of the radiomics signature was evaluated using the receiver operating characteristics curve and area under the curve (AUC) and compared with the diagnostic performance of the combination of CT and rectal endoscopy performed by two radiologists.*Results Nine radiomics factors ("Sphericity," "SurfaceArea," "Flatness," "LeastAxis," "DependenceNonUniformity," "Energy," "TotalEnergy," "RunLengthNonUniformity," and "GrayLevelNonUniformity") were extracted by variable selection using Boruta. In the test group, the AUC of the model using these parameters was 0.81, which was significantly higher (p < 0.01) than the AUCs of the radiologists using the CT (Reader 1, 0.56; Reader 2, 0.55) and the endoscope (Reader 1, 0.47; Reader 2, 0.53).*Conclusions Whole-tumor CT radiomics signatures may be a useful tool for the differentiation between T2- and T3-stage rectal cancer.*Clinical Relevance/Application Whole-tumor CT radiomics signatures can differentiate between T2- and T3-stage rectal cancer using preoperative contrast-enhanced CT with high diagnostic accuracy.

RESULTS

Nine radiomics factors ("Sphericity," "SurfaceArea," "Flatness," "LeastAxis," "DependenceNonUniformity," "Energy," "TotalEnergy,"

"RunLengthNonUniformity," and "GrayLevelNonUniformity") were extracted by variable selection using Boruta. In the test group, the AUC of the model using these parameters was 0.81, which was significantly higher (p < 0.01) than the AUCs of the radiologists using the CT (Reader 1, 0.56; Reader 2, 0.55) and the endoscope (Reader 1, 0.47; Reader 2, 0.53).

CLINICAL RELEVANCE/APPLICATION

Whole-tumor CT radiomics signatures can differentiate between T2- and T3-stage rectal cancer using preoperative contrast-enhanced CT with high diagnostic accuracy.

SDP-GI-6   Extracellular Volume Fraction With Equilibrium Contrast-enhanced MRI For Predicting Chemotherapy Response In Pancreatic Ductal Adenocarcinoma: Comparison With DCE-MRI

Participants
Yoshihiko Fukukura, MD, PhD, Kagoshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Tumor extracellular volume (ECV) fraction determined with equilibrium contrast-enhanced CT has been reported to be a useful imaging biomarker to predict the treatment response and survival of patients with pancreatic ductal adenocarcinoma (PDAC) after chemotherapy. However, the clinical relevance of ECV fraction determined with equilibrium contrast-enhanced MRI as an imaging biomarker for cancer patients has not been reported. Moreover, the exact underlining mechanisms in the association between ECV fraction and treatment response to chemotherapy in PDAC remain unclear. Therefore, this study aimed to assess the feasibility of ECV fraction with equilibrium contrast-enhanced MRI for prediction of treatment response to chemotherapy in PDAC in comparison with DCE-MRI and to clarify the association between ECV fraction and dynamic contrast-enhanced (DCE) MRI-derived parameters.*Methods and Materials This retrospective study included 34 consecutive patients (22 men, 12 women; mean age, 68.0 years; range, 47-82) with histologically confirmed PDAC who underwent DCE-MRI before systemic chemotherapy. Tumor pharmacokinetic parameters including the volume transfer coefficient (Ktrans), rate constant (kep), and extracellular extravascular volume fraction (ve) of DCE-MRI, and ECV fraction quantified with equilibrium contrast-enhanced MRI were calculated using ROI measurements within PDAC. These parameters were compared between the response (complete or partial response) and nonresponse groups (stable or progressive disease). The correlation of tumor ECV fraction with each DCE-MRI-derived parameter was examined using Spearman's rank correlation coefficient.*Results Tumor Ktrans (P=0.004), ve (P <0.001), and ECV fraction (P <0.001) were significantly higher in the response group than in the non-response group, whereas no significant difference was found in kep (P=0.190). Tumor ECV fraction showed the highest AUC of 0.910, with a sensitivity of 87.5%, specificity of 88.9%, and accuracy of 88.2% (cut off, >34.8%). The ECV fraction showed a significant positive correlation with Ktrans (Spearman's coefficient=0.68, P <0.001) and ve (Spearman's coefficient=0.82, P <0.001).*Conclusions ECV fraction determined with equilibrium contrast-enhanced MRI was as useful as DCE-MRI-derived parameters for predicting treatment response to chemotherapy in patients with PDAC.*Clinical Relevance/Application ECV fraction could offer an alternative imaging biomarker to DCE-MRI for predicting the response to chemotherapy in patients with PDAC.

RESULTS

Tumor Ktrans (P=0.004), ve (P <0.001), and ECV fraction (P <0.001) were significantly higher in the response group than in the non-response group, whereas no significant difference was found in kep (P=0.190). Tumor ECV fraction showed the highest AUC of 0.910, with a sensitivity of 87.5%, specificity of 88.9%, and accuracy of 88.2% (cut off, >34.8%). The ECV fraction showed a significant positive correlation with Ktrans (Spearman's coefficient=0.68, P <0.001) and ve (Spearman's coefficient=0.82, P <0.001).

CLINICAL RELEVANCE/APPLICATION

ECV fraction could offer an alternative imaging biomarker to DCE-MRI for predicting the response to chemotherapy in patients with PDAC.

SDP-GI-60   Development And Validation Of Radiomics Signatures To Predict Kras Mutation Subtypes Based On Enhanced Computed Tomography In Patients With Colorectal Cancer

Participants
Yuntai Cao, MS,MS, Xining, China (*Presenter*) Nothing to Disclose

PURPOSE

Recent accumulating evidence indicates different KRAS mutation subtypes have different anti-EGFR therapeutic efficacy in colorectal cancer (CRC) patients. This retrospective study was designed to investigate whether a computed tomography (CT)-based radiomic features can be non-invasively predicting KRAS mutation subtypes.*Methods and Materials Our study included 447 patients with CRCs, who underwent preoperative contrast-enhanced CT examinations and performed the KRAS mutations analysis. 1037 radiomic features were extracted from the delayed phase CT images of each patient. Three tasks (task 1, Prediction of KRAS G13D mutation; task 2, Prediction of other KRAS mutation; task 3, differentiating KRAS G13D mutation from other KRAS mutation) were performed in the current study to explore the capability of radiomic features for predicting KRAS mutation subtypes. Univariate analysis and Boruta method were used to select the key features for KRAS mutation subtypes. Radiomic models were built using the random forest (RF) analysis, and the ROC curve and corresponding AUC value, calibration curve and decision curve were used to evaluate the predictive performance and clinical usefulness of each model.*Results After removed irrelevant features, 8 radiomics features were retained as the final signatures for the prediction of KRAS G13D mutation, while 9 radiomics features were final signatures for the prediction of other KRAS mutation. Moreover, 3 features demonstrated a statistically significant in the discrimination of KRAS G13D mutation and other KRAS mutation. Based on these relevant features, this study constructed 3 radiomics models for analyzing KRAS mutation subtypes. The constructed radiomic models showed promising performance in predicting KRAS mutation subtypes. Task 1 had the AUCs of 0.759 (95CI, 0.673-0.846) and 0.790 (95CI, 0.679-0.901) in training cohort and validation cohort, respectively. Task 2 had the AUCs of 0.753 (95CI, 0.697-0.810) and 0.715 (95CI, 0.614-0.815) two cohorts, respectively. Task 3 had the AUCs of 0.785 (95CI, 0.693-0.876) and 0.773 (95CI, 0.639-0.907) in two cohorts, respectively.*Conclusions The radiomics model based on enhanced CT has promising performance for predicting KRAS mutation subtypes of CRC, and the constructed model has been effectively verified on the internal validation cohort.*Clinical Relevance/Application Our models can be used as an auxiliary tool for preoperative non-invasive detection of KRAS mutation subtypes, to achieve precise targeted therapy stratification, and help to develop effective personalized treatment strategies for patients with CRC.

RESULTS

After removed irrelevant features, 8 radiomics features were retained as the final signatures for the prediction of KRAS G13D mutation, while 9 radiomics features were final signatures for the prediction of other KRAS mutation. Moreover, 3 features demonstrated a statistically significant in the discrimination of KRAS G13D mutation and other KRAS mutation. Based on these relevant features, this study constructed 3 radiomics models for analyzing KRAS mutation subtypes. The constructed radiomic models showed promising performance in predicting KRAS mutation subtypes. Task 1 had the AUCs of 0.759 (95CI, 0.673-0.846) and 0.790 (95CI, 0.679-0.901) in training cohort and validation cohort, respectively. Task 2 had the AUCs of 0.753 (95CI, 0.697-0.810) and 0.715 (95CI, 0.614-0.815) two cohorts, respectively. Task 3 had the AUCs of 0.785 (95CI, 0.693-0.876) and 0.773 (95CI, 0.639-0.907) in two cohorts, respectively.

CLINICAL RELEVANCE/APPLICATION

Our models can be used as an auxiliary tool for preoperative non-invasive detection of KRAS mutation subtypes, to achieve precise targeted therapy stratification, and help to develop effective personalized treatment strategies for patients with CRC.

SDP-GI-61   Comparison Analysis Of Ivim And 4d Flow-MRI In Patients With Liver Cirrhosis

Participants
Nan Wang, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the correlation between liver IVIM quantitative parameters and portal vein 4D flow quantitative parameters in patients with liver cirrhosis.*Methods and Materials This study has been approved by the institutional IRB. 11 patients were recruited with informed consent acquired from each subject. All patients were scanned using a 3.0 T MR scanner (Ingenia CX, Philips Healthcare, the Netherlands) with a 16-channel abdominal array coil. The MR protocols include T1WI, T2WI, DWI, IVIM, 4D Flow and DYNAMIC sequence. For 4D Flow imaging, a 2D phase-contrast scan was performed first to measure the flow velocity in the portal vein, as a reference for velocity encodings (VENC). The 4D Flow sequence with 8-fold compressed sensing acceleration was scanned with the following parameters: axial, TR/TE = 5.0/3.2 ms, FOV = 300×350 mm2, resolution = 2.5×2.5×2.5 mm3, PC direction = RL-AP-FH, VENC = 30 cm/s, scan time = 4min37s. The detailed parameters for all the other sequences were listed in Table 1. After the MR scan is completed, the 4D flow images were processed on CVI42 package (Canada Circle Cardiovascular Imaging)by an experienced radiologist to obtain the 3D angiogram. Four planes were manually placed vertical on the targeted vessel segments to measure the flow direction,the flow rate (cm/s), the axial-wall shear stress (WSS, Pa), and the pressure gradient (mmHg). Three planes were placed at the proximal, middle, and distal of the main portal vein and one at the splenic vein confluence as reference (Figure1). The images of other sequences were analyzed on a post-processing ISP workstation (Intelli Space Portal, Philips Healthcare) to measure IVIM parameters included: sADC, D, D* and F (Figure2). Spearman test (SPSS 22.0) was used to analyze the correlation between IVIM parameters and 4D flow-MRI parameters.*Results sADC and D values were negatively correlated with the proximal Flow rate (r=0.626, P<0.05) and the middle Flow rate (r=0.709, P<0.05), respectively. D* value was positively correlated with the middle Flow and proximal Flow rate (r=0.900, P=0.037). There was no correlation among the other parameters (P>0.05).*Conclusions The changes in portal blood flow during the development of liver cirrhosis were associated with the variation of the signals in intrahepatic blood flow. There is a certain correlation among sADC and D values measured by IVIM and flow rate in 4D flow sequences. The mechanism behind this correlation need the further investigation and may shed light on the disease assessment and the development of novel therapies.*Clinical Relevance/Application The changes in portal blood flow during the development of liver cirrhosis were associated with the variation of the signals in intrahepatic blood flow.

RESULTS

sADC and D values were negatively correlated with the proximal Flow rate (r=0.626, P<0.05) and the middle Flow rate (r=0.709, P<0.05), respectively. D* value was positively correlated with the middle Flow and proximal Flow rate (r=0.900, P=0.037). There was no correlation among the other parameters (P>0.05).

CLINICAL RELEVANCE/APPLICATION

The changes in portal blood flow during the development of liver cirrhosis were associated with the variation of the signals in intrahepatic blood flow.

SDP-GI-62   Estimation Of Liver Steatosis In Patients With Non Alcoholic Fatty Liver Disease With A New Parameter Lisa That Calculates The Attenuation Of Ultrasound B-mode Acoustic Signal.

Participants
Petros Drazinos, PhD,MSc, Kifissia, Greece (*Presenter*) Nothing to Disclose

PURPOSE

Non Alcoholic Fatty Liver Disease (NAFLD) is one the most widespread type of chronic liver disease in the Western Countries. NAFLD may lead to Non Alcoholic Steatohepatitis (NASH) and, if not opposed, to Cirrhosis and liver failure. Ultrasound (US) is widely used for the disease diagnosis and staging as it is a low cost and radiation-free non invasive method. One of the US B-Mode imaging methods developed for NAFLD diagnosis is the calculation of signal attenuation. Several studies suggest that ultrasonic wave attenuation is faster in livers with increased fat content. Acoustic attenuation parameters may, therefore, contribute to fat liver content quantification. An established parameter for calculation of attenuation and hence steatosis estimation is offered by Fibroscan, known as Controlled Attenuation Parameter (CAP). CAP is measured without a visual placement of a ROI in the B-Mode acoustic window. Recently a new attenuation parameter was developed, Liver Ultrasound Attenuation (LiSA) which is similar to CAP with the addition of visual ROI placement through B-Mode imaging for attenuation measurement. Our purpose is the evaluation of the LiSA performance in Liver Steatosis Estimation using MRI-PDFF examinations as 'gold-standard'.*Methods and Materials 159 consecutive NAFLD patients were included in the study with mean age of 59 years (range: 24-85) and a mean BMI of 28.09 (range 17.3-45.6). An MRI-PDFF examination for liver steatosis quantification and an US B-Mode examination and a LiSA measurement was performed an all subjects in the study.*Results The median (IQR) values of MRI-PDFF and LiSA were 4.9% (11.2%) and 246 (71.75) db/m. The Pearson Correlation Coefficient was calculated, PCC = 0.80 with a p-value = 3.21*10-36 (<<0.05). Using regression analysis we obtained the following equation for MRI-PDFF calculation using a LiSA measurement with a Mean Absolute Error of 4.39%. MRI-PDFF=0.14*LiSA-27.79*Conclusions The attenuation parameter LiSA presented a good correlation with the liver fat percentage as measured with an MRI-PDFF examination. We can quantify liver fat content using LiSA with a mean error of 4.39%. More subjects should be included in the future so LiSA can be further evaluated as a valuable non-invasive tool estimating liver steatosis in a fatty liver.*Clinical Relevance/Application A new attenuation parameter LiSA similar to Fibroscan/CAP was evaluated in liver steatosis estimation using MRI-PDFF examinations as reference.

RESULTS

The median (IQR) values of MRI-PDFF and LiSA were 4.9% (11.2%) and 246 (71.75) db/m. The Pearson Correlation Coefficient was calculated, PCC = 0.80 with a p-value = 3.21*10-36 (<<0.05). Using regression analysis we obtained the following equation for MRI-PDFF calculation using a LiSA measurement with a Mean Absolute Error of 4.39%. MRI-PDFF=0.14*LiSA-27.79

CLINICAL RELEVANCE/APPLICATION

A new attenuation parameter LiSA similar to Fibroscan/CAP was evaluated in liver steatosis estimation using MRI-PDFF examinations as reference.

SDP-GI-63   Diagnosis Of Gastric Cancer Serosa Invasion Using A Radiomics Model Focusing On Localized Stomach Wall And Peritumoral Tissue Texture Features In Dual-Energy Computed Tomography(DECT)

Participants
Junyi Sun, Shijiazhuang, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the performance of a localized radiomics model derived from the dual-energy computed topoghapy (DECT) iodine and mixed images for the serosa invasion discriminating in patients with gastric cancer.*Methods and Materials This study retrospectively reviewed 231 patients who had postoperative pathology confirmed gastric adenocarcinoma. All patients underwent preoperative DECT scans and were randomly allocated into the developing (n= 132 for training cohort, n= 58 for test cohort) and validation cohort (n=41). The radiomics feature were extracted using a dedicated radiomics software (Frontier, Siemens). Instead of segmenting the intact volume of the lesion, ROI was placed on the most suspicious location which includes the lesion and peri-gastric fat within 5 mm at the maximum invasion layer. Meanwhile, ROI was also automatically synchronized to iodine map which can directly reflect the blood supply in that region. Intraclass correlation coefficient (ICC)>0.8 and Boruta were used to screen out the significant features for the radiomics model construction with Random Forest algorithm. Finally, a radiomics nomogram was developed by integrating the radiomics signatures and CT findings via multivariable logistic regression. The diagnostic performance between models (clinical, radiomics, and combined model) was evaluated by receiver operating characteristic (ROC) curve analysis and decision curve analysis(DCA).*Results 631 features with ICC>0.8 and the top 200 vital features from the Boruta feature selection were selected for the model construction. The radiomics model performed well in train (AUC and 95%CI, 0.9[0.84-0.95]), test (0.90[0.81-0.98]) and the validation cohort (0.849 [0.728-0.969]).The nomogram consisted of radiomics scores and the CT findings(haziness of the perigastric fat, lymph node and location)showed higher discrimination accuracy (AUC and 95%CI for training:0.92[0.87-0.97],testing:0.93[0.87-0.99],validation:0.90, [0.81-0.99]) compared to clinical model(P<0.05, AUC and 95%CI for training:0.786 [0.70- 0.86], testing:0.78 [0.65-0.91], validation:0.79 [0.66-0.93]). The DCA curves indicated the combined model was superior to the clinical model alone in terms of clinical usefulness.*Conclusions Radiomic model derived from localized tumor and peritumoral features in DECT showed an incremented diagnostic value for the identification of serosa invasion.*Clinical Relevance/Application Preoperative precise identification of serosa invasion in clinical remains a challenge. The integration of DECT image with radiomics and CT clinical finding shows great potential for discriminating of serosa invasion in gastric cancer patient.

RESULTS

631 features with ICC>0.8 and the top 200 vital features from the Boruta feature selection were selected for the model construction. The radiomics model performed well in train (AUC and 95%CI, 0.9[0.84-0.95]), test (0.90[0.81-0.98]) and the validation cohort (0.849 [0.728-0.969]).The nomogram consisted of radiomics scores and the CT findings(haziness of the perigastric fat, lymph node and location)showed higher discrimination accuracy (AUC and 95%CI for training:0.92[0.87-0.97],testing:0.93[0.87-0.99],validation:0.90, [0.81-0.99]) compared to clinical model(P<0.05, AUC and 95%CI for training:0.786 [0.70- 0.86], testing:0.78 [0.65-0.91], validation:0.79 [0.66-0.93]). The DCA curves indicated the combined model was superior to the clinical model alone in terms of clinical usefulness.

CLINICAL RELEVANCE/APPLICATION

Preoperative precise identification of serosa invasion in clinical remains a challenge. The integration of DECT image with radiomics and CT clinical finding shows great potential for discriminating of serosa invasion in gastric cancer patient.

SDP-GI-64   The Role Of Gadoxetic Acid-enhanced MRI In Predicting Severe Microvascular Invasion Of Hepatocellular Carcinoma

Participants
Jae Seok Bae, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the role of gadoxetic acid-enhanced MRI (GA-MRI) in predicting severe microvascular invasion (MVI) of hepatocellular carcinoma (HCC).*Methods and Materials We retrospectively analyzed 247 consecutive treatment-naïve patients (median age, 63 years [range, 56-69]) who underwent GA-MRI before hepatic resection for single HCC between July 2014 and December 2017. When MVI was detected on surgical specimens, the number of tumor cells and the number of invaded vessels were analyzed to identify severe-MVI. When the number of tumor cells = 50 and the number of invaded vessels = 5, the MVI was considered severe-MVI that may have a higher prognostic impact over any degree of MVI. Two radiologists independently GA-MRI images and reached a consensus for the presence of the four following imaging features that have been reported to be associated with MVI: arterial peritumoral enhancement, non-smooth tumor margin, peritumoral hypointensity on hepatobiliary phase, and satellite nodule. Logistic regression analysis was performed to identify GA-MRI imaging features that are associated with severe-MVI. Sensitivity and specificity of imaging features for detecting severe-MVI were calculated. In addition, the area under the curve of each imaging feature for detecting severe-MVI were calculated by using receiver operating characteristics curve analysis.*Results On histopathologic examination, any degree of MVI and severe-MVI were found in 88 (34%) and 54 (21%) patients, respectively. Among the GA-MRI imaging features, non-smooth tumor margin (Odds ratio [OR], 4.09; 95% confidence interval [CI], 1.32-12.74) and satellite nodule (OR, 4.27; 95% CI, 1.41-12.98) were independently associated with severe-MVI. For predicting severe-MVI, non-smooth tumor margin demonstrated a high sensitivity of 92.9% and satellite nodule demonstrated a high specificity of 96.9%. However, the areas under the curve of non-smooth tumor margin and satellite nodule for the detection of severe-MVI were 0.658 and 0.609, respectively.*Conclusions Although non-smooth tumor margin and satellite nodule were associated with severe-MVI, their diagnostic performances for predicting severe-MVI were at best modest.*Clinical Relevance/Application Considering the limited diagnostic performance of GA-MRI imaging features to detect severe-MVI, caution is needed when preoperatively predicting severe-MVI using GA-MRI.

RESULTS

On histopathologic examination, any degree of MVI and severe-MVI were found in 88 (34%) and 54 (21%) patients, respectively. Among the GA-MRI imaging features, non-smooth tumor margin (Odds ratio [OR], 4.09; 95% confidence interval [CI], 1.32-12.74) and satellite nodule (OR, 4.27; 95% CI, 1.41-12.98) were independently associated with severe-MVI. For predicting severe-MVI, non-smooth tumor margin demonstrated a high sensitivity of 92.9% and satellite nodule demonstrated a high specificity of 96.9%. However, the areas under the curve of non-smooth tumor margin and satellite nodule for the detection of severe-MVI were 0.658 and 0.609, respectively.

CLINICAL RELEVANCE/APPLICATION

Considering the limited diagnostic performance of GA-MRI imaging features to detect severe-MVI, caution is needed when preoperatively predicting severe-MVI using GA-MRI.

SDP-GI-65   Validation Of Liver Imaging Reporting And Data System Tumor In Vein Category Using CT And Hepatobiliary Agent-enhanced MR Imaging

Participants
Jae Seok Bae, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To assess the diagnostic performances of the LR-TIV category in detecting macroscopic tumor in vein (TIV) on CT and hepatobiliary contrast agent-enhanced MRI (HBA-MRI) using pathologic results as the reference standard.*Methods and Materials Between January 2010 and December 2019, 1322 consecutive patients with (n=101) or without (n=1221) macroscopic TIV who underwent both CT and HBA-MRI before hepatic resection or liver transplantation were retrospectively included. Three radiologists independently assessed the LR-TIV features of 'enhancing soft tissue in vein' and features suggestive of TIV (FSTIV), and reached a consensus. Macroscopic TIV on pathologic examination served as the reference standard. Sensitivities and specificities of the LR-TIV category without and with FSTIV were calculated, and the added value of FSTIV was evaluated using the McNemar test. Interobserver agreements were calculated using Fleiss ?.*Results In the 1322 total patients (median age, 64 years; 1053 men), without considering FSTIV, the sensitivity and specificity of 'enhancing soft tissue in vein' in detecting macroscopic TIV on pathology were 64.4% (65/101) and 99.8% (1218/1221) with CT and 62.4% (63/101) and 99.8% (1218/1221) with HBA-MRI, respectively. When considering FSTIV, the sensitivity and specificity of the LR-TIV category became 67.3% (68/101) and 99.7% (1217/1221) on both CT and HBA-MRI. There was no significant difference between measurements without and with FSTIV (P values = .18). Interobserver agreements for the LR-TIV category were nearly perfect for CT and substantial for HBA-MRI (?=0.82 and 0.75, respectively).*Conclusions The Liver Imaging Reporting and Data System tumor in vein category showed moderate sensitivity and high specificity in detecting macroscopic tumors in veins on both CT and hepatobiliary contrast agent-enhanced MRI using pathology as the reference standard.*Clinical Relevance/Application The high specificity of the LI-RADS tumor in vein category would be desirable for transplant candidates who have a sufficient enough waiting period to confirm the presence or absence of macroscopic TIV.

RESULTS

In the 1322 total patients (median age, 64 years; 1053 men), without considering FSTIV, the sensitivity and specificity of 'enhancing soft tissue in vein' in detecting macroscopic TIV on pathology were 64.4% (65/101) and 99.8% (1218/1221) with CT and 62.4% (63/101) and 99.8% (1218/1221) with HBA-MRI, respectively. When considering FSTIV, the sensitivity and specificity of the LR-TIV category became 67.3% (68/101) and 99.7% (1217/1221) on both CT and HBA-MRI. There was no significant difference between measurements without and with FSTIV (P values = .18). Interobserver agreements for the LR-TIV category were nearly perfect for CT and substantial for HBA-MRI (?=0.82 and 0.75, respectively).

CLINICAL RELEVANCE/APPLICATION

The high specificity of the LI-RADS tumor in vein category would be desirable for transplant candidates who have a sufficient enough waiting period to confirm the presence or absence of macroscopic TIV.

SDP-GI-66   Contrast-enhanced Ultrasound Liver Imaging Reporting And Data System Category M: A Systematic Review And Meta-analysis

Participants
Jaeseung Shin, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

We performed a meta-analysis to determine the proportion of identifying contrast-enhanced ultrasound (CEUS) Liver Imaging Reporting and Data System (LI-RADS) category M (LR-M) in hepatocellular carcinomas (HCCs) and non-HCC malignancies and to determine the frequency of individual CEUS LR-M imaging features.*Methods and Materials MEDLINE and EMBASE databases were searched from inception to July 23, 2020, for studies reporting the proportion of CEUS LR-M in HCC and non-HCC malignancies. The meta-analytic pooled proportions of HCC and non-HCC malignancies in the CEUS LR-M category were calculated. The meta-analytic frequencies of CEUS LR-M imaging features in non-HCC malignancies were also determined. Risk of bias and applicability were evaluated using the Quality Assessment of Diagnostic Accuracy Studies-2 tool.*Results A total of twelve studies were identified reporting the diagnostic performance of the CEUS LR-M category and seven studies reporting the frequencies of individual CEUS LR-M imaging features. The pooled proportions of HCC and non-HCC malignancies in the CEUS LR-M category were 54% (95% confidence interval [CI], 44%-65%) and 40% (95% CI, 28%-53%), respectively. The pooled frequencies of individual CEUS LR-M imaging features in non-HCC malignancies were 30% (95% CI, 17%-45%) for rim arterial phase hyperenhancement, 79% (95% CI, 66%-90%) for early (<60 s) washout, and 42% (95% CI, 21%-64%) for marked washout.*Conclusions For observations categorized as CEUS LR-M, 94% were malignancies, with HCCs representing 54% and non-HCC malignancies representing 40%. The frequencies of individual CEUS LR-M imaging features were variable, with early washout showing the highest frequency for non-HCC malignancies.*Clinical Relevance/Application Along with high proportion of overall malignancies, substantial proportion of CEUS LR-M is HCC with atypical imaging features as well as non-HCC malignancy. Therefore, the accurate diagnosis with biopsy is required for nodules with CEUS LR-M to deploy appropriate management.

RESULTS

A total of twelve studies were identified reporting the diagnostic performance of the CEUS LR-M category and seven studies reporting the frequencies of individual CEUS LR-M imaging features. The pooled proportions of HCC and non-HCC malignancies in the

CEUS LR-M category were 54% (95% confidence interval [CI], 44%-65%) and 40% (95% CI, 28%-53%), respectively. The pooled frequencies of individual CEUS LR-M imaging features in non-HCC malignancies were 30% (95% CI, 17%-45%) for rim arterial phase hyperenhancement, 79% (95% CI, 66%-90%) for early (<60 s) washout, and 42% (95% CI, 21%-64%) for marked washout.

CLINICAL RELEVANCE/APPLICATION

Along with high proportion of overall malignancies, substantial proportion of CEUS LR-M is HCC with atypical imaging features as well as non-HCC malignancy. Therefore, the accurate diagnosis with biopsy is required for nodules with CEUS LR-M to deploy appropriate management.

SDP-GI-67   Diagnostic Value Of The 2017 US Li-Rads Algorithm: Results From An Academic Medical Center In British Columbia

Participants
Rohith Bhargavan, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the 2017 US LI-RADS standardized reporting system and assess sensitivity and specificity in the detection of hepatocellular carcinoma in at risk patients.*Methods and Materials 720 patients meeting LI-RADS criteria for screening US examination were assessed over a 2.5 year period from July 2017. All examinations were performed by trained sonographers. Results of screening and surveillance examinations were recorded using the 2017 US LI-RADS categories for findings and liver visualization score using a standardized proforma. Examinations were reported by fellowship trained abdominal radiologists. All follow up imaging was reviewed for occurrence of HCC defined as LR4/5 findings on contrast enhanced CT or MR imaging.*Results 347 patients were female (48.2%), mean age at first examination 59 years (range 19-94 years). 347 patients had Hepatitis B +/- cirrhosis (67.5%) and 117 patients had Hepatitis C (16.3%), while only 21 patients had alcohol-related liver disease (2.9%). Initial US findings were US1A 491, US1B 123, US1C 20 (total US1 634). US2A 37, US2B 9, US2C 2 (total US2 48). US3A 25, US3B 10, US3C 3 (total US3 38). 170 were lost to follow-up following initial examination. Mean length of follow up was 366 days (range 2-994 days). Positive predictive value of US3 for the subsequent diagnosis of HCC/LRM was 18%. Negative predictive value of US1/2 for subsequent diagnosis of HCC/LRM was 99%. The overall sensitivity of US3 results for the diagnosis of HCC was 50% (6/12) and the specificity was 95% (511/538). Specificity was 95% in US-A, 93.5% in US-B, and 91.7% in US-C.*Conclusions LIRADS US categories provide a clinically useful screening tool for the detection of HCC in at risk patients, with high specificity and negative predictive value.*Clinical Relevance/Application In the assessment of rare occurrences of HCC in surveillance populations, US-LIRADS remains a cost-effective screening tool to increase early detection and treatment for HCC in both cirrhotic and non-cirrhotic patients.

RESULTS

347 patients were female (48.2%), mean age at first examination 59 years (range 19-94 years). 347 patients had Hepatitis B +/- cirrhosis (67.5%) and 117 patients had Hepatitis C (16.3%), while only 21 patients had alcohol-related liver disease (2.9%). Initial US findings were US1A 491, US1B 123, US1C 20 (total US1 634). US2A 37, US2B 9, US2C 2 (total US2 48). US3A 25, US3B 10, US3C 3 (total US3 38). 170 were lost to follow-up following initial examination. Mean length of follow up was 366 days (range 2-994 days). Positive predictive value of US3 for the subsequent diagnosis of HCC/LRM was 18%. Negative predictive value of US1/2 for subsequent diagnosis of HCC/LRM was 99%. The overall sensitivity of US3 results for the diagnosis of HCC was 50% (6/12) and the specificity was 95% (511/538). Specificity was 95% in US-A, 93.5% in US-B, and 91.7% in US-C.

CLINICAL RELEVANCE/APPLICATION

In the assessment of rare occurrences of HCC in surveillance populations, US-LIRADS remains a cost-effective screening tool to increase early detection and treatment for HCC in both cirrhotic and non-cirrhotic patients.

SDP-GI-68   Clinical Staging Of Mass-forming Intrahepatic Cholangiocarcinoma: CT Versus MRI

Participants
Yeun-Yoon Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To compare the performance of CT and MRI for preoperative clinical staging of mass-forming intrahepatic cholangiocarcinoma (iCCA) using the 8th American Joint Committee on Cancer (AJCC) system.*Methods and Materials This retrospective, multicenter, cohort study consecutively identified patients who underwent partial hepatectomy for mass-forming iCCA and had preoperative CT and MRI performed from January 2009 to December 2015. CT and MRI imaging characteristics were used to determine clinical stage based on the 8th AJCC system. Performances of CT and MRI for clinical T and N staging were compared using generalized estimating equations.*Results In 334 patients (median age, 63 years; 221 men), MRI sensitivities were significantly higher than CT sensitivities for detecting T1b or higher stages (91.0% vs 80.5%, P <0.001), T2 or higher stages (89.1% vs 73.8%, P <0.001), and T3 or T4 stage (77.8% vs 58.0%, P <0.001). MRI was also more sensitive at identifying multiple tumors than CT (66.7% vs 50.0%, respectively, P = 0.026), without a significant difference in specificity (78.1% vs 80.1%, respectively, P = 0.342). Sensitivities were comparable between CT and MRI for determination of size >5 cm (i.e., T1b for single tumor), and extrahepatic organ invasion (i.e., T4). Sensitivities of CT and MRI were not different for N stage (65.0% vs 64.0%, respectively, P = 0.808), but the specificity of CT was significantly higher than that of MRI (80.7% vs 72.9%, respectively, P = 0.001) when using a composite reference standard.*Conclusions MRI showed superior sensitivity to CT for diagnosing T2 and T3 stages, particularly multiple tumors. CT and MRI had comparable sensitivity for N staging, but CT provided higher specificity than MRI.*Clinical Relevance/Application MRI can more sensitively detect multiple tumors than CT in patients with iCCA, without impaired specificity, and may help decide patient eligibility for curative resection.

RESULTS

In 334 patients (median age, 63 years; 221 men), MRI sensitivities were significantly higher than CT sensitivities for detecting T1b or higher stages (91.0% vs 80.5%, P <0.001), T2 or higher stages (89.1% vs 73.8%, P <0.001), and T3 or T4 stage (77.8% vs 58.0%, P <0.001). MRI was also more sensitive at identifying multiple tumors than CT (66.7% vs 50.0%, respectively, P = 0.026), without a significant difference in specificity (78.1% vs 80.1%, respectively, P = 0.342). Sensitivities were comparable between CT and MRI for determination of size >5 cm (i.e., T1b for single tumor), and extrahepatic organ invasion (i.e., T4). Sensitivities of CT and MRI were not different for N stage (65.0% vs 64.0%, respectively, P = 0.808), but the specificity of CT was significantly higher than that of MRI (80.7% vs 72.9%, respectively, P = 0.001) when using a composite reference standard.

CLINICAL RELEVANCE/APPLICATION

MRI can more sensitively detect multiple tumors than CT in patients with iCCA, without impaired specificity, and may help decide patient eligibility for curative resection.

SDP-GI-69 Deep Learning Reconstruction (DLR): Comparison For Image Quality And Diagnostic Performance For IPMN On 3D MRCPs By Conventional Parallel Imaging, Compressed Sensing And Multiple Slice Encoding In TR (Fast 3D Mode Multiple)

Participants
Takahiro Matsuyama, Toyoake, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To compare the capability of deep learning reconstruction (DLR) for image quality and diagnostic performance improvements on 3D MRCP by conventional parallel imaging (PI), compressed sensing (CS) and multiple slice encoding in TR (Fast 3D mode multiple: i.e. Fast 3Dm) methods in patients with IPMN.*Methods and Materials 32 consecutive IPMN patients underwent 3D MRCPs by PI, CS and Fast 3Dm methods, surgical resections, and pathological examinations. Then, each MRCP data was reconstructed with and without DLR. Standard reference for IPMN was determined by pathological examination results. Examination time for each MRCP was recorded. Then, signal-to-noise ratio (SNR) and contrast ratio (CR) between pancreas and liver were assessed by ROI measurements. In addition, overall image quality and lesion depiction were assessed by 5-point scales by consensus of two readers. Moreover, IPMN types were also evaluated by consensus of two readers. Examination time, SNR and CR were compared among all MRCP data set by Tukey's HSD test. Moreover, all qualitative indexes were compared among all data set by Wilcoxon signed-rank test. Agreement for IPMN type evaluation between each MRCP data and standard reference was determined by ? statistics with ?2 test. Finally, diagnostic accuracy for IPMN evaluation was compared each other by McNemar's test.*Results Examination times of CS and Fast 3Dm were significantly shorter than that of PI (p<0.05). All image quality indexes of each method with DLR were significantly higher than those without DLR (p<0.05). In addition, each index of PI and Fast 3Dm with and without DLR showed significantly higher than those of CS with and without DLR (p<0.05). Agreements of all MRCP data except CS without DLR were substantial (0.64<?<0.79, p<0.0001), although CS without DLR was moderate (?=0.46, p<0.0001). For diagnostic performance of IPMN, all MRCP data except CS without DLR (78%<AC<88%) were significantly accurate than CS without DLR (65.5%, p<0.05).*Conclusions DLR is able to improve image quality and diagnostic performance of 3D MRCP in patients with IPMN and would be better to be applied CS rather than others in routine clinical practice.*Clinical Relevance/Application DLR is able to improve image quality and diagnostic performance in patients with IPMN and would be better to be applied CS rather than PI and Fast 3Dm.

RESULTS

Examination times of CS and Fast 3Dm were significantly shorter than that of PI (p<0.05). All image quality indexes of each method with DLR were significantly higher than those without DLR (p<0.05). In addition, each index of PI and Fast 3Dm with and without DLR showed significantly higher than those of CS with and without DLR (p<0.05). Agreements of all MRCP data except CS without DLR were substantial (0.64<?<0.79, p<0.0001), although CS without DLR was moderate (?=0.46, p<0.0001). For diagnostic performance of IPMN, all MRCP data except CS without DLR (78%<AC<88%) were significantly accurate than CS without DLR (65.5%, p<0.05).

CLINICAL RELEVANCE/APPLICATION

DLR is able to improve image quality and diagnostic performance in patients with IPMN and would be better to be applied CS rather than PI and Fast 3Dm.

SDP-GI-7 Liver Fibrosis: Staging With MR Elastography And Extracellular Volume Fraction Analysis With Contrast-enhanced CT

Participants
Keigo Yano, MD, Osaka, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To compare the accuracy of staging liver fibrosis by MR elastography and extracellular volume fraction (fECV) analysis with contrast-enhanced CT.*Methods and Materials Sixty-one consecutive patients, who underwent both liver MR imaging including MR elastography and contrast-enhanced CT before hepatic surgery, constituted the study population. Liver fibrosis stages were histopathologically confirmed with surgical specimens. Two radiologists (R1 and R2) measured liver stiffness on MR elastography and fECV with CT images, independently. Correlations between liver stiffness or fECV and pathological liver fibrosis stage were evaluated by using Spearman rank correlation coefficient [rs]. Subgroup analyses classified with pathological inflammation grade (A0, A1, and A2) were also assessed. Accuracy of liver stiffness and fECV analysis for staging liver fibrosis was assessed with receiver operating characteristic (ROC) analysis and the results were compared using the method of DeLong et al.*Results Correlation of liver stiffness with liver fibrosis stage (rs = 0.69, 0.67) was significantly superior to that of fECV (0.26, 0.30) for each radiologist (P < .01, respectively). The areas under the ROC curves for MR elastography for each stage differentiation (0.84 for F0 vs F1-4, 0.87 for F0-1 vs F2-4, 0.86 for F0-2 vs F3-4, and 0.84 for F0-3 vs F4 for R1 and 0.81, 0.87, 0.86, 0.83 for R2) were higher than those for fECV analysis with CT (0.64, 0.61, 0.61, and 0.69; P = .06, < .005, < .005, and = .06 for R1, 0.69, 0.63, 0.61, and 0.69; P = 0.2, < .01, < .005, and = 0.1 for R2, respectively). In the subgroup analyses, the correlation coefficients between liver stiffness and liver fibrosis in A0, A1 and A2 group (0.673, 0.641 and 0.622 for R1, 0.691, 0.66 and 0.56 for R2, respectively) were significantly higher than those between fECV and liver fibrosis (0.28, 0.272 and 0.199 for R1, 0.299, 0.306 and 0.012 for R2, respectively, and P < .05 for all comparisons).*Conclusions MR elastography allows more accurate liver fibrosis staging compared with fECV analysis with CT. In addition, MR elastography was less affected by the inflammatory state than fECV analysis.*Clinical Relevance/Application MR elastography is recommended over extracellular volume fraction analysis with CT for the noninvasive evaluation of the liver fibrosis stage.

RESULTS

Correlation of liver stiffness with liver fibrosis stage (rs = 0.69, 0.67) was significantly superior to that of fECV (0.26, 0.30) for each radiologist (P < .01, respectively). The areas under the ROC curves for MR elastography for each stage differentiation (0.84 for F0 vs F1-4, 0.87 for F0-1 vs F2-4, 0.86 for F0-2 vs F3-4, and 0.84 for F0-3 vs F4 for R1 and 0.81, 0.87, 0.86, 0.83 for R2) were higher than those for fECV analysis with CT (0.64, 0.61, 0.61, and 0.69; P = .06, < .005, < .005, and = .06 for R1, 0.69, 0.63, 0.61, and 0.69; P = 0.2, < .01, < .005, and = 0.1 for R2, respectively). In the subgroup analyses, the correlation coefficients between liver stiffness and liver fibrosis in A0, A1 and A2 group (0.673, 0.641 and 0.622 for R1, 0.691, 0.66 and 0.56 for R2, respectively) were significantly higher than those between fECV and liver fibrosis (0.28, 0.272 and 0.199 for R1, 0.299, 0.306 and 0.012 for R2, respectively, and P < .05 for all comparisons).

MR elastography is recommended over extracellular volume fraction analysis with CT for the noninvasive evaluation of the liver fibrosis stage.

SDP-GI-70   Establishment Of Automatic Segmentation Model Of Gastric Tumor-like Lesions Based On 3D U-Net

Participants
Jiejin Yang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Establish and validate a 3D U-Net-based automatic segmentation model of stomach tumor-like lesions using abdominal enhanced CT.*Methods and Materials To establish a segmentation model of gastric tumor-like lesions, a total of 584 portal-phase thin-layer CT images of patients with gastric tumor-like lesions diagnosed before 2019 were retrospectively collected, including 389 cases of diffuse tumor-like lesions and 195 cases of focal tumor-like lesions. According to the ratio of 8:1:1, all the data were randomly allocated to the training set (n=465), the validation set (n=60), and the test set (n=59). For external verification of the model, a total of 70 consecutive cases of gastric diffuse tumor-like lesions (35 cases) and focal tumor-like lesions (35 cases) were retrospectively collected. The 3D U-Net network architecture was adopted by the segmentation model. Using the 3D stomach wall label as a mask, and artificially outlined gastric tumor-like lesion label as the gold standard, a 3D U-Net-based gastric tumor-like lesion segmentation model was established. The accuracy of the model segmentation results was evaluated from the following three aspects: qualitative (accuracy, sensitivity), quantitative (corrected Dice correlation coefficient, and Hausdorff distance) and comprehensive evaluation (comprehensive rating table).*Results In the external validation set, with lesions as the unit, the accuracy and sensitivity of the model's qualitative evaluation were 80.5% and 94.3%, respectively. The average corrected DSC and the average corrected HD were 0.752, 20.354mm, respectively. The average corrected HD of diffuse gastric lesions was slightly worse than that of focal lesions, and the difference was statistically significant. In the comprehensive evaluation aspect, 55.7% of the cases with the subjective rating of the model prediction result above A-.*Conclusions The automatic segmentation model of gastric tumor-like lesions based on 3D U-Net has satisfactory segmentation performance.*Clinical Relevance/Application The segmentation of gastric tumor-like lesions can obtain the diameter and volume of the lesion, and provide important information for the estimation of the scope of surgical resection, the calculation of the radiation field, and the dose of tumor radiotherapy. It is also an important basis for lesion location, differential diagnosis, and staging. By using this model in conjunction with the basic gastric segmentation and classification model, the radiology department can efficiently provide more vivid lesion images and quantitative measurement information for tumor treatment, reducing the work pressure of imaging physicians.

RESULTS

In the external validation set, with lesions as the unit, the accuracy and sensitivity of the model's qualitative evaluation were 80.5% and 94.3%, respectively. The average corrected DSC and the average corrected HD were 0.752, 20.354mm, respectively. The average corrected HD of diffuse gastric lesions was slightly worse than that of focal lesions, and the difference was statistically significant. In the comprehensive evaluation aspect, 55.7% of the cases with the subjective rating of the model prediction result above A-.

CLINICAL RELEVANCE/APPLICATION

The segmentation of gastric tumor-like lesions can obtain the diameter and volume of the lesion, and provide important information for the estimation of the scope of surgical resection, the calculation of the radiation field, and the dose of tumor radiotherapy. It is also an important basis for lesion location, differential diagnosis, and staging. By using this model in conjunction with the basic gastric segmentation and classification model, the radiology department can efficiently provide more vivid lesion images and quantitative measurement information for tumor treatment, reducing the work pressure of imaging physicians.

SDP-GI-72   Evaluation Of Body Composition Measurements From Preoperative CT Using Convolutional Neural Network For Prediction Of Pancreatic Fistula And Overall Survival After Pancreaticoduodenectomy For Pancreatic Ductal Adenocarcinoma

Participants
Jeongin Yoo, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate whether body composition measurements acquired using convolutional neural network (CNN) from preoperative CT images could predict postoperative pancreatic fistula (POPF) and overall survival (OS) after pancreaticoduodenectomy in patients with pancreatic ductal adenocarcinoma (PDAC).*Methods and Materials A total of 149 patients (M:F=100:49, mean age ± standard deviation, 64.0 ± 9.1 years) who underwent pancreaticoduodenectomy for PDAC were included in this retrospective study. All patients underwent contrast-enhanced abdominal CT scan. The body composition measurements were based on CNN trained to segment portal venous phase images into skeletal muscle area, abdominal visceral fat (AVF), and subcutaneous fat (SF). Skeletal muscle area, AVF, and SF were standardized by body surface area. Electronic medical records and national registry data were reviewed to determine the diagnosis of POPF and death. POPF severity was classified into three grades (grade A, biochemical leak; grade B that requires drains either left in place >3 weeks or repositioned; and grade C that requires reoperation or lead to single or multiple organ failure and/or mortality) according to the 2016 International Study Group guideline. The independent risk factors for POPF were determined using a multivariate logistic regression model and the prognostic factors for OS were assessed using Cox proportional hazards regression analyses.*Results Among the 149 patients, 34 (22.8%) patients had POPF (grade A [n=18], grade B [n=15], and grade C [n=1]). Standardized AVF (odds ratio [OR]=1.01, p=0.001) and main pancreatic diameter (OR=0.72, p=0.028) were independent prognostic factors for POPF grade B or C (n=16). During the mean follow-up period of 29.7 months, 126 (84.6%) patients died. For prediction of OS, skeletal muscle area (hazard ration [HR]=0.56, p=0.048) and SF (HR=1.68, p=0.007) were significant factors, along with N stage (HR=1.63, p=0.017), vascular invasion (HR=1.76, p=0.005) and CA 19-9 level (HR=1.01, 0.006).*Conclusions Standardized AVF was significantly associated with POPF, while skeletal muscle area and SF were independent predictors for OS.*Clinical Relevance/Application Body composition measurements acquired using CNN from preoperative CT images could predict POPF and OS in patients who underwent pancreaticoduodenectomy for PDAC.

RESULTS

Among the 149 patients, 34 (22.8%) patients had POPF (grade A [n=18], grade B [n=15], and grade C [n=1]). Standardized AVF (odds ratio [OR]=1.01, p=0.001) and main pancreatic diameter (OR=0.72, p=0.028) were independent prognostic factors for POPF grade B or C (n=16). During the mean follow-up period of 29.7 months, 126 (84.6%) patients died. For prediction of OS, skeletal

muscle area (hazard ration [HR]=0.56, p=0.048) and SF (HR=1.68, p=0.007) were significant factors, along with N stage (HR=1.63, p=0.017), vascular invasion (HR=1.76, p=0.005) and CA 19-9 level (HR=1.01, 0.006).

CLINICAL RELEVANCE/APPLICATION

Body composition measurements acquired using CNN from preoperative CT images could predict POPF and OS in patients who underwent pancreaticoduodenectomy for PDAC.

SDP-GI-73   Automatic Pancreatic Cystic Lesions Segmentation Using Deep Learning Method: Evaluation On Arterial, Portal And Dual-phase CT

Participants
Xiheng Wang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To present a novel deep learning method for automatic pancreas and pancreatic cystic lesions(PCLs) segmentation and evaluate segmentation performance on arterial, portal and dual-phase images.*Methods and Materials We present a multi-phase multi-scale segmentation network, a framework that integrates cross-phase information of the venous and arterial phases images for multi-phase pancreas and PCLs segmentation. The network is built upon a dual-path model in which each path is intended for one phase. Inter-phase contextual information is explored via interactive linear connections between the two paths. We further devise a cross-phase attention to exploring non-euclidean relationships between phases. Besides, to effectively integrate local and global information, we adopt the multi-scale segmentation strategy. 232 patients with preoperative CT images from our institution are retrospectively enrolled, and are successively divided 151 for training, 22 for validation and 59 for testing with both arterial and portal phase CT images according to the scanning date. Dice similarity coefficient(DSC) is the objective evaluation index. Wilcoxon signed-rank test is used to compare the segmentation results of single-phase and dual-phase, p<0.05 indicates the difference is statistically significant.*Results The training and validation set has 69 males and 104 females (60.12%), with the mean age of 50 years (range: 13-75 years), and there are 29 males and 30 females (50.85%) in the testing set, with the mean age of 51 years (range: 14-79 years). There are no significant differences either in gender or mean age of the two groups (p=0.101 and 0.213, respectively). The DSC of both pancreas and PCLs segmentation are highest on dual-phase (0.928 and 0.851, respectively), which is higher than that on arterial phase (0.873 and 0.764 respectively) and portal phase (0.906 and 0.770 respectively) (both p<0.001).*Conclusions We present a multi-phase multi-scale segmentation network for pancreas and PCLs segmentation. Experimental result shows good performance of segmentation on dual-phase CT.*Clinical Relevance/Application Reliable performance of pancreas segmentation and PCLs detection on dual-phase shows promise for the following PCLs' classification. Besides, the dual-phase provides additional information for the conventional single-phase images.

RESULTS

The training and validation set has 69 males and 104 females (60.12%), with the mean age of 50 years (range: 13-75 years), and there are 29 males and 30 females (50.85%) in the testing set, with the mean age of 51 years (range: 14-79 years). There are no significant differences either in gender or mean age of the two groups (p=0.101 and 0.213, respectively). The DSC of both pancreas and PCLs segmentation are highest on dual-phase (0.928 and 0.851, respectively), which is higher than that on arterial phase (0.873 and 0.764 respectively) and portal phase (0.906 and 0.770 respectively) (both p<0.001).

CLINICAL RELEVANCE/APPLICATION

Reliable performance of pancreas segmentation and PCLs detection on dual-phase shows promise for the following PCLs' classification. Besides, the dual-phase provides additional information for the conventional single-phase images.

SDP-GI-74   Performance Evaluation Of Artificial Intelligence Technology For Fast And Accurate Bolus-tracking Process In Abdomen Enhanced CT

Participants
Juan Yu, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Process of bolus-tracking scans before enhancement CT scanning usually include monitoring location selection and region-of-interest (ROI) placement to generate time-density curve (TDC) triggering the enhanced scanning. In this study we aimed to evaluate the performance of an artificial intelligence-based technology (SmartPlan, GE Healthcare) for fast and accurate bolus-tracking process compared with manual operation by technicians.*Methods and Materials Total of 27 abdominal enhanced CT scans performed using the SmartPrep triggering technique were prospectively enrolled. The monitoring location for placing ROI by CT technicians for dynamic contrast-enhancement monitoring in bolus-tracking scans and TDC generated in the ROI were collected and recorded as the control group; The scout scans and time-resolved images were then imported into the SmartPlan software to automatically determine the monitoring location for placing ROI and to generate TDC, and the results were recorded as the experimental group. The consistency and time consuming of the location selection and the peak value of TDC curve triggering the scan between the experimental and control groups were analyzed using paired sample t-test. P < 0.05 was considered statistically significant.*Results There was no significant difference in monitoring position between the experimental group (305.33±22.63mm) and control group (305.44±22.82mm) (P=0.840). Therefore, monitoring locations are consistent with physicians' personal judgement. There was no difference in the peak value of TDC curves between the experimental group (233.40±34.05) and the control group (228.54±30.57), (P=0.093).Time consuming were found significant decreased in the experimental group compared with the control group (26.26 vs 0.600), (P=0.000).*Conclusions The AI-based automatic bolus-tracking technique can simplify CT scan process and physician intervention to provide reliable information for automatically triggering enhancement CT scanning.*Clinical Relevance/Application The intelligent automatic bolus-tracking technique based on deep learning neural network may reduce the manual intervention and simplify the process of automatically triggering enhancement CT scanning.

RESULTS

There was no significant difference in monitoring position between the experimental group (305.33±22.63mm) and control group (305.44±22.82mm) (P=0.840). Therefore, monitoring locations are consistent with physicians' personal judgement. There was no difference in the peak value of TDC curves between the experimental group (233.40±34.05) and the control group (228.54±30.57), (P=0.093).Time consuming were found significant decreased in the experimental group compared with the control group (26.26 vs 0.600), (P=0.000).

CLINICAL RELEVANCE/APPLICATION

The intelligent automatic bolus-tracking technique based on deep learning neural network may reduce the manual intervention and simplify the process of automatically triggering enhancement CT scanning.

SDP-GI-75 Prediction Of Risk Grading Of Primary Gastric Gastrointestinal Stromal Tumors: Integration Of Semantic Features, Radiomics And Deep Learning Features Of CT

Participants
Jiamei Wu, Chongqing, China (*Presenter*) Nothing to Disclose

PURPOSE

To establish and evaluate risk grading prediction models based on semantic features, radiomics and deep learning features of CT for differentiating the malignant risk of primary gastric gastrointestinal stromal tumors (GISTs).*Methods and Materials A total of 193 patients with primary gastric GISTs were enrolled. 70% of the data were used for model training and validation, and 30% were used for model testing. Senior radiologists segmented the three-dimensional images of the tumor area manually, extracted radiomics features of the region of interest, and extracted deep learning features based on ResNet50. Recursive feature elimination and multivariate logistic regression were used for feature selection and model construction. Receiver operating characteristic (ROC) curve was used to evaluate the efficacy of models. The efficacy of the radiomics and deep learning features construction models of venous phase, arterial phase and two-phase (combination of arterial & venous phases) were compared. Finally, the combined model was constructed by adding semantic features to the two-phase model. The clinical application value of the combined model was determined through the decision curve analysis (DCA) and the net reclassification index (NRI) of the combined model was analyzed.*Results The area under the curve (AUC) of the model constructed from the radiomics and deep learning features of two-phase was 0.876, which was higher than that of the model of venous or arterial phase alone (0.813, 0.838, respectively). The combined model with semantic features was more powerful than the models above, with an AUC of 0.921 (95% CI: 0.874 - 0.953) (p = 0.012, Delongtest). DCA demonstrated that the combined model was clinically useful and NRI is 0.575 (95% CI: 0.357 - 0.891).*Conclusions This study presents a combined model that incorporates semantic features, the radiomics and deep learning features of two-phase, which can be used to facilitate the preoperative individualized prediction of malignancy in primary gastric GISTs.*Clinical Relevance/Application Tumor location in GISTs is closely related to risk stratification. GISTs are most common in the stomach (about 60%). Meanwhile, some semantic features on CT have shown improved performance for diagnosis of malignancy. However, these semantic features are derived using visual assessment which can lead to variations in diagnostic accuracy. Radiomics and deep learning features can capture relationships between image voxels that can not be perceived by the naked eye. So, this study combines semantic features, radiomics and deep learning features for the precise treatment and follow-up of patients with primary gastric GISTs.

RESULTS

The area under the curve (AUC) of the model constructed from the radiomics and deep learning features of two-phase was 0.876, which was higher than that of the model of venous or arterial phase alone (0.813, 0.838, respectively). The combined model with semantic features was more powerful than the models above, with an AUC of 0.921 (95% CI: 0.874 - 0.953) (p = 0.012, Delongtest). DCA demonstrated that the combined model was clinically useful and NRI is 0.575 (95% CI: 0.357 - 0.891).

CLINICAL RELEVANCE/APPLICATION

Tumor location in GISTs is closely related to risk stratification. GISTs are most common in the stomach (about 60%). Meanwhile, some semantic features on CT have shown improved performance for diagnosis of malignancy. However, these semantic features are derived using visual assessment which can lead to variations in diagnostic accuracy. Radiomics and deep learning features can capture relationships between image voxels that can not be perceived by the naked eye. So, this study combines semantic features, radiomics and deep learning features for the precise treatment and follow-up of patients with primary gastric GISTs.

SDP-GI-76 Predicting Therapeutic Response Using Peritumoral Radiomics Based On Contrast-enhanced MRI For Patients With HCC Treated With TACE

Participants
Ying Zhao JR, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop and validate a contrast-enhanced (CE) MRI-based peritumoral radiomics to predict an early response to transarterial chemoembolization (TACE) in patients with hepatocellular carcinoma (HCC).*Methods and Materials Preoperative CE-MRI datasets of 89 HCC patients (45 objective response, 44 non-response) were collected and randomly divided into the training (n = 61) and validation cohorts (n = 28). Tumor segmentation was performed by manually delineating the region of interest (ROI) along the tumor contour on each axial slice of arterial phase (AP), portal venous phase (PVP), and delayed phase (DP) images. To capture radiomics features from the tumor periphery, the VOIperi3 and VOIperi5 were generated by automatically expanding 3 mm and 5 mm from the lesion border. The VOIplus3 and VOIplus5 were also generated with automatic tumor border expansion (3 mm and 5 mm) plus the VOI of intratumor regions (VOIintratumor), shown in Figure 1. Total 1206 radiomics features were extracted using AK software for VOIintratumor, VOIperi3, VOIperi5, VOIplus3 and VOIplus5. Five radiomics models based on intratumoral, peritumoral expansion (3 mm and 5 mm) and intratumoral plus peritumoral expansion (3 mm and 5 mm) were established using logistic regression analysis. Receiver operating characteristic curve (ROC) analysis was performed to evaluate the performance of each prediction model.*Results The radiomics models demonstrated favorable discrimination in the both cohorts (AUC: training 0.816 - 0.963, validation 0.801 - 0.903), and the radiomics model based on VOIplus3 showed the best predictive performance with the AUCs of 0.963 (95% CI, 0.921 - 1.000) and 0.903 (95% CI, 0.773 - 1.000) in the training and validation cohorts. ROC curves and discriminative performance of the five radiomics models in the two cohorts are shown in Figure 2A, 2B and Table 1. *Conclusions The radiomics approach based on peritumoral regions has potential to improve performance for response prediction using preoperative CE-MRI.*Clinical Relevance/Application In this study, we proposed a CE-MRI-based peritumoral radiomics strategy to preoperatively predict therapeutic response to TACE in HCC, which may guide further individualized surveillance and therapeutic option.

RESULTS

The radiomics models demonstrated favorable discrimination in the both cohorts (AUC: training 0.816 - 0.963, validation 0.801 - 0.903), and the radiomics model based on VOIplus3 showed the best predictive performance with the AUCs of 0.963 (95% CI, 0.921 - 1.000) and 0.903 (95% CI, 0.773 - 1.000) in the training and validation cohorts. ROC curves and discriminative performance of the five radiomics models in the two cohorts are shown in Figure 2A, 2B and Table 1.

In this study, we proposed a CE-MRI-based peritumoral radiomics strategy to preoperatively predict therapeutic response to TACE in HCC, which may guide further individualized surveillance and therapeutic option.

SDP-GI-77 Incidental Nonfunctioning Pancreatic Neuroendocrine Tumors: Contrast Enhanced Ultrasound Features In Diagnosis

Participants
Yi Dong, MD, PhD, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

More than 50% nonfunctioning pancreatic neuroendocrine tumors (pNETs) are incidental findings on cross-sectional imaging and most of these lesions are asymptomatic. We retrospectively reviewed the contrast enhanced ultrasound features of a series of pNETs, with the aim to identify the capability of preoperatively diagnosis of pNETs on the basis of their contrast enhancemennt pattern.*Methods and Materials In this retrospective study, 46 histologically proved pNETs lesions incidentally detected with ultrasound examination were included. Various ultrasound features such as size, echogenicity, presence of pancreatic duct dilation and CEUS enhancement features were evaluated and were correlated with histopathological results of tumors. Fifty-two patients with surgery and histopathologically proved pancreatic ductal adenocarcinoma (PDAC) lesions who underwent CEUS examination for pancreatic lesions were enrolled as control group.*Results After injection of ultrasound contrast agents, most pNETs lesions displayed focal hyperenhancement (40/46, 86.9 %) in the arterial phase. During the late phase, most pNETs lesions were hyper- (31/46, 67.4 %) or iso-enhancing (11/46, 23.9 %). Six patients showed vascular involvement by CEUS. Liver metastases were detected in 5 patients during the late phase scan of the whole liver. However, most of PDAC lesions showed hypoenhancement (50/52, 96.1%) during arterial phase and late phase (51/52, 98.1%) (P < 0.05).*Conclusions CEUS features may preoperatively allow the diagnosis of pNETs, assisting decisions about treatment.*Clinical Relevance/Application CEUS is helpful to differentiate pNETs from PDAC and to determine the potential of resectability.

RESULTS

After injection of ultrasound contrast agents, most pNETs lesions displayed focal hyperenhancement (40/46, 86.9 %) in the arterial phase. During the late phase, most pNETs lesions were hyper- (31/46, 67.4 %) or iso-enhancing (11/46, 23.9 %). Six patients showed vascular involvement by CEUS. Liver metastases were detected in 5 patients during the late phase scan of the whole liver. However, most of PDAC lesions showed hypoenhancement (50/52, 96.1%) during arterial phase and late phase (51/52, 98.1%) (P < 0.05).

CEUS is helpful to differentiate pNETs from PDAC and to determine the potential of resectability.

SDP-GI-78 Determination Of Reference Intervals Of Liver And Spleen Volumes Using Deep Learning CT Volumetry

Participants
Dong Wook Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To establish population-based and personalized reference intervals for liver volume, spleen volume, and liver-to-spleen volume ratio (LSVR).*Methods and Materials This retrospective study consecutively included healthy adult liver donors from 2001 to 2013 (reference group) and from 2014 to 2016 (healthy validation group) and patients with viral hepatitis from 2007 to 2017. Liver volume, spleen volume, and LSVR were measured by CT using a deep learning algorithm. In the reference group, the reference intervals for the volume indices were determined using the population-based (ranges encompassing the central 95% of donors) and personalized (quantile regression modeling of the 2.5th and 97.5th percentiles using age, sex, height, and weight) approaches. The validity of the reference intervals was evaluated in the healthy validation and the viral hepatitis group.*Results The reference and healthy validation groups had 2989 (30 years ± 9; 1828 men) and 472 (30 years ± 9; 334 men) donors, respectively. The viral hepatitis group had 158 patients (48 years ± 12; 95 men). The population-based reference intervals were 824.5-1700.0 cm3, 81.1-322.0 cm3, and 3.96-13.78 for liver volume, spleen volume, and LSVR, respectively. Formulae and a web calculator were presented to calculate the personalized reference intervals. In the healthy validation group, both the population-based and personalized reference intervals classified the volume indices of 94%-96% of the donors as falling within the normal ranges. In the viral hepatitis group, compared with the population-based reference intervals, the personalized reference intervals identified higher proportions of patients with volume indices outside the normal range, (liver volume, 21.5% vs 13.3%, P=.01; spleen volume, 29.1% vs 22.2%, P=.01; LSVR, 35.4% vs 26.6%, P<.001).*Conclusions The proposed reference intervals may enable evidence-based liver and spleen volume assessment.*Clinical Relevance/Application Deep learning-based automated CT volumetry would be implemented in the clinical practice based on the proposed reference intervals.

RESULTS

The reference and healthy validation groups had 2989 (30 years ± 9; 1828 men) and 472 (30 years ± 9; 334 men) donors, respectively. The viral hepatitis group had 158 patients (48 years ± 12; 95 men). The population-based reference intervals were 824.5-1700.0 cm3, 81.1-322.0 cm3, and 3.96-13.78 for liver volume, spleen volume, and LSVR, respectively. Formulae and a web calculator were presented to calculate the personalized reference intervals. In the healthy validation group, both the population-based and personalized reference intervals classified the volume indices of 94%-96% of the donors as falling within the normal ranges. In the viral hepatitis group, compared with the population-based reference intervals, the personalized reference intervals identified higher proportions of patients with volume indices outside the normal range, (liver volume, 21.5% vs 13.3%, P=.01; spleen volume, 29.1% vs 22.2%, P=.01; LSVR, 35.4% vs 26.6%, P<.001).

Deep learning-based automated CT volumetry would be implemented in the clinical practice based on the proposed reference intervals.

SDP-GI-79 Clinical Impact Of PET/MRI In Oligometastatic Colorectal Cancer

Participants

Felipe Furtado, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Oligometastatic colorectal cancer (CRC) is potentially curable and demands individualized strategies. This study investigated if positron emission tomography (PET)/magnetic resonance imaging (MR) had a clinical impact on oligometastatic CRC relative to the standard of care imaging (SCI).*Methods and Materials This single-center retrospective study included adult patients with oligometastatic CRC on SCI who also underwent PET/MR between 3/2016 and 3/2019. The exclusion criterion was lack of confirmatory standard of reference, either surgical pathology, intraoperative gross confirmation, or imaging follow-up. SCI consisted of contrast-enhanced (CE) computed tomography of the chest/abdomen/pelvis (CT), abdominal/pelvic CE-MR, and/or CE whole-body PET/CT with diagnostic-quality (i.e., standard radiation dose) CT. Follow-up was evaluated until 3/2020.*Results Thirty-one patients constituted the cohort, 16 (52%) male, median patient age was 53 years (interquartile range: 49-65 years). PET/MR and SCI results were divergent in 19% (95% CI 9%-37%) of the cases, with PET/MR leading to management changes in all of them. The diagnostic accuracy of PET/MR was 90±5%, versus 71±8% for SCI. In a pairwise analysis, PET/MR outperformed SCI when compared to the reference standard (p = 0.0412).*Conclusions These findings suggest the potential usefulness of PET/MR in the management of oligometastatic CRC.*Clinical Relevance/Application Oligometastatic disease is curable and demands individualized treatment. PET/MRI may aid in the clinical decision and potentially changes the management course.

RESULTS

Thirty-one patients constituted the cohort, 16 (52%) male, median patient age was 53 years (interquartile range: 49-65 years). PET/MR and SCI results were divergent in 19% (95% CI 9%-37%) of the cases, with PET/MR leading to management changes in all of them. The diagnostic accuracy of PET/MR was 90±5%, versus 71±8% for SCI. In a pairwise analysis, PET/MR outperformed SCI when compared to the reference standard (p = 0.0412).

CLINICAL RELEVANCE/APPLICATION

Oligometastatic disease is curable and demands individualized treatment. PET/MRI may aid in the clinical decision and potentially changes the management course.

SDP-GI-8   Diagnostic Performance Of Contrast Enhanced MRI In T- Restaging Of Locally Advanced Rectal Cancer Following Neoadjuvant Chemoradiotherapy

Participants
Qiaoyuan Lu, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of our study was to determine the value of contrast enhenced(ceMRI) in distinguishing between ypT0-1 and non-ypT0-1 rectal cancer following NCRT,and to compare the accuracy of restaging by ceMRI to that of the conventional combination of T2WI and DWI for the selection of Local excision candidates .*Methods and Materials This retrospective study included 334 patients with locally advanced rectal cancer evaluated from january 2014 to October 2018.All baseline and post-NCRT MRI features(mrT,mrEMVI,mrMRF, ratio of tumor involvement in the circumference of intestinal lumen and tumor location) were evaluated by two experienced radiologists. The post-NCRT T stage(ymrT) were evaluated on high b-value (b1000) DWIs together with the T2WI in the first round(named as"T2DWI Protocol"), and was evaluated again on the third series of ceMRI (named as"ceMRI Protocol")at least two weeks after completion of the first round. All patients were divided into ymrT0-1 group and non-ymrT0-1 group by 2 Protocols respectively. Pathological results(ypT0-1 and non-ypT0-1)were regarded as the gold standard. The diagnostic accuracies for the differentiation of ypT0-1tumors from non-ypT0-1 tumors with 2 protocols were compared. Multivariate regression analysis was used to explore the independent predictors of ypT0-1 lesions.*Results From January 2014 to October 2018, a total of 334 patients (231 males [69%]; mean age 57 years ± 10 [standard deviation]) were enrolled. The AUC of ceMRI protocol to predict ypT0-1 was 0.81 (95% CI, 0.75-0.88), which was better than that of T2DWI protocol (0.651) (95% CI, 0.58-0.72; P< 0.001). Multivariate logistic regression analysis revealed that ymrT on ceMRI was the independent predictor of ypT0-1 lesions(P< 0.001).*Conclusions The conventional approach of T2WI plus DWI is not applicable for the restaging of rectal cancer patients following NCRT. We found that ceMRI could distinguish residual tumor from fibrosis by their different enhancement characteristics, significantly improving the accuracy of T-restaging.*Clinical Relevance/Application The capability of ceMRI in restaging rectal cancer can provide improved individualized treatment strategies, particularly in organ-saving surgery.

RESULTS

From January 2014 to October 2018, a total of 334 patients (231 males [69%]; mean age 57 years ± 10 [standard deviation]) were enrolled. The AUC of ceMRI protocol to predict ypT0-1 was 0.81 (95% CI, 0.75-0.88), which was better than that of T2DWI protocol (0.651) (95% CI, 0.58-0.72; P< 0.001). Multivariate logistic regression analysis revealed that ymrT on ceMRI was the independent predictor of ypT0-1 lesions(P< 0.001).

CLINICAL RELEVANCE/APPLICATION

The capability of ceMRI in restaging rectal cancer can provide improved individualized treatment strategies, particularly in organ-saving surgery.

SDP-GI-80   Early Changes Of DCE-MRI Biomarkers May Predict Survival Outcomes In Patents With Advanced Hepatocellular Carcinoma Treated With 2nd-line Targeted Therapy After Sorafenib Failure

Participants
Bang Bin Chen, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose

PURPOSE

To predict survival outcomes using DCE-MRI biomarkers in patients with advanced hepatocellular carcinoma (HCC) receiving 2nd-line targeted therapy after progression from 1st-line sorafenib treatment.*Methods and Materials Methods: This study included 74 participants (men/women = 64/10, mean age 60 ± 11.8) with advanced HCC who received 2nd-line targeted therapy (n= 41 with lenalidomide; n = 33 with axitinib) after sorafenib failure from two prospective phase II studies. Among them, all patients underwent DCE-MRI at baseline, on days 3 and day 14 of treatment. The relative changes (?) of DCE-MRI parameters, including ?Peak, ?AUC, and ?Ktrans, were derived from the largest hepatic tumor. The treatment response was evaluated by The Response Evaluation Criteria in Solid Tumors (RECIST 1.1). The Cox model was used to investigate the associations of the clinical variables and DCE-MRI biomarkers with progression-free survival (PFS) and overall survival (OS).*Results The objective response rate (ORR) was 10.8%

(8/74) and the disease control rate (DCR) was 58.1% (43/74). The median PFS and OS were 1.9 and 7.8 months, respectively. On day 3, participants with low reductions in ?Peak_D3 [hazard ratio (HR) 2.58, 95% confidence interval (CI) 1.1-6.07, P = 0.017] or ?AUC_D3 (HR 1.96, 95% CI 0.96-3.99, P = 0.043) were associated with shorter PFS. On day 14, participants with low reductions of ?Peak_D14 (HR 1.95, 95% CI 0.99-3.85, P < 0.032), ?AUC_D14 (HR 1.86, 95% CI 1.12-3.08, P = 0.009), or ?Ktrans_D14 (HR 4.56, 95% CI 2.1-9.9, P < 0.001) had shorter PFS than did those with high reduction values. Also, low reductions of ?AUC_D14 (HR 1.89, 95% CI 1.12-3.18, P = 0.016) or ?Ktrans_D14 (HR 2.13, 95% CI 1.02-4.42, P = 0.038) were associated with poor OS. Among clinical variables, ORR was associated with both PFS (P = 0.001) and OS (P= 0.005). DCR was associated with PFS (P = 0.002), but not OS (P= 0.089). Cox multivariable analysis revealed that ?Ktrans_D14 (P = 0.004) remained independent predictors of PFS after control for ORR and DCR.*Conclusions Early reduction of tumor perfusion detected by DCE-MRI biomarkers, especially on day 14, may predict survival outcomes in participants with HCC receiving 2nd-line targeted therapy after sorafenib failure.*Clinical Relevance/Application Post-treatment DCE-MRI biomarkers may predict survival outcomes as early as 14 days in participants with HCC receiving 2nd-line targeted therapy after sorafenib failure.

RESULTS

The objective response rate (ORR) was 10.8% (8/74) and the disease control rate (DCR) was 58.1% (43/74). The median PFS and OS were 1.9 and 7.8 months, respectively. On day 3, participants with low reductions in ?Peak_D3 [hazard ratio (HR) 2.58, 95% confidence interval (CI) 1.1-6.07, P = 0.017] or ?AUC_D3 (HR 1.96, 95% CI 0.96-3.99, P = 0.043) were associated with shorter PFS. On day 14, participants with low reductions of ?Peak_D14 (HR 1.95, 95% CI 0.99-3.85, P < 0.032), ?AUC_D14 (HR 1.86, 95% CI 1.12-3.08, P = 0.009), or ?Ktrans_D14 (HR 4.56, 95% CI 2.1-9.9, P < 0.001) had shorter PFS than did those with high reduction values. Also, low reductions of ?AUC_D14 (HR 1.89, 95% CI 1.12-3.18, P = 0.016) or ?Ktrans_D14 (HR 2.13, 95% CI 1.02-4.42, P = 0.038) were associated with poor OS. Among clinical variables, ORR was associated with both PFS (P = 0.001) and OS (P= 0.005). DCR was associated with PFS (P = 0.002), but not OS (P= 0.089). Cox multivariable analysis revealed that ?Ktrans_D14 (P = 0.004) remained independent predictors of PFS after control for ORR and DCR.

CLINICAL RELEVANCE/APPLICATION

Post-treatment DCE-MRI biomarkers may predict survival outcomes as early as 14 days in participants with HCC receiving 2nd-line targeted therapy after sorafenib failure.

SDP-GI-81 Predicting Microvascular Invasion In Hepatocellular Carcinoma: A Dual-institution Study Based On Gadoxetate Disodium-enhanced MRI

Participants
Hanyu Jiang, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

Microvascular invasion (MVI) is an independent risk factor for increased postoperative recurrence and worse survival in patients with hepatocellular carcinoma (HCC). This dual-institution study aimed to develop a predictive model for MVI and to evaluate its capacity in stratifying postoperative survival in HCC patients.*Methods and Materials From July 2015 to November 2020, this retrospective study enrolled consecutive patients with surgically confirmed HCC who underwent preoperative gadoxetate disodium-enhanced MRI from two tertiary care hospitals. All MR images were assessed centrally by three independent masked reviewers who were blinded to the outcomes. A predictive model for MVI encompassing significant clinical and imaging features was developed via logistic regression analysis in the training center and tested in the validation center. Model performances were evaluated using area under the receiver operating curve (AUC), sensitivity and specificity. Survival was analyzed in the training center by the Kaplan-Meier method and compared with log-rank test.*Results A total of 328 (267 men; 52.4 ± 11.6 years) and 105 (89 men; 55.5 ± 10.0 years) patients were included in the training and validation center, respectively. MVI was confirmed pathologically in 158 (48.2%) patients from the training center and in 50 (47.6%) patients from the validation center. In the training center, five imaging features were significantly predictive of MVI: non-smooth tumor margin (odds ratio [OR]=4.949, p<0.001), hepatobiliary phase peritumoral hypointensity (OR=2.952, p<0.001), internal artery (OR=2.915, p<0.001), marked restricted diffusion (OR=2.820, p<0.001) and number of lesions (OR=2.261, p=0.008). Based on these features, the predictive model for MVI demonstrated an AUC of 0.823 (95% confidence interval [CI]: 0.742-0.903), a sensitivity of 64.0% (95%CI: 49.2%-77.1%) and a specificity of 81.5% (95%CI: 68.6%-90.7%) in the validation center. Patients with MVI predicted by the model had significantly shorter progression free survival (median, 486 vs. 1522 days, p<0.001) and overall survival (mean, 1422 vs. 1869 days, p<0.001) compared with those without.*Conclusions A preoperative model based on five EOB-MRI features could help accurately predict MVI and stratify postoperative survival in patients with HCC.*Clinical Relevance/Application A preoperative model based on EOB-MRI features non-smooth tumor margin, hepatobiliary phase peritumoral hypointensity, internal artery, marked restricted diffusion and number of lesions could help accurately predict MVI and stratify postoperative survival in patients with HCC.

RESULTS

A total of 328 (267 men; 52.4 ± 11.6 years) and 105 (89 men; 55.5 ± 10.0 years) patients were included in the training and validation center, respectively. MVI was confirmed pathologically in 158 (48.2%) patients from the training center and in 50 (47.6%) patients from the validation center. In the training center, five imaging features were significantly predictive of MVI: non-smooth tumor margin (odds ratio [OR]=4.949, p<0.001), hepatobiliary phase peritumoral hypointensity (OR=2.952, p<0.001), internal artery (OR=2.915, p<0.001), marked restricted diffusion (OR=2.820, p<0.001) and number of lesions (OR=2.261, p=0.008). Based on these features, the predictive model for MVI demonstrated an AUC of 0.823 (95% confidence interval [CI]: 0.742-0.903), a sensitivity of 64.0% (95%CI: 49.2%-77.1%) and a specificity of 81.5% (95%CI: 68.6%-90.7%) in the validation center. Patients with MVI predicted by the model had significantly shorter progression free survival (median, 486 vs. 1522 days, p<0.001) and overall survival (mean, 1422 vs. 1869 days, p<0.001) compared with those without.

CLINICAL RELEVANCE/APPLICATION

A preoperative model based on EOB-MRI features non-smooth tumor margin, hepatobiliary phase peritumoral hypointensity, internal artery, marked restricted diffusion and number of lesions could help accurately predict MVI and stratify postoperative survival in patients with HCC.

SDP-GI-82 Radiomic Analysis Of Gadoxetic Acid-enhanced Mri Predicts Vessels Encapsulating Tumor Clusters And Outcome In Hepatocellular Carcinoma

Participants
Fangming Chen, Wuxi, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop a model integrating multi-scale clinical and imaging factors, especially radiomic features from gadoxetic acid-enhanced MRI, for vessels encapsulating tumor clusters (VETC) prediction in hepatocellular carcinoma (HCC), and to evaluate the model's ability to predict outcomes.*Methods and Materials This retrospective two-center study included a training cohort of 152 patients at center 1 and a validation cohort of 75 patients at center 2 from Jan 2015 to Dec 2018. All the patients underwent preoperative gadoxetic acid-enhanced MRI scan and curative hepatectomy for HCC. The VETC phenotype is confirmed when unequivocal immunoreactivity of a continuous lining around tumor clusters in the CD34-stained HCC tissue section was found under light microscopy (400×). VETC-related radiomic score (Radscore) was built using 8,470 radiomic features extracted from T2- and diffusion-weighted imaging, 4 consecutive contrast-enhanced dynamics, and hepatobiliary phase images. Six clinical variables, 11 radiologic features of aggressive HCCs, and the Radscore were integrated into a prediction model, the clinic-radiologic-radiomic (CRR) model, by using multivariate logistic regression.*Results VETC HCCs were pathologically confirmed in 26%(58/227) of whole cohorts. The Radscore, comprised of ten radiomic features related to tumor size and intratumoral heterogeneity, showed significant differences according to VETC status (P <0.001). Regression analysis identified 4 risk factors of VETC HCCs, including AFP level, tumor necrosis, mosaic enhancement, and the Radscore. The CRR model achieved an area under the curve (AUC) of 0.909 in the training cohort and 0.889 in the validation cohort. CRR-predicted VETC HCC was associated with early recurrence (hazard ratio [HR]: 1.38 [1.02-2.55], P = 0.033) and disease-free survival (HR: 1.45 [1.10-2.66], P = 0.002) at multivariable analysis.*Conclusions The proposed model integrating multi-scale clinical and imaging data, especially radiomic features from gadoxetic acid-enhanced MRI, accurately predicts VETC HCCs. The model-predicted VETC HCC is associated with early disease recurrence and poor disease-free survival.*Clinical Relevance/Application VETC, a newly proposed vascular growth pattern of HCC and characterized by the presence of CD34+ vessels completely encapsulating tumor clusters, is a powerful predictor of poor survival. To date, there is no single highly reliable factor to preoperatively predict VETC HCCs. A reliable preoperative VETC HCC prediction method may be useful for identifying patients less likely to obtain a durable benefit from hepatectomy.

RESULTS

VETC HCCs were pathologically confirmed in 26%(58/227) of whole cohorts. The Radscore, comprised of ten radiomic features related to tumor size and intratumoral heterogeneity, showed significant differences according to VETC status (P <0.001). Regression analysis identified 4 risk factors of VETC HCCs, including AFP level, tumor necrosis, mosaic enhancement, and the Radscore. The CRR model achieved an area under the curve (AUC) of 0.909 in the training cohort and 0.889 in the validation cohort. CRR-predicted VETC HCC was associated with early recurrence (hazard ratio [HR]: 1.38 [1.02-2.55], P = 0.033) and disease-free survival (HR: 1.45 [1.10-2.66], P = 0.002) at multivariable analysis.

CLINICAL RELEVANCE/APPLICATION

VETC, a newly proposed vascular growth pattern of HCC and characterized by the presence of CD34+ vessels completely encapsulating tumor clusters, is a powerful predictor of poor survival. To date, there is no single highly reliable factor to preoperatively predict VETC HCCs. A reliable preoperative VETC HCC prediction method may be useful for identifying patients less likely to obtain a durable benefit from hepatectomy.

SDP-GI-83   Ultra-low Dose Pancreatic Perfusion CT Without Requiring Additional Conventional CT: Value Of Deep Learning Reconstruction

Participants
Juan Li, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the value of deep learning reconstruction (DLR) to pancreatic perfusion CT in replacing the combination of perfusion CT with conventional CT.*Methods and Materials 33 patients underwent ultra-low dose (CTDIvol 1.1mGy for each phase, total effective dose was 6.405 mSv) pancreatic perfusion CT plus conventional CT for suspected pancreatic neuroendocrine tumor were prospectively included. DLR and statistical-based iterative reconstruction (SBIR) were used for perfusion image reconstruction. SBIR images were post-processed by temporal image technique. The objective image quality (SNR, CNR) and overall image quality based on 4-point scale were compared between the four groups (DLR, SBIR images based on temporal image technique, combination of the two, conventional CT). ANOVA and Friedman test were used to do analysis.*Results All quantitative image quality parameters of DLR and SBIR based on temporal image technique are higher than that of conventional CT (all p<0.001), except for the SNR of portal vein (p=0.234 and 0.290, respectively). The overall image quality of DLR and SBIR based on temporal image technique were lower than that of conventional CT (all p< 0.05). However, there was no significant difference of the overall image quality (all scores are 4(3,4)) between the combination of the two and conventional CT (p=0.234 and 0.061 for arterial phase and portal vein phase, respectively).*Conclusions DLR has additional value to temporal image technique in assisting perfusion CT to be used alone without the requiring for additional conventional CT.*Clinical Relevance/Application DLR could be used when the temporal images have significant motion artifacts or patients with multiple neuroendocrine tumors, especially when tumors are small or absent of significant contrast enhancement.

RESULTS

All quantitative image quality parameters of DLR and SBIR based on temporal image technique are higher than that of conventional CT (all p<0.001), except for the SNR of portal vein (p=0.234 and 0.290, respectively). The overall image quality of DLR and SBIR based on temporal image technique were lower than that of conventional CT (all p< 0.05). However, there was no significant difference of the overall image quality (all scores are 4(3,4)) between the combination of the two and conventional CT (p=0.234 and 0.061 for arterial phase and portal vein phase, respectively).

CLINICAL RELEVANCE/APPLICATION

DLR could be used when the temporal images have significant motion artifacts or patients with multiple neuroendocrine tumors, especially when tumors are small or absent of significant contrast enhancement.

SDP-GI-84   Contrast Enhanced Ultrasound Features With Sonazoid Of Hepatocellular Carcinoma In The Non-cirrhotic Liver

Participants
Yi Dong, MD, PhD, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

Current report on the role of contrast enhanced ultrasound (CEUS) with Sonazoid in diagnosis hepatocellular carcinoma (HCC) in non-cirrhotic patients is limited. The aim of this retrospective study was to analyze CEUS features of histologically proven HCC in patients with non-cirrhotic liver.*Methods and Materials 96 patients with histologically proven HCC lesions with non-cirrhotic liver were retrospectively reviewed regarding CEUS features. Two radiologists assessed the CEUS enhancement pattern and came to a consensus using the WFUMB (World Federation of Societies for Ultrasound in Medicine and Biology) guideline criteria.*Results Most of the lesions were heterogeneous but predominantly hypoechoic on B mode ultrasound (64.5 %, 62/96), with ill-defined margins and irregular shapes. During the arterial phase of CEUS, most of the HCC lesions with non-cirrhotic liver displayed a heterogeneous hyperenhancement (78.1 %, 75/96) compared to the surrounding liver parenchyma. Almost 30 % of HCC lesions (28.1 %, 27/96) showed early washout (< 60 seconds). All lesions showed washout and hypoenhancement in the late phase and Kupffer phase.*Conclusions Sonazoid enhanced CEUS features of HCC lesions in non-cirrhotic patients including typically hyperenhancement in the arterial phase and relatively rapid washout in the portal venous phase, which is different from HCC in cirrhotic livers and more similar to liver metastasis.*Clinical Relevance/Application Sonazoid (GE Healthcare, Waukesha, WI, USA), a second-generation contrast agent, shows the unique property of accumulation in the liver and spleen.

RESULTS

Most of the lesions were heterogeneous but predominantly hypoechoic on B mode ultrasound (64.5 %, 62/96), with ill-defined margins and irregular shapes. During the arterial phase of CEUS, most of the HCC lesions with non-cirrhotic liver displayed a heterogeneous hyperenhancement (78.1 %, 75/96) compared to the surrounding liver parenchyma. Almost 30 % of HCC lesions (28.1 %, 27/96) showed early washout (< 60 seconds). All lesions showed washout and hypoenhancement in the late phase and Kupffer phase.

CLINICAL RELEVANCE/APPLICATION

Sonazoid (GE Healthcare, Waukesha, WI, USA), a second-generation contrast agent, shows the unique property of accumulation in the liver and spleen.

SDP-GI-85   The Application Of LI-RADS In Liver Transplantation Candidates: Determination Of Transplantation Eligibility According To The Milan Criteria

Participants
Jae Seok Bae, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To assess the performance of Liver Imaging Reporting and Data System (LI-RADS) in diagnosing hepatocellular carcinoma (HCC) and in determining liver transplantation (LT) eligibility according to the Milan criteria in LT candidates.*Methods and Materials We retrospectively analyzed 136 consecutive patients (mean age, 54 years ± 8) who underwent CT before LT between January 2010 and December 2018. All patients were in LI-RADS target population and were treatment-naïve. Two radiologists independently evaluated CT images by using LI-RADS, and reached a consensus. The positive predictive value and sensitivity of each LI-RADS category for detecting HCC were calculated by using the explanted liver as a reference standard. The accuracy of LI-RADS in determining the patient's LT eligibility by using the Milan criteria was assessed based on pathological result.*Results On histopathologic examination of explanted liver, 163 HCCs were found in 80.1% (109/136) of the patients. The positive predictive values and sensitivities of LI-RADS for detecting HCC were 95.0% (96/101) and 58.9% (96/163) when only LR-5 was considered HCC, and were 89.7% (104/116) and 63.8% (104/163) when both LR-5 and LR-4 LR-5 were considered HCC, respectively. According to pathological examination, 100 patients (73.5%) met Milan criteria and 36 patients (26.5%) were beyond the Milan criteria. The accuracy of LI-RADS in determining LT eligibility based on the Milan criteria was 93.4% (127/136) when only LR-5 was considered HCC, whereas it was 94.1% (128/136) when both LR-5 and LR-4 were considered HCC.*Conclusions In LT candidates, the LR-5 category demonstrated a high positive predictive value for detecting HCC. LI-RADS was also accurate for assessing the Milan criteria in LT candidates.*Clinical Relevance/Application LI-RADS would be useful for determining LT eligibility based on Milan criteria owing to the high positive predictive value in detecting HCC on explanted liver.

RESULTS

On histopathologic examination of explanted liver, 163 HCCs were found in 80.1% (109/136) of the patients. The positive predictive values and sensitivities of LI-RADS for detecting HCC were 95.0% (96/101) and 58.9% (96/163) when only LR-5 was considered HCC, and were 89.7% (104/116) and 63.8% (104/163) when both LR-5 and LR-4 LR-5 were considered HCC, respectively. According to pathological examination, 100 patients (73.5%) met Milan criteria and 36 patients (26.5%) were beyond the Milan criteria. The accuracy of LI-RADS in determining LT eligibility based on the Milan criteria was 93.4% (127/136) when only LR-5 was considered HCC, whereas it was 94.1% (128/136) when both LR-5 and LR-4 were considered HCC.

CLINICAL RELEVANCE/APPLICATION

LI-RADS would be useful for determining LT eligibility based on Milan criteria owing to the high positive predictive value in detecting HCC on explanted liver.

SDP-GI-86   Advantages Of The Latest Deep Learning Reconstruction Algorithm In Ultra-high-resolution Computed Tomography For Pancreatic Cystic Neoplasms

Participants
Keitaro Sofue, MD, Kobe, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Ultra-high-resolution (UHR) CT substantially increases image noise caused by insufficient incident photons on smaller detectors, which deteriorates image quality especially in the abdomen. To improve the image quality, a new deep learning reconstruction algorithm (AiCE Body Sharp; Canon Medical Systems) has been recently implemented into UHR CT of the abdomen. The purpose of this study was to investigate the image quality and clinical utility of the latest deep learning reconstruction algorithm in UHR CT for pancreatic cystic neoplasms.*Methods and Materials This retrospective study included 32 patients (17men; mean age, 67 years; mean body mass index 21.6 kg/m2) with pancreatic cystic neoplasms who underwent contrast-enhanced CT with a UHR CT scanner (Aquilion Precision; Canon Medical Systems). Image data were reconstructed with a 1024 matrix and 0.25-mm section thickness using hybrid iterative (AIDR 3D) and the latest deep learning (AiCE Body Sharp) reconstruction algorithms. Image noise of the paraspinal muscle, contrast-to-noise ratio (CNR) between the liver, pancreas, artery, or portal vein and paraspinal muscle, and pancreas-to-lesion CNR were calculated on arterial and portal venous phase images. Overall image quality, image noise, sharpness, vessel conspicuity, and lesion delineation were evaluated using a 5-point scale (1= unacceptable to 5= excellent). Presence or

absence of continuity between the cystic lesion and pancreatic duct, and thickened wall or mural nodule were also assessed with refer to endoscopic ultrasound examination. Objective and subjective assessments were compared between the two reconstruction algorithms.*Results The mean CNRs of the liver, pancreas, artery, and portal vein, and pancreas-to-lesion CNR were significantly higher in UHR CT images with AiCE Body Sharp than those in UHR CT images with AIDR 3D (P<.001 for all). Overall image quality, image noise, sharpness, and vessel conspicuity were significantly superior in UHR CT images with AiCE Body Sharp (P<.01 for all), although lesion delineation was equivalent between the two reconstruction algorithms (P=.112). Accuracy of continuity between the cystic lesion and pancreatic duct, and thickened wall or mural nodule were superior in UHR CT images with AiCE Body Sharp (P=.157 and .083, respectively).*Conclusions UHR CT images with AiCE Body Sharp can provide less image noise and high image quality CT images, which may contribute to precise evaluation of the pancreatic cystic neoplasms.*Clinical Relevance/Application Ultra-high-resolution CT with the latest deep learning-based reconstruction algorithm may contribute to precise evaluation of the pancreatic cystic neoplasms and adjacent anatomical structures.

RESULTS

The mean CNRs of the liver, pancreas, artery, and portal vein, and pancreas-to-lesion CNR were significantly higher in UHR CT images with AiCE Body Sharp than those in UHR CT images with AIDR 3D (P<.001 for all). Overall image quality, image noise, sharpness, and vessel conspicuity were significantly superior in UHR CT images with AiCE Body Sharp (P<.01 for all), although lesion delineation was equivalent between the two reconstruction algorithms (P=.112). Accuracy of continuity between the cystic lesion and pancreatic duct, and thickened wall or mural nodule were superior in UHR CT images with AiCE Body Sharp (P=.157 and .083, respectively).

CLINICAL RELEVANCE/APPLICATION

Ultra-high-resolution CT with the latest deep learning-based reconstruction algorithm may contribute to precise evaluation of the pancreatic cystic neoplasms and adjacent anatomical structures.

SDP-GI-87   Feasibility Of Four-dimensional Flow MRI To Assess Collateral Vessels In The Portal Hypertension Of Liver Cirrhosis

Participants
Nan Wang, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the feasibility of 4D flow MRI in assessing the patency of collateral vessels in the portal hypertension of liver cirrhosis.*Methods and Materials This study has been approved by the local IRB. 15 patients with clinically diagnosed liver cirrhosis were retrospectively selected for this study. Imaging was performed on a 3.0T MR scanner (Ingenia CX, Philips Healthcare, Netherlands) with a 16-channel abdominal array coil. The MR protocols included a 2D quantitative flow sequence to measure the flow velocity in the portal vein as a reference for velocity encodings and a 4D flow sequence with CS for hemodynamics quantification. VENC was set to 30 cm/s for the 4D flow sequence to slightly surpass the measured velocity and avoid phase wrapping. Combined with gastroscopy and imaging findings, patients with liver cirrhosis were divided into normal group and collateral circulation group. The acquired images were processed on CVI42 package by an experienced radiologist to obtain the 3D angiogram. Four cut planes were manually placed to measure the flow,the flow rate (cm/s), the axial-wall shear stress (WSS, Pa), and the pressure gradient (mmHg) in the targeted vessel segments. Three planes were placed at the proximal, middle, and distal of the main portal vein and one at the splenic vein confluence as reference (Figure 1). The Mann-Whitney U test was used to analyze the difference of flow, the flow rate, axial-wall shear stress, and pressure gradient measured from the normal group and the collateral circulation group on the platform of SPSS22.0 (IBM). ROC analysis was employed to evaluate the diagnostic performance of the flow and the pressure gradient in the middle portal vein on patency of collateral circulation.*Results The values of the flow and the pressure gradient in the middle portal vein of cirrhotic patients with collateral circulation were higher than those without collateral circulation, and the difference was statistically significant. There was no statistical difference in quantitative parameters from other parts of the portal vein (Table 1). The AUCs of flow, pressure gradient, and flow combined with pressure gradient were 0.911, 0.833, and 0.956 (Figure 2 and Table 2). The sensitivity was 88.9%, and the specificity was 100% when the joint use quantitative values of flow, pressure gradient.*Conclusions Portal vein hypertension could be measured noninvasively using 4D flow MRI, which helps diagnose whether the collateral circulation is open or not. This strategy provides a quantitative guidance on choosing proper medical interventions for patients with liver fibrosis.*Clinical Relevance/Application Portal vein hypertension could be measured noninvasively using 4D flow MRI, which helps diagnose whether the collateral circulation is open or not.

RESULTS

The values of the flow and the pressure gradient in the middle portal vein of cirrhotic patients with collateral circulation were higher than those without collateral circulation, and the difference was statistically significant. There was no statistical difference in quantitative parameters from other parts of the portal vein (Table 1). The AUCs of flow, pressure gradient, and flow combined with pressure gradient were 0.911, 0.833, and 0.956 (Figure 2 and Table 2). The sensitivity was 88.9%, and the specificity was 100% when the joint use quantitative values of flow, pressure gradient.

CLINICAL RELEVANCE/APPLICATION

Portal vein hypertension could be measured noninvasively using 4D flow MRI, which helps diagnose whether the collateral circulation is open or not.

SDP-GI-88   The Risk Stratification For Hypervascular Transformation Of Hepatobiliary Phase Hypointense Nodules Without Arterial Phase Hyperenhancement On Gadoxetic Acid-enhanced MRI

Participants
Na Li, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To establish a risk stratification scale based on the combination of imaging findings which enable to predict hypervascular transformation for Hepatobiliary phase hypointense (HBP) hypointense nodules without Arterial phase hyperenhancement (APHE).*Methods and Materials In this retrospective, single-institutional study during January 2015 to January 2017, a total of 55 HBP hypointense nodules without APHE in 35 patients with chronic liver disease were investigated. After reviewing the regular 3~6 months interval follow-up MRI examinations and analyzing the primary endpoint of the nodules: transformed to hypervascular HCC or not (remained stable, size decreased, or disappeared). Univariate and multivariate analysis with a Cox proportional hazard regression model were performed to identify imaging findings which enabled predicting the hypervascular transformation. Establish a

risk stratification scale based on combining the contributing imaging findings and evaluate its efficacy.*Results Two MR imaging features were independently associated with hypervascular transformation: diffusion weighted imaging (DWI) hyperintensity (odds ratio [OR] = 4.984; 95% confidence interval [CI]: 1.599, 15.538; p=0.006) and portal venous phase (PVP) hypointensity (OR = 4.079; 95% CI: 1.430, 11.639; p = 0.009). When two imaging findings were combined, the specificity was 100% (28/28) though the sensitivity was insufficient (37.03%, 10/27). When either DWI hyperintensity or PVP hypointensity was satisfied, the sensitivity was 88.89% (24/27) while the specificity was 67.86% (19/28). Based on the observation of nodules with both, either or none of these two findings, the risk for hypervascular transformation was divided into: high, intermediate and low, respectively. The area under the curve (AUC) of receiver operator characteristics (ROC) of the risk scale for transformation was 0.843 (95%CI, 0.739-0.948. The mean interval for transformation for nodules with high, intermediate and low risk was 329 (95% CI, 195-463), 1066 (95% CI, 743-1388) and 2258 (95% CI, 1738-2778) days, respectively (P<0.001).*Conclusions A combination of two findings in gadoxetic acid-enhanced MRI: DWI hyperintensity and PVP hypointensity, can be used as high-risk indicator for hypervascular transformation, while nodules with either finding should be followed-up closely for the intermediate potential for transformation.*Clinical Relevance/Application To establish a risk stratification scale based on the combination of imaging findings which enabled to predict hypervascular transformation for HBP hypointense nodules without APHE and to provide evidence for making more appropriate imaging diagnosis and next-step clinical allocation.

RESULTS

Two MR imaging features were independently associated with hypervascular transformation: diffusion weighted imaging (DWI) hyperintensity (odds ratio [OR] = 4.984; 95% confidence interval [CI]: 1.599, 15.538; p=0.006) and portal venous phase (PVP) hypointensity (OR = 4.079; 95% CI: 1.430, 11.639; p = 0.009). When two imaging findings were combined, the specificity was 100% (28/28) though the sensitivity was insufficient (37.03%, 10/27). When either DWI hyperintensity or PVP hypointensity was satisfied, the sensitivity was 88.89% (24/27) while the specificity was 67.86% (19/28). Based on the observation of nodules with both, either or none of these two findings, the risk for hypervascular transformation was divided into: high, intermediate and low, respectively. The area under the curve (AUC) of receiver operator characteristics (ROC) of the risk scale for transformation was 0.843 (95%CI, 0.739-0.948. The mean interval for transformation for nodules with high, intermediate and low risk was 329 (95% CI, 195-463), 1066 (95% CI, 743-1388) and 2258 (95% CI, 1738-2778) days, respectively (P<0.001).

CLINICAL RELEVANCE/APPLICATION

To establish a risk stratification scale based on the combination of imaging findings which enabled to predict hypervascular transformation for HBP hypointense nodules without APHE and to provide evidence for making more appropriate imaging diagnosis and next-step clinical allocation.

SDP-GI-89   Assessment Of Prognostic Value And Interreader Agreement Of Anali Scores In Patients With Primary Sclerosing Cholangitis

Participants
Aristeidis Grigoriadis, STOCKHOLM, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

The aim of the study is two-fold, namely to both assess the interreader agreement between expert radiologists of the two ANALI scores and of the radiological parameters they utilize, and to test the performance of the scores in our population.*Methods and Materials Three radiologists evaluated MRIs of 98 PSC patients from a prospectively collected cohort with a median follow-up of 6.7 years. Each parameter of ANALI scores was assessed, and the scores were calculated. Interreader agreement was assessed with intraclass correlation coefficient (ICC). The prognostic value of the ANALI scores was assessed by means of Cox regression analysis, and outcome-free survival rates were evaluated by means of Kaplan-Meier estimates.*Results The ANALI score without gadolinium had poor to moderate interreader agreement (ICC=0.56, 95% CI, 0.42-0.68) and with gadolinium poor agreement (ICC=0.30, 95% CI, 0.16- 0.44). Liver deformity (ICC=0.28, 95% CI, 0.13-0.44)and parenchymal enhancement heterogeneity (ICC=0.24, 95% CI, 0.12-0.38) had poor agreement. Portal hypertension (ICC=0.48, 95% CI, 0.36-0.59) had poor to moderate agreement and dilatation of the intrahepatic ducts had moderate agreement (ICC=0.64, 95% CI, 0.54-0.73). Hazard ratios for liver-related death, transplantation or cirrhosis decompensation of the ANALI scores with and without gadolinium were 3.53 (95% CI, 1.40- 8.93) and 2.25 (95% CI, 1.56-3.24), respectively. Outcome-free survival was better for patients with low ANALI scores.*Conclusions The ANALI scores show poor to moderate agreement, which challenges their usefulness in clinical practice. They are associated with clinical outcomes, confirming the value of imaging in prognosis of PSC, but need further fine-optimization and multicenter evaluation.*Clinical Relevance/Application There is need for prognostic markers in primary sclerosing cholangitis (PSC). The two prognostic ANALI scores utilize magnetic resonance imaging (MRI); however, their reproducibility is unknown. In 98 PSC patients the interreader agreement between experienced radiologists for the ANALI scores and the radiological parameter they utilize was shown to be poor to moderate which challenges their usefulness in everyday clinical practice. On the other hand, imaging parameters seem to be good candidates as prognostic markers, as the current study shows good association of radiological parameters to clinical outcomes. MRI is well established for the diagnosis and detection of complications in PSC patents. However, for prognostication, including the ANALI scores, fine optimisation and multicenter validation is necessary before implementation in clinical practice.

RESULTS

The ANALI score without gadolinium had poor to moderate interreader agreement (ICC=0.56, 95% CI, 0.42-0.68) and with gadolinium poor agreement (ICC=0.30, 95% CI, 0.16- 0.44). Liver deformity (ICC=0.28, 95% CI, 0.13-0.44)and parenchymal enhancement heterogeneity (ICC=0.24, 95% CI, 0.12-0.38) had poor agreement. Portal hypertension (ICC=0.48, 95% CI, 0.36-0.59) had poor to moderate agreement and dilatation of the intrahepatic ducts had moderate agreement (ICC=0.64, 95% CI, 0.54-0.73). Hazard ratios for liver-related death, transplantation or cirrhosis decompensation of the ANALI scores with and without gadolinium were 3.53 (95% CI, 1.40- 8.93) and 2.25 (95% CI, 1.56-3.24), respectively. Outcome-free survival was better for patients with low ANALI scores.

CLINICAL RELEVANCE/APPLICATION

There is need for prognostic markers in primary sclerosing cholangitis (PSC). The two prognostic ANALI scores utilize magnetic resonance imaging (MRI); however, their reproducibility is unknown. In 98 PSC patients the interreader agreement between experienced radiologists for the ANALI scores and the radiological parameter they utilize was shown to be poor to moderate which challenges their usefulness in everyday clinical practice. On the other hand, imaging parameters seem to be good candidates as prognostic markers, as the current study shows good association of radiological parameters to clinical outcomes. MRI is well established for the diagnosis and detection of complications in PSC patents. However, for prognostication, including the ANALI scores, fine optimisation and multicenter validation is necessary before implementation in clinical practice.

SDP-GI-9   **The Added Value Of Virtual Monoenergetic Imaging With Dual-layer Spectral Detector CT To Conventional Polyenergetic Imaging For Detecting Small Pancreatic Ductal Adenocarcinoma**

Participants
Yoshihiko Fukukura, MD, PhD, Kagoshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Dual-layer spectral detector CT (DLCT) enables retrospective reconstruction of virtual monoenergetic imaging (VMI) in addition to conventional polyenergetic imaging (PEI) to optimize tumor conspicuity. However, no prior studies have investigated the potential added value of VMI in the detection of pancreatic ductal adenocarcinoma (PDAC). Therefore, the purpose of this study was to evaluate the benefit of adding VMI to PEI in the preoperative detection of small PDAC.*Methods and Materials This study included consecutive 82 patients with pathologically confirmed small PDAC (=30 mm; mean size, 22 mm; range, 7-30 mm) and 20 patients without a pancreas tumor who underwent three-phase contrast-enhanced DLCT. Three observers reviewed the two image sets, a 120kVp PEI set and a combined image set (120kVp PEI + 40 keV VMI) to evaluate the detection of small PDAC using receiver operating characteristic analysis. Tumors' visual attenuation on each phase and tumor-to-pancreas contrast-to-noise ratio (CNR) was compared between 120kVp PEI and 40 keV VMI.*Results Area under the receiver operating characteristic curve values for the three observers were 0.974, 0.965, and 0.960 for the PEI set and 0.992, 0.993, and 0.986 for the combined image set (P=0.017-0.029), respectively. The combined image set (89.0% [observer 1]; 93.9% [observer 2], 98.8% [observer 3]) yielded better sensitivity than the conventional image set (78.0% [observer 1]; 84.1% [observer 3], 85.4% [observer 3]) (P=0.001-0.023) without loss of specificity (all, P>0.999). Tumor-to-pancreas CNR of 40 keV VMI was approximately threefold higher than those of conventional 120 kVp PEI.*Conclusions The addition of 40 keV VMI to conventional PEI had better sensitivity for detecting small PDAC.*Clinical Relevance/Application In preoperative evaluation of small pancreatic adenocarcinoma, the addition of 40 keV virtual monoenergetic imaging to conventional polyenergetic imaging improves the sensitivity of cancer detection.

RESULTS

Area under the receiver operating characteristic curve values for the three observers were 0.974, 0.965, and 0.960 for the PEI set and 0.992, 0.993, and 0.986 for the combined image set (P=0.017-0.029), respectively. The combined image set (89.0% [observer 1]; 93.9% [observer 2], 98.8% [observer 3]) yielded better sensitivity than the conventional image set (78.0% [observer 1]; 84.1% [observer 3], 85.4% [observer 3]) (P=0.001-0.023) without loss of specificity (all, P>0.999). Tumor-to-pancreas CNR of 40 keV VMI was approximately threefold higher than those of conventional 120 kVp PEI.

CLINICAL RELEVANCE/APPLICATION

In preoperative evaluation of small pancreatic adenocarcinoma, the addition of 40 keV virtual monoenergetic imaging to conventional polyenergetic imaging improves the sensitivity of cancer detection.

SDP-GI-90   **Computed Tomography In Evaluating Gastroesophageal Varices In Patients With Liver Cirrhosis: A Systematic Review And Meta-analysis**

Participants
Jinkui Li, Lanzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

This systematic review and meta-analysis was designed to evaluate the accuracy of computed tomography (CT) as a noninvasive method for diagnosing gastroesophageal varices (GEV) and identifying high-risk varices in patients with liver cirrhosis in reference to esophagogastroduodenoscopy (EGD).*Methods and Materials A systemic literature search of PubMed, Embase, Cochrane Library, and Web of Science databases were conducted to identify eligible articles. The following indices were calculated: pooled sensitivity (SEN) and specificity (SPE), positive and negative likelihood ratio (PLR and NLR), diagnostic odds ratio (DOR), and area under receiver operating characteristics(AUC). Subgroup analyses were also carried out according to the location of varices, CT technique, and study design. All statistical analyses were conducted by STATA 15.0,Meta-Disc 1.4 and RevMan 5.4.*Results Finally, 26 eligible studies were included, including 17 articles evaluating the presence of high-risk varices. Data were presented based on patient in 25 articles, while only one was presented based on number of varices. Based on patients, the pooled SEN, SPE, PLR, NLR, DOR, and AUC of CT for predicting any size and high-risk GEV were 0.91/0.81/4.73/0.11/41.60/0.93 and 0.89/0.90/8.86/0.12/75.71/0.95, respectively. Subgroup analysis: 1) accuracy was found in predicting any size esophageal varices (AUC=0.93) alone than any size gastric varices alone (AUC=0.89) (P<0.05); 2) CT performed with = 16-slice scanner (AUC=0.95) showed significantly better accuracy for predicting any size GEV compared with imaging performed with < 16-slice scanner (AUC=0.81), and with 64-slice CT (SEN=0.97) might be more sensitive to detect any size GEV than 16-slice CT (SEN=0.92) (P<0.05); 3) prospective study showed better performance in identifying any size GEV(AUC=0.95) than retrospective studies (AUC=0.90) (P<0.05). In the subgroup analysis of the cut-off of high-risk esophageal varices, a cut-point of 3mm seems to have the best diagnostic performance (AUC=0.99). Five of the included studies suggested that most patients prefer undergoing CT scan instead of EGD for screening for varices. A Deek's funnel plot indicated a low probability for publication bias*Conclusions CT had both high diagnostic accuracy for evaluating any size and high-risk varices in cirrhotic patients. As a more tolerable modality, CT could potentially replace EGD as a primary screening method.*Clinical Relevance/Application Such a high diagnostic accuracy of CT scans for predicting varices is clinically meaningful for cirrhotic patients with portal hypertension. If high-risk varices is identified at CT scans, early intervention would be helpful to reduce the risk of variceal bleeding.

RESULTS

Finally, 26 eligible studies were included, including 17 articles evaluating the presence of high-risk varices. Data were presented based on patient in 25 articles, while only one was presented based on number of varices. Based on patients, the pooled SEN, SPE, PLR, NLR, DOR, and AUC of CT for predicting any size and high-risk GEV were 0.91/0.81/4.73/0.11/41.60/0.93 and 0.89/0.90/8.86/0.12/75.71/0.95, respectively. Subgroup analysis: 1) accuracy was found in predicting any size esophageal varices (AUC=0.93) alone than any size gastric varices alone (AUC=0.89) (P<0.05); 2) CT performed with = 16-slice scanner (AUC=0.95) showed significantly better accuracy for predicting any size GEV compared with imaging performed with < 16-slice scanner (AUC=0.81), and with 64-slice CT (SEN=0.97) might be more sensitive to detect any size GEV than 16-slice CT (SEN=0.92) (P<0.05); 3) prospective study showed better performance in identifying any size GEV(AUC=0.95) than retrospective studies (AUC=0.90) (P<0.05). In the subgroup analysis of the cut-off of high-risk esophageal varices, a cut-point of 3mm seems to have the best diagnostic performance (AUC=0.99). Five of the included studies suggested that most patients prefer undergoing CT scan instead of EGD for screening for varices. A Deek's funnel plot indicated a low probability for publication bias

CLINICAL RELEVANCE/APPLICATION

Such a high diagnostic accuracy of CT scans for predicting varices is clinically meaningful for cirrhotic patients with portal hypertension. If high-risk varices is identified at CT scans, early intervention would be helpful to reduce the risk of variceal bleeding.

SDP-GI-91 Deep Learning For The Automatic Detection Of The Adhesive-related Small Bowel ObstrucionTransition Zone

Participants
Quentin Vanderbecq, Paris, France (*Presenter*) Nothing to Disclose

PURPOSE

To train machine learning models to locate the transition zone of adhesive related small bowel obstruction (SBO) in CT scans.*Methods and Materials We used 562 CT examinations performed between January 2005 and July 2018 from 404 patients with diagnosis of adhesive related SBO. Annotation of the transition zone was performed by experimented radiologists and trained residents with bounding boxes. A pretrained model was used to extract abdominal and pelvic areas as a preprocessing. We modeled the localization problem of the transition zone as a binary classification problem by splitting the abdominal and pelvic area into 125 patches and trained a neural network model to classify each patch as containing or not a transition zone. We coupled this with a trained probabilistic estimation of the presence of a transition zone in each patch. The models were evaluated first using Area under the curve metric (AUC). Secondly, in order to evaluate the clinical benefit, we measured the ratio of abdomen volume classified as containing the transition zone for a given localization success rate.*Results SBO transition zone had a higher probability to locate in the hypogastric region. The coupled classification network and spatial probability estimation obtained an AUC of 0.94. For a 15% volume ratio classified as transition zone the probability to contain the transition zone is 92%.*Conclusions Modeling the SBO localization problem by coupling CNN classification and probabilistic localization estimation shows the way to a possible automatic detection of the transition zone, a complex radiological task with a high clinical impact.*Clinical Relevance/Application Help radiologists to detection of the SBO transition zone, to improve workflow and accuracy of this task.

RESULTS

SBO transition zone had a higher probability to locate in the hypogastric region. The coupled classification network and spatial probability estimation obtained an AUC of 0.94. For a 15% volume ratio classified as transition zone the probability to contain the transition zone is 92%.

CLINICAL RELEVANCE/APPLICATION

Help radiologists to detection of the SBO transition zone, to improve workflow and accuracy of this task.

SDP-GI-92 How Much Abdominal Fat Do Obese Patients Lose Short Term After Laparoscopic Sleeve Gastrectomy? A Quantitative Study Evaluated With MRI

Participants
Jing Sun, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to elucidate the changes in the amount of abdominal adipose tissue after laparoscopic sleeve gastrectomy in obese Chinese patients over a relatively short follow-up period. The differences in surgical effects between genders would also be analyzed.*Methods and Materials We enrolled 91 patients, including 18 males and 73 females, who underwent laparoscopic sleeve gastrectomy between November 2017 and November 2019. The areas of subcutaneous/visceral adipose tissue and the liver proton density fat fraction were calculated before and short term after surgery with upper abdominal magnetic resonance examinations.*Results Approximately 100 days after surgery, the median values of weight loss and body mass index reduction were 23.1 kg and 8.1 kg/m2, respectively. The patients achieved a greater absolute loss of subcutaneous adipose tissue index than of visceral adipose tissue index (3.2×10^{-3} vs 1.6×10^{-3}, p<0.001). The amounts of weight loss, body mass index loss and absolute/relative reduction in visceral adipose tissue index were much greater in males than in females (31.7 kg vs 21.7 kg, p<0.001; 9.8 kg/m2 vs 7.9 kg/m2, p=0.016; 2.5×10^{-3} vs 1.3×10^{-3}, p=0.007; 28.2% vs 20.9%, p=0.029). There was a correlation between decreased amounts in subcutaneous and visceral adipose tissue in sum and weight loss (r=0.282, p=0.032). The absolute/relative reduction in visceral adipose tissue index was also correlated with absolute/relative reduction in liver proton density fat fraction (r=0.283, p=0.013; r=0.372, p=0.001).*Conclusions The reductions in body weight and visceral fat were more significant in male patients. The sum of absolute reduction in subcutaneous and visceral fat depots was correlated with weight loss. For severely obese patients, an upper abdominal MR examination could assess the body tissue composition and how it changes after bariatric surgery.*Clinical Relevance/Application Clinicians are recommended the use of upper abdominal MR for the preoperative and postoperative evaluation of body tissue composition.

RESULTS

Approximately 100 days after surgery, the median values of weight loss and body mass index reduction were 23.1 kg and 8.1 kg/m2, respectively. The patients achieved a greater absolute loss of subcutaneous adipose tissue index than of visceral adipose tissue index (3.2×10^{-3} vs 1.6×10^{-3}, p<0.001). The amounts of weight loss, body mass index loss and absolute/relative reduction in visceral adipose tissue index were much greater in males than in females (31.7 kg vs 21.7 kg, p<0.001; 9.8 kg/m2 vs 7.9 kg/m2, p=0.016; 2.5×10^{-3} vs 1.3×10^{-3}, p=0.007; 28.2% vs 20.9%, p=0.029). There was a correlation between decreased amounts in subcutaneous and visceral adipose tissue in sum and weight loss (r=0.282, p=0.032). The absolute/relative reduction in visceral adipose tissue index was also correlated with absolute/relative reduction in liver proton density fat fraction (r=0.283, p=0.013; r=0.372, p=0.001).

CLINICAL RELEVANCE/APPLICATION

Clinicians are recommended the use of upper abdominal MR for the preoperative and postoperative evaluation of body tissue composition.

SDP-GI-93 Unenhanced CT For Non-invasive Diagnosis Of Hepatic Steatosis Using Low Tube Voltage CT

Participants
Yunjung Choi, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Unenhanced CT is reported to have high specificity for diagnosing moderate to severe hepatic steatosis. However, previous results are derived from 120 kVp scans. Lowering kVp affects the image contrast and CT attenuation values of low kVp CT is different from those of 120 kVp scans. The purposes of this study are to determine the diagnostic performance and to establish the reference range of low kVp unenhanced CT for the assessment of hepatic steatosis in liver transplantation donors using MRS as a reference standard*Methods and Materials This retrospective study included 165 potential donors (M:F=114:51, 36.5±12 years old) who underwent 100 kVp single slice unenhanced CT scan and MRS. The difference between hepatic and splenic attenuation (CTL-S) and liver-to-spleen attenuation ratio (CTL/S) were measured. Reference standard was the fat signal fraction measured by MR spectroscopy. The limits of agreement between CT measurements and the reference standard were calculated. Area under receiver operating curves (AUROC) of CTL-S and CTL/S were compared for diagnosing moderate to severe degree hepatic steatosis. The cut-off values of CTL-S and CTL/S that provided 1) a balance between sensitivity and specificity, and 2) the highest specificity using the lower limit of the reference range were calculated.*Results Eighty-seven subjects were confirmed to have non-steatotic liver. Sixty-one subjects had mild degree steatosis and 17 subjects with moderate to severe steatosis based on MR spectroscopy. CTL-S and CTL/S values showed negative correlation with the degree of the fat signal fraction (p<0.001) and the limits of agreement were -8.4% to 8.4% for CTL-S and -9.6% to 9.6% for CTL/S. AUROCs of CTL-S and CTL/S for diagnosing moderate to severe steatosis were 0.956 and 0.957, respectively. Cut-off values of CTL-S and CTL/S for diagnosis moderate to severe degree steatosis by the Youden index were -0.5 HU and 0.99 for CTL-S and CTL/S, respectively, with sensitivity and specificity of 100% and 84.46%, respectively. Reference ranges of non-steatotic liver were -6.90 to 31.40 HU for CTL-S and 0.89 to 1.77 for CTL/S. With -6.9 HU for CTL-S and 0.89 for CTL/S as the cut-off values, the sensitivity and specificity for diagnosing moderate to severe steatosis were 70.59 and 90.54% for CTL-S and 76.47% and 90.54% for CTL/S, respectively.*Conclusions Diagnosis performance of CTL-S and CTL/S for hepatic steatosis were similar and reliable. Low kVp unenhanced CT is robust technique for diagnosing hepatic steatosis with reduced radiation exposure.*Clinical Relevance/Application Low kVp unenhanced CT can be used for the diagnosis of hepatic steatosis and helpful for avoiding unnecessary biopsy and minimize radiation exposure.

RESULTS

Eighty-seven subjects were confirmed to have non-steatotic liver. Sixty-one subjects had mild degree steatosis and 17 subjects with moderate to severe steatosis based on MR spectroscopy. CTL-S and CTL/S values showed negative correlation with the degree of the fat signal fraction (p<0.001) and the limits of agreement were -8.4% to 8.4% for CTL-S and -9.6% to 9.6% for CTL/S. AUROCs of CTL-S and CTL/S for diagnosing moderate to severe steatosis were 0.956 and 0.957, respectively. Cut-off values of CTL-S and CTL/S for diagnosis moderate to severe degree steatosis by the Youden index were -0.5 HU and 0.99 for CTL-S and CTL/S, respectively, with sensitivity and specificity of 100% and 84.46%, respectively. Reference ranges of non-steatotic liver were -6.90 to 31.40 HU for CTL-S and 0.89 to 1.77 for CTL/S. With -6.9 HU for CTL-S and 0.89 for CTL/S as the cut-off values, the sensitivity and specificity for diagnosing moderate to severe steatosis were 70.59 and 90.54% for CTL-S and 76.47% and 90.54% for CTL/S, respectively.

CLINICAL RELEVANCE/APPLICATION

Low kVp unenhanced CT can be used for the diagnosis of hepatic steatosis and helpful for avoiding unnecessary biopsy and minimize radiation exposure.

SDP-GI-94   Deep Learning Analysis For The Diagnosis Of Acute Pancreatitis On Non-enhanced CT Images: A Pilot Study

Participants
Yi Wang, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to develop a deep learning (DL) model using abdominal non-enhanced computed tomography (NECT) images and validate its feasibility of differentiating acute pancreatitis (AP) from non-AP (NAP) patients.*Methods and Materials Nine hundred and ninety AP patients underwent NECT scan within 72 hours of disease onset and 416 non-acute pancreatitis (NAP) people with NECT scan were enrolled in this retrospective study. Patients were divided to a training dataset (782 AP and 343 NAP) and an independent testing dataset (208 AP and 73 NAP). A DL system based on the lightweight network (modified 3D MobileNetV2) was proposed to process 3D pancreas-centered patches cropped from CT images and automatically predict pancreas status. Model performance was evaluated using the receiver operating characteristic (ROC) analysis and the decision curve analysis. The diagnostic performance of DL model was also compared with that of a junior and a senior radiologist in a dataset including atypical cases (106 AP and 106 NAP).*Results The DL model had achieved a sensitivity, specificity, and AUC of 80.82%, 81.34%, and 0.871 (95% CI, 0.850-0.890) in the training dataset, respectively. The sensitivity, specificity, and AUC of the DL model were 74.04%, 78.08%, and 0.810 (95% CI, 0.759-0.854) in the independent testing dataset, respectively. Decision curve analysis demonstrated the clinical usefulness of the DL model. The DL model showed non-inferior performance to the senior radiologist (p = 0.625) and outperformed the junior radiologist (p < 0.001) with a very fast diagnostic speed (0.15 sec per-case). The performance of the junior and senior radiologists improved after the assistance of DL model with accuracy increased from 62.23% and 79.25% to 94.81% and 97.22%, while the diagnostic time per-case was reduced from 14.34 sec and 8.92 sec to 4.43 sec and 3.17 sec, respectively.*Conclusions The lightweight network-based DL model has good feasibility in diagnosing AP on NECT images and can assist junior radiologists to achieve better performance, which could benefit clinical practice.*Clinical Relevance/Application The deep learning model shows good performance and can improve emergency efficiency and help inexperienced doctors diagnose AP on non-enhanced CT images.

RESULTS

The DL model had achieved a sensitivity, specificity, and AUC of 80.82%, 81.34%, and 0.871 (95% CI, 0.850-0.890) in the training dataset, respectively. The sensitivity, specificity, and AUC of the DL model were 74.04%, 78.08%, and 0.810 (95% CI, 0.759-0.854) in the independent testing dataset, respectively. Decision curve analysis demonstrated the clinical usefulness of the DL model. The DL model showed non-inferior performance to the senior radiologist (p = 0.625) and outperformed the junior radiologist (p < 0.001) with a very fast diagnostic speed (0.15 sec per-case). The performance of the junior and senior radiologists improved after the assistance of DL model with accuracy increased from 62.23% and 79.25% to 94.81% and 97.22%, while the diagnostic time per-case was reduced from 14.34 sec and 8.92 sec to 4.43 sec and 3.17 sec, respectively.

CLINICAL RELEVANCE/APPLICATION

The deep learning model shows good performance and can improve emergency efficiency and help inexperienced doctors diagnose AP on non-enhanced CT images.

SDP-GI-95   Non-invasive Assessment Of Hemodynamics In Portal Venous System Using 4d Flow MR Imaging: Association With Liver Fibrosis

Participants
Atsushi Higaki, MD, Kurashiki, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the relationship between the degree of liver fibrosis and hemodynamic changes in the portal venous system using 4D flow MR imaging.*Methods and Materials A total of 81 patients with (n=49) and without (n=32) chronic liver disease underwent 4D flow MR imaging using a 3-T system (Figure 1). Quantitative indices such as forward flow (ml/s), backward flow (ml/s), sum of forward and backward flow (ml/s), and average velocity (cm/s) were measured in middle part of the portal trunk (PT), proximal part of the right and left portal veins (PV), the superior mesenteric vein (SMV), and the splenic vein (SV). Liver fibrosis was assessed by a combination of qualitative assessment by radiologists and quantitative assessment such as Fib-4 index and aspartate transaminase-to-platelet ratio index (APRI), and divided into three groups (A: normal (n=16), B: mild-to-moderate fibrosis (n=54), and C: severe fibrosis (n=11)). Statistical analysis was performed using the Kruskal-Wallis and Mann-Whitney U tests.*Results In the comparison between the three groups, there were significant differences in backward flow (p<0.001) and average velocity (p=0.002) for the PT, average velocity for the SMV (p=0.003), sum of forward and backward flow for the SV (p=0.018), and backward flow (p=0.002) and average velocity (p=0.008) for the right PV. These six indices had significant differences between Group A and Group C (p<0.001to p=0.006) and between Group B and Group C (p=0.001 to p=0.045), but no significant differences between group A and group B (Figure 2).*Conclusions Our study results suggest that the change of hemodynamics in the portal venous system accelerates when liver fibrosis progresses to some extent. At the advanced stage of liver fibrosis, the flow rate and/or the velocity of portal trunk, SMV, and right portal vein decrease, whereas the flow rate of SV increases. These observations might be associated with stenosis of the right PV caused by liver fibrosis, and subsequent formation of collateral circulation. In addition, the difference in hemodynamics between right PV and left PV may be a cause of morphological change of the liver in cirrhosis.*Clinical Relevance/Application The 4D flow MR imaging could non-invasively evaluate hemodynamics in the portal venous system.

RESULTS

In the comparison between the three groups, there were significant differences in backward flow (p<0.001) and average velocity (p=0.002) for the PT, average velocity for the SMV (p=0.003), sum of forward and backward flow for the SV (p=0.018), and backward flow (p=0.002) and average velocity (p=0.008) for the right PV. These six indices had significant differences between Group A and Group C (p<0.001to p=0.006) and between Group B and Group C (p=0.001 to p=0.045), but no significant differences between group A and group B (Figure 2).

CLINICAL RELEVANCE/APPLICATION

The 4D flow MR imaging could non-invasively evaluate hemodynamics in the portal venous system.

SDP-GI-96   Relationship Of Apparent Bowel Wall Thickness At CT And Bowel Intralumenal Attenuation: A Phantom Study

Participants
Mark Sugi, MD, San Francisco, California (*Presenter*) Consultant, Nextrast, IncAuthor with royalties, RELX

PURPOSE

Bowel wall thickness assessment is critical for bowel disease diagnosis at CT. We assess the effect of bowel lumen attenuation on measured bowel wall thickness in a CT phantom at dual-energy CT.*Methods and Materials 6 cm cylinders were affixed to a "bowel wall" plastic plate (Original Solid Water Sheets, Gammex, Middleton, WI) 2mm+/-0.2 mm thick, validated to 10 HU at across 80 to 140 kVp. The cylinders were filled with water, canola oil, Breeza™, VoLumen™, air, Omnipaque Oral Solution, Readi-Cat 2™, and 2 experimental Dark Borosilicate Contrast Materials (DBCM, which has FDA IND). This phantom was immersed in fat to simulate mesenteric fat, and scanned at 80, 100, 120 and 140 kVp on dual-energy CT scanners. CT image thickness of the bowel wall plate was measured at ImageJ by count of voxels within zero +/- 3 standard deviations of background noise across large ROIs. Bowel wall clarity for each agent was rated by two radiologist readers on a 3-point scale: 0=poor, 1= adequate, 2=clear.*Results At 120 kVp, the CT attenuation of the lumen contents were -3, -123, 11, 23, -1001, 264, 375, -85, and -169 HU for water, oil, Breeza™, VoLumen™, air, Omnipaque Oral Solution, and Readi-Cat 2™, and DBCM A (low concentration) and DBCM B (high concentration), respectively. The bowel wall thicknesses at 120 kVp were measured to be 4.35, 2.01, 4.53, 4.53, 1.09, 1.17, 1.12 mm, 2.43, and 2.01 mm, respectively. Bowel wall clarity was rated lowest for the lumens with lowest difference in HU value with the bowel wall (p<0.005).*Conclusions At CT, measured bowel wall thickness diverges substantially from true thickness depending on the lumen CT attenuation at CT. The CT attenuation of the bowel lumen to that of the bowel wall must be considered at CT imaging for accurate assessment of bowel wall thickness and possible bowel wall disease. The most accurate bowel wall thickness measurements were seen with moderate (~100-200HU), but not excessive (>300HU) differences in HU between the wall and contrast agent.*Clinical Relevance/Application The CT attenuation of the bowel lumen relative to that of the bowel wall must be considered at CT imaging for accurate assessment of bowel wall thickness and hence sensitivity for bowel wall disease.

RESULTS

At 120 kVp, the CT attenuation of the lumen contents were -3, -123, 11, 23, -1001, 264, 375, -85, and -169 HU for water, oil, Breeza™, VoLumen™, air, Omnipaque Oral Solution, and Readi-Cat 2™, and DBCM A (low concentration) and DBCM B (high concentration), respectively. The bowel wall thicknesses at 120 kVp were measured to be 4.35, 2.01, 4.53, 4.53, 1.09, 1.17, 1.12 mm, 2.43, and 2.01 mm, respectively. Bowel wall clarity was rated lowest for the lumens with lowest difference in HU value with the bowel wall (p<0.005).

CLINICAL RELEVANCE/APPLICATION

The CT attenuation of the bowel lumen relative to that of the bowel wall must be considered at CT imaging for accurate assessment of bowel wall thickness and hence sensitivity for bowel wall disease.

SDP-GI-97   CT Perfusion During Routine Staging And Restaging As A Potential Biomarker For Pancreatic Ductal Adenocarcinoma

Participants

Ryan O'Malley, MD, Seattle, Washington (*Presenter*) Research Grant, General Electric Company

PURPOSE

To evaluate the significance of perfusion parameters acquired in conjunction with routine multi-phase contrast-enhanced CT on a 160 mm wide-coverage 256-slice scanner in patients with pancreatic ductal adenocarcinoma (PDAC).*Methods and Materials 28 patients with PDAC naïve to prior treatment (15 male; median age, 67; median BMI, 25 kg/m2), underwent routine multiphase CT before and after chemoradiation therapy. CT perfusion was added to routine CT with 15 acquisitions obtained 5-42.5 sec after contrast administration, followed by standard pancreatic arterial and portal venous phases using the same IV contrast injection. Perfusion maps were generated and blood flow (BF), blood volume (BV), and permeability surface area product (PS) for tumor and uninvolved pancreas were calculated using deconvolution algorithms. 90 perfusion features were created: 5 distribution parameters (min, max, mean, standard deviation [SD], and coefficient of variation [CV or heterogeneity]) were measured over the 3 tissue-specific parameters (BF, BV, PS) in 6 ROIs (aorta, tumor center, tumor max, tumor rim, pancreas near tumor, normal pancreas). Ability of these features to discriminate patients who responded or did not respond to therapy (stable disease or partial response [n=18] vs. progressive disease [n=10], per RECIST 1.1) was evaluated, and those with AUC = 0.70 were retained. Further, logistic regression was used to assess association of select BL perfusion features with response to treatment. P-values were adjusted for multiple comparisons with BH procedure.*Results 9 of the initial 90 perfusion features were retained. Baseline BFCV, PSCV and BVCV in the tumor max ROI, and BVmean in tumor center, were significantly associated with treatment nonresponse (OR: 6.8, 4.4, 4.0, and 0.3 per SD?, respectively; adj. P = 0.047, for all); BFmin, BFmean and PSmax in tumor center, BVmean in tumor rim, and PSCV in normal pancreas were not significantly associated with the outcome (adj. P = 0.09-0.14).*Conclusions Using a single comprehensive multiphase pancreas perfusion CT, decreasing tumor-perfusion homogeneity and blood volume mean correlated with worse outcomes for patients with PDAC.*Clinical Relevance/Application Perfusion CT combined with standard multiphase CT is an efficient comprehensive examination for patients with PDAC with added information predicting response and very little downside. By combining perfusion CT with standard of care CT, this utilizes a single IV contrast injection, adds no time or cost to the patient, and simultaneously acquiring quantitative data and standard of care staging and restaging information.

RESULTS

9 of the initial 90 perfusion features were retained. Baseline BFCV, PSCV and BVCV in the tumor max ROI, and BVmean in tumor center, were significantly associated with treatment nonresponse (OR: 6.8, 4.4, 4.0, and 0.3 per SD?, respectively; adj. P = 0.047, for all); BFmin, BFmean and PSmax in tumor center, BVmean in tumor rim, and PSCV in normal pancreas were not significantly associated with the outcome (adj. P = 0.09-0.14).

CLINICAL RELEVANCE/APPLICATION

Perfusion CT combined with standard multiphase CT is an efficient comprehensive examination for patients with PDAC with added information predicting response and very little downside. By combining perfusion CT with standard of care CT, this utilizes a single IV contrast injection, adds no time or cost to the patient, and simultaneously acquiring quantitative data and standard of care staging and restaging information.

SDP-GI-98 T2-Weighted MRI Of The Liver: The Value Of Deep Learning Reconstruction Is Higher In High-Resolution Single-Shot Fast Spin-Echo Sequence Than In Conventional Fast Spin-Echo Sequence.

Participants
Kengo Kiso, Suita-city, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To compare the efficacy of deep leaning reconstruction (DLR) for high-resolution single-shot fast spin-echo (SSFSE) sequence with that for conventional fast spin-echo (FSE) sequence in T2-weighted MRI of the liver.*Methods and Materials Fifty-five patients with suspected focal liver lesions underwent liver MRI. Respiratory-triggered T2-weighted imaging was obtained with FSE and SSFSE at the same spatial resolution (5-mm thickness and 320×256 matrix). The mean acquisition time of FSE and SSFSE was 233 and 64 sec, respectively. For each sequence, conventional reconstruction (CR) and DLR were applied and two sets of imaging were generated. One radiologist measured the signal-to-noise-ratio (SNR) and the relative contrast. Two radiologists independently assessed the image quality. The results were compared using repeated-measures analysis of variance or Friedman's test.*Results The mean SNR of the liver parenchyma was 10.3, 12.9, 6.0, and 12.0 on FSE-CR, FSE-DLR, SSFSE-CR, and SSFSE-DLR, respectively. The SNR was significantly the lowest in SSFSE-CR, and the highest in SSFSE-DLR and FSE-DLR (P < .01). There was no significant difference in liver-to-focal liver lesion contrast among the four imaging sets. Qualitative analyses showed that DLR significantly improved noise (P < .05) but did not change motion artifacts both for FSE and SSFSE. Sharpness was significantly improved by DLR on FSE in one reader but was significantly diminished on SSFSE in both readers. Consequently, two readers assigned the worst noise to SSFSE-CR, the worst motion artifacts to FSE-CR and FSE-DLR, and the worst sharpness to SSFSE-DLR. Overall image quality was the lowest on SSFSE-CR in both readers, and the highest on SSFSE-DLR in one reader, and on SSFSE-DLR and FSE-DLR in the other reader (P < .05). Lesion conspicuity was the lowest in SSFSE-CR (P < .05), and equivalently high in SSFSE-DLR, FSE-CR, and FSE-DLR.*Conclusions Noise is the main problem in high-resolution SSFSE, which is efficiently reduced by DLR, whereas motion artifacts are the main problem in FSE, which is not resolved by DLR. As a result, the effect of DLR is greater in SSFSE than in FSE.*Clinical Relevance/Application In liver T2-weighted MRI, high-resolution SSFSE with DLR can be a powerful back-up sequence or even have a potential to replace the conventional FSE as it achieves high image quality in a short acquisition time.

RESULTS

The mean SNR of the liver parenchyma was 10.3, 12.9, 6.0, and 12.0 on FSE-CR, FSE-DLR, SSFSE-CR, and SSFSE-DLR, respectively. The SNR was significantly the lowest in SSFSE-CR, and the highest in SSFSE-DLR and FSE-DLR (P < .01). There was no significant difference in liver-to-focal liver lesion contrast among the four imaging sets. Qualitative analyses showed that DLR significantly improved noise (P < .05) but did not change motion artifacts both for FSE and SSFSE. Sharpness was significantly improved by DLR on FSE in one reader but was significantly diminished on SSFSE in both readers. Consequently, two readers assigned the worst noise to SSFSE-CR, the worst motion artifacts to FSE-CR and FSE-DLR, and the worst sharpness to SSFSE-DLR. Overall image quality was the lowest on SSFSE-CR in both readers, and the highest on SSFSE-DLR in one reader, and on SSFSE-DLR and FSE-DLR in the other reader (P < .05). Lesion conspicuity was the lowest in SSFSE-CR (P < .05), and equivalently high in SSFSE-DLR, FSE-CR, and FSE-DLR.

CLINICAL RELEVANCE/APPLICATION

In liver T2-weighted MRI, high-resolution SSFSE with DLR can be a powerful back-up sequence or even have a potential to replace

the conventional FSE as it achieves high image quality in a short acquisition time.

SDP-GI-99   A Combined Region And Pixel Based Deep Learning Approach For Abdominal Adipose Tissue Quantification Using Dixon Magnetic Resonance Imaging

Participants
Li-Yueh Hsu, Bethesda, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Dixon based Magnetic Resonance Imaging (MRI) offers an effective assessment of subcutaneous (SAT) and visceral (VAT) adipose tissues in the abdomen without exposure to ionizing radiation. Conventional computerized quantification relies on segmenting abdomen regions of interest for empirical thresholding. In contrast, deep learning approach classifies both tissues with distinct pixel labels. We propose a convolutional neural network (CNN) approach combining both region and pixel-based labels for SAT and VAT quantification.*Methods and Materials 475 abdomen scans acquired on a 3T Philips MRI scanner using a 3D Dixon SENSE sequence were included in this study. For each scan, fat-only axial images located at the L2/3 and L4/5 disc spaces were selected for the quantification. For each image, an outer and an inner region around the abdomen wall as well as SAT and VAT pixel masks were generated by expert readers using an in-house software. These four types of masks served as the reference labels for CNN training and testing. A standard U-Net architecture with generalized Wasserstein distance loss was used to train two models; one for region segmentation and one for fat pixel classification. The performance was evaluated using Dice Similarity Coefficient (DSC) with five-fold cross-validation, and by Pearson correlation and Student's t-test. A $p < 0.05$ was considered statistically significant.*Results Mean and standard deviation of DSC for the outer region, inner region, SAT, and VAT were 0.974 ± 0.026, 0.997 ± 0.003, 0.981 ± 0.025, and 0.932 ± 0.047. Pearson coefficients were 1.000 for both outer (p=0.999) and inner (p=0.944) regions; and 1.000 and 0.982 for SAT (p=0.978) and VAT (p=0.620) comparisons. These results showed our method not only provides excellent agreement with the reference SAT and VAT measurements, it also produces accurate abdominal region segmentation allowing the user to modify the automated results using alternative threshold-based approach if needed.*Conclusions The proposed four-label CNN approach offers a comprehensive and accurate SAT and VAT quantification which may ease clinical workflow integration.*Clinical Relevance/Application Dixon based Magnetic Resonance Imaging is an effective technique for measuring adipose tissue. This study presents an accurate hybrid deep learning approach for quantification of subcutaneous and visceral abdominal adipose tissue.

RESULTS

Mean and standard deviation of DSC for the outer region, inner region, SAT, and VAT were 0.974 ± 0.026, 0.997 ± 0.003, 0.981 ± 0.025, and 0.932 ± 0.047. Pearson coefficients were 1.000 for both outer (p=0.999) and inner (p=0.944) regions; and 1.000 and 0.982 for SAT (p=0.978) and VAT (p=0.620) comparisons. These results showed our method not only provides excellent agreement with the reference SAT and VAT measurements, it also produces accurate abdominal region segmentation allowing the user to modify the automated results using alternative threshold-based approach if needed.

CLINICAL RELEVANCE/APPLICATION

Dixon based Magnetic Resonance Imaging is an effective technique for measuring adipose tissue. This study presents an accurate hybrid deep learning approach for quantification of subcutaneous and visceral abdominal adipose tissue.

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Sub-Events

BR04-B1   Correlating Shear-wave Elastography Features With Molecular Subtype And Axillary Lymph Node Status In Breast Cancer

Participants
Hee Jeong Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Breast cancer is composed of distinct molecular subtypes that differ in etiology, treatment response, and prognosis. Different biological behavior of tumors may be related to the lesion stiffness measured by shear-wave elastography in US. The purpose of our study is to correlate shear-wave elastography features with molecular subtype and also with axillary lymph node status of breast cancer.*Methods and Materials We retrospectively included 691 consecutive women (mean age, 52.50 ± 10.94 years; range, 24-83) who underwent breast US including shear-wave elastography for preoperative evaluation of breast cancer at our center between Decemter 2019 and January 2021. Stiffness values (maximum stiffness value; Emax, mean stiffness value; Emean, and lesion-to-fat elasticity ratio; Eratio) and the maximum diameter of the lesion on US were recorded. Histopathologic findings including immunohistochemical profiles, size of invasive cancer, histologic type, histologic grade, Ki-67 proliferation index, and axillary lymph node status were used. The relationship between the stiffness values and the histopathologic findings was analyzed by using independent sample T-test or one-way ANOVA test with Tukey's post hoc test, as well as logistic regression analyses.*Results Large lesion size on US was associated with higher stiffness values in all three parameters (P < .001). Large size of invasive cancer (P < .001 for all three parameters), high histologic grade (P = 0.015 for Emax and 0.042 for Emean), high Ki-67 (P = 0.003 for Emax and 0.020 for Emean) and positive axillary lymph node metastasis (P = 0.002 for Emax, 0.001 for Emean, and 0.019 for Eratio) were associated with higher stiffness values. Emax and Emean were higher in the order of luminal A < HER2 < triple negative < luminal B subtype (P = 0.006 and 0.015, respectively) and Eratio was higher in the order of luminal A < HER2 < luminal B < triple negative subtype (P = 0.032). Lower Emax (P = 0.026) and Emean (P = 0.028) were found to be independently associated with low grade luminal A subtype breast cancer. Higher Emean was independently associated with axillary lymph node metastasis for lesions 20 mm or smaller on US (P = 0.041).*Conclusions Increased tumor stiffness on shear-wave elastography was associated with aggressive histopathologic features of breast cancer, while low stiffness values were associated with better prognostic features.*Clinical Relevance/Application Shear-wave elastography in the preoperative US may noninvasively provide prognostic information of the breast cancer.

RESULTS

Large lesion size on US was associated with higher stiffness values in all three parameters (P < .001). Large size of invasive cancer (P < .001 for all three parameters), high histologic grade (P = 0.015 for Emax and 0.042 for Emean), high Ki-67 (P = 0.003 for Emax and 0.020 for Emean) and positive axillary lymph node metastasis (P = 0.002 for Emax, 0.001 for Emean, and 0.019 for Eratio) were associated with higher stiffness values. Emax and Emean were higher in the order of luminal A < HER2 < triple negative < luminal B subtype (P = 0.006 and 0.015, respectively) and Eratio was higher in the order of luminal A < HER2 < luminal B < triple negative subtype (P = 0.032). Lower Emax (P = 0.026) and Emean (P = 0.028) were found to be independently associated with low grade luminal A subtype breast cancer. Higher Emean was independently associated with axillary lymph node metastasis for lesions 20 mm or smaller on US (P = 0.041).

CLINICAL RELEVANCE/APPLICATION

Shear-wave elastography in the preoperative US may noninvasively provide prognostic information of the breast cancer.

BR04-B2   Machine Learning Models Using Breast Ultrasound Radiomic And Clinical Features: Potential For Prediction Of Response To Neoadjuvant Chemotherapy At Baseline

Participants
Panagiotis Kapetas, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate whether machine learning (ML) models using selected clinical and radiomics features acquired from pre-therapeutic, B-mode breast ultrasound (US) can predict response to neoadjuvant chemotherapy (NAC).*Methods and Materials 253 patients with histologically confirmed invasive breast cancer who underwent NAC were included in this retrospective, IRB-approved study. A representative B-mode US image of each tumor from the baseline examination was selected. Tumors were manually segmented (with and without inclusion of surrounding tissue) and overall 851 radiomic features were extracted using dedicated software. Two analysis approaches were followed: on the one hand, principal component analysis (PCA) was used for feature reduction and a multilayer perceptron (MLP) artificial neural network was trained using the remaining US radiomic and selected clinical features. 1/3 of the cases were withheld and used as an external validation set. The rest of the dataset was split into 75% and 25% for training and testing the model. On the other hand, a decision tree using the exhaustive chi-squared automatic interaction detection method with 10-fold cross validation was constructed. Postoperative histology was the reference standard. Pathological complete response (pCR) was defined as the lack of invasive tumor in the breast or metastases in the axillary lymph-nodes. Diagnostic performance of each method was evaluated by means of the area under the ROC-curve (AUC).*Results 104 patients (41.1%) achieved pCR. In the

first model, 69 radiomic features remained after PCA and were combined with clinical features to train the MLP. In the validation set, the combination of radiomic features, age and molecular subtype showed the highest AUC, both for the tumor containing ROI (0.715; 95%CI: 0.606-0.809) and for the ROI containing peritumoral tissue as well (0.709; 95%CI: 0.599-0.803; p>0.05). The model resulted in 66.3% of correct classifications only considering the tumor ROI and 55.4% using the ROI containing peritumoral tissue in the validation set. On the other hand, decision trees based on molecular subtype and 5-6 radiomic features showed AUCs of 0.852 (95%CI: 0.802-0.893) for the tumor-only ROI and 0.896 (95%CI: 0.852-0.931) for the ROI containing peritumoral tissue as well (p>0.05). The corresponding percentages of correct classifications were 83.4% and 82.6%.*Conclusions ML models based on radiomic features from baseline B-mode breast US examinations and simple clinical features have the potential to predict response to NAC.*Clinical Relevance/Application Machine learning using simple clinical and sonographic radiomic features from breast tumors may help predict response to neoadjuvant chemotherapy even before its initiation.

RESULTS

104 patients (41.1%) achieved pCR. In the first model, 69 radiomic features remained after PCA and were combined with clinical features to train the MLP. In the validation set, the combination of radiomic features, age and molecular subtype showed the highest AUC, both for the tumor containing ROI (0.715; 95%CI: 0.606-0.809) and for the ROI containing peritumoral tissue as well (0.709; 95%CI: 0.599-0.803; p>0.05). The model resulted in 66.3% of correct classifications only considering the tumor ROI and 55.4% using the ROI containing peritumoral tissue in the validation set. On the other hand, decision trees based on molecular subtype and 5-6 radiomic features showed AUCs of 0.852 (95%CI: 0.802-0.893) for the tumor-only ROI and 0.896 (95%CI: 0.852-0.931) for the ROI containing peritumoral tissue as well (p>0.05). The corresponding percentages of correct classifications were 83.4% and 82.6%.

CLINICAL RELEVANCE/APPLICATION

Machine learning using simple clinical and sonographic radiomic features from breast tumors may help predict response to neoadjuvant chemotherapy even before its initiation.

BR04-B6   Cortical Thickness Of Axillary Lymph Nodes As An Indicator For Lymph Node Metastases

Participants
Maximilian Moreth, Frankfurt am Main, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To determine the role of cortical thickness as an indicator for several scenarios of lymph node metastasis during axillary ultrasound (AUS).*Methods and Materials During four years, 593 breast cancer patients had received an axillary ultrasound during clinical work-up and were retrospectively included in this study. Lymph nodes were defined as suspicious whenever they showed a cortical thickness of > 3,0 mm at 11-15 MHz harmonic imaging ultrasound. As golden standard for lymph node involvement core needle biopsy (n = 115), sentinel node dissection or axillary dissection were used. Extensive axillary involvement (EAI) was diagnosed if more than two lymph nodes showed metastatic disease on histology.*Results In 353 out of 593 patients (59,5%), the axilla was correctly classified as N0. Pathological lymph nodes were detected by ultrasound in 140 of the 593 patients (23,6%). False positive ultrasound diagnoses were made in 22 cases (3,7%). In 78 patients (13%), the lymph node metastases were not described by ultrasound. Of these patients, extensive axillary involvement was detected in 14 (17,9%), transcapsular growth of the lymph node metastasis in 27 (34,6%) cases. Based on these data, AUS for detecting all lymph node metastases had a sensitivity (95% CI) of 64,2 % (57,5 - 70,6), a specificity (95% CI) of 94,1% (91,3 - 96,3) and a negative predictive value (95% CI) of 81,9 % (77,9 - 85,4). However, the resulting negative predictive value (95% CI) for transcapsular growth was 92,9% (89,8 - 95,3), and for extensive axillary spread 96,2% (93,7 - 97,9).*Conclusions Using cortical thickness as an indicator for lmpyh node metastasis in axillary ultrasound was moderately efficient for detecting all involved lymph nodes. It was, however, sufficiently efficient for ruling out extensive axillary involvement.*Clinical Relevance/Application Cortical thickness in AUS is a feasable and reliable tool to rule out EAI. It helps to reduce the number of classic axillary dissections and decreases relevant morbidity.

RESULTS

In 353 out of 593 patients (59,5%), the axilla was correctly classified as N0. Pathological lymph nodes were detected by ultrasound in 140 of the 593 patients (23,6%). False positive ultrasound diagnoses were made in 22 cases (3,7%). In 78 patients (13%), the lymph node metastases were not described by ultrasound. Of these patients, extensive axillary involvement was detected in 14 (17,9%), transcapsular growth of the lymph node metastasis in 27 (34,6%) cases. Based on these data, AUS for detecting all lymph node metastases had a sensitivity (95% CI) of 64,2 % (57,5 - 70,6), a specificity (95% CI) of 94,1% (91,3 - 96,3) and a negative predictive value (95% CI) of 81,9 % (77,9 - 85,4). However, the resulting negative predictive value (95% CI) for transcapsular growth was 92,9% (89,8 - 95,3), and for extensive axillary spread 96,2% (93,7 - 97,9).

CLINICAL RELEVANCE/APPLICATION

Cortical thickness in AUS is a feasable and reliable tool to rule out EAI. It helps to reduce the number of classic axillary dissections and decreases relevant morbidity.

BR04-B8   Mammographic Density, Its Changes Over Time And Risk Of Breast Cancer Among A Diverse Cohort Of Women Undergoing Mammography Screening

Participants
Aimilia Gastounioti, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Mammographic density (MD) is a strong risk factor for breast cancer. MD is also a dynamic trait that may change over time, with potential implications for breast cancer risk. However, few studies have assessed the associations between MD change and breast cancer, none focusing on racially diverse populations. This study investigates the relationships between MD and MD change and breast cancer risk in a large, racially diverse, screening cohort.*Methods and Materials We retrospectively analyzed data from 8,468 women (age: median 56 y; BMI: mean 29.2 kg/m2; race: 49.6% Black, 44.7% white, 5.7% other; 65.5% postmenopausal) who underwent = 2 mammographic screening exams at our institution in Sept. 2010 - Dec. 2014 (between-screening interval: median 1.1 years, IQR 1.0-1.5; 20,779 exams in total); 118 women were diagnosed with breast cancer 1-5 years after their screening. LIBRA (v1.0.4) was used to estimate breast percent density (PD) and dense tissue area (DA) from raw digital mammograms (Selenia Dimensions, Hologic Inc.). For each MD measure, we conducted Cox regression analyses to examine the associations between MD, between-screening MD change, and breast cancer risk, adjusting for age, menopausal status, BMI, and race, and accounting for multiple exams per woman.*Results PD at screening was significantly associated with breast cancer risk

(hazard ratio (HR) for PD = 1.04 (95% CI [1.02, 1.06], p < 0.0005), but change in PD was not associated with breast cancer risk (HR for PD change = 1.35 [0.69, 2.64], p = 0.4). Though we observed differences in PD and PD change between Black and White women (p = 0.009), race was not significantly associated with breast cancer risk. Results using DA were essentially identical.*Conclusions Using a large racially diverse cohort, we found no evidence for an association between short-term change in MD and risk of breast cancer, suggesting that MD change may not be a strong predictor for risk.*Clinical Relevance/Application Longitudinal short-term MD changes seem to be of lesser importance from a risk point of view compared to MD, suggesting that short-term MD changes might have minimal effect on breast cancer risk.

RESULTS

PD at screening was significantly associated with breast cancer risk (hazard ratio (HR) for PD = 1.04 (95% CI [1.02, 1.06], p < 0.0005), but change in PD was not associated with breast cancer risk (HR for PD change = 1.35 [0.69, 2.64], p = 0.4). Though we observed differences in PD and PD change between Black and White women (p = 0.009), race was not significantly associated with breast cancer risk. Results using DA were essentially identical.

CLINICAL RELEVANCE/APPLICATION

Longitudinal short-term MD changes seem to be of lesser importance from a risk point of view compared to MD, suggesting that short-term MD changes might have minimal effect on breast cancer risk.

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Sub-Events

NMMI02-A1 Clinical Utility Of 18F-fluciclovine Pet/ct In Recurrent Prostate Cancer With Very Low (0.3 Ng/ml) Prostate-specific Antigen Levels.

Participants
Charles Marcus, MD, Altanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

To assess 18F-fluciclovine PET/CT detection rates in the evaluation of biochemical recurrence in prostate cancer patients with very low (=0.3 ng/mL) serum prostate-specific antigen (PSA) levels following definitive treatment*Methods and Materials Prostate cancer patients with biochemical recurrence and very low serum PSA (=0.3 ng/mL) who underwent clinical 18F-fluciclovine PET/CT were included in this single-institution retrospective study. Data on patient demographics, Gleason scores, primary definitive treatment, and serum PSA at the time of the scan were collected. PET/CT clinical reports at the time of interpretation were reviewed and categorized as positive or negative. In patients who had further evaluation with imaging and/or biopsy, the results were recorded to determine the true detection rate*Results Of the 64 eligible patients with very low serum PSA (median serum PSA of 0.17 ng/mL), 57.8% (37/64) scans were categorized as positive. Stratified by PSA levels, positivity rates were 43.8% (7/16), 60.0% (15/25) and 65.2% (15/23) for PSA <0.1 ng/mL, 0.1-<0.2 ng/mL and 0.2-=0.3 ng/mL, respectively. The most common location of disease was the prostate bed (73%), followed by pelvic lymph nodes (22%) and distant disease (14%). In the small subset of patients who had further evaluation after a positive study (n = 7), all had confirmed disease with a positive predictive value of 100%*Conclusions In prostate cancer patients with biochemical recurrence, 18F-fluciclovine PET/CT is useful in patients with very low serum PSA of =0.3 ng/mL, with a 57.8% positivity rate, higher than previously reported. Though standard of truth could only be ascertained in 19% (7/37) of patients with a positive study, the positive predictive value was 100%*Clinical Relevance/Application Reports on 18F-fluciclovine PET/CT detection rates in patients with biochemical prostate cancer recurrence with very low serum PSA has been highly variable, ranging from 0-56%. Our study results demonstrate high detection rates, even in patients with very low serum PSA and shows that 18F-fluciclovine PET/CT is useful in the evaluation of this patient cohort.

RESULTS

Of the 64 eligible patients with very low serum PSA (median serum PSA of 0.17 ng/mL), 57.8% (37/64) scans were categorized as positive. Stratified by PSA levels, positivity rates were 43.8% (7/16), 60.0% (15/25) and 65.2% (15/23) for PSA <0.1 ng/mL, 0.1-<0.2 ng/mL and 0.2-=0.3 ng/mL, respectively. The most common location of disease was the prostate bed (73%), followed by pelvic lymph nodes (22%) and distant disease (14%). In the small subset of patients who had further evaluation after a positive study (n = 7), all had confirmed disease with a positive predictive value of 100%

CLINICAL RELEVANCE/APPLICATION

Reports on 18F-fluciclovine PET/CT detection rates in patients with biochemical prostate cancer recurrence with very low serum PSA has been highly variable, ranging from 0-56%. Our study results demonstrate high detection rates, even in patients with very low serum PSA and shows that 18F-fluciclovine PET/CT is useful in the evaluation of this patient cohort.

NMMI02-A3 Classification Of Mediastinal Lymph Node Metastasis Of Non-small Cell Lung Cancer: Improved Performance By Incorporating Primary Tumor Features

Participants
Stephan Blazis, Dordrecht, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

This study investigates and compares a range of prediction models and the incorporation of primary tumor features to differentiate between FDG-avid malignant and benign mediastinal lymph nodes that could possibly improve the preoperative staging of lung cancer patients.*Methods and Materials We performed a retrospective analysis of 173 patients from two hospitals aging from 43 to 89 years comprising 101 men and 72 women (mean age 68 years); who underwent FDG PET-CT for primary staging of pathologically confirmed non-small cell lung cancer (NSCLC). For the annotation and segmentation of the primary tumors and hilar lymph nodes in the PET-CT images, ROIs were manually drawn and the resulting dataset combined with the pathology findings was used as the "ground truth". Diagnostic features were extracted from the PET data only and consisted of the SUV (mean and max) and tumor size for both the primary tumors as the lymph nodes. The resulting dataset was used for training and testing the developed prediction models at a 70/30 ratio. A comparison was performed for four different prediction models: A simple thresholding model based on the maximal SUV value of the lymph nodes. The second model is a classical machine learning Random Forest model based on the diagnostic features of the lymph nodes only, which was extended to a third model by incorporating the primary tumor diagnostic features. Finally, a CNN model based on the segmented lymph nodes and extended with the primary tumor SUV mean and max values was trained. The performance of the prediction models was evaluated by the area under the curve operating characteristic (AUC) and the diagnostic accuracy (ACC) value. For clinical comparison, a performance point of human doctors from a similar study was added to the results.*Results The ACC values of the four evaluated models ranged from 0.62 to 0.92 and the AUC values from 0.83 to 0.94. A significant difference was found between the Random Forest model with and without primary tumor features (ACC 0.79-0.83 and AUC 0.86-0.94). The simple thresholding model performed similarly in AUC(0.83) to the CNN model

(0.84). but the CNN model showed a significantly higher accuracy (0.83-0.63).*Conclusions This study showed that incorporating the diagnostic features of the primary tumor can significantly improve performance for the classification of lymph node metastasis of NSLCL from PET-CT images.*Clinical Relevance/Application Incorporating diagnostic features of the primary tumor into the development of prediction models significantly improves the performance of model-based lymph node metastasis classification and could replace the use of costly and invasive procedures such as endobronchial ultrasound or mediastinoscopy procedures for NSCLC patients.

RESULTS

The ACC values of the four evaluated models ranged from 0.62 to 0.92 and the AUC values from 0.83 to 0.94. A significant difference was found between the Random Forest model with and without primary tumor features (ACC 0.79-0.83 and AUC 0.86-0.94). The simple thresholding model performed similarly in AUC(0.83) to the CNN model (0.84). but the CNN model showed a significantly higher accuracy (0.83-0.63).

CLINICAL RELEVANCE/APPLICATION

Incorporating diagnostic features of the primary tumor into the development of prediction models significantly improves the performance of model-based lymph node metastasis classification and could replace the use of costly and invasive procedures such as endobronchial ultrasound or mediastinoscopy procedures for NSCLC patients.

NMMI02-A4 68Ga PSMA PET Is A Better Imaging Modality Than Multiparametric Mr In Biochemical Recurrent Disease.

Participants
juana martinez, MD,MD, NEW YORK, New York (*Presenter*) Nothing to Disclose

PURPOSE

68Ga Prostate Specific Membrane Antigen (PSMA) positron emission tomography (PET) improved the detection rate of prostate cancer related lesions compared with conventional imaging. PSMA PET combined with magnetic resonance imaging (MRI) has the advantages of both PET and MRI modalities, is a promising technique in the evaluation of patients with prostate cancer. Here, we compare PSMA PET with concomitant multiparametric MRI in detecting lesions suspicious for biochemical recurrence. We hypothesize that PSMA PET is a more robust modality for biochemical recurrence with the potential of identifying small lesions which would otherwise be dismissed on MRI alone.*Methods and Materials A review of all patients with prostate cancer who prospectively enrolled in a HIPAA-compliant, IRB-approved clinical trial of 68Ga PSMA PET/MRI done at New York Presbyterian Hospital - Weill Cornell campus from April 2018 to January 2021 was performed. Per protocol, Nuclear Medicine physicians read the PSMA PET portion of the study while a radiologist with fellowship training in cancer imaging read the MRI of the skull base to thigh, independent of each other. Patient demographics, the indication for PSMA PET/MRI, and serum prostate specific antigen (PSA) levels closest to the PSMA PET/MRI (within 60 days before the study and 30 days after the study) were extracted from patient charts.*Results There were 165 patients who had a PSMA PET/MRI, of whom 109 where imaged for biochemical recurrence. From our findings, PSMA PET was able to detect more lesions suspicious for recurrence than MRI at all PSA levels (Figure 1). After subgrouping the sample to only include patients who had PSMA PET/MRI for biochemical recurrent disease, PSMA PET fared superiorly at all PSA levels in comparison to MRI (Figure 2). An example of PSMA PET/MRI where an abnormal lesion was detected on PET for benign morphology on MRI is depicted in Figure 3.*Conclusions 68Ga PSMA PET has high utility in detection of suspicious lesions in biochemically recurrent prostate cancer. When compared with MRI, PSMA PET is highly robust in identifying lesions which are otherwise deemed unremarkable.*Clinical Relevance/Application We recommend the use of 68Ga PSMA PET/MR for biochemical recurrent prostate cancer with potential to be the new standard of care for this indication.

RESULTS

There were 165 patients who had a PSMA PET/MRI, of whom 109 where imaged for biochemical recurrence. From our findings, PSMA PET was able to detect more lesions suspicious for recurrence than MRI at all PSA levels (Figure 1). After subgrouping the sample to only include patients who had PSMA PET/MRI for biochemical recurrent disease, PSMA PET fared superiorly at all PSA levels in comparison to MRI (Figure 2). An example of PSMA PET/MRI where an abnormal lesion was detected on PET for benign morphology on MRI is depicted in Figure 3.

CLINICAL RELEVANCE/APPLICATION

We recommend the use of 68Ga PSMA PET/MR for biochemical recurrent prostate cancer with potential to be the new standard of care for this indication.

Sub-Events

HN01-B1 **CT-based Iterative Metal Artefact Reduction In Patients With Head And Neck Abscess**

Participants
Ibrahim Yel, MD, Frankfurt, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the impact of a CT-based iterative metal artefact (iMAR) algorithm on image quality in patients with head and neck abscess and dental implants.*Methods and Materials A total of 80 patients with dental implants and head and neck abscess were retrospectively reconstructed with iMAR. Two senior radiologists specialized with 6 and 10 years of experience evaluated standard and iMAR reconstructed CT images for subjective and objective image quality, metal artefacts, and delineation of the abscess based on a 5-point-rating-scale. Interobserver agreement was calculated using the Cohens Kappa.*Results Compared with uncorrected images, iMAR showed a significant artefact reduction from -480 HU to 53 HU in all patients (P < 0.001). Subgroup analysis of 38 patients with abscess and metal artifacts on equivalent anatomic levels showed a significantly higher objective and subjective noise reduction for iMAR images (P =0.005 and P = 0.028). Furthermore, iMAR images were rated superior regarding image quality, artefact reduction, and lesion delineation. Interrater agreement was excellent for overall image quality (? = .88), artefact reduction (? = .91), and lesion delineation (? = .95).*Conclusions CT images using iMAR significantly improve image quality and lesion delineation of head and neck abscesses in patients with dental hardware.*Clinical Relevance/Application Implementation of an iterative metal artefact reduction algorithm for CT imaging of head and neck abscess in patients with dental implants improves image quality and diagnostic accuracy.

RESULTS

Compared with uncorrected images, iMAR showed a significant artefact reduction from -480 HU to 53 HU in all patients (P < 0.001). Subgroup analysis of 38 patients with abscess and metal artifacts on equivalent anatomic levels showed a significantly higher objective and subjective noise reduction for iMAR images (P =0.005 and P = 0.028). Furthermore, iMAR images were rated superior regarding image quality, artefact reduction, and lesion delineation. Interrater agreement was excellent for overall image quality (? = .88), artefact reduction (? = .91), and lesion delineation (? = .95).

CLINICAL RELEVANCE/APPLICATION

Implementation of an iterative metal artefact reduction algorithm for CT imaging of head and neck abscess in patients with dental implants improves image quality and diagnostic accuracy.

HN01-B2 **Comparison Study Of Spectral Energy Mode Scans And Non-spectral Energy Mode Scans Combined With Adaptive Statistical Iterative Reconstruction-veo Algorithm On Thyroid Scan**

Participants
Zhaorong Tian, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the effects of spectral energy mode scans and non-spectral energy mode scans combined with Adaptive Statistical Iterative Reconstruction-Veo (ASiR-V) on image quality and radiation dose in thyroid scan.*Methods and Materials Forty-six patients prepared for CT thyroid scan were collected prospectively. They were labeled as group A and group B . Group A was set as spectral energy scanning mode with tube voltage fast kV switch (80/140 kV). Group B was set as non-spectral energy scanning mode with tube voltage 120kVp. Two groups of ASiR-V images with different levels (1: 0%,2:20%, 3: 40%, 4: 60%, 5: 80% and6: 100%) were reconstructed for comparative analysis. Group A was divided into A1, A2, A3, A4, A5 and A6 according to different ASiR-V levels. Similarly, group B was divided into B1- B6. Region of interest(ROI)was delineated at the maximum level of thyroid parenchyma . CT values and background noise (SD) of ROI in twelve groups were measured and compared respectively. The dose length product (DLP) of each scan was recorded after scanning, and the value of effective dose (ED) was calculated according to the formula: ED(mSv)=k(mSv*mGy-1*cm-1)*DLP(mGy*cm). The subjective image scores were assessed blindly by two experienced physicians using a 5-point system. The differences of SD among different ASiR-V groups were compared by one-way analysis of variance, and the differences of subjective scoring were compared by Kappa test.*Results The SD values of group A1- A6 image were (35.98±8.23)HU, (30.65±5.57)HU, (27.25±7.28)HU, (22.93±7.09)HU, (19.14±7.10)HU, (15.78±7.70)HU, respectively. The SD values of group B1-B6 were (29.98±7.68) HU, (26.69±7.36) HU, (22.79±6.16) HU, (18.27±6.14) HU, (15.19±5.31) HU, (11.81±5.04) HU, respectively. There was statistically significant difference of SD value on same ASiR-V between energy spectrum and non-energy spectrum scan (P<0.05). DLP of energy spectrum and non-spectrum scanning were (279.16±39.08) mGy*cm and (305.92±62.84) mGy*cm, respectively. The energy spectral scans decreased by 9.59% compared with non-spectrum. Subjective scores showed that the optimal ASiR-V of energy spectrum scans and non-spectral scans was 80%, and the Kappa values of consistency between two observers were 0.56, respectively.*Conclusions Combined with subjective scores, this study concluded that 80% ASiR-V can significantly improve the image quality of thyroid on energy spectrum scans and non-spectrum scans, and the radiation dose of energy spectrum scans decreases by 9.59% compared with that of non-spectrum scans.*Clinical Relevance/Application The level of ASiR-V can be used to optimize the image quality of energy spectrum and non-spectrum scans,which can be used in clinical examiation.

RESULTS

The SD values of group A1- A6 image were (35.98±8.23)HU, (30.65±5.57)HU, (27.25±7.28)HU, (22.93±7.09)HU, (19.14±7.10)HU, (15.78±7.70)HU, respectively. The SD values of group B1-B6 were (29.98±7.68) HU, (26.69±7.36) HU, (22.79±6.16) HU, (18.27±6.14) HU, (15.19±5.31) HU, (11.81±5.04) HU, respectively. There was statistically significant difference of SD value on same ASiR-V between energy spectrum and non-energy spectrum scan (P<0.05). DLP of energy spectrum and non-spectrum scanning were (279.16±39.08) mGy*cm and (305.92±62.84) mGy*cm, respectively. The energy spectral scans decreased by 9.59% compared with non-spectrum. Subjective scores showed that the optimal ASiR-V of energy spectrum scans and non-spectral scans was 80%, and the Kappa values of consistency between two observers were 0.56, respectively.

CLINICAL RELEVANCE/APPLICATION

The level of ASiR-V can be used to optimize the image quality of energy spectrum and non-spectrum scans,which can be used in clinical examiation.

HN01-B3   Visualization Of The Saccule And Utricle With Non-contrast-enhanced Flair Sequences.

Participants
Hikaru Fukutomi, Kyoto, Japan (*Presenter*) Technical support, Canon Medical Systems Corporation

PURPOSE

3D-FLAIR sequence collected four hours after gadolinium injection can delineate the perilymphatic space (PLS) from the endolymphatic space (ELS) to capture endolymphatic hydrops, the pathological counterpart of Ménière's disease. However, satisfactory delineation without injection has not been reported in the literature yet. Because the PLS and ELS protein concentrations are different, we hypothesized that non-injected 3D-FLAIR using an optimal setting of imaging parameters would allow visualization of inner ear internal anatomy.*Methods and Materials Twenty-two healthy subjects (11 men, and 11 women), 22-42 years old (mean: 29), with no history of inner ear disorders were scanned on 3T MRI unit (Vantage Galan 3T/ZGO, Canon Medical Systems Corporation, Tochigi, Japan) with a 32-channel array head coil. All subjects were scanned with non-injected 3D-FLAIR with variable T2 preparations (T2Preps) (OFF, 200, 400, and 600 ms), variable inversion times (TIs) (from 224 to 5000 ms) and different resolution (intermediate: 1.0×1.0×1.5 mm3, high: 0.6×0.6×0.8 mm3 and higher: 0.6×0.6×0.6 mm3). For all images, we used a denoising approach with deep learning-based reconstruction. Relative contrast between PLS and ELS was assessed and compared with Welch's t-test on intermediate resolution. The saccule and utricle's visibility were assessed with signal curve analysis on the reference line cross the two structures and compared between high and higher resolution.*Results The PLS and ELS were only differentiated with T2Prep. The maximum relative contrast between them was larger with T2Prep of 400 ms than 200 or 600 ms (0.72±0.22 vs. 0.44±0.11, p=0.019; and 0.72±0.22 vs. 0.46±0.28, p=0.034, respectively). The saccule and utricle were best delineated in 87.5 % cases when using T2Prep of 400 ms and TI of 2100 ms at the higher resolution (0.6×0.6×0.6 mm3). The optimized non-injected 3D-FLAIR images were consistent with anatomical knowledge and looked very similar to the images from the literature when using an injected 3D-FLAIR.*Conclusions For inner ear exploration, combining a specific T2Prep and TI on a non-injected 3D-FLAIR could provide a high enough contrast to separate the PLS and ELS and even a good delineation of the saccule and utricle.*Clinical Relevance/Application The results of this study pave the way toward future application to diagnose Ménière's disease.

RESULTS

The PLS and ELS were only differentiated with T2Prep. The maximum relative contrast between them was larger with T2Prep of 400 ms than 200 or 600 ms (0.72±0.22 vs. 0.44±0.11, p=0.019; and 0.72±0.22 vs. 0.46±0.28, p=0.034, respectively). The saccule and utricle were best delineated in 87.5 % cases when using T2Prep of 400 ms and TI of 2100 ms at the higher resolution (0.6×0.6×0.6 mm3). The optimized non-injected 3D-FLAIR images were consistent with anatomical knowledge and looked very similar to the images from the literature when using an injected 3D-FLAIR.

CLINICAL RELEVANCE/APPLICATION

The results of this study pave the way toward future application to diagnose Ménière's disease.

NMMI03-C

Nuclear Medicine/Molecular Imaging Tuesday Poster Discussions

Sub-Events

NMMI03-C3 Correlation Of Functional MRI With Changes In Tumor Microenvironment Following Sorafenib And Immunotherapy In Hepatocellular Carcinoma

Participants
Yanqiao Ren, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

Previously, few studies have focused on the dynamic monitoring of the tumor microenvironment changes during anti-vascular therapy and immunotherapy. Here, we used serial multimodal structural and functional magnetic resonance imaging (MRI) dynamic early assessment of tumor microenvironmental changes in HCC after treatment with sorafenib and anti-PD-L1 antibody and elucidate the synergistic mechanism.*Methods and Materials Subcutaneous syngeneic HCC tumors were established in the right flanks of C57/BL6 mice. Mice were longitudinally scanned using T1/T2-weighted MRI, diffusion-weighted (DW) MRI, and magnetic resonance spectroscopy (MRS) 1 day before and on days 7, 14 and 21 after treatment initiation to determine tumor size, necrosis area, apparent diffusion coefficient (ADC) value, and tumor metabolites including lactate. At indicated days later, the tumor-bearing mice were euthanized, and tumor tissues were harvested for further analysis including western blotting and qPCR array, immunohistochemistry, and immunofluorescence.*Results We treated 6-week-old C57/BL6 mice with subcutaneous tumor volume of about 80-120mm3 with daily sorafenib (50mg/kg) gavage or intraperitoneal injection of anti-PD-L1 antibody (10mg/kg) every 3 days, and control mice with intraperitoneal injection of isotype-matched IgG antibody (10mg/kg) every 3 days (Fig. 1A). Compared to sorafenib or anti-PD-L1 antibody, combination therapy of sorafenib and anti-PD-L1 antibody markedly retarded tumor growth increased tumor necrosis area, and led to increases in ADC value (Fig. 2, A-C). However, T1 mapping showed no significant difference in T1 values between the four groups at different time points (Fig. 1, D-E). Excessive pruning of tumor vessels by sorafenib resulted in increased tumor hypoxia in the tumor microenvironment, and MRS showed an enhancement of lactate levels (Fig. 3, A-D). Hypoxia causes drug resistance and high expression of PD-L1 in tumor cells, leading to immunosuppressive microenvironment (Fig.3, C and E).*Conclusions These imaging methods serve as a unique and non-invasive MRI biomarker for the early dynamic evaluation of tumor microenvironment changes after anti-vascular treatment and immunotherapy for HCC.*Clinical Relevance/Application The findings of this study are conducive to the establishment of an accurate correlation between imaging features-microenvironment characteristics-tumor anti-vascular treatment and immunotherapy, and the realization of scientific and precise individualized treatment of HCC.

RESULTS

We treated 6-week-old C57/BL6 mice with subcutaneous tumor volume of about 80-120mm3 with daily sorafenib (50mg/kg) gavage or intraperitoneal injection of anti-PD-L1 antibody (10mg/kg) every 3 days, and control mice with intraperitoneal injection of isotype-matched IgG antibody (10mg/kg) every 3 days (Fig. 1A). Compared to sorafenib or anti-PD-L1 antibody, combination therapy of sorafenib and anti-PD-L1 antibody markedly retarded tumor growth increased tumor necrosis area, and led to increases in ADC value (Fig. 2, A-C). However, T1 mapping showed no significant difference in T1 values between the four groups at different time points (Fig. 1, D-E). Excessive pruning of tumor vessels by sorafenib resulted in increased tumor hypoxia in the tumor microenvironment, and MRS showed an enhancement of lactate levels (Fig. 3, A-D). Hypoxia causes drug resistance and high expression of PD-L1 in tumor cells, leading to immunosuppressive microenvironment (Fig.3, C and E).

CLINICAL RELEVANCE/APPLICATION

The findings of this study are conducive to the establishment of an accurate correlation between imaging features-microenvironment characteristics-tumor anti-vascular treatment and immunotherapy, and the realization of scientific and precise individualized treatment of HCC.

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Abstract Archives of the RSNA, 2021

SDP-PH

Physics Pre-recorded Scientific Posters

Sub-Events

SDP-PH-1   A Phantom Prototype For The Quantitative Evaluation Of The Dynamic Performance Of Flat-panel Detectors

Participants
Kwan Wai Li, Hong Kong, Hong Kong (*Presenter*) Nothing to Disclose

PURPOSE

The phantoms and experimental setups for the quantitative evaluation of the static performance of digital radiographic detectors have been well established for a long time. Although instantaneous image lag artifact is common and important in fluoroscopy and cine acquisition, standard for the quantitative evaluation of this artifact is yet to be developed. In this study, an in-house fabricated phantom is used to address this issue.*Methods and Materials The phantom consisted of a brushed DC geared motor driven by a battery-powered pulse width modulation (PWM) DC motor speed controller and two circular acrylic discs with different test patterns that could be rotated by the motor interchangeably. The first test pattern had three clinically used guidewires of diameters 0.46 mm, 0.63 mm and 0.89 mm equally spaced at 60° from each other. The second pattern had eight rows of holes equally spaced at 45° from each other, drilled at depths of 1.5 mm, 2 mm, 2.5 mm, 3 mm, 3.5 mm, 4 mm, 5 mm and 5.5 mm representing different contrast ratios, with six holes of diameters from 1 mm to 6 mm at 1 mm intervals in each row. The phantom was tested using Siemens Artis zee with PURE multi-purpose system equipped with an indirect-conversion flat-panel detector for fluoroscopy and angiography. The phantom rotation speed could be adjusted manually by the knob on the PWM controller and was set at 3 rpm, 15 rpm and 30 rpm to simulate cardiac wall motion speed at different heart rates. The phantom was placed at the isocenter and its fluoroscopic and cine acquisition images were acquired using the default digital subtraction angiography body protocol provided by the manufacturer.*Results Image retention was observed in both patterns for some settings of the protocol at 15 rpm and 30 rpm due to residual signals from previous acquisitions and image processing such as recursive filtering which temporally averaged images. For the first pattern, ghosting was quantitatively evaluated by plotting the pixel intensity profile across the guidewires or measuring the widening of the guidewires. For the second pattern, ghosting was quantitatively evaluated by measuring the normalized pixel values of the regions-of-interest (ROIs) at each pulse and counting the number of pulses the residual signal faded completely, with the size of the ROIs covering 80% of the area of the low-contrast targets at the first pulse.*Conclusions We have developed a portable phantom and simple quantitative methods to fine-tune the image processing parameters of imaging protocols used in angiography where dynamic performance is important.*Clinical Relevance/Application The portable phantom can be used for the optimization of image processing parameters when setting up clinical imaging protocols during acceptance of angiography machines.

RESULTS

Image retention was observed in both patterns for some settings of the protocol at 15 rpm and 30 rpm due to residual signals from previous acquisitions and image processing such as recursive filtering which temporally averaged images. For the first pattern, ghosting was quantitatively evaluated by plotting the pixel intensity profile across the guidewires or measuring the widening of the guidewires. For the second pattern, ghosting was quantitatively evaluated by measuring the normalized pixel values of the regions-of-interest (ROIs) at each pulse and counting the number of pulses the residual signal faded completely, with the size of the ROIs covering 80% of the area of the low-contrast targets at the first pulse.

CLINICAL RELEVANCE/APPLICATION

The portable phantom can be used for the optimization of image processing parameters when setting up clinical imaging protocols during acceptance of angiography machines.

SDP-PH-10   Measurement Of Directional Task-based Modulation Transfer Function At Abdominal CT: A Phantom Study

Participants
Toru Higaki, PhD, Minami-ku, Hiroshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

A modulation transfer function (MTF) is an index of spatial resolution of CT images. MTFs depend on contrast of a target object in non-linear image reconstruction methods such as iterative reconstruction (IR), and task contrast-based modulation transfer function (TTF) have been proposed. TTF is generally measured by the circular edge method, but direction dependence is not taken into consideration. This study aimed to investigate the direction-dependency of the TTF using a 3D printed abdominal phantom.*Methods and Materials We made two phantoms, one was a simple cylindrical phantom, the other was a structured phantom that simulated abdominal CT (Fig. left). The outer size of each phantom was 200×200 mm and 300×200 mm, respectively. Each phantom harbored a simulated low-contrast tumor, which was filled with diluted iodine contrast medium with 4.0 mgI/ml.We scanned the phantoms with our standard abdominal scan protocol (tube voltage: 120 kV, tube current: automatic exposure control with preset image noise 12 HU) 200 times repeatedly. We reconstructed images using hybrid IR (AIDR 3D with FC13 kernel, Canon Medical Systems Corp). We generated an average image from 200 repeated scans to reduce image noise for each phantom. We measured directional TTF using the circular edge method on the simulated low-contrast lesion. We divided 360 degrees into 8 parts

every 45 degrees and recorded the average TTF for each part. We recorded 50, 20, 10 and 5% TTF values for each direction and created a radar chart.*Results The CTDIvol of the cylindrical and abdominal phantom were 4.9 and 9.5 mGy, respectively. The 50, 20, 10, and 5% TTF of the cylindrical phantom were 0.316±0.012 (mean ± standard deviation [SD]), 0.496±0.023, 0.603±0.026, and 0.697±0.026 cy/mm, respectively. The 50, 20, 10, and 5% TTF of the structured abdominal phantom were 0.303±0.019, 0.476±0.035, 0.577±0.044, and 0.667±0.051 cy/mm, respectively. The SD of the directional TTF values in the structured abdominal phantom were higher than that of the cylindrical phantom, and the radar chart also showed that it was highly directionally dependent (Fig. right).*Conclusions TTFs in asymmetrically shaped objects vary from direction to direction.*Clinical Relevance/Application Due to the orientation dependence of TTF in non-rotationally symmetric objects such as the human body, the appearance of tumors may differ from direction to direction.

RESULTS

The CTDIvol of the cylindrical and abdominal phantom were 4.9 and 9.5 mGy, respectively. The 50, 20, 10, and 5% TTF of the cylindrical phantom were 0.316±0.012 (mean ± standard deviation [SD]), 0.496±0.023, 0.603±0.026, and 0.697±0.026 cy/mm, respectively. The 50, 20, 10, and 5% TTF of the structured abdominal phantom were 0.303±0.019, 0.476±0.035, 0.577±0.044, and 0.667±0.051 cy/mm, respectively. The SD of the directional TTF values in the structured abdominal phantom were higher than that of the cylindrical phantom, and the radar chart also showed that it was highly directionally dependent (Fig. right).

CLINICAL RELEVANCE/APPLICATION

Due to the orientation dependence of TTF in non-rotationally symmetric objects such as the human body, the appearance of tumors may differ from direction to direction.

SDP-PH-11 Super-resolution Deep Learning Reconstruction At CT: A Phantom Study For Coronary CT Angiography

Participants
Toru Higaki, PhD, Minami-ku, Hiroshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

In this study, we newly developed a super-resolution deep learning reconstruction (SR-DLR), converting conventional- to high-resolution CT images. We evaluated the diagnostic potential of the SR-DLR using a coronary CT angiography (CCTA) phantom with a 3D printer.*Methods and Materials The SR-DLR was implemented using a super-resolution DCNN (SR-DCNN). It was trained with pairs of high-resolution- and conventional resolution images (Fig. left-top). The high-resolution images were acquired using an actual ultra-high-resolution CT scanner (Aquilion Precision, Canon Medical Systems Corp.: CMSC), and reconstructed with deep learning based reconstruction. In order to virtually generate conventional resolution images, firstly, the super-high-resolution sinograms were down-sized, and then they were reconstructed with a conventional reconstruction method. We made a CCTA phantom (Fig. left-bottom) using a 3D printer (Agilista-3200, Keyence). Outer diameter of the phantom was 350×250 mm. Iodine contrast medium diluted with 20 mgI/ml was filled to the simulated left ventricle and coronary arteries, and there was a 70% stenosis in the simulated coronary arteries. We scanned the CCTA phantom using a conventional CT scanner (Aquilion ONE GENESIS, CMSC) with standard CCTA protocol (tube voltage: 120 kV, tube current: automatic exposure control with SD 23 HU, rotation speed: 0.275 s/rot, ECG-gated volume scan). Images were reconstructed with the SR-DLR and conventional hybrid iterative reconstruction (IR) (Adaptive Iterative Dose Reduction 3D with FC14 kernel, CMSC). We measured image noise, noise power spectrum (NPS), and modulation transfer function (MTF).*Results The image noise of the images reconstructed with SR-DLR and hybrid IR were 16.5- and 24.4 HU. In NPS, low-frequency noise was reduced on the SR-DLR image (Fig. right-top). The spatial resolution of the SR-DLR image was superior to the hybrid IR, 10% MTF values were 1.09 and 0.67 cy/mm, respectively. Margin of the simulated stenosis was more clearly delineated in SD-DLR- than hybrid IR image (Fig. right-bottom).*Conclusions The SR-DLR improved not only spatial resolution but also image noise.*Clinical Relevance/Application The super-resolution deep learning reconstruction may improve the diagnostic ability of coronary CT angiography.

RESULTS

The image noise of the images reconstructed with SR-DLR and hybrid IR were 16.5- and 24.4 HU. In NPS, low-frequency noise was reduced on the SR-DLR image (Fig. right-top). The spatial resolution of the SR-DLR image was superior to the hybrid IR, 10% MTF values were 1.09 and 0.67 cy/mm, respectively. Margin of the simulated stenosis was more clearly delineated in SD-DLR- than hybrid IR image (Fig. right-bottom).

CLINICAL RELEVANCE/APPLICATION

The super-resolution deep learning reconstruction may improve the diagnostic ability of coronary CT angiography.

SDP-PH-12 Physical Characteristics Of A New Photon-counting Detector CT Scanner: Comparison Of The Contrast-to-noise Ratio And The Noise Power Spectrum With Those On Conventional Energy-integrated Detector CT

Participants
Toru Higaki, PhD, Minami-ku, Hiroshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

FUJIFILM Healthcare Corporation developed a photon-counting detector CT (PCD-CT) scanner that features a photon sensor was made of CdZnTe. It has two scan modes, multi-energy discrimination (MED) mode where 3x3 detector pixels are bundled [detector pixel pitch (DPP) 0.58x0.63 mm, the same as the conventional energy-integrated detector CT (EID-CT)]. It can obtain projection data from four energy bins. The other is the ultra-high resolution (UHR) mode where each detector pixel is used separately; it can obtain high spatial resolution images (DPP: 0.19x0.21 mm) with projection data of one energy bin. We compared the contrast-to-noise ratio (CNR) of virtual monochromatic images (VMIs) obtained with the MED mode of the PCD-CT- and the conventional 120 kV images of the EID-CT scanner.*Methods and Materials A prototype PCD-CT scanner was built on the platform of a conventional EID-CT scanner (SCENARIA View, FUJIFILM Healthcare Corporation). We used a home-made phantom for PCD-CT and EID-CT scanning. The scan parameters were scan field-of-view 42.6 cm, tube voltage 120 kV, tube current time product 300 mAs, tube focal spot 0.7x0.8 mm, view rate 2880 view/sec, slice thickness 1.25 mm, matrix size 512x512, reconstruction with filtered back projection (kernel: abdominal sharp) on both instruments. The number of energy bin of the PCD-CT was 4. The phantom consisted of a cylindrical acrylic 20-cm diameter background [54 Hounsfield units (HU)] and 1.5-cm diameter cylindrical modules filled with iodine solution (2-, 10-, 15-, and 40 mgI/ml). We measured the CNR of each module.*Results For all modules the CNR of the PCD-

CT was the largest (55 - 65 keV). The maximum CNR of the PCD-CT for modules with 2-, 10-, 15-, and 40 mgI/ml was 6.1, 58.6, 94.6, and 265.6, respectively; the corresponding CNR of the EID-CT was 1.1, 49.8, 80.3, and 231.3. The noise power spectrum of PCD-CT and EID-CT was almost identical.*Conclusions The CNR was better in the SR mode of the PCD-CT than the EID-CT.*Clinical Relevance/Application As contrast resolution is better in the SR mode of PCD-CT- than on EID-CT images, it may be superior for identifying soft tissue tumors such as liver tumors.

RESULTS

For all modules the CNR of the PCD-CT was the largest (55 - 65 keV). The maximum CNR of the PCD-CT for modules with 2-, 10-, 15-, and 40 mgI/ml was 6.1, 58.6, 94.6, and 265.6, respectively; the corresponding CNR of the EID-CT was 1.1, 49.8, 80.3, and 231.3. The noise power spectrum of PCD-CT and EID-CT was almost identical.

CLINICAL RELEVANCE/APPLICATION

As contrast resolution is better in the SR mode of PCD-CT- than on EID-CT images, it may be superior for identifying soft tissue tumors such as liver tumors.

SDP-PH-13 Deep-learning-based Lumen Extraction Method To Improve The Diagnostic Performance To Detect Significant Stenosis In Coronary CT Angiography With Severe Calcification

Participants
Hidekazu Inage, Tokyo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic performance of a deep-learning-based lumen extraction method (DL-LEM) to detect significant stenosis on coronary CT angiography (CCTA) in patients with severe coronary calcification.*Methods and Materials DL-LEM was trained using 900 CCTA and non-contrast CT datasets to produce virtual non-contrast CT images. Lumen images were created by subtracting the virtual non-contrast CT images from the original CCTA images. We tested the DL-LEM images using datasets of 99 patients with severe coronary calcification who underwent invasive coronary angiography (ICA). One radiologist and one radiological technologist evaluated the stenosis severity of the DL-LEM images and the original CCTA images. We compared the diagnostic accuracy to detect significant stenosis (diameter stenosis =50%) between the two methods with ICA as the reference standard.*Results Of the 891 segments, 228 segments were determined as significant stenosis due to severe calcification in the original CCTA images. DL-LEM improved the per-segment diagnostic accuracy from 73.5% to 74.6%, and the AUC improved from 0.751 to 0.762 (p = 0.019). When analyzing the 228 segments that could not be evaluated due to severe calcification on the original CCTA images, DL-LEM improved the accuracy from 35.5% to 41.2%, and the AUC improved from 0.500 to 0.581 (p = 0.0009).*Conclusions DL-LEM might be useful to improve the diagnostic performance to detect significant stenosis in patients with severe calcification.*Clinical Relevance/Application This preliminary study suggests that patients with severe coronary calcification might defer catheter angiography if a deep-learning-based model confirms the lumen is not stenotic.

RESULTS

Of the 891 segments, 228 segments were determined as significant stenosis due to severe calcification in the original CCTA images. DL-LEM improved the per-segment diagnostic accuracy from 73.5% to 74.6%, and the AUC improved from 0.751 to 0.762 (p = 0.019). When analyzing the 228 segments that could not be evaluated due to severe calcification on the original CCTA images, DL-LEM improved the accuracy from 35.5% to 41.2%, and the AUC improved from 0.500 to 0.581 (p = 0.0009).

CLINICAL RELEVANCE/APPLICATION

This preliminary study suggests that patients with severe coronary calcification might defer catheter angiography if a deep-learning-based model confirms the lumen is not stenotic.

SDP-PH-14 Physical Image Quality Of Deep Learning-based Image Reconstruction In ECG-gated CT Imaging

Participants
Kaoru Kitagawa, Kobe, Japan (*Presenter*) Support, General Electric Company

PURPOSE

In recent years, CT imaging using deep learning-based image reconstruction method has been performed. The physical characteristics of DLIR have been reported using ECG-non-gated imaging at 120 kV. However, it is necessary to clarify the physical characteristics of ECG-gated, low-tube voltage imaging for coronary CTA. In the present study, we evaluated the physical characteristics of DLIR and compared them with those of filtered back projection (FBP) and hybrid iterative reconstruction (HIR) by varying the radiation dose while performing ECG-gated imaging using a phantom.*Methods and Materials All phantom measurements were performed with an ECG-gated scan at 60 bpm. For CNR measurements, the elliptical phantom made from a water-equivalent material with 12mgI/ml rod insertion was scanned at 70, 80, 100 and 120 kV with same radiation dose level (2.2 mGy). For NPS measurements, the water phantom with a 20 cm diameter was scanned at two radiation levels (CTDIvol 1.2 and 0.6 mGy) for 4 tube voltages. All data were reconstructed using FBP, HIR (ASiR-V70%), and three levels of DLIR (DLIR-low [L], medium [M], high [H], respectively). CNR and NPS were calculated and compared for each tube voltage and reconstruction method.*Results The CNR for FBP was 12.8 for 70 kV, 9.8 for 80 kV, 6.9 for 100 kV, and 5.1 for 120 kV, while DLIR-H showed the best values of 16.8 for 80 kV, 14.6 for 100 kV, and 11.6 for 120 kV. The DLIR-H showed the best values at 16.8 for 80 kV, 14.6 for 100 kV and 11.6 for 120 kV. However, at 70 kV, the HIR value was 20.2, which was higher than the DLIR-H of 17.3. In the NPS, when the CTDIvol was 1.2 mGy, the peak frequency was 0.25 mm-1 for FBP, DLIR-L, and DLIR-M, but 0.15 mm-1 for HIR and DLIR-H. When the CTDIvol was 0.6 mGy, the peak frequency was 0.2 mm-1 for FBP, DLIR-L, and DLIR-M, but 0.15 mm-1 for HIR and DLIR-H.*Conclusions The effect of DLIR on image quality depends on its own strength and the tube voltage at the time of imaging.*Clinical Relevance/Application In this study, we evaluated the effect of DLIR on image quality in ECG-gated CT. For NPS, the peak frequencies changed with increasing strength of DLIR.

RESULTS

The CNR for FBP was 12.8 for 70 kV, 9.8 for 80 kV, 6.9 for 100 kV, and 5.1 for 120 kV, while DLIR-H showed the best values of 16.8 for 80 kV, 14.6 for 100 kV, and 11.6 for 120 kV. The DLIR-H showed the best values at 16.8 for 80 kV, 14.6 for 100 kV and 11.6 for 120 kV. However, at 70 kV, the HIR value was 20.2, which was higher than the DLIR-H of 17.3. In the NPS, when the CTDIvol was 1.2 mGy, the peak frequency was 0.25 mm-1 for FBP, DLIR-L, and DLIR-M, but 0.15 mm-1 for HIR and DLIR-H. When the CTDIvol was 0.6 mGy, the peak frequency was 0.2 mm-1 for FBP, DLIR-L, and DLIR-M, but 0.15 mm-1 for HIR and DLIR-H.

In this study, we evaluated the effect of DLIR on image quality in ECG-gated CT. For NPS, the peak frequencies changed with increasing strength of DLIR.

SDP-PH-15 Automatic And Accurate Detection Of Lesions Across The Whole Body Using Multi-view Deep Learning Network

Participants
Yan Zhang, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning methods have shown success in detecting lesions of a particular type. We aim at detecting various lesions from different parts of the body (universal lesions) from CT through an end-to-end convolutional neural network.*Methods and Materials A total of 32,120 axial CT slices including 32,735 lesion instances from the whole body were retrieved from the NIH DeepLesion dataset. We separated this dataset into independent training (70%), validation (15%), and testing (15%) cohorts.We proposed a multi-view attention-aware network to detect universal lesion. Inspired by clinical practice, we adopted different window widths and window levels (so-called multi-view) for CT reconstructions. We collected recommended window level and window width of each slice, then clustered these statistics using the k-means algorithm. Three representative windows were generated from cluster centers, which are [50, 449], [-505, 1980], [446, 1960] respectively. These windows approximately correspond to the ideal CT windows for soft-tissue, lung, and other tissues (bone, brain, and mediastinal). For better 3D context modeling, 9 z-axis slices were sampled as inputs. Features from different views were extracted by a shared three-pathway residual architecture. Afterward, we employed a channel-wise attention module for feature aggregation. Enlightened by manually window selection process, this module was designed to put different weights upon all the channels. Given outputs of the abovementioned structures, another neural network predicted lesion locations. We evaluated our network by the sensitivity at a series of false positives (FPs) per image.*Results The sensitivity at 0.5, 1, 2, 3, and 4 FPs per image reached 73.11%, 80.92%, 87.01%, 89.11%, and 90.09% respectively. With far less 3D context, our model surpassed previous state-of-the-art method which used 27 slices by a large margin (4.44% for FPs@4.0 and 10.63% for FPs@0.5). Case study visualized this gap intuitively, as shown in the figure.*Conclusions We developed an end-to-end automated network for universal lesion detection which could pick up most of the lesions while diminishing FPs effectively.*Clinical Relevance/Application Automated screening of whole-body lesions could assist clinical diagnosis of disease or trauma. The high accuracy of our detection algorithm brings light to the future implementation of the computer-aided lesion detection system.

RESULTS

The sensitivity at 0.5, 1, 2, 3, and 4 FPs per image reached 73.11%, 80.92%, 87.01%, 89.11%, and 90.09% respectively. With far less 3D context, our model surpassed previous state-of-the-art method which used 27 slices by a large margin (4.44% for FPs@4.0 and 10.63% for FPs@0.5). Case study visualized this gap intuitively, as shown in the figure.

CLINICAL RELEVANCE/APPLICATION

Automated screening of whole-body lesions could assist clinical diagnosis of disease or trauma. The high accuracy of our detection algorithm brings light to the future implementation of the computer-aided lesion detection system.

SDP-PH-16 Correlation Between CT Signs And The Volume Of Intraoperative Bleeding Of Carotid Body Tumor

Participants
Dongmei Zhou, Xining, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the application value of head and neck CT angiography(CTA) in the prediction of the volume of intraoperative bleeding(VIB) of carotid body tumor(CBT).*Methods and Materials Twenty-six patients with CBT undergoing head and neck CTA examination before CBT resection were enrolled. All patients accepted the same operation method. The transverse and longitudinal diameters of the tumor, the encased degree of carotid artery by tumor (EDCA), the number of blood supply arteries (NBSA) and VIB were measured or recorded. EDCA was divided into three levels:<90°;90°-180°;>180°. The correlation between tumor diameters, NBSA, EDCA and VIB were analyzed by Spearman Correlation.*Results The average age of 26 patients was 51.81(SD,±7.73)years old, including 3 males and 23 females. The mean values of the tumor transverse diameter(TTD), tumor longitudinal diameter(TLD),NBSA and VIB are(3.07±1.34)cm,(3.37±1.38)cm,(1.73±0.87)and(157.69±249.13)ml, respectively. VIB had strong positive correlation with TTD, TLD and EDCA (rho=0.778,0.669 and 0.663,respectively, all P<0.001) and moderate correlation with NBSA(rho=0.573, P=0.002).*Conclusions The transverse and longitudinal diameters of the tumor and EDCA are all strongly positively correlated with VIB. Among all measurements, tumor transverse diameter is the best indicator.*Clinical Relevance/Application The head and neck CT angiography images can evaluate the VIB of CBT and provide help for clinical surgical treatment.

RESULTS

The average age of 26 patients was 51.81(SD,±7.73)years old, including 3 males and 23 females. The mean values of the tumor transverse diameter(TTD), tumor longitudinal diameter(TLD),NBSA and VIB are(3.07±1.34)cm,(3.37±1.38)cm, (1.73±0.87)and(157.69±249.13)ml, respectively. VIB had strong positive correlation with TTD, TLD and EDCA (rho=0.778,0.669 and 0.663,respectively, all P<0.001) and moderate correlation with NBSA(rho=0.573, P=0.002).

CLINICAL RELEVANCE/APPLICATION

The head and neck CT angiography images can evaluate the VIB of CBT and provide help for clinical surgical treatment.

SDP-PH-18 Estimation Of Radiation Risk Of Third Trimester Pregnant Patients And Fetus In Chest CT

Participants
Zhuang Nie, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

to estimate the radiation dose and radiation-related cancer risks associated with single phase chest CT examinations of pregnant patients and fetus by using standard radiation risk estimation models.*Methods and Materials We retrospectively included 84 pregnant patients admitted to the obstetrics department of our hospital underwent chest CT scan for COVID-19 screening, with

age average of 31.9±4.2 years and age range of 24-43 years. Based on CT scan parameters (such as tube voltage, mAs, pitch, etc.) and CTDIvol, DLP, using the digital anthropomorphic model of pregnant patients from the Radimetrics platform and Monte Carlo simulation to estimate the patient's organ dose, effective dose, and fetal dose. Then use the risk model from the International Commission on Radiological Protection (ICRP) to estimate the effective risk of the patient and the radiation-related cancer induction risks of each organ.*Results The average values of CTDIvol, SSDE and DLP are 7.8 ± 2.4mGy, 10.4 ± 2.7mGy, 256.2 ± 78.9mGy*cm. Breast (12 ± 3.4 mGy), lungs (11.8 ± 3.2 mGy), and heart (10.7 ± 3 mGy) have the highest organ dose, and the doses of other organs were all below 10 mGy. The average effective dose is 6.2 ± 1.7 mSv, and the average effective radiation risk is 5.8 ± 1.6 (the number of cases per 10,000 people). The three organs with the highest radiation-related cancer risk are: breast (2.1±0.6 cases per 10,000 people), lung (1.6±0.4 cases per 10,000 people) and stomach (0.7±0.2 cases per 10,000 people). The average equivalent dose to the fetus is 0.77±0.3mSv.*Conclusions This study can provide a quantitative reference for the risk-benefit ratio for clinical decision-making on radiological examinations for pregnant patients, and improve medical staff's awareness of the potential risks of radiological examinations for pregnant patients.*Clinical Relevance/Application This study can provide a quantitative reference for the risk-benefit ratio for clinical decision-making on radiological examinations for pregnant patients, and improve medical staff's awareness of the potential risks of radiological examinations for pregnant patients.

RESULTS

The average values of CTDIvol, SSDE and DLP are 7.8 ± 2.4mGy, 10.4 ± 2.7mGy, 256.2 ± 78.9mGy*cm. Breast (12 ± 3.4 mGy), lungs (11.8 ± 3.2 mGy), and heart (10.7 ± 3 mGy) have the highest organ dose, and the doses of other organs were all below 10 mGy. The average effective dose is 6.2 ± 1.7 mSv, and the average effective radiation risk is 5.8 ± 1.6 (the number of cases per 10,000 people). The three organs with the highest radiation-related cancer risk are: breast (2.1±0.6 cases per 10,000 people), lung (1.6±0.4 cases per 10,000 people) and stomach (0.7±0.2 cases per 10,000 people). The average equivalent dose to the fetus is 0.77±0.3mSv.

CLINICAL RELEVANCE/APPLICATION

This study can provide a quantitative reference for the risk-benefit ratio for clinical decision-making on radiological examinations for pregnant patients, and improve medical staff's awareness of the potential risks of radiological examinations for pregnant patients.

SDP-PH-19 Intermanufacturer Comparison Of Dual-Energy CT Monochromatic Attenuation: A Phantom Study

Participants
Yong Chen, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To determine the accuracy of dual-energy computed tomography monochromatic image CT value in a phantom system by comparing 3 types of structure dual energy CT: fast kilovolt peak-switching, dual-source, and dual-layer detector systems.*Methods and Materials An iodine phantom (Gammex 472, Middleton, WI, USA) containing five iodine concentration (IC) (2, 2.5, 5, 7.5, 10 mg/mL) was scanned three times with five dual-energy CT systems with 20 mGy radiation dose. Monochromatic images (40, 70, 100 and 140 keV) were created through post reconstruction. Monochromatic attenuation for each insert and reconstruction energy level were recorded. The recorded monochromatic attenuation value was compared to the theoretic value calculated from National Institute of Standards and Technology (NIST) XCOM database. The mean percentage error bias between the recorded value and NIST value at four monochromatic energy level and five (IC) was calculated and compared.*Results One dual source paradigm had the lowest bias in all iodine concentration (IC) for 40 keV (from 0.2% to 11.1%). Fast kilovolt peak switching paradigms showed tendency to perform better in low IC (2, 2.5 and 5mg/mL) for 70 and 100 keV (bias from 0.6% to 8.6%), while dual source paradigms were prone to have lower bias in high IC (7.5 and 10mg/mL, from 1.5% to 5.0%). Dual-layered detector arrays showed poor performance in 40, 70 and 100 KeV but had the best performance for 140 keV in IC of 2, 2.5 and 5mg/mL (bias of 20.4%, 2.3% and 2.1%).*Conclusions Fast kilovolt peak switching and dual source systems showed higher accuracy in low-to-moderate monochromatic energy level while dual-layered detector performed better in high monochromatic energy level.*Clinical Relevance/Application The difference in accuracy of dual-energy CT could provide useful information for the clinical diagnosis.

RESULTS

One dual source paradigm had the lowest bias in all iodine concentration (IC) for 40 keV (from 0.2% to 11.1%). Fast kilovolt peak switching paradigms showed tendency to perform better in low IC (2, 2.5 and 5mg/mL) for 70 and 100 keV (bias from 0.6% to 8.6%), while dual source paradigms were prone to have lower bias in high IC (7.5 and 10mg/mL, from 1.5% to 5.0%). Dual-layered detector arrays showed poor performance in 40, 70 and 100 KeV but had the best performance for 140 keV in IC of 2, 2.5 and 5mg/mL (bias of 20.4%, 2.3% and 2.1%).

CLINICAL RELEVANCE/APPLICATION

The difference in accuracy of dual-energy CT could provide useful information for the clinical diagnosis.

SDP-PH-2 Improvement Of Low-contrast Detectability Using Novel Iterative Progressive Reconstruction With Multifrequency Processing In Brain Ct

Participants
Yoshinori Funama, PhD, Kumamoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Iterative progressive reconstruction with visual modeling (IPV) with a multifrequency process that focuses on improving low-contrast detectability (IPV-LCD) is newly introduced in brain computed tomography (CT) imaging. IPV-LCD with multifrequency processing can adaptively reduce image noise that varies according to the spatial frequency.The present study aimed to investigate the performance of IPV-LCD as compared with conventional IPV in terms of noise texture patterns and low-contrast detectability at different radiation doses.*Methods and Materials Helical scans were performed on a 64-detector CT scanner (SCENARIA View, FUJIFILM Healthcare Corporation, Tokyo, Japan) using a CCT189 MITA CT IQ phantom (low-contrast modules with a contrast of 3 HU and diameters of 10 mm [C3?10]). The tube voltage was set at 120 kVp, and the tube current-time product was changed from 120 to 360 mAs (seven types). All images were reconstructed at 5-mm thickness using FBP, IPV-LCD with eight strength levels, and conventional IPV with two strength levels. The noise power spectrum (NPS) was calculated. A model observer involving a channelized Hotelling observer model was applied using low-contrast modules in the phantom for evaluating low-contrast detectability.*Results The NPS for all IPV-LCD images showed similar curves as those for FBP images. For C3?10, the detectability indices were 5.6-12.1 at FBP, 6.7-15.2 at conventional IPV with standard level (STD), 8.8-16.3 at IPV-LCD with STD, 8.0-17.4 at

conventional IPV with strong level (STR), 9.5-19.7 at IPV-LCD with STR, respectively. For STD and STR, the low-contrast detectabilities with IPV-LCD were 6%-32% and 10%-35% higher than those with conventional IPV. The contrast-to-noise ratio at 210 mAs was 1.1 at FBP. Similarly, CNRs of IPV-LCD with standard and strong levels were 1.8 and 2.9, and those of IPV were 1.3 and 2.3, respectively.*Conclusions IPV-LCD images showed improved low-contrast detectability as compared with FBP and conventional IPV and a similar noise texture pattern as that of FBP images.*Clinical Relevance/Application The use of IPV-LCD with multifrequency processing provides better brain tissue visibility without a lack of image texture appearance in brain CT.

RESULTS

The NPS for all IPV-LCD images showed similar curves as those for FBP images. For C3?10, the detectability indices were 5.6-12.1 at FBP, 6.7-15.2 at conventional IPV with standard level (STD), 8.8-16.3 at IPV-LCD with STD, 8.0-17.4 at conventional IPV with strong level (STR), 9.5-19.7 at IPV-LCD with STR, respectively. For STD and STR, the low-contrast detectabilities with IPV-LCD were 6%-32% and 10%-35% higher than those with conventional IPV. The contrast-to-noise ratio at 210 mAs was 1.1 at FBP. Similarly, CNRs of IPV-LCD with standard and strong levels were 1.8 and 2.9, and those of IPV were 1.3 and 2.3, respectively.

CLINICAL RELEVANCE/APPLICATION

The use of IPV-LCD with multifrequency processing provides better brain tissue visibility without a lack of image texture appearance in brain CT.

SDP-PH-20　The Influence Of Dual-energy Data Reconstruction Parameters On The Monosodium Urate Detection Based On Dual-energy CT

Participants
Yan Zhang, Peking, China (*Presenter*) Nothing to Disclose

PURPOSE

To study the influence of dual-energy data reconstruction parameters on the monosodium urate (MSU) detection based on Dual-energy CT.*Methods and Materials A total of 46 patients with gout, who were undergone gout dual-energy CT scan, were included in this study. Four groups with different slice thicknesses and increments were reconstructed based on the same CT raw data, they were group A:0.6/0.3mm, group B:0.75/0.4mm, group C: 1.0/0.5mm,group D:1.5/0.8mm. The fields of display view and the central position in the four groups were the same. The MSU was detected by the software of Dual-Energy Gout based on the dual-energy data, and volumes of the MSU were calculated automatically by the software of Volume. The distribution and shape scores of the MSU were evaluated subjectively. Using SPSS22.0 software, and the x2 test and the rank test were used for statistical analysis.*Results The MSU volumes detected in four groups were (6.93+19.36), (6.49+18.26), (6.18+17.55),(5.42+15.18) mm3, the MSU distribution scores were (1.09+0.28), (1.00+0.00), (0.04+0.21),(0.04+0.21), and the MSU shape scores were (2.24+1.40), (2.15+1.49), (1.30+1.40), (1.23+1.41) respectively. There were statistical significant differences in the MSU volumes, distributions and shapes in four groups (P<0.05). There was significant statistical difference between group A (6.93+19.36) mm3and C(6.18+17.55) mm3 (P<0.05), group A (6.93+19.36) mm3 and D(5.42+15.18) mm3 (P<0.05)on the MSU volumes. Besides group A and B, group C and D, there were significant statistical differences on MSU distributions and shapes between the other two groups (P<0.0083).*Conclusions The setting of reconstruction slice thickness and increment of dual-energy data had an effect on the MSU detection based on Dual-energy CT.*Clinical Relevance/Application It was suggested that the slice thickness of dual-energy data should be less than 1mm.

RESULTS

The MSU volumes detected in four groups were (6.93+19.36), (6.49+18.26), (6.18+17.55),(5.42+15.18) mm3, the MSU distribution scores were (1.09+0.28), (1.00+0.00), (0.04+0.21),(0.04+0.21), and the MSU shape scores were (2.24+1.40), (2.15+1.49), (1.30+1.40), (1.23+1.41) respectively. There were statistical significant differences in the MSU volumes, distributions and shapes in four groups (P<0.05). There was significant statistical difference between group A (6.93+19.36) mm3and C(6.18+17.55) mm3 (P<0.05), group A (6.93+19.36) mm3 and D(5.42+15.18) mm3 (P<0.05)on the MSU volumes. Besides group A and B, group C and D, there were significant statistical differences on MSU distributions and shapes between the other two groups (P<0.0083).

CLINICAL RELEVANCE/APPLICATION

It was suggested that the slice thickness of dual-energy data should be less than 1mm.

SDP-PH-21　Comparison Of Threshold Contrast Detail Detectability Curves Of A Solid-state Flat-panel Detector And An Image Intensifier For Fluoroscopy And Digital Acquisition

Participants
Kwan Wai Li, Hong Kong, Hong Kong (*Presenter*) Nothing to Disclose

PURPOSE

Detective quantum efficiency (DQE) has been regarded as a key indicator of the overall imaing performance of x-ray image receptors, yet it only relates to the physical characteristics of the receptors. With the recent advances in image processing, image quality assessment on for-presentation images using threshold contrast detail detectability (TCDD) objects becomes more important. In this study, TCDD curves were compared between an image intensifier (II) and a solid-state flat-panel detector (FPD) which is commonly available in interventional systems nowadays.*Methods and Materials The two systems used for comparison were (i) Siemens Artis zee with PURE multi-purpose system equipped with a 30 cm x 40 cm indirect-conversion FPD made from amorphous silicon photodiode with CsI scintillator and (ii) GE OEC Elite surgical imaging C-arm equipped with a 9-inch II. Both systems provided three dose levels, corresponding to low, normal and high input air kerma rate (IAKR). An additional 1.5 mm copper filter was placed at the collimator. Leeds test objects TO10 and TO12 were placed on the entrance plane of the image receptors for fluoroscopy and digital acquisition, respectively. The test object images were acquired under automatic dose rate control (ADRC) without anti-scatter grid and then analyzed using AutoPIA software based on heuristic algorithms instead of human observers. Target object contrasts given in TO10 and TO12 specifications were interpolated and extrapolated to generate contrast curves for any kVp and copper filter combination. Threshold detection index (HT(A)) values were caculated at each detail area.*Results Fluoroscopy and digital acquisition HT(A) curves for both systems were compared. The two protocols (Siemens: Service; GE: General) were selected such that the IAKR or IAK for both systems were very close. The settings of the two protocols were left as default. The TCDD performance of the FPD system for digital acquisition was significantly better than that of the II system. However, it was inferior to that of the II system during fluoroscopy.*Conclusions The preliminary results of this study show that the use of FPD does not necessarily improve the TCDD performance compared with II which was commonly used in the past. Proper adjustements to the protocols in the FPD system, especially the parameters of the internal image processing algorithms like

I-Noise Reduction and Digital Density Optimization from Siemens Healthineers, should be made to boost the TCDD performance in each specific organ and clinical scenario.*Clinical Relevance/Application Robust hardware as well as carefully adjusted image processing parameters for clinical protocols are equally important for radiologists to better identify low-contrast lesions.

RESULTS

Fluoroscopy and digital acquisition HT(A) curves for both systems were compared. The two protocols (Siemens: Service; GE: General) were selected such that the IAKR or IAK for both systems were very close. The settings of the two protocols were left as default. The TCDD performance of the FPD system for digital acquisition was significantly better than that of the II system. However, it was inferior to that of the II system during fluoroscopy.

CLINICAL RELEVANCE/APPLICATION

Robust hardware as well as carefully adjusted image processing parameters for clinical protocols are equally important for radiologists to better identify low-contrast lesions.

SDP-PH-23 Physicist

Participants
Vishruta Dumane, PhD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Knowledge-based planning (KBP) in which a large number of accepted clinical plans for treatment are used to generate a model that would optimally produce a dosimetric result for the given anatomy is an approach to improving efficiency and reducing variability in treatment planning. The aim of this work was to determine if the Varian Rapidplan™ system can efficiently produce volumetric modulated arc therapy (VMAT) plans for the prostate and lymph nodes.*Methods and Materials A total of 91 patient plans treated at our institution with radiation using VMAT with two coplanar arcs and 6 MV photons was used to build the dose volume histogram (DVH) estimation model for organs at risk (OARs, namely the bladder, bladder wall, rectum, rectal wall, bowel and femoral heads. Prescription dose to the PTV was 45Gy. Dose constraints for the rectal wall and bladder wall were V40Gy < 30%, V30Gy < 50%, bowel maximum < 50Gy, femoral head maximum < 45Gy and V30Gy < 50%. Coverage to the planning target volume (PTV) was expected to be = 98%. The DVH estimation model was trained and tested using the knowledge-based planning software. Treatment plans for 20 patients generated clinically as well as using KBP were compared for dosimetric parameters using the Wilcoxon rank-sum test.*Results Comparison of dosimetric parameters for clinical versus KBP showed as much as a 12% reduction in bladder dose on average with KBP compared to the clinical plan. Specifically, the bladder wall V40 Gy was reduced by 6%, the V30 Gy by 9% and the V20 Gy by 13%. The rectal dose was reduced on average with KBP by as much as 8%. The rectal wall V40Gy was decreased by 3%, the V30Gy by 5% and the V20 Gy by 8%. All these results were found to be statistically significant (p<0.05). No significant differences were seen in the sparing of the bowel or the femoral heads for both planning techniques. Out of the plans tested for verification, 77% showed an improvement after using the KBP technique while 23% showed no significant difference.*Conclusions Despite meeting standard dose constraints for bladder and rectum, the toxicity cannot be ignored. Both the clinical and the KBP plans were able to meet these constraints, however, the bladder and rectum showed improved sparing with respect to doses in the range of 20Gy to 40Gy in the KBP plans also showing the potential to reduce treatment planning time.*Clinical Relevance/Application KBP has not only the potential to improve plan quality but to also improve organs sparing, thereby reduce toxicity to the organs at risk while improving speed and efficiency.

RESULTS

Comparison of dosimetric parameters for clinical versus KBP showed as much as a 12% reduction in bladder dose on average with KBP compared to the clinical plan. Specifically, the bladder wall V40 Gy was reduced by 6%, the V30 Gy by 9% and the V20 Gy by 13%. The rectal dose was reduced on average with KBP by as much as 8%. The rectal wall V40Gy was decreased by 3%, the V30Gy by 5% and the V20 Gy by 8%. All these results were found to be statistically significant (p<0.05). No significant differences were seen in the sparing of the bowel or the femoral heads for both planning techniques. Out of the plans tested for verification, 77% showed an improvement after using the KBP technique while 23% showed no significant difference.

CLINICAL RELEVANCE/APPLICATION

KBP has not only the potential to improve plan quality but to also improve organs sparing, thereby reduce toxicity to the organs at risk while improving speed and efficiency.

SDP-PH-25 Clinical Value Of Artifact Identification In Ankle Dual-energy CT For Gout Diagnosis

Participants
Yan Zhang, Peking, China (*Presenter*) Nothing to Disclose

PURPOSE

To study the clinical value of artifact identification in ankle dual-energy CT for gout diagnosis.*Methods and Materials A total of 58 patients with gout, who were definitely diagnosed in Peking University Third Hospital from December 2018 to May 2019, were included in the case group, which was composed of 57 men and 1 woman. And 37 individuals without gout were regarded as the control group, which was composed of 36 men and 1woman. DECT was performed for one foot, and the affected side or the more serious side was chosen in the case group. The dual-energy data were used in gout-recognition software to highlight the monosodium urate (MSU) with green-colored. And to compare the difference in MSU relevance ratio on the images of the toenail, submillimeter spots, skins, movements and vascular calcification between two groups*Results In the case group, 55 patients were revealed with MSU green-colored toenails(relevance ratio 94.8%), while 22 cases in the control groups(relevance ratio 59.5%). There was significant statistical difference in the mean toenails' numbers and the MSU distribution scores in the two groups (P<0.01).In the case group ,47 patients were revealed with green-colored submillimeter spots(relevance ratio 81%),while 5 cases in the control group(relevance ratio 13.5%). The relevance ratio of submillimeter spots on tendon and ligament in the case group and control group were 75.9%(44/58)and 13.5%(5/37).There was also significant statistical difference in the two groups on submillimeter spots(P<0.01). And there was no significant statistical difference in the two groups on MSU green-colored skins, movements and vascular calcification.*Conclusions The detection of green MSU on toenails and sub-millimeter spots has great value in the clinical diagnosis of gout and should not be simply judged as an artifact.*Clinical Relevance/Application For the clinical diagnosis of gout , skins, movements and vascular calcification artifacts could be defined easily in ankle dual-energy CT, but toenails and submillimeter spots detected as green MSU, should be considered seriously.

RESULTS

In the case group, 55 patients were revealed with MSU green-colored toenails(relevance ratio 94.8%), while 22 cases in the control groups(relevance ratio 59.5%). There was significant statistical difference in the mean toenails' numbers and the MSU distribution scores in the two groups (P<0.01).In the case group ,47 patients were revealed with green-colored submillimeter spots(relevance ratio 81%),while 5 cases in the control group(relevance ratio 13.5%). The relevance ratio of submillimeter spots on tendon and ligament in the case group and control group were 75.9%(44/58)and 13.5%(5/37).There was also significant statistical difference in the two groups on submillimeter spots(P<0.01). And there was no significant statistical difference in the two groups on MSU green-colored skins, movements and vascular calcification.

CLINICAL RELEVANCE/APPLICATION

For the clinical diagnosis of gout , skins, movements and vascular calcification artifacts could be defined easily in ankle dual-energy CT, but toenails and submillimeter spots detected as green MSU, should be considered seriously.

SDP-PH-26 Synthetic CT Images From Head Magnetic Resonance(MR) Images Based On Deep Learning Technique

Participants
ZHENG TANG, Shenzhen, China (*Presenter*) Nothing to Disclose

PURPOSE

To generate CT modality images from their corresponding T1-weighted MRI sequence, applying deep learning (DL) method.*Methods and Materials 10 patients scanned with both CT and MRI modality sequences were retrospectively enrolled. Data formed up our experimental dataset were acquired on different United Imaging Healthcare MRI and CT machines including, uMR588, uMR780, uCT780 and uCT960+. The MRI and CT sequences were acquired within different time intervals varied from 7 days to 20 days. Both sequences were acquired and reconstructed in the same slice thickness of 1.0mm in order to have accurate correspondence between two sequences in different modalities. MRI data was then aligned to the corresponding CT images using rigid registration method. Dataset constructed with patients head scanning sequences. ROIs of MRI sequences were selected by experienced radiologists manually and images in the same area were simultaneously implemented on corresponding CT images. After that, registered CT/MRI pairs in total of 3000 images were used to train a DL model based on U-Net structure. 100 randomly selected images pairs from our datasets were then sent into the well-trained model and quantitative measurement included PSNR, MAE, SSIM were then calculated.*Results Our results showed outstanding performance on generating realistic CT image from MRI data (PSNR = 60.85 +/- 3.19 dB, SSIM = 96.52 +/- 5.74 %, MAE = 0.49 +/- 0.13 e-4). Quantitative analysis results demonstrated that our generated CT images have very high structural similarity, high reconstruction quality and only minor difference from real CT images.*Conclusions We applied a novel deep learning model to generate head synthetic CT from routine T1-weighted MR images. This work demonstrated that excellent quality CT images can be generated from MR sequence using a deep learning based scheme based on corresponding MR and CT images data. The common issue of MRI-only implementing treatment was image distortion and accurate synthetic CT can be very significant. Our generated CT images demonstrated high diagnostic value from its high accuracy, sensitivity and outstanding quantitative analysis result.*Clinical Relevance/Application Deep learning method has the potential to generate CT images from MR data, which can avoid ionizing radiation to human flesh by generating CT result using DL scheme from the acquired MR sequence.

RESULTS

Our results showed outstanding performance on generating realistic CT image from MRI data (PSNR = 60.85 +/- 3.19 dB, SSIM = 96.52 +/- 5.74 %, MAE = 0.49 +/- 0.13 e-4). Quantitative analysis results demonstrated that our generated CT images have very high structural similarity, high reconstruction quality and only minor difference from real CT images.

CLINICAL RELEVANCE/APPLICATION

Deep learning method has the potential to generate CT images from MR data, which can avoid ionizing radiation to human flesh by generating CT result using DL scheme from the acquired MR sequence.

SDP-PH-27 Differentiating Between The Intracerebral Hematoma And Hemorrhage In Initial CT Image With Hierarchical Deep Learning Approach

Participants
Kazunori Oka, Himeji, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Extracting intracerebral hematoma (ICH) region in CT images is a quite difficult task in image processing because there are similar density areas such as intraventricular and subdural hemorrhage. This study aims to propose a novel method to automatically extract the ICH region in thick-slice initial CT images of emergency patients.*Methods and Materials Subjects used in this study were 33 patients who were transported to the emergency department for cerebral hemorrhage. For each subject, head CT images were acquired twice: at the time of emergency transport and after 24 hours. The subjects were collected by J-ASPECT study. This study was conducted with the approval of the Ethics Committee of Kyushu University. The proposed method extracts the ICH region with a hierarchical deep learning approach. At first, it segments the intracranial region with level set method from CT images, and extracts the high-density areas inside the intracranial region. Next, it classifies the high-density voxels into the ICH region and the others with a convolutional neural network (CNN). For each voxel of the high-density areas, neighboring 129 by 129 voxels are feed to the input layer. The network model consists of convolution layer with ReLU, max pooling, batch normalization, fully connected layer with ReLU, and Softmax. The output layer has two neurons that provide possibilities of the ICH and the others. The training data are synthesized from only high-density voxels inside the intracranial region. That is, the role of the network is to classify a high-density voxel into ICH class and non-ICH class. The teaching labels are assigned by using the annotated ICH region in CT images with some well-trained neurosurgeon. In 33 subjects, 27, 3, 3 cases were used for training, validation, and test, respectively. The performance of the model was evaluated using a confusion matrix.*Results The accuracy, recall, specificity, and precision of the model on the training data were 0.94, 0.92, 0.96, and 0.96, respectively. The accuracy, recall, specificity, and precision of the model on the validation data were 0.83, 0.76, 0.92, and 0.91, respectively. It confirmed that the method has a performance of extracting the ICH region from the high-density area.*Conclusions The hierarchical deep learning approach can overcome a problem to extract the ICH region from the high-density areas. Although some studies discuss the ICH region segmentation in CT images, all methods extract the high-density areas including not only ICH but also intraventricular hemorrhage and subdural hemorrhage.*Clinical Relevance/Application Accurate segmentation and volumetry of the ICH region excepting the hemorrhage region will support neurosurgeons to predict the ICH growing, and decide medical treatment planning.

RESULTS

The accuracy, recall, specificity, and precision of the model on the training data were 0.94, 0.92, 0.96, and 0.96, respectively. The accuracy, recall, specificity, and precision of the model on the validation data were 0.83, 0.76, 0.92, and 0.91, respectively. It confirmed that the method has a performance of extracting the ICH region from the high-density area.

CLINICAL RELEVANCE/APPLICATION

Accurate segmentation and volumetry of the ICH region excepting the hemorrhage region will support neurosurgeons to predict the ICH growing, and decide medical treatment planning.

SDP-PH-28 Automated Tooth Recognition In Panoramic Radiograph Using Deep Learning And Anatomical Priori Knowledge

Participants
Kota Motoki, Himeji, Japan (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to develop a computer-aided diagnosis (CAD) system, which assists dentists by automatically recognizing teeth in dental panoramic radiographs based on faster R-CNN and optimization with anatomical priori knowledge.*Methods and Materials This study collected 200 panoramic radiographs acquired in multiple dental clinics. The mean and standard deviation (SD) of lost teeth was 3.01± 2.58. The tooth numbering follows universal tooth numbering (UTN) system. The method is based on two steps; (1) tooth candidate detection step, and (2) optimization based candidate selection step. The first step detects tooth candidates in a panoramic radiograph as much as possible. It is performed with is a faster R-CNN and which is a well-known object detection method based on deep learning. The different tooth numbers are treated as the different objects. The trained faster R-CNN using ImageNet called ResNet-100 is fine-tuned using panoramic radiographs with annotated teeth. That is, multiple candidates will be detected for each tooth, same candidate will be detected by the different tooth, and candidates will overlap each other.By selecting the most appropriate one from the candidates at the second step, the method recognizes the teeth. The selection can be formulated as an optimization problem whose optimization function evaluates the following conditions; (1) the selected candidates do not overlap with each other, (2) the relative relationship among the selected candidates follow the anatomical spatial relationship. The proposed method is validated by 10-fold-cross-validation test. The evaluation indices are precision, recall, and F1-score.*Results Figure 1 shows the recognized teeth from a panoramic radiograph. Red boxes show the detected teeth, and the number shows the tooth number (T1-T32) and the confidence value (0-1). For the training subjects, the proposed method achieved the high recognition performance; the precision was 96.28%, recall was 96.97%, and F1-score was 96.63%.*Conclusions The combination of the object detection method and anatomical priori knowledge optimization method is effective to recognize the teeth from panoramic radiographs.*Clinical Relevance/Application Interpretation of dental panoramic radiographs is required in all initial diagnosis at dental clinics. However, it takes a time, and is causing faults of teeth recognition. This study completely automates the dentists' interpretation, and will improve the quality of diagnosis.

RESULTS

Figure 1 shows the recognized teeth from a panoramic radiograph. Red boxes show the detected teeth, and the number shows the tooth number (T1-T32) and the confidence value (0-1). For the training subjects, the proposed method achieved the high recognition performance; the precision was 96.28%, recall was 96.97%, and F1-score was 96.63%.

CLINICAL RELEVANCE/APPLICATION

Interpretation of dental panoramic radiographs is required in all initial diagnosis at dental clinics. However, it takes a time, and is causing faults of teeth recognition. This study completely automates the dentists' interpretation, and will improve the quality of diagnosis.

SDP-PH-29 The Effect Of Different CT Reconstruction Methods In The Coronary Artery: A Combined Clinical And Phantom Study

Participants
Xiaowei Ruan, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the different reconstruction methods of the energy spectral CT coronary computed tomography angiography (CCTA) in heart stent impanted patients and phantom, respectively, to show the differences in coronary artery stents and whether the effects of stent cavity display are consistent.*Methods and Materials 1) Twenty-five patients with coronary artery stent implantation in our hosptital were collected . 2) At the same time, three different materials (Cypher, TSUNAMI, Cypher), different internal diameters (4mm, 3mm, 2mm) coronary artery stent model filled with contrast agent solution (concentration of 10mg/ml) were fixed to the water tank, and the coronary artery stent model was scanned using electrocardiogram mode to simulate 62 times/min heart rate on 256 row dector CT (CT, GE Healthcare) to simulate 62 times/min heart rate. 3) Common scan protocals: high-definition mode, tube voltage 100kVp, tube current automatic milliamps, NI 26, front ASiR-V40%. After the scanning, both sets of images are reconstructed in Stnd and Detail modes. Two sets of images were measured, the inner diameter of the bracket tube cavity, the middle section, the far bracket inner diameter and the CT value, and the average and average CT values of the inner diameter of the two sets of image bracket were calculated respectively. Paired T-tests were used to compare the difference between the average and CT means of the inner diameter of the bracket tube cavity.*Results Patient group: the internal diameter of Stnd and Detail of the reconstruction mode were 2.55±0.33 and 2.65±0.32 mm, the differences are statistically significant (P<0.05);the CT values were 382.65±72.25 and 381.64±73.4 HU with no statistical significance(P>0.05).Phantom group: the average diameter of the Stand and Detail reconstruction mode bracket tube cavity were 2.41±0.350 and 2.55±0.34 mm, the difference is statistically significant (P<0.01).);The CT values were 220.96±37.79 and 225.42±32.28 HU, respectively, the difference was not statistically significant(P>0.05).*Conclusions The HD Detail reconstruction mode in Revolutio CT was consistent in the clinical coronary artery scan and phantom study, which showed a consistentcy in the difference of coronary artery stent and the effect of the cavity display inside the stent.*Clinical Relevance/Application The HD CT Detail reconstruction mode improves the image quality of coronary artery stents and has important clinical application value in coronary artery stent image evaluation.

RESULTS

Patient group: the internal diameter of Stnd and Detail of the reconstruction mode were 2.55±0.33 and 2.65±0.32 mm, the differences are statistically significant (P<0.05);the CT values were 382.65±72.25 and 381.64±73.4 HU with no statistical

significance(P>0.05).Phantom group: the average diameter of the Stand and Detail reconstruction mode bracket tube cavity were 2.41±0.350 and 2.55±0.34 mm, the difference is statistically significant (P<0.01).);The CT values were 220.96±37.79 and 225.42±32.28 HU, respectively, the difference was not statistically significant(P>0.05).

CLINICAL RELEVANCE/APPLICATION

The HD CT Detail reconstruction mode improves the image quality of coronary artery stents and has important clinical application value in coronary artery stent image evaluation.

SDP-PH-3 The Evaluation Of Iron Quantification With Dual-energy CT For Liver Iron Deposition In Patients With Blood Transfusion Dependent Non-severe Aplastic Anemia

Participants
Xia Zhao, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the application value of DECT in the diagnosis of liver iron deposition in patients with blood transfusion dependent non-severe aplastic anemia, by analyzing the various parameters of dual energy CT and serum ferritin in the same period.*Methods and Materials This study retrospectively evaluated the dual energy CTs in 32 in-patients with blood transfusion dependent non-severe aplastic anemia between November 2020 and March 2021. All patients had the RBC input range of 6u~22u within the past 6 months. Patients all checked serum ferritin on the day of hospitalization, and the interval between CT scans was 0~2 days. The examinational protocol used dual-energy (DE, 80 and 140kVp) with a scanning range from the top of the lung to the bottom of the ribs. The effective tube currents were 195mA with 0.6s rotation time, 40% ASiR-V. The images were reconstructed in STND mode, 1.25mm thickness. A liver map was created using base material decomposition into water and iron. The specific processing was as follows: 1) Measure the Hounsfield unit of the liver and aorta by placing ROIs in the differennt lobes of liver and aorta at the level where the portal vein branches between 40 and 140KeV every 5KeV intervals, and calculate the mean CT value of liver; 2) Obtain the iron (water) content of liver, calculate the mean LIC and LIC/AIC; 3) Calculate the Slope, the calculation formula was: Slope= (mean CT value at 75KeV- mean CT value at 40KeV)/(75-40).*Results In the group, the mean LIC, LIC/AIC, the Slope and serum ferritin content were 2.71±1.46mg/cm3, 2.773±3.394, 0.845±0.433, 1159.07±1176.67ng/ml, respectively. Correlations between LIC, the slope and serum ferritin were assessed by using Pearson correlation analysis. The slope showed a strong positive correlation with serum ferritin (r=0.714; p=0.003), and LIC showed a strong positive correlation with serum ferritin (r = 0.761; p=0.001).*Conclusions LIC and the Slope determined based on DECT image data obtained with a routine examinational protocol and calculated with the proposed post-processing prototype shows strong correlation with serum ferritin. Therefore, non-contrast routine DECT exam could be used in the daily routine diagnosis for complementary evaluation of liver iron deposition in patients with blood transfusion dependent non-severe aplastic anemia.*Clinical Relevance/Application non-contrast routine DECT exam could be used in the daily routine diagnosis for complementary evaluation of liver iron deposition in patients with blood transfusion.

RESULTS

In the group, the mean LIC, LIC/AIC, the Slope and serum ferritin content were 2.71±1.46mg/cm3, 2.773±3.394, 0.845±0.433, 1159.07±1176.67ng/ml, respectively. Correlations between LIC, the slope and serum ferritin were assessed by using Pearson correlation analysis. The slope showed a strong positive correlation with serum ferritin (r=0.714; p=0.003), and LIC showed a strong positive correlation with serum ferritin (r = 0.761; p=0.001).

CLINICAL RELEVANCE/APPLICATION

non-contrast routine DECT exam could be used in the daily routine diagnosis for complementary evaluation of liver iron deposition in patients with blood transfusion.

SDP-PH-30 Evaluation Of Basic Performance Of CTDI And Dose Distribution Measurement Method Using Plastic Scintillator And Digital Camera

Participants
Hiroshi Yoshitani, Fukuoka, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To develop and evaluate the performance of a system that acquires the dose distribution of the cross section of the phantom in real time using a plastic scintillator and a CMOS camera.*Methods and Materials A disk-shaped plastic scintillator plate was installed next to the cylindrical PMMA phantom. The light emission of the scintillator was photographed using a CMOS camera from one-way irradiation localizer radiograph. The brightness of the four points at the center and the edge was measured from the luminescence image, and a graph of the relationship between the luminescence amount and the dose was created. Next, a helical scan was performed and the state of light emission was continuously photographed at a shutter speed of 0.1 s. The dose at each luminescence image was estimated from the relationship between the luminescence amount and the dose. CTDI is also estimated from the estimated dose in the central and marginal regions of the luminescent image as before. We compared the displayed values of CT equipment and CTDI derived from semiconductor dosimeters.*Results At the time of localizer radiograph, even when the phantom was irradiated and the scintillator was not directly irradiated with X-rays, weak light emission could be detected, and the influence of scattered rays could be detected. In addition, the amount of light emitted and the dose in the five-point region showed a proportional relationship. When the shutter speed was 0.1 s, the rotation of the X-ray tube in the helical scan could be visually grasped from the emission distribution including the scattered rays in the phantom. CTDI was estimated from the relationship and showed a value close to the measured value.*Conclusions High-sensitivity cameras and scintillators were able to estimate CTDI from the amount of light emitted. When the shutter speed was 0.1 s, the dose profile in the central region was close to the shape measured by an actual dosimeter.*Clinical Relevance/Application A scintillator can be used to estimate doses in any area of the cross section in a single scan. The distribution of scattered rays can also be grasped by using a high-sensitivity camera.

RESULTS

At the time of localizer radiograph, even when the phantom was irradiated and the scintillator was not directly irradiated with X-rays, weak light emission could be detected, and the influence of scattered rays could be detected. In addition, the amount of light emitted and the dose in the five-point region showed a proportional relationship. When the shutter speed was 0.1 s, the rotation of the X-ray tube in the helical scan could be visually grasped from the emission distribution including the scattered rays in the phantom. CTDI was estimated from the relationship and showed a value close to the measured value.

A scintillator can be used to estimate doses in any area of the cross section in a single scan. The distribution of scattered rays can also be grasped by using a high-sensitivity camera.

SDP-PH-31 Normalization Of Temperature Effects For Improved Quantitative Prostate Apparent Diffusion Coefficient (ADC) Imaging Across Multiple Sites

Participants
Ken-Pin Hwang, PHD, Houston, Texas (*Presenter*) Research Grant, General Electric Company;Research Grant, Siemens AG

PURPOSE

While ADC measurements within a protocol may be validated with the use of a standardized phantom, acquisition of these phantom measurements necessitates a phantom temperature of 0oC to eliminate the temperature dependence of ADC. In this study, we investigated the feasibility of using a model for temperature dependence of ADC as a correction factor on measurements acquired at room temperature within a multiparametric prostate protocol on multiple MR scanners.*Methods and Materials The NIST / QIBA diffusion standard phantom was scanned on both 1.5 T and 3T scanners at four separate geographical sites across our institutional network. At each site, the phantom was filled with water that was adjusted to match room temperature. The phantom was acquired with the small FOV DWI sequence employed for our multiparametric prostate MR protocol. 3T non-endorectal and dynamic field correction variants were also acquired.ADC values were measured within each of the vial of the phantom. A model for ADC dependence of PVP on temperature for each vial concentration was used to predict ADC values in our experiments. One set of calculations normalized the measured ADC values to predicted ADC at 20oC, while a second set normalized to predicted ADC using the individual temperatures measured for acquisition. For each set of normalized measurements, percent difference from predicted values was calculated, and the mean and standard deviation of those differences across scanners was compared for each vial.*Results For PVP concentrations from 0% to 40%, the standard deviation of measured ADC across scanners ranged from 2.12% to 5.99% for 1.5T and 5.14% to 7.79% for 3T when measurements were normalized to predicted ADC at 20oC. The standard deviation of the same measurements ranged from 0.21% to 4.87% for 1.5T and 1.12% to 3.13% for 3T when measurements were normalized to predicted ADC at their respective measured temperatures. While normalized ADC at 50% varied widely on a percent basis, measured ADC values generally trended higher than predicted ADC values with increasing PVP concentrations.*Conclusions ADC variance due to temperature can be reduced by applying a model for predicted ADC that takes temperature into account. By reducing or eliminating temperature as a factor, variances of ADC values may more accurately reflect variations in other factors, potentially establishing a simplified QA process for ADC measurements when employing a protocol across multiple scanners at multiple, separate geographic sites.*Clinical Relevance/Application Temperature dependence of ADC can complicate quantitative imaging QA across multiple systems. ADC measurements normalized to values predicted by a model can reduce the variance due to temperature when all other factors are accounted for.

RESULTS

For PVP concentrations from 0% to 40%, the standard deviation of measured ADC across scanners ranged from 2.12% to 5.99% for 1.5T and 5.14% to 7.79% for 3T when measurements were normalized to predicted ADC at 20oC. The standard deviation of the same measurements ranged from 0.21% to 4.87% for 1.5T and 1.12% to 3.13% for 3T when measurements were normalized to predicted ADC at their respective measured temperatures. While normalized ADC at 50% varied widely on a percent basis, measured ADC values generally trended higher than predicted ADC values with increasing PVP concentrations.

CLINICAL RELEVANCE/APPLICATION

Temperature dependence of ADC can complicate quantitative imaging QA across multiple systems. ADC measurements normalized to values predicted by a model can reduce the variance due to temperature when all other factors are accounted for.

SDP-PH-32 Impact Of Deep Learning Reconstructions On Image Quality And Detectability Of Hepatocellular Carcinoma In Multi-energy Spectral Imaging CT: A Phantom Study

Participants
Aurélie Pauthe, Toulouse, France (*Presenter*) Nothing to Disclose

PURPOSE

To quantitatively assess on phantom the impact of a new Deep Learning Image Reconstructions (DLIR) on task-based image quality metrics and the detection of simulated hepatocellular carcinomas (HCC) in Dual-Energy CT (DECT).*Methods and Materials An anthropomorphic phantom with customized liver including mimickers of HCC lesions on a standard patient morphology (BMI 23), was scanned on a DECT (Revolution Apex, GE Healthcare) at 4 dose levels (CTDIvol: 5/8/10/13mGy) each repeated 10 times. Raw data were reconstructed in monochromatic images at 4 energy levels (40/50/60/70 keV) using FBP, ASIRV50, ASIRV100 and DLIR low (DLIR-L), medium (DLIR-M) and high (DLIR-H). The contrast between the lesion and the liver parenchyma, the Noise Power Spectrum (NPS) and the Task-based Transfer Function (TTF) were measured. A detectability index (d') was then computed to model the detection of HCC. Metrics were compared between reconstruction using a Friedman test with follow-up post-hoc multiple comparison (p<.05 considered as statistically significant).*Results The contrast was not impacted by the reconstruction (p=.166). DLIR-M and DLIR-H reduced the noise magnitude compared to ASIRV50 by 13±2 and 31±3% respectively (p<.0001). The noise magnitude was minimized when using ASIRV100 (p<.0001) The average frequency of the NPS (favg), reflecting noise texture, decreased with the energy level and increased with the level of ASIRV and DLIR. While DLIR-M and DLIR-H had texture similar to ASIRV50 (favg= 0.24±0.01, 0.23±0.01 and 0.24±0.01mm-1 respectively), ASIRV100 had the lowest noise frequency component (0.16mm-1 p<.0001). The TTF was degraded when increasing the level of ASIRV and DLIR. Compared to ASIRV50, DLIR-M and DLIR-H increased d' at all energy and dose levels (d'=12.13±1.89, 15.17±2.64 and 18.18±3.37 respectively; p<.0001). There was no significant difference between DLIR-H and ASIRV100 (d'= 19.24±3.40; p=.798).*Conclusions Compared to routinely used level of Iterative Reconstruction, DLIR reduces noise without degrading its texture, and may improve the detectability of HCC, whatever the monochromatic energy level studied.*Clinical Relevance/Application Optimizing reconstruction methods of DECT using DLIR could improve both image texture and detectability of HCC lesions and should be implemented in clinical practice.

RESULTS

The contrast was not impacted by the reconstruction (p=.166). DLIR-M and DLIR-H reduced the noise magnitude compared to ASIRV50 by 13±2 and 31±3% respectively (p<.0001). The noise magnitude was minimized when using ASIRV100 (p<.0001) The average frequency of the NPS (favg), reflecting noise texture, decreased with the energy level and increased with the level of ASIRV and DLIR. While DLIR-M and DLIR-H had texture similar to ASIRV50 (favg= 0.24±0.01, 0.23±0.01 and 0.24±0.01mm-1

respectively), ASIRV100 had the lowest noise frequency component (0.16mm-1 p<.0001). The TTF was degraded when increasing the level of ASIRV and DLIR. Compared to ASIRV50, DLIR-M and DLIR-H increased d' at all energy and dose levels (d'=12.13±1.89, 15.17±2.64 and 18.18±3.37 respectively; p<.0001). There was no significant difference between DLIR-H and ASIRV100 (d'= 19.24±3.40; p=.798).

CLINICAL RELEVANCE/APPLICATION

Optimizing reconstruction methods of DECT using DLIR could improve both image texture and detectability of HCC lesions and should be implemented in clinical practice.

SDP-PH-33 Energy-bin Downsampling Method For Grayscale Image Reconstruction For A Deep Silicon Photon-Counting CT Clinical Prototype

Participants
Taly Gilat Schmidt, PhD, Milwaukee, Wisconsin (*Presenter*) Research Grant, General Electric Company;Research collaboration, Varian Medical Systems, Inc

PURPOSE

An energy-bin downsampling method for grayscale image generation was investigated on a clinical photon-counting CT prototype with deep silicon detector.*Methods and Materials The clinical photon-counting CT prototype uses a deep silicon detector with eight energy bins, with energy thresholds optimized for material decomposition performance. It is desired to form a high-quality grayscale image in a short time after acquisition for initial image review. This work developed an energy-bin downsampling method to reduce the number of energy-bin measurements used to form the grayscale image while maintaining image quality. The proposed method uses a simulated model or calibration transmission measurements to determine the optimal bin combinations. At each iteration, the downsampling optimization method evaluates the combination of all pairs of energy bins and selects the combination that maximizes an image quality metric. Downsampling continues iteratively while the image quality metric is maintained. This work used the CNR between a measurement with and without a contrast element as the image quality metric, but the method generalizes to other metrics. The grayscale image was formed as a virtual monoenergetic image (VMI) after material decomposition. The method was investigated using previously acquired head CT data of a human subject. Grayscale VMI images were reconstructed from the optimally downsampled three energy bins and compared to images reconstructed from the eight acquired energy bins.*Results The downsampling optimization method selected the combination of noncontiguous energy bins, suggesting that the resulting grayscale image may benefit from acquiring eight energy-bins despite subsequent downsampling. The head CT image reconstructed after optimal downsampling to three energy bins provided a bone / soft tissue CNR of 19.9 and soft tissue / adipose CNR of 2.0 compared to CNRs of 21.3 and 2.0, respectively, when reconstructing from eight energy bins.*Conclusions The proposed energy-bin downsampling method maintained grayscale CNR in head CT images from a clinical photon-counting CT prototype. Results suggest that having more native energy bins may benefit the optimal bin combinations.*Clinical Relevance/Application Results suggest that the proposed energy-bin downsampling method provides the image quality advantages of acquiring many energy bins while facilitating the workflow efficiencies of fewer energy bins.

RESULTS

The downsampling optimization method selected the combination of noncontiguous energy bins, suggesting that the resulting grayscale image may benefit from acquiring eight energy-bins despite subsequent downsampling. The head CT image reconstructed after optimal downsampling to three energy bins provided a bone / soft tissue CNR of 19.9 and soft tissue / adipose CNR of 2.0 compared to CNRs of 21.3 and 2.0, respectively, when reconstructing from eight energy bins.

CLINICAL RELEVANCE/APPLICATION

Results suggest that the proposed energy-bin downsampling method provides the image quality advantages of acquiring many energy bins while facilitating the workflow efficiencies of fewer energy bins.

SDP-PH-34 Image Quality Assessment With Deep Learning Based Image Reconstruction Algorithm For Ultra-high-resolution CT: A Phantom Study

Participants
Lingming Zeng, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To quantify the effects of a deep learning (DL) algorithm on CT values, noise, spatial resolution, and detectability of CT images at different radiation doses compared to FBP and hybrid iterative reconstruction (HIR), and to explore the dose reduction opportunity of the DL algorithm for ultra-high-resolution CT reconstructed with 1024 matrix.*Methods and Materials A phantom was scanned by a 160-slice CT scanner at seven decreasing dose levels. All images were reconstructed using FBP, HIR at strength level 5 and DL algorithm at all strength levels with both 512 × 512 and 1024 × 1024 matrix; CT value, noise power spectrum (NPS), task-based transfer function (TTF), and the detectability index (d') were used to compare image quality.*Results CT values showed excellent consistency among different reconstruction algorithms. The noise reduction performance of DL in 512-matrix images is much better than that of DL in 1024-matrix images. DL algorithm performed very well in image noise reduction when the CTDIvol is 4.71 and 2.36mGy. The loss of spatial resolution increases with the decrease of radiation dose and the increase of DL level. Images reconstructed with a 1024 matrix have an improved spatial resolution compared to 512 matrix reconstructions. At CTDIvol above 7.06mGy, the d' values for DL were similar to those of HIR-5. At low radiation doses, the d' values for DL were significantly higher than those of HIR-5.*Conclusions The DL reconstruction algorithm can reduce radiation dose to 40% of regular dose while maintaining the image quality on 1024-matrix images.*Clinical Relevance/Application Deep learning trained algorithm (DELTA) is a data driven image reconstruction method based on deep learning method, which was aimed at denoising low-dose CT image.The noise reduction performance of DELTA in 512-matrix images is much better than that of DELTA in 1024-matrix images.Our data show that DELTA can reduce radiation dose to 40% of regular dose while maintaining the image quality on 1024-matrix images.

RESULTS

CT values showed excellent consistency among different reconstruction algorithms. The noise reduction performance of DL in 512-matrix images is much better than that of DL in 1024-matrix images. DL algorithm performed very well in image noise reduction when the CTDIvol is 4.71 and 2.36mGy. The loss of spatial resolution increases with the decrease of radiation dose and the increase of DL level. Images reconstructed with a 1024 matrix have an improved spatial resolution compared to 512 matrix reconstructions. At CTDIvol above 7.06mGy, the d' values for DL were similar to those of HIR-5. At low radiation doses, the d' values for DL were significantly higher than those of HIR-5.

SDP-PH-35 Computer-aided Identification Of Clinically Significant Prostate Lesions In Multiparametric MRI For Low-Dose-Rate Prostate Brachytherapy Treatment Planning

Participants
Jeremiah Sanders, Houston, Texas (*Presenter*) Consultant, C4 Imaging LLC

PURPOSE

Deep learning (DL) has the potential to improve MRI based detection and targeting of prostate cancer. Such improvements are critical for the development of image-guided radiotherapy regimens based upon targeted dose escalation instead of whole gland therapy. The purpose of this study was to investigate the feasibility of computer-aided identification of clinically significant prostate lesions on prostate multiparametric MRIs (mpMRIs) in order to facilitate MRI-guided brachytherapy with intraprostatic tumor dose escalation.*Methods and Materials One-hundred-eighteen males with histologically confirmed prostate underwent diagnostic mpMRI of the prostate. mpMRI included axial T2-weighted and diffusion-weighted MRIs; apparent diffusion coefficient (ADC) maps and synthetic high b-value images (b=1400 s/mm2) were computed from the DWIs. Clinically significant lesions were identified by an abdominal radiologist and manually contoured on the T2-weighted MRIs, ADC maps, and high b-value images. Fully convolutional networks (FCNs) were investigated for computer-aided identification of the clinically significant prostate lesions. The FCNs were developed on 100 of the mpMRIs (85%/15% train/validation split) and evaluated on the remaining 18 mpMRIs. Custom extensions to a commercial treatment planning system (TPS) (MIM Symphony, Cleveland, OH) were written to integrate the FCNs into a low-dose-rate prostate brachytherapy (LDRPBT) treatment planning workflow. The lesion identification performance was evaluated in the TPS using a criteria of at least 1 voxel overlap to be considered a true positive.*Results At user defined operating points, 18/19 clinically significant prostate lesions were identified on the mpMRIs with an average of approximately 2 false positives (FPs) per patient. There was a maximum of 7 FPs for one patient.*Conclusions Nearly all clinically significant prostate lesions were automatically identified on the prostate mpMRIs. Integration into the commercial TPS facilitated efficient rejection of false positive findings and additional refinements. Refined predictions may be used for dose escalation to the dominant lesion during treatment planning. Inclusion of additional mpMRIs into the development data set is underway to improve lesion identification performance and potentially facilitate a fullyautomated MRI-based LDRPBT imaging workflow.*Clinical Relevance/Application Computer-aided identification of clinically significant prostate lesions on mpMRI is feasible with DL, and the integration of the DL model into a commercial TPS enables MRI guided brachytherapy with potential for intraprostatic tumor dose escalation.

RESULTS

At user defined operating points, 18/19 clinically significant prostate lesions were identified on the mpMRIs with an average of approximately 2 false positives (FPs) per patient. There was a maximum of 7 FPs for one patient.

CLINICAL RELEVANCE/APPLICATION

Computer-aided identification of clinically significant prostate lesions on mpMRI is feasible with DL, and the integration of the DL model into a commercial TPS enables MRI guided brachytherapy with potential for intraprostatic tumor dose escalation.

SDP-PH-36 Feasibility Of Performing Abdominal Cta In Children With Both Low Radiation Dose And Contrast Medium Dose By Using 70kvp And Deep Learning Image Reconstruction (dlir)

Participants
Jianying Li, Beijing, China (*Presenter*) Employee, General Electric Company

PURPOSE

To assess the feasibility of performing abdominal CTA in children with low radiation dose and contrast medium dose using 70kVp and Deep Learning Image Reconstruction (DLIR) algorithm.*Methods and Materials 37 children (age range 7 month-14 years, average 6.87±3.11 years) underwent low dose abdominal CTA with 70kVp and automatic tube current modulation, the noise index was set at 11-15 based on children's age, contrast medium (CM) dose was 0.8-1.2ml/kg. Images were reconstructed at slice thickness of 0.625 and standard kernel with 50% and 100% Adaptive Statistical Iterative Reconstruction-V (ASIR-V) and DLIR with a high setting (DL-H). Two radiologists in consensus evaluated images for image noise, visualization of large artery and small artery separately on a 5-point scale (5, excellent, 4, good, 3, measurable and acceptable, 2, detectable and 1, not acceptable). CT attenuation number and image noise of Aorta (Ao), liver (LV) and back muscle (Mu) on the same image slice was measured for the objective image quality assessment, the signal-to-noise ratio (SNR) and contrast-to-noise ratio were calculated. The results among the 3 reconstruction groups were statistically compared using Kruskal-Wallis and ANOVA test. Radiation dose and CM dose were recorded.*Results The average CTDIvol and DLP was 1.47±0.26mGy and 37.41±10.98mGy.cm, respectively and the CM dose was 28.19±13.47 ml. The image noises (in HU) of Ao were 30.27±7.88 with 50%ASIR-V, 19.35±6.73 with 100%ASIR-V and 20.48±5.74 with DL-H. The 100%ASIR-V images had over-smoothed vessel margins and only the DL-H images provided acceptable scores on all three aspects (image noise, large artery and small artery) of the qualitative image quality evaluation.*Conclusions It is feasible to provide acceptable sub-mm slice thickness images with both low radiation dose and contrast dose in abdominal CTA in children using 70kVp and DLIR algorithm*Clinical Relevance/Application double-low-dose thin slice thickness abdominal CTA in children can be achieved by combining 70kVp and DL-H algorithm.

RESULTS

The average CTDIvol and DLP was 1.47±0.26mGy and 37.41±10.98mGy.cm, respectively and the CM dose was 28.19±13.47 ml. The image noises (in HU) of Ao were 30.27±7.88 with 50%ASIR-V, 19.35±6.73 with 100%ASIR-V and 20.48±5.74 with DL-H. The 100%ASIR-V images had over-smoothed vessel margins and only the DL-H images provided acceptable scores on all three aspects (image noise, large artery and small artery) of the qualitative image quality evaluation.

CLINICAL RELEVANCE/APPLICATION

double-low-dose thin slice thickness abdominal CTA in children can be achieved by combining 70kVp and DL-H algorithm.

SDP-PH-37 Comparison Of Virtual Unenhanced And True Unenhanced Images Of Upper Abdomen In A Rapid

Kvp-switching Spectral Ct

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study was to compare attenuation image quality on virtual unenhanced (VUE) images and true unenhanced (true non-contrast, TNC) images acquired with a rapid kVp-switching spectral CT.*Methods and Materials A total of 21 patients with acute upper abdominal pain underwent multiphase CT examination using a rapid kVp-switching spectral CT scanner (Revolution CT, GE Healthcare). Non-unenhanced, contrast-enhanced hepatic arterial and portal venous phase images were acquired. The following parameters were used in image acquisitions: 80/140 kV, noise index (NI) 8, rotation time 0.5s, pitch 0.992, pre-adaptive statistical iterative reconstruction (ASIR-V) 40%. CT value and image noise of liver, spleen, pancreas, kidney, and aorta were measured on TNC and VUE images (hepatic arterial and portal venous phase). The subjective image quality were independently assessed by two experienced radiologists. A five-point scale system (from 1=poor to 5=excellent) was utilised. Differences between groups were analysed using two-way ANOVA. A p value <0.05 was considered to indicate statistical significance.*Results There was no significant difference in CT values of liver (58.23±7.90 58.38±6.04 61.13±6.10, p=0.297), spleen (51.90±3.53; 52.84±3.33; 52.94±3.64, p=0.577), pancreas (42.79±6.19; 42.41±4.61; 40.14±4.54, p=0.208), kidney (33.21±3.22; 34.18±5.57; 36.12±4.25, p=0.108) and aorta (40.19±6.83; 43.94±8.39; 44.08±6.79, p=0.161) between VUE and TNC images. The image noise of the liver, spleen, pancreas and aorta (p = 0.000, p=0.000, p=0.001, p=0.000) were significantly lower in VUE than in TNC. The subjective image scores of TNC, arterial phase VUE scans, and venous phase VUE scans were 5.00±0.00, 4.81±0.40 and 3.86±0.36, respectively. The subjective image quality scores of arterial phase VUE were higher than that of venous phase (P=0.000).*Conclusions On abdominal examination, arterial phase VUE virtual unenhanced closer to the real plain, has the potential to replace the conventional scan has important clinical value.*Clinical Relevance/Application The VUE arterial phase virtual plain scan image is close to the real plain scan image quality, has the potential to replace the conventional plain scan, and can reduce unnecessary radiation dose in the upper abdominal examination.

RESULTS

There was no significant difference in CT values of liver (58.23±7.90 58.38±6.04 61.13±6.10, p=0.297), spleen (51.90±3.53; 52.84±3.33; 52.94±3.64, p=0.577), pancreas (42.79±6.19; 42.41±4.61; 40.14±4.54, p=0.208), kidney (33.21±3.22; 34.18±5.57; 36.12±4.25, p=0.108) and aorta (40.19±6.83; 43.94±8.39; 44.08±6.79, p=0.161) between VUE and TNC images. The image noise of the liver, spleen, pancreas and aorta (p = 0.000, p=0.000, p=0.001, p=0.000) were significantly lower in VUE than in TNC. The subjective image scores of TNC, arterial phase VUE scans, and venous phase VUE scans were 5.00±0.00, 4.81±0.40 and 3.86±0.36, respectively. The subjective image quality scores of arterial phase VUE were higher than that of venous phase (P=0.000).

CLINICAL RELEVANCE/APPLICATION

The VUE arterial phase virtual plain scan image is close to the real plain scan image quality, has the potential to replace the conventional plain scan, and can reduce unnecessary radiation dose in the upper abdominal examination.

SDP-PH-38 Radiation Dose Dependence Of Noise Level In Reconstructed Images By Advanced CT Noise Reduction Techniques.

Participants
Marcus Hook, MD, Charlottesville, Virginia (*Presenter*) Nothing to Disclose

PURPOSE

In our practice, we are currently using Siemens' iterative algorithm, ADMIRE, for reconstruction of pediatric abdominal CT images. Testing a new post-processing deep learning noise reduction technique, PixelShine, we conducted a comparative study using a phantom, as a first step. ADMIRE requires the user to select a strength of noise reduction when reconstructing images. PixelShine, on the other hand, has Adaptive Processing that automatically determines the strength of post-processing depending on the ideal amount of noise selected. The purpose of this study was to investigate the radiation dose dependence of the noise level in CT images reconstructed using ADMIRE and PixelShine.*Methods and Materials The ACR phantom was scanned with our pediatric abdomen protocol using a technique of 90 kVp with varying effective mAs (22, 44, 88, 131, and 176 mAs) to obtain different radiation dose levels (CTDIvol ranged between 0.5 and 4.0 mGy). Each of the acquired datasets was reconstructed using filter back projection (FBP) and ADMIRE (strength 3, our institutional standard) with a slice thickness of 1.5 mm. The images reconstructed by FBP were processed by PixelShine in Soft Tissue mode (PixelShine S). At each radiation dose level, the noise (standard deviation: SD) was measured at the center of the images reconstructed with FBP, ADMIRE, and processed by PixelShine. The radiation dose and the corresponding SD values were then plotted.*Results For the FBP images, the SD values varied between 16.5 HU (4.0 mGy) and 45.5 HU (0.5 mGy). As expected, the SD values of the ADMIRE images are smaller compared to the SD values of the FBP images, decreasing at a constant rate. The SD values of the ADMIRE images varied from 12.7 HU (4.0 mGy) to 35.0 HU (0.5 mGy). When processed with PixelShine, the noise was reduced to a greater extent than ADMIRE for the lowest does tested (0.5 and 1.0 mGy), and had approximately the same level of noise reduction as ADMIRE for 2.0 mGy. However, at high dose levels (3.0 and 4.0 mGy), little noise reduction was observed with PixelShine compared to FBP. As a result, the SD value of the PixelShine images varied from 16.2 HU (4.0 mGy) to 23.0 HU (0.5 mGy). The results show that compared to FBP and ADMIRE, PixelShine outputs images with smaller swings in the noise level even when the radiation dose changes.*Conclusions The noise in the images processed by PixelShine S was found to be less dose-dependent than that in the images reconstructed by ADMIRE 3. PixelShine S offers greater noise reduction at low-dose and very low-dose techniques than ADMIRE 3.*Clinical Relevance/Application It is clinically useful to understand characteristics of deep learning based noise reduction techniques by comparing with existing iterative reconstruction techniques, which are currently used.

RESULTS

For the FBP images, the SD values varied between 16.5 HU (4.0 mGy) and 45.5 HU (0.5 mGy). As expected, the SD values of the ADMIRE images are smaller compared to the SD values of the FBP images, decreasing at a constant rate. The SD values of the ADMIRE images varied from 12.7 HU (4.0 mGy) to 35.0 HU (0.5 mGy). When processed with PixelShine, the noise was reduced to a greater extent than ADMIRE for the lowest does tested (0.5 and 1.0 mGy), and had approximately the same level of noise reduction as ADMIRE for 2.0 mGy. However, at high dose levels (3.0 and 4.0 mGy), little noise reduction was observed with PixelShine compared to FBP. As a result, the SD value of the PixelShine images varied from 16.2 HU (4.0 mGy) to 23.0 HU (0.5 mGy). The results show that compared to FBP and ADMIRE, PixelShine outputs images with smaller swings in the noise level even when the radiation dose changes.

SDP-PH-39   **Sensitivity Enhanced Fast X-ray-induced Acoustic Computed Tomography (XACT) Imaging System**

Participants
Siqi Wang, Irvine, California (*Presenter*) Nothing to Disclose

PURPOSE

X-ray-induced acoustic computed tomography (XACT) as a novel imaging modality has shown great potential in applications ranging from biomedical imaging to nondestructive testing. A major challenge in XACT imaging is to detect the weak acoustic signal induced by X-ray with high sensitivity. The existing XACT systems require thousands of signal averages to improve the signal to noise ratio (SNR) due to the insufficient signal amplification. We developed a 128-channel data acquisition (DAQ) system with 2-stage amplification for XACT, which drastically reduces the number of averages needed for XACT imaging, and makes 3D imagine from a single X-ray projection realizable.*Methods and Materials The developed system consists of two amplification stages. The first preamplification stage prepares the weak raw acoustic signals into output-ready signals that are noise-tolerant and detectable by the next stage. Next, the conditioned signals travel through another amplification path integrated in the DAQ device. In the end, the 128-channel analog signals are sampled and converted to digital values by the onboard 12-bit ADCs. To demonstrate the performance of the proposed 2-stage amplification and DAQ system in XACT, a T-shaped lead samples fixed inside of a 3% gelatin water-based phantom was used as the imaging target. A 128 channel ring array was used as the ultrasound detector. Reconstruction was done using a universal back projection method.*Results Comparing with similar tests done previously by S. Tang (2017) using the first-generation XACT system configuration, the proposed system achieved comparable reconstruction result by using only 1 pulse of X-ray. In contrast, more than 6000 frames were taken in S. Tang's tests using the first generation SonixDAQ based DAQ system.*Conclusions By utilizing a 128-channel 2 amplification stage design, the developed system can greatly enhance the raw XA signals for further post-processing. With higher SNR, the total X-ray pulses needed for XACT signal averaging can be drastically reduced, which in turn reduces the overall dosage to the target and shortens the scanning time. We expect that the proposed 2-stage DAQ system provides a solid alternative to currently expensive-to-acquire commercially available ultrasound systems.*Clinical Relevance/Application XACT system can achieve 3D volumetric imaging with a single X-ray projection, which reduces the complexity of the operation, the scanning time and radiation dose compared with conventional CT.

RESULTS

Comparing with similar tests done previously by S. Tang (2017) using the first-generation XACT system configuration, the proposed system achieved comparable reconstruction result by using only 1 pulse of X-ray. In contrast, more than 6000 frames were taken in S. Tang's tests using the first generation SonixDAQ based DAQ system.

CLINICAL RELEVANCE/APPLICATION

XACT system can achieve 3D volumetric imaging with a single X-ray projection, which reduces the complexity of the operation, the scanning time and radiation dose compared with conventional CT.

SDP-PH-40   **Sophisticated Characterization Of State-of-the-art Iterative Reconstruction Techniques With A Single Scan Of A Basic Water Phantom**

Participants
Marcel Van Straten, PhD, Rotterdam, Netherlands (*Presenter*) Research collaboration, Siemens AG

PURPOSE

To characterize the performance of iterative reconstruction (IR) techniques in general, and of texture preserving noise removal in particular, without the need for multiple scans and/or complex phantoms.*Methods and Materials A cylindrical, 20 cm diameter, water phantom was scanned with three CT scanners from one manufacturer (Siemens) and reconstructed with and without the iterative reconstruction (IR) technique available at each scanner (SOMATOM Edge with SAFIRE, SOMATOM Force with ADMIRE, and NAEOTOM Alpha with QIR). CTDIvol (1 mGy), pitch (0.8), rotation time (0.5 s), slice thickness (1 mm), and pixel spacing (0.5 mm) were kept constant. Both a kernel with medium spatial resolution and a sharp reconstruction kernel were used. Image noise was determined for all radial distances r from the phantom iso-center by calculating the variance of the CT numbers in the angular direction. Texture preserving noise removal was quantified by the image noise dynamic range (DR), i.e. the ratio of the largest (found at the phantom edge) to the smallest variance (found in water). The noise power spectrum (NPS) was estimated in multiple small regions in water and averaged. The high contrast modulation transfer function (MTF) was estimated via the edge spread function calculated at the radial transition from phantom to air. Inspired by the known relationship between noise variance, NPS, and MTF in case of conventional filtered back projection (FBP), the first moment of the normalized NPS and the second moment of MTF^2 were calculated.*Results At medium resolution, the DR of noise variance varied between approx. 2 (FBP) and 8 (full strength IR) for all scanners. Dependency on IR strength for noise variance in water was virtually the same for all scanners. For the sharp kernel, DR of noise variance for the newest scanner (Alpha) was up to approx. 4 times smaller than for the other scanners. This might be thanks to the smaller detector pixels. Noise levels in water were the lowest for this scanner, but less reduced at maximum IR strength compared to FBP in this case. A shift of the NPS to lower frequencies for higher IR strengths was virtually absent for the newest scanner. MTF was more constant as well while varying IR strength.*Conclusions Based on a single scan, the contribution of texture preserving noise removal was proven to be the dominant factor for the resulting noise level when varying IR strength. Compared to its two predecessors, the latest IR technique leaves the high contrast MTF and normalized NPS more intact when reducing noise by increasing IR strength.*Clinical Relevance/Application A quick assessment of IR techniques with a readily available phantom allows for protocol optimization and standardization, which could be relevant for multi-center clinical trials.

RESULTS

At medium resolution, the DR of noise variance varied between approx. 2 (FBP) and 8 (full strength IR) for all scanners. Dependency on IR strength for noise variance in water was virtually the same for all scanners. For the sharp kernel, DR of noise variance for the newest scanner (Alpha) was up to approx. 4 times smaller than for the other scanners. This might be thanks to the smaller detector pixels. Noise levels in water were the lowest for this scanner, but less reduced at maximum IR strength compared to FBP in this case. A shift of the NPS to lower frequencies for higher IR strengths was virtually absent for the newest scanner. MTF was more constant as well while varying IR strength.

CLINICAL RELEVANCE/APPLICATION

A quick assessment of IR techniques with a readily available phantom allows for protocol optimization and standardization, which could be relevant for multi-center clinical trials.

SDP-PH-41 Feasibility Of Low-tube Voltage For Small-diameter Coronary Stent Imaging Using High-definition 256-detector Row Ct: A Phantom Study

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of low tube voltage, high-definition scan protocol for imaging small-diameter stents.*Methods and Materials Three different types of coronary stent phantoms made of different materials and with different inner diameters were used (3mm Cypher, 3mm Tsunami, and 2.5mm Cypher). The tubes were filled with iodinated contrast medium (10mg/ml), positioned in a plastic container filled with water. The scan was performed using a 256-detector row CT (Revolution CT, GE healthcare) with prospective ECG-triggered axial cardiac mode and ECG simulation at a heart rate of 62 BPM. High definition mode was turned on during data acquisition and different tube voltages (120, 100 and 80 kVp) were applied. Other parameters: noise index of 33.6, auto mA. Subjective image quality was assessed independently by two radiology, image quality was evaluated with five-point Likert scale (1, very poor; 2, suboptimal; 3, acceptable; 4, good; 5, excellent.). CT value, image noise, signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR) and visible diameter in percentage (VD%=VD/ID) were compared between all three sets of images.*Results The mean CT values of the sent lumens were significantly different in 120, 100, and 80 kVp images (198.83±25.70 264.30±26.35 343.80±14.11, p=0.001). The SD values in 120, 100, and 80 kVp images were also statistically different (33.43±2.45 38.33±1.22 45.90±1.99, p=0.001). However, there was no significant difference in SNR and CNR between the three groups (6.00±1.22 6.91±0.85 7.49±0.11, p=0.182) (6.66±1.20 7.46±1.19 7.83±0.41, p=0.702). There was no significant difference in the stent internal diameter display rate between the three tube voltages (58.44% ± 5.82% 50.22% ± 6.34% 55.78% ± 10.33%, p = 0.148). The CTDI at 120kv, 100kv, and 80kv tube voltages were (3.87, 3.36, 2.47), respectively. The subjective scores of the three groups of tube voltages were (4.50±0.50 4.33±0.58 4.17±0.29), with no statistical difference (p= 0.405).*Conclusions The low tube voltage, high definition scan protocol using a 256-detector row CT is feasible to evaluate small internal diameter, and it can reduce the radiation dose of patients.*Clinical Relevance/Application The low tube voltage can be used for the imaging of small-diameter stent to reduce the radiation dose while maintaining image quality.

RESULTS

The mean CT values of the sent lumens were significantly different in 120, 100, and 80 kVp images (198.83±25.70 264.30±26.35 343.80±14.11, p=0.001). The SD values in 120, 100, and 80 kVp images were also statistically different (33.43±2.45 38.33±1.22 45.90±1.99, p=0.001). However, there was no significant difference in SNR and CNR between the three groups (6.00±1.22 6.91±0.85 7.49±0.11, p=0.182) (6.66±1.20 7.46±1.19 7.83±0.41, p=0.702). There was no significant difference in the stent internal diameter display rate between the three tube voltages (58.44% ± 5.82% 50.22% ± 6.34% 55.78% ± 10.33%, p = 0.148). The CTDI at 120kv, 100kv, and 80kv tube voltages were (3.87, 3.36, 2.47), respectively. The subjective scores of the three groups of tube voltages were (4.50±0.50 4.33±0.58 4.17±0.29), with no statistical difference (p= 0.405).

CLINICAL RELEVANCE/APPLICATION

The low tube voltage can be used for the imaging of small-diameter stent to reduce the radiation dose while maintaining image quality.

SDP-PH-42 Radioactive Plaque Episcleral Brachytherapy Of Uveal Melanoma: Is Determination Of Eye-ball Curvature At The Tumor Site Through Tomographic Imaging Required For Accurate Treatment Planning?

Participants
Konstantinos Perisinakis, PhD, Heraklion, Greece (*Presenter*) Nothing to Disclose

PURPOSE

To investigate and quantify the effect of episcleral brachytherapy Ru-106 plaque misposition due to differences in curvature between sclera and plaque on dose delivered to uveal melanoma tumors.*Methods and Materials Participants in the study were 15 patients presented with uveal melanoma (UM) and treated with radioactive plaque episcleral brachytherapy (EB). A 24 mm diameter silver Ru-106 plaque was used. Eye-ball curvature at the site of tumor was determined through pre-operation tomographic imaging. A mathematical model was developed to predict the distance of the tumor margin from the plaque when the curvature of the sclera at the tumor region was different than the curvature of the plaque. The standard treatment planning software package was used to determine the dose to apex and the outer margins of the tumor. Doses were determined assuming an eyeball of the same curvature as the radioactive plaque and b) assuming the real curvature at the tumor site. Differences between corresponding doses were recorded for each treated patient.*Results The curvature of patient's eye-ball at the tumor site was found to occasionally differ considerably from the curvature of the radioactive plaque available in our institution. The diameter of the equivalent sphere was found to range 20.5-26.4 mm. Dose difference for the tumor apex was found to be up to 15% while dose differences for the distant tumor margin was found to be up to 35%.*Conclusions The exact eye-ball curvature at the tumor site should be measured through pre-therapy tomographic imaging and taken into account in the treatment planning of radioactive plaque episcleral brachytherapy to avoid uncertainties in dose delivered to the tumor.*Clinical Relevance/Application Radioactive plaque episcleral brachytherapy (EB) is nowadays the dominant vision-preserving alternative treatment against enucleation. The treatment efficiency regarding tumor control is heavily relied on the accuracy of the treatment plan and the correct positioning of the plaque above the tumor during surgery.

RESULTS

The curvature of patient's eye-ball at the tumor site was found to occasionally differ considerably from the curvature of the radioactive plaque available in our institution. The diameter of the equivalent sphere was found to range 20.5-26.4 mm. Dose difference for the tumor apex was found to be up to 15% while dose differences for the distant tumor margin was found to be up to 35%.

CLINICAL RELEVANCE/APPLICATION

Radioactive plaque episcleral brachytherapy (EB) is nowadays the dominant vision-preserving alternative treatment against enucleation. The treatment efficiency regarding tumor control is heavily relied on the accuracy of the treatment plan and the

correct positioning of the plaque above the tumor during surgery.

SDP-PH-43 Phantom Investigation Of Digital Tomosynthesis As An Orbit Screening Modality Prior To MRI

Participants
Christina Brunnquell, PhD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

To investigate and compare digital x-ray tomosynthesis (DT) to 2-view radiography (DR) and CT for detecting tungsten carbide, steel, and aluminum fragments in the orbits for screening prior to MRI.*Methods and Materials A semi-anthropomorphic head phantom was created by placing a human skull model into a water bath. Shaving fragments of aluminum, steel, and tungsten carbide were created. Varying sized fragments of aluminum (N=4, 0.1-2.7mg, 0.04-1.0mm3), steel (N=8, 0.4-5.9mg, 0.05-0.75mm3), and tungsten carbide (N=5, 0.2-8.1mg, 0.01-0.52mm3) were embedded in table grapes, with one fragment in each grape. The grapes were placed into the respective orbits, submerged in a water bath, and imaged with our institution's orbit CT protocol (including thin slices and maximum intensity projections), 2-view facial bone DR protocol, and facial DT protocol. Images were reviewed to qualitatively evaluate comparative detectability on each modality. For each grape with a different fragment embedded, repeatability was investigated by acquiring repeat images after repositioning of the grapes, the skull, and/or no repositioning.*Results Considered as a group, >90% of all fragments were detected on CT, ~65% on DT, and ~55% on DR. All tungsten carbide fragments were detectable on all modalities. All steel fragment sizes were detectable on CT, while 6/8 (=0.7mg) were detectable on DT and 5/8 (=0.8mg) were detectable on DR. Aluminum fragments went undetected on DR, while the largest was just detectable on DT (2.7mg) and 3/4 (=0.7mg) were detectable on CT. Observation of repeat image acquisitions indicated high consistency in metal fragment detectability on CT, while detection of fragments on DR and DT was more position-dependent.*Conclusions With respect to detectability of metal fragments in the orbit, DT performance was found to lie in between that of DR and CT. DT may be an appropriate modality for orbit metal screening, providing a balance between the radiation dose, detection capabilities, and cost of DR and CT. Expansion of this work into a formal detectability study with multiple image readers is warranted, and establishment of optimal DT reconstruction variables (slice thickness and interval) could improve performance.*Clinical Relevance/Application Given the heterogeneity of orbit metal screening practices, the results of this study comparing DT, DR, and CT in an orbit phantom can inform MRI screening decisions to balance conspicuity, resource availability, cost, and radiation dose.

RESULTS

Considered as a group, >90% of all fragments were detected on CT, ~65% on DT, and ~55% on DR. All tungsten carbide fragments were detectable on all modalities. All steel fragment sizes were detectable on CT, while 6/8 (=0.7mg) were detectable on DT and 5/8 (=0.8mg) were detectable on DR. Aluminum fragments went undetected on DR, while the largest was just detectable on DT (2.7mg) and 3/4 (=0.7mg) were detectable on CT. Observation of repeat image acquisitions indicated high consistency in metal fragment detectability on CT, while detection of fragments on DR and DT was more position-dependent.

CLINICAL RELEVANCE/APPLICATION

Given the heterogeneity of orbit metal screening practices, the results of this study comparing DT, DR, and CT in an orbit phantom can inform MRI screening decisions to balance conspicuity, resource availability, cost, and radiation dose.

SDP-PH-44 Survey On The Use Of Artificial Intelligence In The Netherlands

Participants
Paul R. Algra, MD, PhD, Alkmaar, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the use of Artificial Intelligence (AI) applications and the impediments experienced when implementing.*Methods and Materials We conducted a survey among boards of directors from all non-university hospitals in the Netherlands in 2021.*Results We received feedback from 49 institutions (54,4%). Most of the respondents (82,6%) see AI as an opportunity or as opportunity and threat (17,4%) while none sees AI as a threat alone. Larger hospitals (>500 beds) are more likely (57,7%) to implement AI-applications than smaller hospitals (42,2%). AI imaging applications are most frequently implemented (47,7%), followed by other AI applications such as clinical decision support (28,9%) and natural language processing applications (14,0%). Only 11,6% of the hospitals has a long-term policy regarding the implementation of AI. According to the survey, a major impediment of AI implementation, is lack of funding or reimbursement. Hospitals mention low budgets or few investors for implementing AI. Therefore, hospitals often (92,7%) fund the implementation of AI themselves. Sharing data between institutions is also limited. Data for training algorithms is mostly retrieved from own hospital data (69,7%), and 18,2% are using data originating from other hospitals. However, a clear majority of 91,7% is willing to share data with other hospitals for improving the quality of algorithms. A lack of AI knowledge might also be an impediment, since a minority (43,6%) has an AI-team and only 30,3% hospitals have an AI-training for their employees.*Conclusions Dutch non-university hospitals are frequently implementing AI. Lack of funding, sharing data, cooperating with other institutions and knowledge can be named as the most impeding factors when implementing AI.*Clinical Relevance/Application Dutch hospital directors see AI as an opportunity. Lack of reimbursement or funding and not (being able) sharing data are the major obstacles for implementation.

RESULTS

We received feedback from 49 institutions (54,4%). Most of the respondents (82,6%) see AI as an opportunity or as opportunity and threat (17,4%) while none sees AI as a threat alone. Larger hospitals (>500 beds) are more likely (57,7%) to implement AI-applications than smaller hospitals (42,2%). AI imaging applications are most frequently implemented (47,7%), followed by other AI applications such as clinical decision support (28,9%) and natural language processing applications (14,0%). Only 11,6% of the hospitals has a long-term policy regarding the implementation of AI. According to the survey, a major impediment of AI implementation, is lack of funding or reimbursement. Hospitals mention low budgets or few investors for implementing AI. Therefore, hospitals often (92,7%) fund the implementation of AI themselves. Sharing data between institutions is also limited. Data for training algorithms is mostly retrieved from own hospital data (69,7%), and 18,2% are using data originating from other hospitals. However, a clear majority of 91,7% is willing to share data with other hospitals for improving the quality of algorithms. A lack of AI knowledge might also be an impediment, since a minority (43,6%) has an AI-team and only 30,3% hospitals have an AI-training for their employees.

CLINICAL RELEVANCE/APPLICATION

Dutch hospital directors see AI as an opportunity. Lack of reimbursement or funding and not (being able) sharing data are the major

obstacles for implementation.

SDP-PH-45   Crystal Characterization And Differentiation In Spectral Photon Counting CT: Results From The First Clinical Scanner Of Its Generation.

Participants
Florian Huber, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the first clinically approved spectral photon-counting CT (SPCCT) in the differentiation of crystals related with gout (monosodium urate, MSU) vs. pseudogout (calcium pyrophosphate, CPP), and to compare its performance with energy-integrating dual-energy CT (DECT) scanners of the previous generation.*Methods and Materials Agar-based (AG) gels mimicking attenuation of the articular cartilage and synthetic crystal suspensions of MSU and CPP at different concentrations (90-500 and 26-109 mg/mL, respectively) were inserted in a phantom. All samples were scanned with SPCCT (NAEOTOM Alpha, Siemens), dual-source (DS), single-source split-filter (SF) and sequential scan (SS) DECT at comparable dose levels (CTDIvol: 4.4-12.5 for each) and tube potentials (80/140, 120 and 140 kV). Images were post-processed using DE overlay (DEO) values optimized for gout/MSU detection with dual-energy ratios as recommended by the literature (DECT) and vendor (SPCCT). Generated low/high kV HU-values and DEO values were measured for all samples by drawing same-sized ROIs (0.3cm2) on every second axial image for ten consecutive steps. Sample consistency and differences between radiation doses and scanners were investigated for all parameters, separately for concentrations and materials, respectively, using ANOVA, t-testing and analysis of mean differences.*Results Regardless of scanner type, all crystal suspensions showed excellent homogeneity (p=0.23-1).HU-values in SPCCT did not depend on radiation dose overall. Apart from that, all quantitative parameters differed between CT scanner types and dose levels (p<0.01). However, mean differences were comparable between scanners [14.3-28.2]. Both CPP and MSU showed significant concentration-dependent differences in HU and DEO (all p<0.01). Correspondingly, concentrations of at least 195 mg/mL MSU and 47 mg/mL CPP crystals could be reliably differentiated with all techniques (mean DEO in SPCCT: -10.9+/-7.4 vs. -36.7+/-15.4, respectively).*Conclusions Differentiation of gout/MSU from pseudogout/CPP crystals at typical clinical concentrations is feasible with a clinical SPCCT system. Related quantitative measurements are comparable with values from DECT-scanners of the latest generation. First results may indicate better dose-related robustness in SPCCT for material decomposition tasks in the future.*Clinical Relevance/Application This is the first in vitro proof-of-concept for material decomposition in a clinical SPCCT workflow. Further investigations in vivo with ex vivo confirmation are needed to transition current knowledge and DECT-based reference values of material decomposition in musculoskeletal and other settings to a new era of quantitative color CT imaging.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

This is the first in vitro proof-of-concept for material decomposition in a clinical SPCCT workflow. Further investigations in vivo with ex vivo confirmation are needed to transition current knowledge and DECT-based reference values of material decomposition in musculoskeletal and other settings to a new era of quantitative color CT imaging.

SDP-PH-46   Clinical Performance Of Temporal Bone MRI Using 3D Bssfp With High Performance Gradients At 0.5t Is Comparable To Conventional Field Strengths

Participants
Elena Cora, MD, Halifax, Nova Scotia (*Presenter*) Nothing to Disclose

PURPOSE

Magnetic resonance imaging of the temporal bone is difficult, and while a high signal to noise ratio (SNR) sequence such as balanced steady state free precession (bSSFP) is preferred, lower SNR sequences are often used to avoid the banding artifacts that occur due to off-resonance when using bSSFP on conventional clinical systems. The 0.5T EvryTM system (Synaptive Medical) combines low field strength with high-performance components, and we postulate that this combination may produce comparable image quality to higher field clinical systems. Our aim was to demonstrate image quality for 0.5T bSSFP acquisitions that was non-inferior to clinical field strength acquisitions, assessed through radiologist rating.*Methods and Materials We acquired de-identified images from 6 patients that had previously undergone clinical temporal bone exams with bSSFP acquisitions (3 patients at 3T and 3 patients at 1.5T). These patients were then recruited to undergo 0.5T scans during which we acquired axial 3D bSSFP images. All images were then shown to two board-certified neuroradiologists who rated their ability to visualize 5 anatomical structures relevant to clinical temporal bone MRI exams: superior semi-circular canal (SSC), facial nerve, cochlear nerve, vestibule, and cochlea. A Likert scale ranging from 1-5 was used. Rating was recorded separately for each ear, but when analyzing the results of radiologist ratings, the data for the left and right anatomy were concatenated so that one result per anatomical structure was obtained. Many of the patients scanned have existing pathologies that we hope to perform a diagnostic sensitivity analysis upon (as more patients receive scans).*Results The mean Likert score for each of the 5 structures was higher for 0.5T than clinical scans, therefore a one-sided, paired t-test was used to evaluate potential superiority of 0.5T image quality. The results showed that the image quality of the SSC and vestibule at 0.5T both showed statistical advantage (p < 0.01 and p < 0.05, respectively) over clinical field strengths. The overall scores (when all anatomical structures were combined) demonstrated significant improvement at 0.5T, reaching p < 0.01.*Conclusions We have shown that temporal bone bSSFP images acquired at 0.5T with the EvryTM system are rated as having better quality than bSSFP images acquired at clinical field strengths. More specifically, the visualization of the SSC and vestibule at 0.5T show statistically significant advantages.*Clinical Relevance/Application The high resolution temporal bone bSSFP images from EvryTM allow for preferable visualization of the SSC compared to clinical field strengths, while the superior artifact suppression enables confident visualization of any schwannomas, if present.

RESULTS

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(when all anatomical structures were combined) demonstrated significant improvement at 0.5T, reaching p < 0.01.

CLINICAL RELEVANCE/APPLICATION

The high resolution temporal bone bSSFP images from EvryTM allow for preferable visualization of the SSC compared to clinical field strengths, while the superior artifact suppression enables confident visualization of any schwannomas, if present.

SDP-PH-47 Using Mobile Ct Scanner In A Field Hospital Setting To Manage Patients With Covid-19

Participants
Nikita Kudryavtsev, MD, Moscow, Russian Federation (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the efficacy of the mobile CT scanner in the field hospital setting to manage patients with COVID-19.*Methods and Materials Due to the spread of the COVID-19 pandemic, temporary field hospitals were organized in Moscow. One of such backup hospitals was arranged in the Krylatskoye Ice Palace. Given the obvious technical and time constraints associated with the installation of a stationary CT scanner, one of the suggested options was a mobile CT scanner. The temporary field hospital accepted patients with mild and moderate COVID-19. The patients with suggestive clinical signs were referred to the CT examinations of the chest, brain, abdomen, pelvis, and bones. To assess the CT efficacy the specialists calculated the workload as the ratio between the average number of studies per day and the target value calculated for Moscow clinics (41 studies per three-shift workday).*Results Totally the field hospital personnel performed 6,264 CT studies. ?hest CT - 6,126 studies; brain - 98; abdomen - 31; other - 9 studies. The long-term scans (15-25 sec.) did not let patients with respiratory insufficiency hold their breath for the entire time of the study. The chest CT images had motion artifacts and stair-step artifacts. The brain CT images contained artifacts of different nature, that got more intense near the skull base, which made an evaluation of the subtentorial areas of the brain difficult. The study of the abdominal organs also detected the gas-interface artifacts and the helical artifacts. The achieved average number of studies per three-shift workday amounted to 44 (from 14 at the launch to 110 and more during the busiest days), which corresponded to 106% of the recommended workload.*Conclusions Despite the artifacts, the use of a mobile CT scanner provided sufficient diagnostic capabilities for the imaging of the chest, brain, and abdomen in the field hospital setting amidst the COVID-19 pandemic. The mentioned workload figures confirmed the efficacy of the equipment under study and validated the viability of the mobile CT scanners for field hospitals.*Clinical Relevance/Application Aside from the temporary field hospitals for patients with COVID-19, the mobile CT units may be effective in the medical facilities, where it is not possible to set up a stationary CT scanner. The mobile CT devices may be used in remote settlements and temporary field hospitals during disaster relief operations.The obtained results allowed to build a list of requirements for such mobile CT scanners, justify the need for new kinds of CT equipment that would be tolerant towards the power source parameters, easy to install in the typical field hospital setting, applicable in emergencies, and suitable for remote areas in an unprepared environment.

RESULTS

Totally the field hospital personnel performed 6,264 CT studies. ?hest CT - 6,126 studies; brain - 98; abdomen - 31; other - 9 studies. The long-term scans (15-25 sec.) did not let patients with respiratory insufficiency hold their breath for the entire time of the study. The chest CT images had motion artifacts and stair-step artifacts. The brain CT images contained artifacts of different nature, that got more intense near the skull base, which made an evaluation of the subtentorial areas of the brain difficult. The study of the abdominal organs also detected the gas-interface artifacts and the helical artifacts. The achieved average number of studies per three-shift workday amounted to 44 (from 14 at the launch to 110 and more during the busiest days), which corresponded to 106% of the recommended workload.

CLINICAL RELEVANCE/APPLICATION

Aside from the temporary field hospitals for patients with COVID-19, the mobile CT units may be effective in the medical facilities, where it is not possible to set up a stationary CT scanner. The mobile CT devices may be used in remote settlements and temporary field hospitals during disaster relief operations.The obtained results allowed to build a list of requirements for such mobile CT scanners, justify the need for new kinds of CT equipment that would be tolerant towards the power source parameters, easy to install in the typical field hospital setting, applicable in emergencies, and suitable for remote areas in an unprepared environment.

SDP-PH-48 Developing A Framework For Prospective Evaluation Of MRI Deep Learning Reconstruction: A Case Study Of Higher Resolution And Higher Image Quality In Shorter Scan Time

Participants
Hung Do, PhD, Tustin, California (*Presenter*) Employee, Canon Medical Systems Corporation

PURPOSE

To develop a comprehensive framework for prospective evaluation of Deep Learning Reconstruction (DLR) and apply it to a case study, in which DLR allows MRI acquisition with higher resolution and image quality in shorter scan time.*Methods and Materials IRB-approved written consent was obtained for 20 patients undergoing clinical knee exams on a 3T MRI. Routine protocol was performed (named REF hereafter) followed immediately by a high-resolution shorter scan-time protocol which was reconstructed with DLR and 3 typical conventional reconstruction filters (NL2, GA43, and GA53). The 5 reconstructions (DLR, NL2, GA43, GA53, and REF) per sequence were de-identified, randomized, and shared with 2 MSK experts for blind review using 8 scoring criteria and force-ranking. Readers were asked to review overall image quality and to review and comment on specific anatomical and pathological features. Quantitative SNR, CNR, and full width at half maximum (FWHM) of small features were measured and compared between the 5 reconstructions. Generalized Estimating Equations (GEE) with Bonferroni adjustment was used for comparing reader's scores, SNR, CNR, and FWHM between DLR vs. NL2, GA43, GA53, and REF. Inter-rater agreement was assessed using Gwet's Agreement Coefficient (AC2) with ordinal weighting. Paired Student's T-test was used to compare mean scan time and resolution.*Results Mean scan time was shortened by 10% with DLR from 157 ± 24 to 142 ± 16 s (p = 0.023) per sequence. Readout resolution was increased by 21% from 316 ± 43 to 382 ± 27 (p=0.007). Phase encoding resolution was increased by 55% from 196 ± 11 to 304 ± 51 (p<0.001). DLR's SNR and CNR were statistically higher than those from NL2, GA43, and GA53 (p<0.008) but statistically lower than those from REF (p<0.001). DLR's FWHM was statistically higher than that of REF (p =0.004) and not significantly different from those from NL2, GA43, and GA53 (p>0.03). For reader 1, DLR was rated statistically higher than all 4 other recons in 35/36 comparisons (p<0.002). For reader 2, DLR was rated statistically higher in 19/36 comparisons (p<0.007). The Gwet's agreement coefficients AC2 range from 0.77 to 0.87 (substantial) for 8 scoring criteria and 0.38 (fair) for force-ranking.*Conclusions We propose a framework for prospective evaluation of DLR and use it to demonstrate that DLR allows MR acquisition of 21%-55% higher resolution and higher image quality with 10% shorter scan time.*Clinical Relevance/Application Deep Learning has been applied extensively in medical image reconstruction, however, to our knowledge, there is no comprehensive framework for prospective

evaluation. We aim to develop one and apply it to a case study, in which DLR allows higher resolution and image quality in shorter scan time.

RESULTS

Mean scan time was shortened by 10% with DLR from 157 ± 24 to 142 ± 16 s (p = 0.023) per sequence. Readout resolution was increased by 21% from 316 ± 43 to 382 ± 27 (p=0.007). Phase encoding resolution was increased by 55% from 196 ± 11 to 304 ± 51 (p<0.001). DLR's SNR and CNR were statistically higher than those from NL2, GA43, and GA53 (p<0.008) but statistically lower than those from REF (p<0.001). DLR's FWHM was statistically higher than that of REF (p =0.004) and not significantly different from those from NL2, GA43, and GA53 (p>0.03). For reader 1, DLR was rated statistically higher than all 4 other recons in 35/36 comparisons (p<0.002). For reader 2, DLR was rated statistically higher in 19/36 comparisons (p<0.007). The Gwet's agreement coefficients AC2 range from 0.77 to 0.87 (substantial) for 8 scoring criteria and 0.38 (fair) for force-ranking.

CLINICAL RELEVANCE/APPLICATION

Deep Learning has been applied extensively in medical image reconstruction, however, to our knowledge, there is no comprehensive framework for prospective evaluation. We aim to develop one and apply it to a case study, in which DLR allows higher resolution and image quality in shorter scan time.

SDP-PH-49   **Evaluation Of Apparent Noise And Low Contrast Detectability On Abdominal Phantom CT Images Reconstructed With A New Deep Learning Algorithm**

Participants
Keisuke Fujii, Nagoya, Japan (*Presenter*) Nothing to Disclose

PURPOSE

It is difficult to evaluate image noise such as blocky noise affecting low contrast detectability on non-linear CT images reconstructed with iterative reconstruction (IR) and deep learning reconstruction (DLR) algorithms. The aims of this study is to evaluate apparent image noise and detectability of low contrast modules on an abdominal phantom CT images reconstructed using a new DLR algorithms, and compare them with those using conventional IR and DLR algorithms.*Methods and Materials A standard sized abdominal phantoms having spherical modules with 3-10 mm in diameter and approximately 12 and 22 HU contrast difference were scanned with different milliampere-second (mAs) settings (CTDIvol: 1.3-33.4 mGy) on an Aquilion Precision CT scanner (Canon Medical Systems, Japan) and were reconstructed with adaptive iterative dose reduction three dimensional (AIDR 3D) algorithm, Advanced Intelligent Clear-IQ Engine (AiCE) body as a conventional DLR algorithm, and AiCE body sharp as a new DLR algorithm. To evaluate apparent image noise, we set a square region of interest (ROI) on the CT images, moved average filters in the ROI, and calculated standard deviation (SD) of the mean CT values for each sized filter. The SD values were fitted with a curve inversely proportional to the filter size, and apparent noise index was determined from the slope of curve fitting results. Next, the presence of 10 mm low contrast modules was assessed by four radiological technologists on a four-point likert scale, and low contrast detectability on AiCE body and AiCE body sharp CT images was compared using area under receiver operating characteristics curve (AUC).*Results Apparent noise index of AiCE body sharp images for a lower mAs value was approximately 20% and 18% lower than that of AIDR 3D and AiCE body images, respectively. The mean AUC of 0.99 for AiCE body sharp images was slightly higher than the value of 0.98 for AiCE body images although there was no significant difference between the two AUC.*Conclusions AiCE body sharp algorithm reduced apparent noise on CT images obtained with lower mAs than conventional IR and DLR algorithms while the noise reduction by AiCE body sharp algorithm did not result in the significant improvement of 10 mm low contrast detectability.*Clinical Relevance/Application AiCE body sharp DLR algorithm allows for more significantly reduction of the apparent image noise on abdominal CT images obtained with lower mAs than conventional IR and DLR algorithm.

RESULTS

Apparent noise index of AiCE body sharp images for a lower mAs value was approximately 20% and 18% lower than that of AIDR 3D and AiCE body images, respectively. The mean AUC of 0.99 for AiCE body sharp images was slightly higher than the value of 0.98 for AiCE body images although there was no significant difference between the two AUC.

CLINICAL RELEVANCE/APPLICATION

AiCE body sharp DLR algorithm allows for more significantly reduction of the apparent image noise on abdominal CT images obtained with lower mAs than conventional IR and DLR algorithm.

SDP-PH-5   **Radiation Exposure ; Diagnostic Reference Levels In The Endovascular Therapy Of Subarachnoid Hemorrhage Related Vasospasm**

Participants
Marcel Opitz, MD, Essen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

The treatment of cerebral vasospasm (CVS) in patients after spontaneous subarachnoid hemorrhage (sSAH) remains one of the major challenges and endovascular treatment is becoming increasingly important. Nevertheless, diagnostic reference levels (DRLs) of endovascular CVS therapy are lacking in this relatively young treatment field of interventional neuroradiology.*Methods and Materials In a retrospective study design, DRLs & achievable dose (AD) were assessed for all patients undergoing selective intra-arterial vasodilator administration or additional mechanical angioplasty for CVS treatment. All procedures were performed at the flat-panel angiography-systems Allura Xper (Philips Healthcare). Interventional procedures were differentiated according to the type of procedure & the number of probed vessels.*Results Altogether 494 neurointerventional procedures of 121 patients with CVS due to sSAH could be included. The following DRL, AD & mean values could be determined: (I) (ICA bilateral+VA) DRL 80.29Gy*cm², AD 67.77Gy*cm², mean 70.12Gy*cm²; (II) (ICA bilateral) DRL 59.15Gy*cm², AD 49.88Gy*cm², mean 50.25Gy*cm²; (III) (ICA unilateral) DRL 34.70Gy*cm², AD 27.12Gy*cm², mean 33.19Gy*cm²; (IV) (VA unilateral) AD 32.57Gy*cm², mean 34.25Gy*cm², (V) (Nimodipine+TBA) DRL 130.17Gy*cm², AD 108.56Gy*cm², mean 106.09Gy*cm² & (VI) (Nimodipine+stent) DRL 107.60Gy*cm², AD 81.13Gy*cm², mean 86.53Gy*cm². Kruskal-Wallis-test confirmed significant dose difference considering the number of probed vessels (p<0.001). Mann-Whitney-U-test revealed significant differences of DAP and fluoroscopy time between chemical-only & additional mechanical angioplasty (p<0.001).*Conclusions The DRLs of intra-arterial chemical angioplasty are substantially lower compared with DRLs proposed for other therapeutic interventions. However, repeated therapy sessions are often required leading to a cumulatively higher radiation exposure. In the absence of clinical criteria of further CVS-vessel involvement, the total dose may be reduced efficiently by probing selectively the primary target vessels during repeated applications.*Clinical Relevance/Application Cerebral vasospasm (CVS) remains one of the major challenges occurring after spontaneous subarachnoid hemorrhage (sSAH)

resulting in delayed cerebral ischemia, increased morbidity and mortality. Interventional techniques such as selective intra-arterial vasodilator administration & mechanical angioplasty procedures are nowadays considered standard of care for medically refractory vasospasm. Nonetheless, for endovascular treatments of cerebral vasospasm DRLs are still lacking.

RESULTS

Altogether 494 neurointerventional procedures of 121 patients with CVS due to sSAH could be included. The following DRL, AD & mean values could be determined: (I) (ICA bilateral+VA) DRL 80.29Gy*cm², AD 67.77Gy*cm², mean 70.12Gy*cm²; (II) (ICA bilateral) DRL 59.15Gy*cm², AD 49.88Gy*cm², mean 50.25Gy*cm²; (III) (ICA unilateral) DRL 34.70Gy*cm², AD 27.12Gy*cm², mean 33.19Gy*cm²; (IV) (VA unilateral) AD 32.57Gy*cm², mean 34.25Gy*cm², (V) (Nimodipine+TBA) DRL 130.17Gy*cm², AD 108.56Gy*cm², mean 106.09Gy*cm² & (VI) (Nimodipine+stent) DRL 107.60Gy*cm², AD 81.13Gy*cm², mean 86.53Gy*cm². Kruskal-Wallis-test confirmed significant dose difference considering the number of probed vessels (p<0.001). Mann-Whitney-U-test revealed significant differences of DAP and fluoroscopy time between chemical-only & additional mechanical angioplasty (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Cerebral vasospasm (CVS) remains one of the major challenges occurring after spontaneous subarachnoid hemorrhage (sSAH) resulting in delayed cerebral ischemia, increased morbidity and mortality. Interventional techniques such as selective intra-arterial vasodilator administration & mechanical angioplasty procedures are nowadays considered standard of care for medically refractory vasospasm. Nonetheless, for endovascular treatments of cerebral vasospasm DRLs are still lacking.

SDP-PH-50 Impact Of Deep Learning Reconstruction On Low ContrastLiver Lesion Detectability

Participants
Damien Racine, Lausanne, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To compare impact between a deep learning (DL) reconstruction algorithm and an iterative reconstruction on low contrast liver lesion detectability (LCD) at different tube voltages and patient sizes.*Methods and Materials An optimized CT protocol used for liver lesion detection was applied to three anthropomorphic abdomen phantoms that simulated slim (BMI<23), non-overweight (BMI<25) and overweight (BMI>25) patients (QRM, Moehrendorf/Germany) (S: 300 × 200 mm; M: 350 × 250 mm; L: 400 × 300 mm). Phantoms contained two different 5 x 7.5 mm lesions with contrast of +30 HU and -30 HU. These phantoms were imaged at three radiation dose levels (CTDIvol of 4.5, 6.5 and 7.5 mGy, respectively). Tube current was adapted to obtain the same CTDIvol at the four tube voltages (80, 100, 120, 140 kVp). Images were reconstructed using a DL algorithm at high strength (TrueFidelity) and an iterative reconstruction algorithm (ASiR-V at 60%). LCD was assessed using a channelized Hotelling (CHO) model observer. The output of the CHO model observer is the area under the ROC curve (AUC), used as figure of merit. AUC was compared among reconstruction algorithms.*Results For the three phantom sizes, at the same kVp the AUC was always higher with TF as compared to ASiR-V. For the S phantom with TF, the AUC of the four tube voltages was always higher than 0.999 whereas with ASiR-V the AUC reached a peak at 100 kVp (AUC=0.990) and then decreased to 0.983 at 140 kV. For the M phantom with TF, the AUC decreased as tube voltage increased with overall excellent accuracy (range 0.991 - 0.979) whereas with ASiR-V, the highest AUC was obtained at 100 kVp (AUC = 0.921). For the L phantom, the AUC values reached a peak at 120 kVp (AUC = 0.958) whereas it was minimal at 80 kVp (AUC = 0.93).*Conclusions Low contrast liver lesion detectability using TF was improved in comparison to ASIR-V. TF could be interesting for high Z contrast imaging because of its potential to improve detection for low tube voltages in slim and non-overweight patients. However, for overweight patients lowering tube voltage sacrificed low contrast detectability even if TF was used.*Clinical Relevance/Application Tube voltage settings in CT need to be adjusted to patient size and diagnostic task to optimize image quality and patient dose.

RESULTS

For the three phantom sizes, at the same kVp the AUC was always higher with TF as compared to ASiR-V. For the S phantom with TF, the AUC of the four tube voltages was always higher than 0.999 whereas with ASiR-V the AUC reached a peak at 100 kVp (AUC=0.990) and then decreased to 0.983 at 140 kV. For the M phantom with TF, the AUC decreased as tube voltage increased with overall excellent accuracy (range 0.991 - 0.979) whereas with ASiR-V, the highest AUC was obtained at 100 kVp (AUC = 0.921). For the L phantom, the AUC values reached a peak at 120 kVp (AUC = 0.958) whereas it was minimal at 80 kVp (AUC = 0.93).

CLINICAL RELEVANCE/APPLICATION

Tube voltage settings in CT need to be adjusted to patient size and diagnostic task to optimize image quality and patient dose.

SDP-PH-51 Task-based Selection Of Virtual Monoenergetic Images Energy Level In Photon-counting Detector CT Reduces Radiation Dose While Improving Iodine Contrast-to-noise Ratio

Participants
Kishore Rajendran, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Task-based dose reduction in conventional CT can be achieved using automated kV selection for non-contrast and contrast-enhanced tasks. Due to its energy discrimination capability, photon-counting detector (PCD) CT facilitates single-kV multi-energy acquisition to routinely provide virtual monoenergetic images (VMIs). We evaluated a new task-based automatic VMI (keV) selection feature for dose optimization in PCD-CT.*Methods and Materials Multi-energy CT phantoms (head- 20 cm diameter, body-40 cm width) containing iodine (2, 5, 10, 15 mg/cc) and calcium (100 and 300 mg/cc) were scanned on an investigational PCD-CT system (NAEOTOM Alpha, Siemens Healthineers) using head and body protocols. The head protocol used 120 kV and automatic task-based keV and dose selection (CARE keV) optimized for non-contrast (39 mGy, 70 keV VMI), bone (36.8 mGy, 65 keV VMI), soft tissue with contrast (32.9 mGy, 60 keV VMI) and vascular (24.4 mGy, 55 keV VMI) imaging tasks. The body protocol used 120 kV for non-contrast task (13.8 mGy, 70 keV), bone (13 mGy, 65 keV), soft tissue with contrast (11.7 mGy, 60 keV) and vascular (8.76 mGy, 55 keV) exams. PCD-CT energy thresholds were set to 20 and 65 keV for all scans. Contrast, noise, and contrast-to-noise ratio (CNR) were measured for iodine and calcium for all images. The low energy threshold image (20 to 120 keV) from the non-contrast task was used as the baseline reference since it mimics a conventional 120 kV image. Percent change in CNR was calculated for the auto-selected keV images for bone (65 keV), vascular (55 keV) and soft tissue with contrast (60 keV) tasks.*Results Iodine at 2 mg/cc and 10 mg/cc and calcium at 100 mg/cc were used to evaluate soft tissue with contrast, vascular and bone imaging tasks, respectively. The VMI images determined by the keV selection tool showed increased CNR (11.7%, 15.3% and 8.7% for soft tissue, vascular and bone tasks, respectively) in the head size phantom compared to the low energy threshold

image, despite a 16%, 37% and 6% dose reduction compared to the reference (non-contrast) task. Similarly, the automatically selected keV images using the body size phantom increased the CNR by 39.5%, 28.6% and 12.8% for soft tissue, vascular and bone tasks, respectively, compared to the low energy threshold image, again demonstrating 16%, 37% and 6% lower dose.*Conclusions A new task-based automatic keV selection feature for PCD-CT automatically selected VMI energy levels that improves CNR for different imaging tasks (8.7 - 39.5%) while reducing radiation dose by 6 - 37%.*Clinical Relevance/Application The number of new parameters associated with PCD-CT could make scan parameter selection more complicated. The automated tool to select appropriate kV and keV level will greatly assist operators and simplify workflow.

RESULTS

Iodine at 2 mg/cc and 10 mg/cc and calcium at 100 mg/cc were used to evaluate soft tissue with contrast, vascular and bone imaging tasks, respectively. The VMI images determined by the keV selection tool showed increased CNR (11.7%, 15.3% and 8.7% for soft tissue, vascular and bone tasks, respectively) in the head size phantom compared to the low energy threshold image, despite a 16%, 37% and 6% dose reduction compared to the reference (non-contrast) task. Similarly, the automatically selected keV images using the body size phantom increased the CNR by 39.5%, 28.6% and 12.8% for soft tissue, vascular and bone tasks, respectively, compared to the low energy threshold image, again demonstrating 16%, 37% and 6% lower dose.

CLINICAL RELEVANCE/APPLICATION

The number of new parameters associated with PCD-CT could make scan parameter selection more complicated. The automated tool to select appropriate kV and keV level will greatly assist operators and simplify workflow.

SDP-PH-52   Virtual Monoenergetic Image Reconstruction For Improved Contrast-to-noise Ratio In CT With Iodinated Contrast Agents: Dual Source Photon Counting CT Operating At One Tube Voltage Versus Dual Source Dual Energy CT Operating At Two Tube Voltages

Participants
Ronald Booij, PhD, Rotterdam, Netherlands (*Presenter*) Research Collaboration, Siemens AG

PURPOSE

To evaluate whether the contrast-to-noise ratio (CNR) of iodinated contrast agent in virtual monoenergetic images (VMI) from a clinical dual-source photon-counting detector (PCD) based CT scanner is superior to VMI from a dual-source dual-energy CT scanner with conventional energy-integrating detectors (EID).*Methods and Materials A medium-sized thoracic and a small-sized abdominal anthropomorphic phantom (QRM) with tubes containing water and water with 15 mg iodine/ml were scanned on a dual-source EID CT scanner (Siemens SOMATOM Force; 80 and Sn150 kVp, thorax phantom; 90 and Sn150 kVp, abdomen phantom) and on a clinical dual-source PCD CT scanner (Siemens NAEOTOM Alpha; 120 kVp). Scans were repeated three times. CTDIvol levels were matched between CT systems (3.8 mGy, thorax; 4.0 mGy, abdomen). VMI (range 40 - 100 keV) were reconstructed (MonoEnergetic Plus algorithm). Kernel (Qr40), effective slice thickness (1.0 mm), total beam collimation (57.6 mm), pitch (0.8) and rotation time (0.5 s) were kept constant. The clinically preferred iterative reconstruction (IR) strength of 60% (ADMIRE) was used for the EID scanner and the two closest matching IR strengths of 50% and 75% (Quantum IR) were used for the PCD scanner. CNR was defined as the difference in mean CT numbers of water and water with iodine, divided by the square root of the added variances measured in water and water with iodine.*Results CNR-measurements appeared to be very reproducible (relative standard error <3%). The CNR of the PCD based images with a 75% IR strength, was 9-73% higher than the CNR of the EID based images with a 60% IR-strength (for both phantoms). At a 50% IR-strength, the CNR of PCD CT was 7-50% higher than the corresponding EID images for the lower keV levels only (40-50 keV in the thorax; 40-70 keV in the abdomen). For the PCD based scanner, CNR levels were approximately 14-21% higher in the abdominal phantom than in the thoracic phantom, irrespective of keV-level and IR-strength. This increase was not observed in the EID based scans.*Conclusions Single tube voltage PCD CT outperforms dual-source EID CT operating at two different tube voltages in virtual monoenergetic iodine imaging.*Clinical Relevance/Application Thanks to the improved CNR for iodinated contrast agents, virtual monoenergetic images obtained with PCD CT may facilitate the reduction of contrast agent and radiation dose and improve lesion detection.

RESULTS

CNR-measurements appeared to be very reproducible (relative standard error <3%). The CNR of the PCD based images with a 75% IR strength, was 9-73% higher than the CNR of the EID based images with a 60% IR-strength (for both phantoms). At a 50% IR-strength, the CNR of PCD CT was 7-50% higher than the corresponding EID images for the lower keV levels only (40-50 keV in the thorax; 40-70 keV in the abdomen). For the PCD based scanner, CNR levels were approximately 14-21% higher in the abdominal phantom than in the thoracic phantom, irrespective of keV-level and IR-strength. This increase was not observed in the EID based scans.

CLINICAL RELEVANCE/APPLICATION

Thanks to the improved CNR for iodinated contrast agents, virtual monoenergetic images obtained with PCD CT may facilitate the reduction of contrast agent and radiation dose and improve lesion detection.

SDP-PH-53   A New Monte Carlo Radiation Transport Tool Designed Specifically For Research In Diagnostic Imaging Application.

Participants
Andrew Sampson, PhD, San Antonio, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Monte Carlo radiation transport (MCRT) software tools provide a valuable research component to a wide variety of applications in the radiation sciences. Unfortunately, the most utilized and publicly available MCRT tools can be cumbersome for some diagnostic imaging applications. PHENX is a new MCRT tool designed from scratch for streamlined simulation of diagnostic imaging applications.*Methods and Materials PHENX is written in the updated FORTRAN 2008 programming language due to its efficiency and ease of optimization. PHENX explicitly models photon transport while assuming local energy deposition for secondary electrons. PHENX includes new routines for coherent and incoherent scattering (including Doppler broadening effects), photoionization with associated atomic relaxation, and a new robust parallel-optimized pseudo-random number generator. The EPICS2017 cross-section library, which includes updated atomic form factors and incoherent scattering functions, is utilized due to its availability and accuracy. Furthermore, PHENX includes a geometry package that allows for complex geometries that include both simulated patient-voxel representations obtained by patient CT exams and analytically defined volumes. OpenMP is utilized for fixed-node

parallelization to leverage multi-threaded CPU hardware. Additionally, optional improvements to computational efficiency are available through application of principally based and bias-free variance-reduction strategies for source generation, particle transport, and energy scoring. A simulated abdominal helical-CT exam is used to compute the efficiency gain achieved by using PHENX's acceleration capabilities relative to analog, non-accelerated Monte Carlo.*Results For the patient abdominal CT dose example, 99.75% of all simulated voxels experience an efficiency gain by applying PHENX's acceleration options. The median efficiency gain was 1947 relative to traditional analog MCRT, while 75% of dose voxels experienced a gain of more than 679.*Conclusions PHENX is an efficient MCRT tool for targeted diagnostic imaging research capable of simulating complex geometries three orders of magnitude faster than traditional, analog MCRT. PHENX can be utilized as an accurate, efficient, and convenient tool for radiation transport simulations targeted towards diagnostic imaging applications.*Clinical Relevance/Application New and/or improved clinical processes depend on accurate, efficient, and convenient clinically targeted research, and PHENX meets that need for Monte Carlo radiation transport medical imaging applications.

RESULTS

For the patient abdominal CT dose example, 99.75% of all simulated voxels experience an efficiency gain by applying PHENX's acceleration options. The median efficiency gain was 1947 relative to traditional analog MCRT, while 75% of dose voxels experienced a gain of more than 679.

CLINICAL RELEVANCE/APPLICATION

New and/or improved clinical processes depend on accurate, efficient, and convenient clinically targeted research, and PHENX meets that need for Monte Carlo radiation transport medical imaging applications.

SDP-PH-54 NCIRF: Organ Dose Calculation Program For Patients Undergoing Radiography And Fluoroscopy Imaging

Participants
Choonsik Lee, PhD, Rockville, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Few resources are available to quantify organ absorbed doses, critical data for epidemiological studies, from fluoroscopically-guided interventional procedures. To address this need, we developed a user-friendly cross-platform computer program with a graphical user interface to calculate organ doses for patients undergoing radiography and fluoroscopy imaging procedures.*Methods and Materials We designed a graphical user interface (GUI) for users to enter the parameters related to a patients' habitus (age, gender, and body size), imaging techniques (x ray energy spectrum, source to isocenter distance, field size, imaged anatomy, positioner primary angle, and positioner secondary angle), and Monte Carlo simulations (particle history). The patients' anatomy is modeled using reference sized computational human phantoms ranging from newborn to adult males and females. The Monte Carlo radiation transport calculations are handled by a custom GEANT4 module built into the program. For users who want to run MCNP6 outside the GUI, we added a feature to export the simulation scenario into input files for MCNP6—the "gold standard" radiation transport code.*Results Our program is able to calculate doses to 31 major organs and tissues. We observed reasonable agreement (within 2%) when comparing the results of our own GEANT 4 module with similar calculations using MCNP6. On a standard laptop, it took less than a minute to run a million particle histories reducing the Monte Carlo errors for in-field organs to less than 2%. The program successfully ran on Windows and Mac operating systems.*Conclusions We developed the National Cancer Institute dosimetry system for Radiography and Fluoroscopy (NCIRF), a user-friendly computer program, to readily estimate doses delivered to major radiosensitive organs and tissues of patients undergoing these imaging procedures. The program is available free of charge for researchers.*Clinical Relevance/Application The computer program developed in this study is a convenient tool providing organ doses for fluoroscopy patients based on the reference phantoms and a Monte Carlo radiation transport technique. The program will be useful for epidemiological studies of health effects from medical exposure to radiation.

RESULTS

Our program is able to calculate doses to 31 major organs and tissues. We observed reasonable agreement (within 2%) when comparing the results of our own GEANT 4 module with similar calculations using MCNP6. On a standard laptop, it took less than a minute to run a million particle histories reducing the Monte Carlo errors for in-field organs to less than 2%. The program successfully ran on Windows and Mac operating systems.

CLINICAL RELEVANCE/APPLICATION

The computer program developed in this study is a convenient tool providing organ doses for fluoroscopy patients based on the reference phantoms and a Monte Carlo radiation transport technique. The program will be useful for epidemiological studies of health effects from medical exposure to radiation.

SDP-PH-55 Evaluation Of Gravity Effect On Renal Function Using Multi-posture MRI

Participants
Yuki Oda, Kanazawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Understanding normal regulation of the kidney is important for improving the diagnosis and management of kidney disease. Nevertheless, it is unclear how regional kidney function is altered by postural changes, ie, differences in the effects of gravity. In this study, we evaluated the effect of gravity on regional kidney function in the supine and upright positions using an original magnetic resonance imaging (MRI) system that can obtain functional information in any posture (multiposture MRI).*Methods and Materials Regional kidney functions (the mean renal blood flow, T2, T2', and apparent diffusion coefficient (ADC)) were evaluated in seven healthy volunteers (mean age, 22.9 ± 0.9 years) in the supine and upright positions using multiposture MRI (0.4 T). The mean renal blood flow, T2, T2*, and ADC of the kidney were obtained with the ECG-triggered cine phase-contrast, single-shot diffusion echo-planar imaging, fast multiple spin-echo, and multiple gradient-echo techniques, respectively. T2' was calculated from the T2 and T2*. Then, those functional values in each region of the kidney were compared between postures.*Results The mean renal blood flow in the upright position (right kidney, 0.81 ± 0.65 mL/s; left kidney, 1.36 ± 1.16 mL/s) was significantly lower than that in the supine position (right, 4.14 ± 1.67 mL/s; left, 3.02 ± 0.96 mL/s) (P < 0.05), despite an increase in the heart rate due to the autoregulation to the fluid shift effect as the body was positioned upright (Fig. 2c). The T2 for all regions in the upright position (right, 114 ± 11.3 ms; left, 106 ± 6.22 ms) were significantly lower than that in the supine position (right, 124 ± 11 ms; left, 122 ± 8.86 ms) (P < 0.05), which indicates decrease in blood and urine volume in the kidney during the upright position. These results potentially provide new diagnostic information on the regulatory functions to the gravity as compared with the standard MRI

examination of the kidney. However, no significant difference was observed in the T2' and ADC for all regions between the supine and upright positions.*Conclusions Gravity reduces the blood flow and T2 of the kidney. Multiposture MRI makes it possible to evaluate the effect of gravity on regional kidney function.*Clinical Relevance/Application We assessed the effect of gravity on regional kidney function in the supine and upright positions using an original MRI that can obtain functional information in any posture. Gravity reduced the blood flow and T2 of the kidney, and these differences between postures potentially provide new diagnostic information.

RESULTS

The mean renal blood flow in the upright position (right kidney, 0.81 ± 0.65 mL/s; left kidney, 1.36 ± 1.16 mL/s) was significantly lower than that in the supine position (right, 4.14 ± 1.67 mL/s; left, 3.02 ± 0.96 mL/s) (P < 0.05), despite an increase in the heart rate due to the autoregulation to the fluid shift effect as the body was positioned upright (Fig. 2c). The T2 for all regions in the upright position (right, 114 ± 11.3 ms; left, 106 ± 6.22 ms) were significantly lower than that in the supine position (right, 124 ± 11 ms; left, 122 ± 8.86 ms) (P < 0.05), which indicates decrease in blood and urine volume in the kidney during the upright position. These results potentially provide new diagnostic information on the regulatory functions to the gravity as compared with the standard MRI examination of the kidney. However, no significant difference was observed in the T2' and ADC for all regions between the supine and upright positions.

CLINICAL RELEVANCE/APPLICATION

We assessed the effect of gravity on regional kidney function in the supine and upright positions using an original MRI that can obtain functional information in any posture. Gravity reduced the blood flow and T2 of the kidney, and these differences between postures potentially provide new diagnostic information.

SDP-PH-56 Time-saving Analysis And Clinical Effectiveness Of Computer-aided Triage And Notification (CADt) Devices Based On Queueing Theory

Participants
Elim Thompson, Silver Spring, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

A Computer-Aided Triage and Notification (CADt) device uses artificial intelligence (AI) to prioritize radiological medical images with an intension to speed up reviews of diseased cases in urgent conditions such as stroke, intercranial hemorrhage, and pneumothorax. We investigate an analytical approach based on queueing theory to quantify time-saving ability of CADt devices in various clinical settings.*Methods and Materials Queueing theory is a theoretical model for studying waiting-in-line. It is applied to calculate the mean waiting time per patient image to be read by a radiologist with and without a CADt device. We compute the amount of time savings for diseased patients who are correctly identified by the AI algorithm and time delays for diseased patients missed by the AI. These time savings and delays are used to define the overall time-saving ability of the CADt. The impacts on time performance from various parameters (AI accuracy, disease prevalence, hospital busyness, number of radiologists on-site, interruptions from emergency cases) are studied. Results from the analytical model are verified using Monte Carlo simulation.*Results CADt effectiveness depends on AI accuracy and clinical conditions. In a busy clinic without an emergency room, with an AI sensitivity (95%) and specificity (89%), a 10% disease prevalence, and a basic workflow where a radiologist spends 10 minutes on average per patient image regardless of its disease condition, a diseased patient will be reviewed 35.5 minutes (95% C.I. [22.8, 52.2]) sooner with the CADt than without. The amount of time savings drops significantly to 5.56 minutes [4.26, 7.32] in a quiet clinic and to 10.1 minutes [6.40, 16.3] with three radiologists instead of one. The impacts due to disease prevalence and presence of emergency patients whose images are not triaged by the CADt device are found to be small.*Conclusions We developed a theoretical approach based on queueing theory to quantify the time-saving ability of CADt devices in realistic clinical settings. With a basic workflow, our model suggests CADt devices are most effective in a busy, short-staffed clinic. These results are consistent with clinical intuition and verified by simulation. For evaluation purposes, a summary plot is proposed to characterize both the diagnostic and time-saving abilities of a CADt device.*Clinical Relevance/Application With an effective CADt device, a radiologist can get to review diseased patients quicker, allowing earlier diagnosis and treatment of time-sensitive diseases. This work presents an analytical approach to quantify time-saving ability and to study the impacts on CADt effectiveness from various parameters in a comprehensive manner. Software developed in this work will be made publicly available.

RESULTS

CADt effectiveness depends on AI accuracy and clinical conditions. In a busy clinic without an emergency room, with an AI sensitivity (95%) and specificity (89%), a 10% disease prevalence, and a basic workflow where a radiologist spends 10 minutes on average per patient image regardless of its disease condition, a diseased patient will be reviewed 35.5 minutes (95% C.I. [22.8, 52.2]) sooner with the CADt than without. The amount of time savings drops significantly to 5.56 minutes [4.26, 7.32] in a quiet clinic and to 10.1 minutes [6.40, 16.3] with three radiologists instead of one. The impacts due to disease prevalence and presence of emergency patients whose images are not triaged by the CADt device are found to be small.

CLINICAL RELEVANCE/APPLICATION

With an effective CADt device, a radiologist can get to review diseased patients quicker, allowing earlier diagnosis and treatment of time-sensitive diseases. This work presents an analytical approach to quantify time-saving ability and to study the impacts on CADt effectiveness from various parameters in a comprehensive manner. Software developed in this work will be made publicly available.

SDP-PH-57 Comparison Of The Regression Fits Between Organ Doses Determined By Monte Carlo Simulation And Dose Metrics In Adult Chest-abdomen-pelvis CT Examinations Across CT Scanners

Participants
Keisuke Fujii, Nagoya, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The aims of this study are to determine organ doses determines by Monte Carlo (MC) simulations for individual patients in routine adult chest-abdomen-pelvis (CAP) CT examinations with different CT scanners and to evaluate the correlations between the organ doses and dose metrics.*Methods and Materials The voxelized models of 80 adult patients undergoing CAP CT examinations with three CT scanners of Aquilion ViSION (n=40), Aquilion Precision (n=20) (Canon Medical Systems, Japan), and SOMATOM Definition Flash (n=20) (Siemens Healthcare, Germany) were created by inputting the CT images into the MC simulation software ImpactMC (Advanced Breast CT, GmbH). MC simulations for each voxelized phantom were performed by inputting detailed descriptions of each CT scanner and scanning parameters including our estimated tube current modulation profiles into the simulation software. Next,

region of interests (ROIs) of seven radiosensitive organs (thyroid, lung, esophagus, breast, liver, stomach, and bladder) were created by delineating each organ on each patient CT images. Each ROI was set on the dose distribution images obtained as simulation results and organ doses for each organ were evaluated as average doses within each ROI. For dose metrics, size-specific dose estimates (SSDE) for each patient were calculated using volume CT dose index (CTDIvol) and average water equivalent diameter (WED) calculated from the CT images over the scan range. Organ-specific SSDE were also calculated using the average CTDIvol and WED over each organ position. The correlations between organ doses and dose metrics for CAP CT examinations were evaluated using coefficients of determination.*Results Organ doses exhibited stronger linear relationships with organ-specific SSDE (R2 = 0.82) than CTDIvol and SSDE for the three CT scanners. The coefficients of variation for the slope of the regression fits were approximately 3-9% across organs and 7-10% across CT scanners.*Conclusions The regression fits and organ-specific SSDE can be widely useful for organ dose estimations in CAP CT examinations with various CT scanners because the variation of the regression fits was small across both organs and CT scanners.*Clinical Relevance/Application Regression fits are widely useful for organ dose estimation for adult patients in CAP CT examinations because the regression fits are almost independent of the type of organ and CT scanners.

RESULTS

Organ doses exhibited stronger linear relationships with organ-specific SSDE (R2 = 0.82) than CTDIvol and SSDE for the three CT scanners. The coefficients of variation for the slope of the regression fits were approximately 3-9% across organs and 7-10% across CT scanners.

CLINICAL RELEVANCE/APPLICATION

Regression fits are widely useful for organ dose estimation for adult patients in CAP CT examinations because the regression fits are almost independent of the type of organ and CT scanners.

SDP-PH-58   Analysis Of Venous Blood Flow In The Lower Leg Using MRI During Intermittent Pneumatic Compression

Participants
Yuki Oda, Kanazawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Lower leg intermittent pneumatic compression (IPC) is widely used to improve the venous outflow, reduce the lymphedema, and prevent the deep venous thrombosis in clinical practice. However, the mechanism through which IPC can improve these parameters remains unclear, and the effects of IPC have not been completely verified. Therefore, in this study, we quantitatively assessed dynamic changes in venous blood flow in the lower leg during IPC using phase contrast magnetic resonance imaging (MRI).*Methods and Materials On a 3.0-T MRI, IPC sleeves (DVT-2500, Nitto Kohki, Japan) were positioned around the right and left calves in seven healthy volunteers (mean age = 23.1 ± 2.1 years). Popliteal venous blood flow (PVBF) images were obtained using two-dimensional phase contrast MRI before, during, immediately after, and 90 seconds after IPC for 10 minutes. The blood velocity and cross-sectional area of the popliteal vein were measured and used to calculated PVBF. Calf IPC and foot IPC were performed, and the PVBF values were compared. The purpose and protocol of the investigation were explained to all subjects, and the studies were performed only after informed consent was obtained from each subject. A P value of <0.05 was considered statistically significant.*Results For both calf IPC and foot IPC, PVBF in the compressed phase during IPC was significantly greater than that in the uncompressed phase (P < 0.05). The increase in PVBF during calf-IPC (460%-2300%) was much greater than that during foot IPC (150%-400%) because of differences in the compressed surface area (tangential shear force effect), total blood flow, and physical properties of tissue. There were no significant differences in PVBF between before, immediately after, and 90 seconds after IPC treatment with both calf IPC and foot IPC.*Conclusions IPC temporarily increases venous blood flow in the lower leg. Phase contrast MRI allows for quantitatively assessing dynamic changes in venous blood flow in the lower leg during IPC.*Clinical Relevance/Application Lower leg intermittent pneumatic compression (IPC) is widely used to prevent the deep venous thrombosis in clinical practice. We quantitatively assessed dynamic changes in venous blood flow in the lower leg during IPC using MRI.

RESULTS

For both calf IPC and foot IPC, PVBF in the compressed phase during IPC was significantly greater than that in the uncompressed phase (P < 0.05). The increase in PVBF during calf-IPC (460%-2300%) was much greater than that during foot IPC (150%-400%) because of differences in the compressed surface area (tangential shear force effect), total blood flow, and physical properties of tissue. There were no significant differences in PVBF between before, immediately after, and 90 seconds after IPC treatment with both calf IPC and foot IPC.

CLINICAL RELEVANCE/APPLICATION

Lower leg intermittent pneumatic compression (IPC) is widely used to prevent the deep venous thrombosis in clinical practice. We quantitatively assessed dynamic changes in venous blood flow in the lower leg during IPC using MRI.

SDP-PH-59   Quality Improvement Of Low-dose CT In The Detection Of A Pulmonary Nodule Using Tin-filtered High-kilovoltage Imaging Reducing The Metal Artifacts Due To Artificial Cardiac Pacemaker: A Phantom Study

Participants
Seita Watanabe, Nagoya, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Metal artifacts are commonly seen on computed tomography (CT), deteriorating imaging quality. Among them, those caused by an artificial cardiac pacemaker (PM) can affect the diagnosis of lung nodules. It has been reported that virtual monoenergetic imaging (VMI) using a dual-energy CT reduced metal artifacts. Also, a tin filter may reduce the artifacts by optimizing the effective x-ray energy. The aim of this study was to compare the effect of metal artifacts caused by a PM on the detectability of pulmonary nodules between low-dose CT images acquired by the standard tube potential, high tube potential with a tin filter, and VMI.*Methods and Materials An 8-mm diameter simulated nodule, composed of urethane resin and hydroxyapatite, was placed inside a chest phantom with a PM on its left anterior surface. The CT-attenuation value of the simulated nodule measured -800 Hounsfield units (HU) on the standard tube potential image when placed outside the phantom. We used a third generation dual-source CT system in this experiment. Images were acquired at 120 kVp, 150 kVp with a tin filter (150 kVp-Sn), and 140-keV VMI using a combination of 90 kVp and 150 kVp-Sn. Axial CT images of 1.0 mm slice thickness were reconstructed. The dataset was

reconstructed using the iterative metal artifact reduction (iMAR) algorithm in addition to conventional reconstruction without iMAR. For all acquisitions, variable tube current was applied to adjust the volume CT dose index (CTDIvol) to be 1.0 mGy. A computer-aided detection/diagnosis (CAD) system was utilized to evaluate the detectability, and the artifact index was employed to calculate the extent of the artifacts.*Results The CAD system detected the lung nodule on all the acquisition protocols in the absence of the PM. When accompanied by the PM, the nodule was missed out on the 120-kVp image and 140-keV VMI, regardless of using iMAR. In contrast, the nodule was detected on the 150-kVp-Sn image. The artifact indexes were 96.5, 38.9, and 61.6 for the 120-kVp, 150-kVp-Sn, and 140-keV VMI, respectively.*Conclusions For chest low-dose CT, using 150-kVp tube potential with a tin filter might improve the detectability of pulmonary lesions by reducing metal artifacts due to PMs.*Clinical Relevance/Application For chest low-dose CT, using 150-kVp tube potential with a tin filter might improve the detectability of pulmonary lesions by reducing metal artifacts due to PMs.

RESULTS

The CAD system detected the lung nodule on all the acquisition protocols in the absence of the PM. When accompanied by the PM, the nodule was missed out on the 120-kVp image and 140-keV VMI, regardless of using iMAR. In contrast, the nodule was detected on the 150-kVp-Sn image. The artifact indexes were 96.5, 38.9, and 61.6 for the 120-kVp, 150-kVp-Sn, and 140-keV VMI, respectively.

CLINICAL RELEVANCE/APPLICATION

For chest low-dose CT, using 150-kVp tube potential with a tin filter might improve the detectability of pulmonary lesions by reducing metal artifacts due to PMs.

SDP-PH-6   Evaluation Of Pre-trained Deep Convolutional Neural Network Models For The Classification Of Brain Tumor Magnetic Resonance Images By Transfer Learning

Participants
Kwan Wai Li, Hong Kong, Hong Kong (*Presenter*) Nothing to Disclose

PURPOSE

Diffusion-weighted magnetic resonance imaging, which can perform quantification of tissue cellularity by means of an apparent diffusion coefficient (ADC), has been used extensively in tumor detection and differentiation. Although ADC maps can be generated automatically by built-in software provided by the MRI scanner vendors, placement of region of interest (ROI) inside the lesion is still needed to be done manually to obtain the corresponding ADC. Therefore, the reproducibility of results depends on the size and location of the selected ROI, which might vary significantly between operators. To make the diagnosis operator independent irrespective of radiologists' experience, this study evaluates the performance of three state-of-the-art pre-trained deep convolutional neural network (CNN) models for brain tumor classification using transfer learning.*Methods and Materials A publicly available brain tumor dataset was used, which consists of 3064 T1-weighted contrast-enhanced MR images with three types of brain tumors, namely meningioma, glioma and pituitary tumor. To reduce overfitting, data augmentation was used to expand the dataset. The dataset was split into 80% and 20% for training and testing, respectively. Three pre-trained CNN models trained on ImageNet, (i) VGG16, (ii) VGG19 and (iii) InceptionV3, were selected for comparison in this study. They were used as the base convolutional models and the pre-trained weights were frozen for feature extraction. The top few fully-connected layers were unfrozen and fine-tuned with the modified classifier layer according to the number of classification classes in the MRI dataset. The customization of the three pre-trained models written in Python 3.7.9 were implemented using Keras 2.4.0 library in Tensorflow 2.3 and trained using root mean square propagation (RMSProp) optimizer with a learning rate of 0.00001. The training convergence began at about 30 epochs as observed from the training accuracy and loss curves. The experiment was performed using NVIDIA GeForce RTX 2060 GPU with Intel i7-9750H @ 2.6 GHz and 32 GB RAM.*Results The customized VGG16 model achieved the best results on all the performance metrics among the three customized pre-trained models, with classification accuracy of 96.2%, macro-averaged recall, precision and f1-score of 96.6%, 95.4% and 95.8%, respectively.*Conclusions The customized VGG16 model attained a reasonably high accuracy for the brain tumor MR images classification. Future studies would include in-house data labelled by radiologists.*Clinical Relevance/Application This study demonstrated the feasibility of using pre-trained CNN models as a clinical decision-support tool for radiologists to differentiate between three types of brain tumors automatically.

RESULTS

The customized VGG16 model achieved the best results on all the performance metrics among the three customized pre-trained models, with classification accuracy of 96.2%, macro-averaged recall, precision and f1-score of 96.6%, 95.4% and 95.8%, respectively.

CLINICAL RELEVANCE/APPLICATION

This study demonstrated the feasibility of using pre-trained CNN models as a clinical decision-support tool for radiologists to differentiate between three types of brain tumors automatically.

SDP-PH-60   Photon-Counting Detector CT And Quantum Iterative Reconstruction - A Quantitative Analysis For Portal-Venous Phase Abdominal CT

Participants
Thomas Sartoretti, Zurich, Switzerland (*Presenter*) Nothing to Disclose

PURPOSE

To quantitatively characterize portal-venous phase CT images acquired on a photon-counting detector CT (PCD-CT) and reconstructed with a novel iterative reconstruction algorithm (Quantum Iterative Reconstruction - QIR).*Methods and Materials A preliminary population of ten patients referred for abdominal CT in portal venous phase and imaged on a first-generation clinical dual-source photon-counting detector CT (PCD-CT; NAEOTOM Alpha, Siemens Healthineers) were included in this ongoing study. Polychromatic images (T3D) and virtual monoenergetic images at 60 keV were reconstructed by means of conventional filtered back projection (FBP) and QIR (4 levels, Q1-Q4). A fully automated computational pipeline for quantitative image characterization was developed in the R programming language. For all image types and reconstructions, noise maps for soft tissues (-300 HU to 100 HU) were generated and the global noise index (GNI) was computed. To quantify differences in attenuation between FBP and QIR images, the standard deviation of the absolute error (AE SD) and the mean absolute error (MAE) were computed. To quantify differences in image structure between FBP and QIR images, the peak signal-to-noise ratio (PSNR) and structural similarity index (SSIM) were computed.*Results For the T3D images, the GNI decreased linearly from FBP (17.4 ± 1.51 HU) to QIR Q4 (10.1 ± 0.63 HU) ($p<0.05$). For the 60 keV images, the GNI decreased linearly from FBP (20.5 ± 2.02 HU) to QIR Q4 (11.7 ± 0.89 HU) ($p<0.05$). For both

T3D and 60 keV images, the differences between FBP and QIR images increased with increasing QIR levels as witnessed by increasing AE SD and MAE values (MAE - T3D: 1.12± 0.26 HU for FBP vs QIR Q1 to 4.49±1 HU for FBP vs QIR Q4 and 60 keV: 1.39±0.32 HU for FBP vs QIR Q1 to 5.6±1.29 HU for FBP vs QIR Q4) ($p<0.05$) and decreasing PSNR and SSIM values (SSIM - T3D: 0.9999991 for FBP vs QIR Q1 to 0.9999862 for FBP vs QIR Q4 and 60 keV: 0.999997 for FBP vs QIR Q1 to 0.9999797 for FBP vs QIR Q4) ($p<0.05$).*Conclusions Global image noise decreased significantly and linearly for each level of QIR compared to FBP in abdominal portal-venous phase CT on a clinical PCD-CT. With increasing levels of QIR, the difference between QIR and FBP images increases both in terms of structural appearance and attenuation.*Clinical Relevance/Application High levels of Quantum Iterative Reconstruction considerably reduce noise on portal-venous phase CT images as acquired with a Photon-counting CT system.

RESULTS

For the T3D images, the GNI decreased linearly from FBP (17.4±1.51 HU) to QIR Q4 (10.1±0.63 HU) ($p<0.05$). For the 60 keV images, the GNI decreased linearly from FBP (20.5±2.02 HU) to QIR Q4 (11.7±0.89 HU) ($p<0.05$). For both T3D and 60 keV images, the differences between FBP and QIR images increased with increasing QIR levels as witnessed by increasing AE SD and MAE values (MAE - T3D: 1.12± 0.26 HU for FBP vs QIR Q1 to 4.49±1 HU for FBP vs QIR Q4 and 60 keV: 1.39±0.32 HU for FBP vs QIR Q1 to 5.6±1.29 HU for FBP vs QIR Q4) ($p<0.05$) and decreasing PSNR and SSIM values (SSIM - T3D: 0.9999991 for FBP vs QIR Q1 to 0.9999862 for FBP vs QIR Q4 and 60 keV: 0.999997 for FBP vs QIR Q1 to 0.9999797 for FBP vs QIR Q4) ($p<0.05$).

CLINICAL RELEVANCE/APPLICATION

High levels of Quantum Iterative Reconstruction considerably reduce noise on portal-venous phase CT images as acquired with a Photon-counting CT system.

SDP-PH-61 Task-specific Spatial Resolution Measurement Using Rod Objects And A Thin Wire Assuming Tasks From Thick And Thin Enhanced Vessels In Computed Tomography

Participants
Yuri Toyohara, Kanazawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The task transfer functions (TTFs) using the circular edge (CE) method (in-plane) and the plane edge (PE) method (z-directional) are task-specific, and not necessarily universally applicable for objects with different sizes. The present study aimed to evaluate TTFs of deep learning-based image reconstruction (DLIR) and iterative reconstruction (IR) using conventional tasks with rod objects and a task given by a wire of 1 mm in diameter, simulating thick and thin enhanced vessels, respectively.*Methods and Materials Phantoms made of a material equivalent to diluted iodine (12 mg/ml) that exhibits ~250 Hounsfield unit (HU) at 120 kV were placed inside a cylindrical water-bath phantom with a diameter of 300 mm for each measurement. For in-plane TTF, a rod of 30 mm in diameter was used for the CE, and a wire of 1 mm in diameter was used to measure a frequency response from its cross-section (point) image (iodine wire [IW] method). For z-directional TTF, a rod of 50 mm in diameter was used for the PE, and the wire was used for the IW. All acquisitions were performed using a 256-row multi-slice CT system with volume CT dose indices (CTDIvols) of 10 and 5 mGy. CT images with a slice thickness of 0.625 mm were reconstructed with all the reconstruction algorithms.*Results For both the in-plane and z-directional properties, the TTFs for both DLIR and IR using IW were significantly lower not only than those using CE or PE (percentage decrease of 50%TTF: IW vs. CE: 29-35% (DLIR), 27-28% (IR); IW vs. PE: 21-27% (DLIR), 26-29% (IR)) but also than those for filtered back projection (FBP) (22-24% (DLIR), 32-36% (IR)). This means that the spatial resolutions of DLIR and IR were insufficient for the task of a wire of 1 mm in diameter. Reflecting the TTF results, the peak intensities of IW's point images with DLIR and IR were lower than with FBP.*Conclusions For both the DLIR and IR used in this study, the TTFs measured using the IW simulating a 1-mm diameter enhanced vessel were notably lower than those measured using the CE (or PE). TTF measurements for small objects require phantoms that have not only the same contrast but also the same diameter as target objects.*Clinical Relevance/Application The IW method allowed to measure TTFs for a task assuming a thin vessel and thus is useful to assess TTFs for such tasks which have not been properly evaluated using the conventional CE (or PE) method.

RESULTS

For both the in-plane and z-directional properties, the TTFs for both DLIR and IR using IW were significantly lower not only than those using CE or PE (percentage decrease of 50%TTF: IW vs. CE: 29-35% (DLIR), 27-28% (IR); IW vs. PE: 21-27% (DLIR), 26-29% (IR)) but also than those for filtered back projection (FBP) (22-24% (DLIR), 32-36% (IR)). This means that the spatial resolutions of DLIR and IR were insufficient for the task of a wire of 1 mm in diameter. Reflecting the TTF results, the peak intensities of IW's point images with DLIR and IR were lower than with FBP.

CLINICAL RELEVANCE/APPLICATION

The IW method allowed to measure TTFs for a task assuming a thin vessel and thus is useful to assess TTFs for such tasks which have not been properly evaluated using the conventional CE (or PE) method.

SDP-PH-62 Quality Assurance For Deep Learning-based Synthetic CT Generation To Facilitate MRI-only Proton Therapy Planning

Participants
Chuang Wang, Memphis, Tennessee (*Presenter*) Nothing to Disclose

PURPOSE

To develop a quality assurance (QA) method for synthetic CT (sCT) generation with consistent-cycle Generative Adversarial Network (ccGAN) for facilitating safe integration of MRI-only proton therapy planning into clinical practice.*Methods and Materials Planning CT and T1/T2-weighted (T1W/T2W) MR images of 197 brain tumor patients (aged 1-20 y, 105 males) were retrospectively analyzed. MRI was preprocessed with the N4 bias correction and histogram matching intensity standardization methods. The ccGAN models were trained on 148 randomly selected patients and evaluated on the remaining 49 patients. All patients in the training set were deformed to a patient of the median brain size to create a QA reference. The sCT of each test patient was deformed to this reference and compared to generate a flag map (fM), which highlights pixels deviating by >100 HU and outside the mean ± standard deviation window of the reference intensity.Furthermore, the gamma passing rate (10%/3mm) of the sCT against the QA reference on the intensity difference was investigated as a surrogate to the sCT quality, including metrics of peak signal-to-noise ratio (PSNR), structural similarity (SSIM) index, and mean absolute error (MAE) from real CT. The Pearson correlation coefficient between gamma passing rate and MAE was calculated for T1W, T2W and combined sets.*Results The mean ± standard deviation of PSNR, SSIM, and MAE were 32.6±1.89, 0.92±0.02, and 43.4±15.7 HU (23±15 HU in air, and 89±13 HU in bone) for T1W-based sCT,

respectively; 31.6±1.9, 0.91±0.02, and 41.7±13.2 HU (48±26 HU in air, and 79±12 HU in bone) for T2W-based sCT, respectively. Gamma passing rate and MAE were highly correlated (T1W, -0.89; T2W, -0.93; combined T1/T2W, -0.90). The fM was able to identify clusters of inaccurate HUs on sCT, especially around oral cavity, nasal cavity and sinuses.*Conclusions The proposed ccGAN generated highly accurate sCT from brain MRI. When ground truth is not available, the gamma passing rate against the QA reference is a good surrogate of sCT accuracy for catching those with high MAE, and the fM can highlight inaccurate regions within the sCT that are associated with large errors in HUs.*Clinical Relevance/Application Highly accurate sCT generated by the proposed ccGAN with a quality assurance mechanism improves the safety and feasibility of MRI only proton therapy for pediatric brain tumor patients.

RESULTS

The mean ± standard deviation of PSNR, SSIM, and MAE were 32.6±1.89, 0.92±0.02, and 43.4±15.7 HU (23±15 HU in air, and 89±13 HU in bone) for T1W-based sCT, respectively; 31.6±1.9, 0.91±0.02, and 41.7±13.2 HU (48±26 HU in air, and 79±12 HU in bone) for T2W-based sCT, respectively. Gamma passing rate and MAE were highly correlated (T1W, -0.89; T2W, -0.93; combined T1/T2W, -0.90). The fM was able to identify clusters of inaccurate HUs on sCT, especially around oral cavity, nasal cavity and sinuses.

CLINICAL RELEVANCE/APPLICATION

Highly accurate sCT generated by the proposed ccGAN with a quality assurance mechanism improves the safety and feasibility of MRI only proton therapy for pediatric brain tumor patients.

SDP-PH-63 Comparison Of Hydroxyapatite Measurements And Hounsfield Measurementin Dual-energy Spectralctfor The Diagnosis Of Osteoporosisin Female Patients

Participants
Yue Yao, Xi'an, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the accuracy of diagnosing osteoporosis in middle-aged and elder women using hydroxyapatite (HAP) concentration on material decomposition (MD) images and CT value on monochromatic images in dual-energy spectral CT (DEsCT).*Methods and Materials An institutional review board approved this prospective study, and all participants signed the informed consent. A total of 239 consecutive postmenopausal female patients (mean age: 58.45±6.67 years, range 52-82 years) were prospectively enrolled. All patients were examined using both chest DEsCT and Dual energy X-ray absorptiometry (DXA). According to the T-score of the 1st lumbar vertebra on DXA, the patients were divided into the osteoporosis group (T<-2.5, n=112) and non-osteoporosis group (T>-2.5, n=127). The chest DEsCT was performed on a 256-row Revolution CT (GE Healthcare) using the spectral imaging mode: 80-140kVp fast switching, 200mA and 0.5s/r. The HAP values of the 1st lumbar vertebra were measured from the coronal-view, HAP(Fat)-based MD images, and CT values were measured on the 75keV monochromatic image. The HAP and CT cutoff values for differentiating osteoporosis from non-osteoporosis were obtained by drawing a receiver operating characteristic (ROC) curve.*Results Both HAP and CT value of the 1st lumbar vertebra had moderate-high correlation with bone-mineral-density measurement on DXA (HAP, r=0.614;CT value,r=0.625; all P<0.01). The HAP cutoff value of the 1st lumbar vertebra was 142.055mg/cm3 to provide the area-under-the-curve (AUC), sensitivity, specificity, PPV and NPV of 0.754, 0.714, 0.693, 0.68 and 0.752, respectively for diagnosing osteoporosis. The CT cutoff value of the 1st lumbar was vertebra 132HU for AUC, sensitivity, specificity, PPV and NPV of 0.766, 0.741, 0.7, 0.685 and 0.754, respectively.*Conclusions HAP measurements on HAP(Fat)-based MD images in DEsCT showed a similar good performance with the conventional CT measurement on monochromatic images in diagnosing osteoporosis in middle-aged and elder females.*Clinical Relevance/Application DEsCT provides multi-parameters to help the diagnosis of osteoporosis than conventional CT scans.

RESULTS

Both HAP and CT value of the 1st lumbar vertebra had moderate-high correlation with bone-mineral-density measurement on DXA (HAP, r=0.614;CT value,r=0.625; all P<0.01). The HAP cutoff value of the 1st lumbar vertebra was 142.055mg/cm3 to provide the area-under-the-curve (AUC), sensitivity, specificity, PPV and NPV of 0.754, 0.714, 0.693, 0.68 and 0.752, respectively for diagnosing osteoporosis. The CT cutoff value of the 1st lumbar was vertebra 132HU for AUC, sensitivity, specificity, PPV and NPV of 0.766, 0.741, 0.7, 0.685 and 0.754, respectively.

CLINICAL RELEVANCE/APPLICATION

DEsCT provides multi-parameters to help the diagnosis of osteoporosis than conventional CT scans.

SDP-PH-65 Artificial Intelligence Teaching Program For Technicians

Participants
Paul R. Algra, MD, PhD, Alkmaar, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

To establish the need for an Artificial Intelligence (AI) teaching program for technologists in The Netherlands*Methods and Materials We performed a survey among technologists (diagnostic, therapeutic and nuclear) to evaluate the need for AI teaching programs.*Results The survey was carried out among members of Dutch Society Medical Imaging and Radiotherapy in the Netherlands in 2020. 126 (33%) technologists responded: 17 % working in university hospitals and 62 % at non-academic centers. Approximately one third is not using AI and the majority who does, has experience with AI in imaging (30%), dose optimization (28%) and workflow management (17%).More than 71% expects to start working with AI in the next two years and 94 % would like to get involved with AI. From the respondents, most interest is for AI application (83%), basic principles (73%), safety and ethical aspects (69%) programming algorithms (24%).*Conclusions A large majority of the technologists see AI as an important development and welcome education in AI. This is in line with earlier statements by international organizations.*Clinical Relevance/ApplicationSupported by the widely felt need of AI education, the Dutch government funded a nationwide teaching program.

RESULTS

The survey was carried out among members of Dutch Society Medical Imaging and Radiotherapy in the Netherlands in 2020. 126 (33%) technologists responded: 17 % working in university hospitals and 62 % at non-academic centers. Approximately one third is not using AI and the majority who does, has experience with AI in imaging (30%), dose optimization (28%) and workflow

management (17%).More than 71% expects to start working with AI in the next two years and 94 % would like to get involved with AI. From the respondents, most interest is for AI application (83%), basic principles (73%), safety and ethical aspects (69%) programming algorithms (24%).

CLINICAL RELEVANCE/APPLICATION

Supported by the widely felt need of AI education, the Dutch government funded a nationwide teaching program.

SDP-PH-66   Deep Learning Reconstruction Vs. Hybrid-type Iterative Reconstruction Vs. Model-based Iterative Reconstruction: Capability For Image Quality Improvements On Brain Contrast-enhanced CT Angiography For Ultra-high-resolution CT

Participants
Kazuhiro Murayama, MD, Toyoake, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation

PURPOSE

To directly compare the capability for image quality improvements on brain contrast-enhanced CT angiography (CE-CTA) for ultra-high-resolution CT (UHR-CT) in intracranial aneurysms patients among deep learning reconstruction (DLR) and hybrid-type iterative reconstruction (IR) and model-based IR.*Methods and Materials 21 consecutive intracranial aneurysms patients underwent brain CE-CTA and reconstructed by DLR, hybrid-type IR and model-based IR using a UHR-CT system with super-high resolution mode (SHR: 0.25mm×160 rows/1792 channels). CT value on each CT dataset at ICA and MCA were assessed by ROI measurements. Image J software were used to generate the profile curves in this study. To assess the capability for improvement of spatial resolution with UHR-CT and DLR, full width at half maximum (FWHM), the width of the edge rise distance (ERD) and the edge rise slope (ERS) were measured at each vessel based on past literatures. For qualitative assessment, overall image quality, artifact, aneurysm and vascular depiction levels were assessed by 5-point scales by two board-certified radiologists. CT values were compared among all data set by Tukey's HSD test. To evaluate the utility of DLR method for accurate visualization of minimal spatial resolution, ERS were compared among all UHR-CT data using Tukey's HSD test. As for qualitatively assessed image quality, inter-observer agreements of each method were evaluated by kappa statistics with ?2 test. All qualitative indexes were compared among all data sets by Wilcoxon signed-rank test.*Results CT values and ERS of model-based IR and DLR were significantly higher than those of hybrid-type IR at MCA (p<0.05). Inter-observer agreement of each index by all methods were determined as moderate, substantial or excellent (0.51=?=0.92, p<0.001). In addition, overall image quality and artifact of DLR were significantly improved as compared with others (p<0.05). Aneurysm and vascular depiction levels had no significant difference among all methods (p>0.05).*Conclusions DLR has a potential for image quality improvements than hybrid-type and model-based IR on brain CE-CTA for UHR-CT.*Clinical Relevance/Application DLR has a potential for image quality improvements than hybrid-type and model-based IR on brain CE-CTA for UHR-CT.

RESULTS

CT values and ERS of model-based IR and DLR were significantly higher than those of hybrid-type IR at MCA (p<0.05). Inter-observer agreement of each index by all methods were determined as moderate, substantial or excellent (0.51=?=0.92, p<0.001). In addition, overall image quality and artifact of DLR were significantly improved as compared with others (p<0.05). Aneurysm and vascular depiction levels had no significant difference among all methods (p>0.05).

CLINICAL RELEVANCE/APPLICATION

DLR has a potential for image quality improvements than hybrid-type and model-based IR on brain CE-CTA for UHR-CT.

SDP-PH-67   Impact Of Reconstruction Kernel On Image Quality Of Coronary Stents With 256-rows Mdct

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the image quality of coronary stents phantom reconstructed by Detail and HD-detail reconstruction kernel.*Methods and Materials Coronary stents with a range of inner diameters (ID: 4mm, 3mm, and 2.5mm) were implanted in thin plastic tubes to simulate a coronary artery. The tubes were filled with iodinated contrast medium (10mg/ml), positioned in a plastic container filled with water. The phantom was scanned using a 256-row detector CT (Revolution CT, GE Healthcare). Images were acquired with 40% pre-ASiR-V (tube voltage 100kVp, automA, Noise index 26). Detail and HD-detail algorithms were used in image reconstruction. Subjective image quality was assessed independently by two radiologists, image quality was evaluated with five-point Likert scale (1, very poor; 2, suboptimal; 3, acceptable; 4, good; 5, excellent.). Paired-samples t test was applied for the comparison between CT value, visible diameter in percentage (VD%=VD/ID) and subjective image quality.*Results There was a significant difference in CT value of coronary stents between Detail and HD-detail algorithms (433.43 ± 205.58; 310.80 ± 43.72, P=0.330). Significant difference for VD% was observed between the two groups (32.00 ± 11.53%; 64.00 ± 4.00%, p=0.019). The subjective image quality in detail and HD detail was 1.83 ± 0.29 and 4.33 ± 0.58, respectively(p=0.013).*Conclusions The image quality of coronary stents phantom was significantly improved in image with HD-detail kernel, compared to that of HD kernel.*Clinical Relevance/Application HD-detail kernel can be used to generate high quality clinical data in the post-processing of image.

RESULTS

There was a significant difference in CT value of coronary stents between Detail and HD-detail algorithms (433.43 ± 205.58; 310.80 ± 43.72, P=0.330). Significant difference for VD% was observed between the two groups (32.00 ± 11.53%; 64.00 ± 4.00%, p=0.019). The subjective image quality in detail and HD detail was 1.83 ± 0.29 and 4.33 ± 0.58, respectively(p=0.013).

CLINICAL RELEVANCE/APPLICATION

HD-detail kernel can be used to generate high quality clinical data in the post-processing of image.

SDP-PH-68   Optimal Reconstruction Algorithm For Deep Learning Assisted Detection Of Rib Fracture In Emergency Trauma

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore detection efficiency differences of AI fracture detection system for emergency rib fracture detection under different reconstruction algorithms, and to seek the best reconstruction algorithm in rib fracture detection based on deep learning.*Methods and Materials 43 patients with emergency chest trauma underwent chest CT examination (Revolution CT, GE Healthcare) and images were reconstructed using standard/lung/bone/soft algorithms. AI-assisted diagnostic system (InferRead CT Bone Research,Infervision, Beijing) was used to detect rib fractures under different reconstruction algorithms. The gold standard of rib fracture was made by two radiologists with more than 15 years of experience in chest diagnosis on the review of AI reading results. The total number of rib fractures together with the true and false positive number of rib fractures detected by AI were recorded under four algorithms. Differences in the sensitivity and false positive rate of rib fracture detection under four reconstruction algorithms by AI were compared.*Results There were 202 rib fractures identified and used as the gold standard. Under standard/lung/bone/soft algorithms, AI system detected 170/203/195/161 fractures, of which 158/170/176/152 were true positive and 12/33/19/9 were false positive, respectively. Therefore, sensitivity of standard/lung/bone/soft for fracture detection was 78.22%/84.16%/87.13%/75.25%, respectively, with a significant difference found among groups (P =0.009). The false positive rates of the four algorithms were 1.45%/3.99%/2.29%/1.09%, and there was a statistically significant difference found among groups (P <0.001). Specifically, the sensitivity of AI in detection of rib fracture under bone and lung algorithm was found significantly higher than that under standard or soft algorithm.*Conclusions AI-assisted fracture detection system demonstrated different diagnostic efficacy for emergency traumatic fractures under different reconstruction algorithms. Particularly, bone and lung algorithm were found to be more sensitive in the detection of emergency traumatic fractures in comparison with standard and soft algorithm.*Clinical Relevance/Application AI exhibited improved detection efficiency under lung and bone algorithm for emergency traumatic rib fracture. It is suggested that bone and lung algorithm could be selected in the diagnosis of emergency traumatic rib fracture when artificial intelligence-assisted system was used.

RESULTS

There were 202 rib fractures identified and used as the gold standard. Under standard/lung/bone/soft algorithms, AI system detected 170/203/195/161 fractures, of which 158/170/176/152 were true positive and 12/33/19/9 were false positive, respectively. Therefore, sensitivity of standard/lung/bone/soft for fracture detection was 78.22%/84.16%/87.13%/75.25%, respectively, with a significant difference found among groups (P =0.009). The false positive rates of the four algorithms were 1.45%/3.99%/2.29%/1.09%, and there was a statistically significant difference found among groups (P <0.001). Specifically, the sensitivity of AI in detection of rib fracture under bone and lung algorithm was found significantly higher than that under standard or soft algorithm.

CLINICAL RELEVANCE/APPLICATION

AI exhibited improved detection efficiency under lung and bone algorithm for emergency traumatic rib fracture. It is suggested that bone and lung algorithm could be selected in the diagnosis of emergency traumatic rib fracture when artificial intelligence-assisted system was used.

SDP-PH-69 Quantitative Evaluation Of Metal Artifacts In CT Images Using No-reference Image Quality Assessment: Comparison Of Filtered Back Projection (FBP) And Deep Learning Image Reconstruction (DLIR)

Participants
Wakiko Tani, RT, Kobe, Japan (*Presenter*) Nothing to Disclose

PURPOSE

It is difficult to evaluate quantitatively a metal artifact in clinical images. No-reference image quality assessment (NR-IQA) model called Natural Image Quality Evaluator (NIQE) is one of the objective evaluations of images. We compared the image quality of metal artifact images using NIQE.*Methods and Materials A 26-cm diameter water phantom including a metal rod and two acryl rods were scanned at 3 different CTDIvol (7 mGy, 14 mGy and 28 mGy) with 120-kV. All CT data were reconstructed by FBP and DLIR (medium strength) with and without metal artifacts reduction (MAR). Metal artifact images were evaluated using NIQE and compared with visual evaluation and image noise. NIQE model was trained based on the high radiation dose input images without metal artifacts, NIQE score was calculated. A lower score indicates better image quality. Metal artifacts images were evaluated by using a 4-point score (1 = severe, 2 = strong, 3 = mild, 4 = minimal) by six radiographers blinded to sequence parameters. NIQE score, visual score and image noise were compared between each sequence by one-way ANOVA followed by Tukey test. Relations between NIQE score and visual score or image noise were assessed with the Pearson correlation coefficient.*Results The mean ± SD of NIQE score of FBP 7 mGy, FBP MAR(+) 7 mGy, FBP 14 mGy, FBP MAR(+) 14 mGy, FBP 28 mGy, FBP MAR(+) 28 mGy, DLIR 7 mGy and DLIR MAR(+) 7 mGy were 7.0±0.5, 6.6±0.4, 6.4±0.4, 5.9±0.4, 5.7±0.6, 5.2±0.4, 6.2±0.5 and 5.8±0.5, respectively. NIQE score decreased significantly with radiation dose, while there was no significant difference between FBP 14 mGy and DLIR 7 mGy. The mean ± SD of the visual score of FBP 7 mGy, FBP MAR(+) 7 mGy, FBP 14 mGy, FBP MAR(+) 14 mGy, FBP 28 mGy, FBP MAR(+) 28 mGy, DLIR 7 mGy and DLIR MAR(+) 7 mGy were 1.0±0.0, 2.8±0.4, 1.2±0.4, 3.2±0.4, 1.2±0.4, 4.0±0.0 1.7±0.5 and 3.8±0.4, respectively. Similar to the NIQE score, the visual score was not significantly different between FBP 14 mGy and DLIR 7 mGy. Pearson correlation coefficient of NIQE score and the visual score was -0.609 and NIQE score was associated with the visual score (P < .05). Furthermore, the Pearson correlation coefficient of NIQE score and image noise was 0.636 and NIQE score was associated with the image noise (P < .05).*Conclusions This study suggests that NIQE can quantitatively evaluate metal artifacts.*Clinical Relevance/Application NIQE is useful for evaluating metal artifacts and will be used for clinical images that it is not possible to place a region of interest (ROI) to measure image noise.

RESULTS

The mean ± SD of NIQE score of FBP 7 mGy, FBP MAR(+) 7 mGy, FBP 14 mGy, FBP MAR(+) 14 mGy, FBP 28 mGy, FBP MAR(+) 28 mGy, DLIR 7 mGy and DLIR MAR(+) 7 mGy were 7.0±0.5, 6.6±0.4, 6.4±0.4, 5.9±0.4, 5.7±0.6, 5.2±0.4, 6.2±0.5 and 5.8±0.5, respectively. NIQE score decreased significantly with radiation dose, while there was no significant difference between FBP 14 mGy and DLIR 7 mGy. The mean ± SD of the visual score of FBP 7 mGy, FBP MAR(+) 7 mGy, FBP 14 mGy, FBP MAR(+) 14 mGy, FBP 28 mGy, FBP MAR(+) 28 mGy, DLIR 7 mGy and DLIR MAR(+) 7 mGy were 1.0±0.0, 2.8±0.4, 1.2±0.4, 3.2±0.4, 1.2±0.4, 4.0±0.0 1.7±0.5 and 3.8±0.4, respectively. Similar to the NIQE score, the visual score was not significantly different between FBP 14 mGy and DLIR 7 mGy. Pearson correlation coefficient of NIQE score and the visual score was -0.609 and NIQE score was associated with the visual score (P < .05). Furthermore, the Pearson correlation coefficient of NIQE score and image noise was 0.636 and NIQE score was associated with the image noise (P < .05).

CLINICAL RELEVANCE/APPLICATION

NIQE is useful for evaluating metal artifacts and will be used for clinical images that it is not possible to place a region of interest

NIQL is useful for evaluating metal artifacts and will be used for clinical images that it is not possible to place a region of interest (ROI) to measure image noise.

SDP-PH-7 A New Quantification Method Of Hand Rheumatoid Arthritis Progression In X-ray Radiographs Using Deep Learning

Participants
Kohei Nakatsu, Himeji, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To propose a novel method to automatically quantify the progress of hand rheumatoid arthritis (RA) using X-ray radiograph.*Methods and Materials This study was approved by the Ethics Committee of Hyogo Prefectural Kakogawa Medical Center. A total of 90 X-ray radiograph images of both hands were used. For training and evaluation purpose, experts annotated the finger joint, the fingertip, and the modified Total Shape Score (mTSS). The mTSS is the standard diagnosis method of RA progression using X-ray radiograph, and is defined as a sum of "erosion" and "joint space narrowing (JSN)" score of hand joints. The proposed method first automatically detects finger joints using support vector machine (SVM) and statistical shape model (SSM). SVM estimates the degree of finger joints and the degree of fingertip for each pixel. Hand joint SSM can represent the spatial relationship among 14 finger joints and 5 fingertips by 6 shape parameters. The hand joint model can be reconstructed from the shape parameters, and the likelihood is estimated by using the finger joint and fingertip degrees. Thus, the proposed method can detect all finger joints by optimizing the 6 shape parameters.Next, the method estimates the erosion and JSN scores from the small image patch at the detected joint. This study compares the performance of some estimation models, ridge regression (RR) and deep learning (DL) with several network architectures. RR model first calculates HOG features, and then estimates the scores. DL model evaluates the image patches directly without feature extraction process. The evaluated network architectures are VGG16, DenseNet201 and Xception. The finger joint detection method was validated using leave-one-out cross validation. The erosion and JSN score estimation method were validated using 10-fold CV. The estimation results were evaluated by the root mean squared error(RMSE) of the estimated and actual scores.*Results The accuracy of finger joint detection with the proposed method was 94.8%. The RMSE of erosion estimation was 0.827 with RR, 0.854 with VGG16, 0.948 with DenseNet201, and 1.03 with Xception. And, the RMSE of JSN estimation was 0.697 with RR, 0.708 with VGG16, 0.821 with DenseNet201, and 0.877 with Xception.*Conclusions The SVM and SSM method detected the finger joint positions in X-ray radiograph with an accuracy of 94.8%. and estimation the mTSS with an accuracy of about 0.8 RMSE.*Clinical Relevance/Application For effective treatment of rheumatoid arthritis, the mTSS should be measured several times a year, but because there are many points to evaluate, manual evaluation requires a great deal of time. If automatic estimation of the mTSS becomes possible through this research, it will reduce the burden on physicians and improve the accuracy of diagnosis.

RESULTS

The accuracy of finger joint detection with the proposed method was 94.8%. The RMSE of erosion estimation was 0.827 with RR, 0.854 with VGG16, 0.948 with DenseNet201, and 1.03 with Xception. And, the RMSE of JSN estimation was 0.697 with RR, 0.708 with VGG16, 0.821 with DenseNet201, and 0.877 with Xception.

CLINICAL RELEVANCE/APPLICATION

For effective treatment of rheumatoid arthritis, the mTSS should be measured several times a year, but because there are many points to evaluate, manual evaluation requires a great deal of time. If automatic estimation of the mTSS becomes possible through this research, it will reduce the burden on physicians and improve the accuracy of diagnosis.

SDP-PH-70 Iterative Reconstruction Vs. Deep Learning Image Reconstruction: Comparison Of Image Quality In Low-dose Lower Extremity CT Angiography

Participants
Tingting Qu, Xi'an, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare image quality in low-dose CT angiography (CTA) of lower extremity between"adaptive statistical iterative reconstruction-V" (ASIR-V) and deep learning reconstruction (DLIR).*Methods and Materials Forty-six patients with lower extremity artery CTA were prospectively collected. Patients were scanned with low dose scheme (80kVp and automatic mA modulation for noise index (NI) of 20), front ASIR-V was 0%. The contrast medium was injected at the flow rates of 4.5ml/s (50ml) and 2.5ml/s (40ml). Images were reconstructed with three ASIR-V (blending factor of 0%, 50% and 100% (AV-100)) and two DLIR (medium-, and high-strength-level (DL-H) settings). CT number and SD values were measured at the upper edge of abdominal aortic bifurcation and left popliteal artery. Conventional indicators (CT number, SD values, signal-to-noise ratio (SNR), and contrast-to-noise ratio (CNR)) of selected regions of interest were determined. For qualitative analyses, the degrees of quantum mottle and blurring were assessed by 5-grade method.*Results The higher the blending factor in ASIR-V or the strength in DLIR, the lower the noise, and the higher the SNR and CNR values. The SNR and CNR values of DLIR images were significantly higher than those of AV-0 and AV-50 images and lower than those of AV-100 images (all p<0.001). Through the evaluation of image blur and quantum mottle, the image quality of DLIR is better than that of ASIR-V (p<0.001), the overall qualitative image quality was best in DL-H images, the image blur of AV-100 was much higher than that of other reconstruction, and the mottle of AV-0 was much higher than that of other reconstruction.*Conclusions Compared with DL-M and ASIR-V, DL-H was the most balanced image in terms of image noise and sharpness in low-dose lower extremity CTA scanning.*Clinical Relevance/Application DL-H can balance the task of reducing image noise and maintaining spatial resolution to provide the best overall image quality in CTA of lower extremities.

RESULTS

The higher the blending factor in ASIR-V or the strength in DLIR, the lower the noise, and the higher the SNR and CNR values. The SNR and CNR values of DLIR images were significantly higher than those of AV-0 and AV-50 images and lower than those of AV-100 images (all p<0.001). Through the evaluation of image blur and quantum mottle, the image quality of DLIR is better than that of ASIR-V (p<0.001), the overall qualitative image quality was best in DL-H images, the image blur of AV-100 was much higher than that of other reconstruction, and the mottle of AV-0 was much higher than that of other reconstruction.

CLINICAL RELEVANCE/APPLICATION

DL-H can balance the task of reducing image noise and maintaining spatial resolution to provide the best overall image quality in CTA of lower extremities.

SDP-PH-71 Towards Big Data And Visualization Analytics: Dose Management 3.0 In A Multi-center European Settings

Participants
Federica Zanca, PhD, Leuven, Belgium (*Presenter*) Nothing to Disclose

PURPOSE

To comply with the 2013/59/Euratom Basic Safety Standards Directive continuous monitoring of dose data is mandatory. The aim of this study was to assess the impact on patient safety improvement and protocol optimization of a Business Intelligence (BI) tools for real-time dose management, in a multinational healthcare organization.*Methods and Materials Two countries were installed with a centralized dose monitoring solution (DoseWatch, GE Healthcare), collecting data from 31 CT scanner installed in diagnostic centers of the same healthcare provider. All protocols were standardized in terms of clinical indications and number of irradiations and mapped through a unique RadLex identifier. An Extract Transform and Load (ETL) framework for the two dose data repositories was used to feed, in real-time, a BI platform. Monitoring goals were defined for: dose metrics, dose alerts, justification of high doses, protocol standardization and optimization, equipment technical performance. To develop tracking dashboards, Key Performance Indicators (KPIs) were defined, and improvement processes put in place.*Results Preliminary metadata of 27687 exams were collected between January 2021 and April 2021. 81% of performed exams was covered by oncology follow up thorax-abdomen-pelvis (29%), head and C-spine trauma (17%), general chest (14%), head trauma (8%), general abdomen-pelvis (7%), general head (6%). Dose alerts for the above clinical indications varied between 2.5% (oncology thorax-abdomen-pelvis) to 0.5% (head and C- spine trauma) and the most recurrent justification were overweight patient, additional phase, or protocol, or over length acquisition. The % of protocols performed with a standard number of irradiations varied between 77% (head and C- spine trauma) and 55% (oncology abdomen-pelvis). Analyses of the median dose distribution per clinical indication showed optimized protocols with dose below institution and European Dose Reference Levels (DRLs), well harmonized across centers. Analysis of the impact of technology is undergoing.*Conclusions BI tools are very helpful software tools for monitoring patient exposure, optimisation, compliance with DRLs and quality assurance in a multinational healthcare organization.*Clinical Relevance/Application Real-time visualization of dose statistical data from CTs in a multinational organization allows to continuously benchmark data while strengthening patient safety and clinical excellence.

RESULTS

Preliminary metadata of 27687 exams were collected between January 2021 and April 2021. 81% of performed exams was covered by oncology follow up thorax-abdomen-pelvis (29%), head and C-spine trauma (17%), general chest (14%), head trauma (8%), general abdomen-pelvis (7%), general head (6%). Dose alerts for the above clinical indications varied between 2.5% (oncology thorax-abdomen-pelvis) to 0.5% (head and C- spine trauma) and the most recurrent justification were overweight patient, additional phase, or protocol, or over length acquisition. The % of protocols performed with a standard number of irradiations varied between 77% (head and C- spine trauma) and 55% (oncology abdomen-pelvis). Analyses of the median dose distribution per clinical indication showed optimized protocols with dose below institution and European Dose Reference Levels (DRLs), well harmonized across centers. Analysis of the impact of technology is undergoing.

CLINICAL RELEVANCE/APPLICATION

Real-time visualization of dose statistical data from CTs in a multinational organization allows to continuously benchmark data while strengthening patient safety and clinical excellence.

SDP-PH-72 Deep Learning Reconstruction Vs. Hybrid-type Iterative Reconstruction Vs. Model-based Iterative Reconstruction: Capability For Image Quality And Disease Depiction Improvements On Unenhanced Brain CT In Acute Ischemic Stroke Patients

Participants
Kazuhiro Murayama, MD, Toyoake, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation

PURPOSE

To directly compare the capability for image quality and disease depiction improvements on unenhanced brain CT in acute ischemic stroke patients among deep learning reconstruction (DLR), hybrid-type iterative reconstruction (IR) and model-based IR.*Methods and Materials 15 consecutive acute ischemic stroke patients underwent unenhanced CT by DLR, conventional hybrid-type IR and model-based IR using a CT system. For quantitative image quality assessment in each patient, SNRs of normal gray- and white matters and CNRs between normal gray- and white matters and between normal gray- and ischemic gray matters were determined by ROI measurements. For qualitative assessment, two board-certified radiologists assessed overall image quality, artifacts and disease depiction level by a 5-point scoring system. To compare quantitative indexes among three methods, SNRs and CNRs were compared among DLR and hybrid-type IR and model-based IR by Wilcoxon signed-rank test. For evaluating inter-observer agreement of each index, weighted kappa statistics and ?2 test was performed. To compare each qualitative index among three methods, each index was also compared among three methods by Wilcoxon signed-rank test.*Results SNRs of DLR were significantly higher than those of hybrid-type IR (p<0.001). CNR of DLR between normal gray- and white matters was significantly higher than that of others (p<0.05). Moreover, CNR of DLR between normal gray- and ischemic gray matters was significantly higher than that of hybrid IR (p<0.001). Inter-observer agreements for diagnostic confidence on all methods were assessed as excellent (0.86=?=0.90, p<0.001), although inter-observer agreements for overall image quality and artifact on all methods were assessed as substantial (0.63=?=0.66, p<0.05). Overall image quality and artifact scores of DLR were significantly higher than that of others (p<0.05). Disease depiction level of DLR were significantly higher than that of hybrid-type IR (p<0.001).*Conclusions DLR has a superior capability for image quality and disease depiction improvements on unenhanced brain CT in acute ischemic stroke patients as compared with conventional hybrid-type and model-based IRs.*Clinical Relevance/Application DLR has a higher capability than conventional hybrid IR and model-based IR for image quality and disease depiction improvements on unenhanced brain CT in acute ischemic stroke patients.

RESULTS

SNRs of DLR were significantly higher than those of hybrid-type IR (p<0.001). CNR of DLR between normal gray- and white matters was significantly higher than that of others (p<0.05). Moreover, CNR of DLR between normal gray- and ischemic gray matters was significantly higher than that of hybrid IR (p<0.001). Inter-observer agreements for diagnostic confidence on all methods were assessed as excellent (0.86=?=0.90, p<0.001), although inter-observer agreements for overall image quality and artifact on all methods were assessed as substantial (0.63=?=0.66, p<0.05). Overall image quality and artifact scores of DLR were significantly higher than that of others (p<0.05). Disease depiction level of DLR were significantly higher than that of hybrid-type IR (p<0.001).

SDP-PH-73 Identification Of The Optimal Asir-v Blending Level For CT Portal Venography

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To assess the image quality of CT portal venography with different blending levels of adaptive statistical iterative reconstruction V (ASiR-V) algorithm, and investigate the optimal blending level of ASiR-V algorithm in the proportion of CT portal venography.*Methods and Materials Thirty patients suspected abdominal disease were enrolled. All the patients underwent upper abdominal enhancement CT scan with a 256 row wide-coverage volumetric CT (Revolution CT, GE healthcare, Milwaukee, WI). The Tube voltage was 120kV, the automatic tube current modulation technique was used with noise index of 10. For each patient, 11 image sets were reconstructed with ASiR-V blending level of 0 to 100% with 10% increasement. Two radiologists independently evaluated the image quality score with 5-point scale for the image artifacts, the capacity of the tiny structures of three level portal vein branches and the capacity of the tiny structures of lesion. The image noise of portal vein and liver parenchyma was measured. Image noise among different image sets was compared with two-way ANOVA, the image score among different image sets was compared with friedman test.*Results With the increase of ASiR-V blending level, the image noise of portal vein and liver parenchyma decreased gradually (both p<0.05). At 50% ,60% and 70% blending levels of ASiR-V, the image quality scores of image artifacts and the capacity of the tiny structures of lesion were the highest, and images scores of these three image sets had no statistical difference (P>0.05). At 50% and 60% blending levels of ASiR-V, the image quality scores of the showing the tiny structures of three level portal vein branches were the highest (4.83±0.36 and 4.78±0.39), and images scores of these two image sets had no statistical difference(P=0.673). At 30% to 80%, the image score of artifacts was above than 3.5 points. At 30% to 80%, the image score of the showing the tiny structures of three level portal vein branches was above than 3.5 points. At 30% to 90%, the image score of the capacity of the tiny structures of lesion was above than 3.5 points.*Conclusions ASiR-V algorithm reduce image noise of CT portal venography. 50% ,60% and 70% blending levels have the highest image quality. High blending level of ASiR-V may cause "fuzzy" effects of the images.*Clinical Relevance/Application ASiR-V algorithm reduce image noise of CT portal venography. 50% ,60% and 70% blending levels have the highest image quality. High blending level of ASiR-V may cause "fuzzy" effects of the images.

RESULTS

With the increase of ASiR-V blending level, the image noise of portal vein and liver parenchyma decreased gradually (both p<0.05). At 50% ,60% and 70% blending levels of ASiR-V, the image quality scores of image artifacts and the capacity of the tiny structures of lesion were the highest, and images scores of these three image sets had no statistical difference (P>0.05). At 50% and 60% blending levels of ASiR-V, the image quality scores of the showing the tiny structures of three level portal vein branches were the highest (4.83±0.36 and 4.78±0.39), and images scores of these two image sets had no statistical difference(P=0.673). At 30% to 80%, the image score of artifacts was above than 3.5 points. At 30% to 80%, the image score of the showing the tiny structures of three level portal vein branches was above than 3.5 points. At 30% to 90%, the image score of the capacity of the tiny structures of lesion was above than 3.5 points.

CLINICAL RELEVANCE/APPLICATION

ASiR-V algorithm reduce image noise of CT portal venography. 50% ,60% and 70% blending levels have the highest image quality. High blending level of ASiR-V may cause "fuzzy" effects of the images.

SDP-PH-74 Evaluation Of Skin Doses For Cone-beam Computed Tomography In Dentomaxillofacial Imaging

Participants
Carolin Reidelbach, MD, Freiburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Evaluation of skin organ doses in six different cone-beam computed tomography scanners (CBCT) dedicated to dentomaxillofacial imaging. Our hypothesis is that the dose varies between different devices, protocols and skin areas.*Methods and Materials An anthropomorphic adult head and neck phantom was used to which a dosimeter (Waterproof Farmer® Chamber, PTW, Freiburg, Germany) was attached to anatomic landmarks of both parotid glands, both ocular lenses, the thyroid gland and the neurocranium. CBCT examinations were performed on six different CBCT devices dedicated to dentomaxillofacial imaging with standard settings and if available also in high dose settings. Measurements were repeated five times each.*Results The measured mean organ skin doses ranged from 0.48 to 2.21 mGy. The comparison of the region based dose evaluation showed a high correlation between the single measurements. Furthermore, the distribution of dosesbetween regions was similar in all devices, except that four devices showed side differences for the dose of the parotid region and one device showed side differences for the lens region. The directly exposed regions, such as the parotid glands, showed significant higher values than the more distant regions like the neurocranium.When comparing examination protocols, a significant difference between the standard dose and the high dose acquisitions could be detected. But also a significant dose difference between the different CBCTs could be shown. 3D Accuitomo 170 (Morita, Osaka, Japan) showed the highest absorbed mean dose value for standard settings with 2.21 mGy, especially at the directly exposed regions and their adjacent organs. The lowest mean value for standard settings was achieved with VGi evo (NewTom, Verona, Italy) with 0.48 mGy.*Conclusions Repeated measurements of skin organ doses in six different CBCT scanners using a surface dosimeter showed side differences in distribution of dose in five devices for the parotid and lens region. Additionally, significant dose differences between the devices could be detected. Further studies should be performed to confirm these results.*Clinical Relevance/Application The possibility of asymmetric dose distribution should be considered in the assessment of and in future studies on radiation dose in dentomaxillofacial CBCT. Furthermore, significant dose differences between the individual devices must be expected.

RESULTS

The measured mean organ skin doses ranged from 0.48 to 2.21 mGy. The comparison of the region based dose evaluation showed a high correlation between the single measurements. Furthermore, the distribution of dosesbetween regions was similar in all devices, except that four devices showed side differences for the dose of the parotid region and one device showed side differences for the lens region. The directly exposed regions, such as the parotid glands, showed significant higher values than the more distant

regions like the neurocranium.When comparing examination protocols, a significant difference between the standard dose and the high dose acquisitions could be detected. But also a significant dose difference between the different CBCTs could be shown. 3D Accuitomo 170 (Morita, Osaka, Japan) showed the highest absorbed mean dose value for standard settings with 2.21 mGy, especially at the directly exposed regions and their adjacent organs. The lowest mean value for standard settings was achieved with VGi evo (NewTom, Verona, Italy) with 0.48 mGy.

CLINICAL RELEVANCE/APPLICATION

The possibility of asymmetric dose distribution should be considered in the assessment of and in future studies on radiation dose in dentomaxillofacial CBCT. Furthermore, significant dose differences between the individual devices must be expected.

SDP-PH-75   Does Detector Pixel Size Have An Effect On Perceived Clinical Image Quality?

Participants
Lesley Cockmartin, Leuven, Belgium (*Presenter*) Nothing to Disclose

PURPOSE

To assess the influence of detector pixel size and dose level on clinical image quality of orthopedic and chest radiography applications.*Methods and Materials Seven x-ray detectors from different vendors, with pixel sizes (ps) ranging from 76µm to 175µm, were assessed at 5 detector air kerma (DAK) levels, from 1.3µGy to 7.4µGy. Four anatomical regions were imaged: human cadaver hand, human cadaver foot, rabbit cadaver pelvis and living rabbit chest. Agfa Musica3 image processing (Agfa Musica3) was applied to the raw images. A visual grading study was set up using, as reference, the detector with an intermediate ps (124µm) at median DAK (2.7µGy to 3.8µGy, depending on application). Four radiologists read the images, scoring sharpness of specific anatomical features on a scale from -2 to +2, from worse to better than the reference. Noise was similarly scored, from -5 to +5. Ordinal logistic regression was applied to evaluate the effect of detector type (i.e. ps) and DAK on perceived sharpness and noise. Reader agreement was assessed using intra-class correlation coefficient (ICC).*Results ICC values ranged from 0.62 to 0.83. Logistic regression showed that dose significantly influenced perceived sharpness and noise (p<0.0001 for all 4 anatomies) with odds ratios (OR) from 4.5 to 27 indicating higher ratings for increasing dose. Pixel size did not significantly influence perceived sharpness, except for the following cases: (1) the detectors with ps of 76µm and 100µm were better (p=0.036,OR=28 and p=0.029,OR=31) than the reference for sharpness in the chest, (2) detectors with ps of 148µm and 175µm had lower sharpness ratings in the foot (p=0.04,OR=0.057, and p=0.001,OR=0.0035), (3) sharpness in the pelvic bones and the hand scored worse for the 175µm pixel detector (p=0.01,OR=0.027 and p=0.04,OR=0.032).*Conclusions A significant reduction in perceived sharpness was only found for the 175µm pixel detector compared to the reference 124µm pixel detector at the same dose, whereas using pixel sizes as small as 76µm did not significantly improve sharpness scores. Dose was the dominant factor in perceived clinical image quality.*Clinical Relevance/Application For routine, plain radiological applications, the benefit of small pixel size detectors may be limited; choice of dose level remains important.

RESULTS

ICC values ranged from 0.62 to 0.83. Logistic regression showed that dose significantly influenced perceived sharpness and noise (p<0.0001 for all 4 anatomies) with odds ratios (OR) from 4.5 to 27 indicating higher ratings for increasing dose. Pixel size did not significantly influence perceived sharpness, except for the following cases: (1) the detectors with ps of 76µm and 100µm were better (p=0.036,OR=28 and p=0.029,OR=31) than the reference for sharpness in the chest, (2) detectors with ps of 148µm and 175µm had lower sharpness ratings in the foot (p=0.04,OR=0.057, and p=0.001,OR=0.0035), (3) sharpness in the pelvic bones and the hand scored worse for the 175µm pixel detector (p=0.01,OR=0.027 and p=0.04,OR=0.032).

CLINICAL RELEVANCE/APPLICATION

For routine, plain radiological applications, the benefit of small pixel size detectors may be limited; choice of dose level remains important.

SDP-PH-76   Comparison Of Performance Of Material Suppression Iodine (msi) Images And Virtual Unenhanced (vue) Images In Liver Ct

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare between images of true non-contrast scan (TNC) and images produced by two different iodine removal techniques - virtual unenhanced (VUE) and material suppressed iodine (MSI) - in liver CT examination.*Methods and Materials A total of 18 patients with suspected upper abdominal disease underwent multiphase CT examination using a rapid kVp-switching spectral CT scanner (Revolution CT, GE Healthcare). Conventional non-contrast scan was followed by two-phase (hepatic arterial and portal venous phase) contrast-enhanced spectral scan using fast kV switching 80/140 kV, noise index (NI) of 8, rotation time of 0.5s, pitch 0.992, and 40% ASIR-V. TNC images were reconstructed from the conventional plain scan, and VUE and MSI images were reconstructed from the spectral data of contrast-enhanced hepatic arterial and portal venous phases. CT value and image noise of liver were measured on TNC, VUE and MSI images. The subjective image quality was independently assessed by two experienced radiologists using a five-point scale system (from 1=poor to 5=excellent). Differences between groups were analysed using two-way ANOVA.*Results There was no significant difference in CT values of five groups (P=0.310). The image noise of TNC, arterial phase VUE, venous phase VUE, arterial phase MSI, venous phase MSI images were 12.70±2.39, 12.27±1.36, 10.72±1.41, 11.44±1.79, and 8.11±1.73, respectively. There was no significant difference between the TNC and the arterial phase VUE (p=0.472), while the image noise of TNC was significantly higher than the venous phase VUE, the arterial phase MSI and the venous phase MSI (p =0.000). The subjective image scores of TNC, arterial phase VUE scans, venous phase VUE scans, arterial phase MSI scans, venous phase MSI scans were (5.00±0.00 4.83±0.38 3.83±0.38 4.33±0.59 3.17±0.51)respectively. The subjective image quality scores of arterial phase VUE and MSI images were better than those of venous phase VUE and MSI (P1=0.000, P2=0.000). Subjective scores of the arterial phase VUE were better than those of the arterial phase MSI (P=0.001)*Conclusions In liver CT examination,the arterial phase VUE was better than the arterial phase MSI, and was closer to conventional plain scan.*Clinical Relevance/Application In the liver energy spectrum CT examination, the VUE image quality is superior to the MSI image,and it has the potential to replace TNC.

RESULTS

There was no significant difference in CT values of five groups (P=0.310). The image noise of TNC, arterial phase VUE, venous phase VUE, arterial phase MSI, venous phase MSI images were 12.70±2.39, 12.27±1.36, 10.72±1.41, 11.44±1.79, and 8.11±1.73,

respectively. There was no significant difference between the TNC and the arterial phase VUE (p=0.472), while the image noise of TNC was significantly higher than the venous phase VUE, the arterial phase MSI and the venous phase MSI (p =0.000). The subjective image scores of TNC, arterial phase VUE scans, venous phase VUE scans, arterial phase MSI scans, venous phase MSI scans were (5.00±0.00 4.83±0.38 3.83±0.38 4.33±0.59 3.17±0.51)respectively. The subjective image quality scores of arterial phase VUE and MSI images were better than those of venous phase VUE and MSI (P1=0.000, P2=0.000). Subjective scores of the arterial phase VUE were better than those of the arterial phase MSI (P=0.001)

CLINICAL RELEVANCE/APPLICATION

In the liver energy spectrum CT examination, the VUE image quality is superior to the MSI image,and it has the potential to replace TNC.

SDP-PH-77   Reduction Of Beam Hardening Artefact With Anew Generation Spectralct: Comparison Of Spectral CT Mode And Conventional CT Modeobjective

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

The aim of study was to compare the reduction of beam hardening artefact (BHA) with conventional CT mode versus spectral CT imaging mode.*Methods and Materials A cylindrical phantom with nine tubes containing iodine with different concentration (0, 1.25, 2.5, 5, 10, 15, 20, 40, 40mgI/ml) was scanned using a MDCT (Revolution CT, GE Healthcare). The phantom was examined with both conventional CT imaging (tube voltage 120kVp, automA, Noise index 6.2,rotation time 0.5s, pitch 0.992) and spectral CT imaging (80/140 kV,automA, Noise index 6.2,rotation time 0.5s, pitch 0.992) mode. Images were reconstructed at a blend of monochromatic energy levels (40 to 140 keV with 10keV interval). A circular region of interest was placed on the region with highest amount of beam hardening. Noise was recorded within the region of interest (A-region between 20 mgI/ml tube and 40 mgI/ml tube, B-region between 40mgI/ml and 10mgI/ml, C-region within 40 mgI/ml tube). BHA was calculated through square root of the squared noise difference between the region of interest (Nr) and background (Nb). The differences between groups were assessed with T test.*Results The SD was 14.2±0.6, 10.5±0.7, 9.0±0.8 in conventional scanning mode and 8.3±0.4, 7.8±0.4, 7.7±0.4 in spectral CT mode. The AI is (12.8±0.6, 8.8 ± 0.9, 7.0 ± 1.0) in conventional scanning mode and (5.2 ± 0.3, 4.3 ± 0.8, 4.1 ± 1.2) in spectral CT modeThe SD and AI values of the GSI mode was lower than those of the conventional CT mode, and the differences were statistically significant (P<0.0.5 for all).*Conclusions The use of spectral CT can reduce the beam hardening artefacts created by high concentration iodine contrast.*Clinical Relevance/Application The use of spectral CT can reduce the beam hardening artefacts created by high concentration iodine contrast.

RESULTS

The SD was 14.2±0.6, 10.5±0.7, 9.0±0.8 in conventional scanning mode and 8.3±0.4, 7.8±0.4, 7.7±0.4 in spectral CT mode. The AI is (12.8±0.6, 8.8 ± 0.9, 7.0 ± 1.0) in conventional scanning mode and (5.2 ± 0.3, 4.3 ± 0.8, 4.1 ± 1.2) in spectral CT modeThe SD and AI values of the GSI mode was lower than those of the conventional CT mode, and the differences were statistically significant (P<0.0.5 for all).

CLINICAL RELEVANCE/APPLICATION

The use of spectral CT can reduce the beam hardening artefacts created by high concentration iodine contrast.

SDP-PH-78   Comparison of Volume High-resolution CT and Conventional High-resolution CT In Interstitial Lung Disease

Participants
Lili Yang, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether there is any difference in diagnosing interstitial lung disease (ILD) using volume high-resolution CT (VHRCT) compared with conventional high-resolution CT (CHRCT).*Methods and Materials A retrospective study was carried out in 31 patients who were diagnosed with ILD between December 2017 and March 2018. The CT scans were all performed using a 256-row detector CT (Revolution CT, GE Healthcare). All patients underwent VHRCT (120kVp, SmartmA, 80mm, Helical, 50% pre- Asir-V) and conventional high-resolution CT (CHRCT) scan. Two experienced radiologists independently assessed the subjective image quality. Both were blinded to scanning parameters of patients. Multiple radiographic patterns include interstitial interlobular septa thickening, intralobular interstitial thickening, ground glass opacity, honey combing and cyst, subpleural line, bronchiolectasis, micro nodules, bronchovascular bundles, respiratory artefact were assessed. CT values and image noise of the left ventricle, musculus erector spinae and thoracic spine were measured by a single observer.*Results CHRCT and VHRCT had no significant difference in recognising interstitial interlobular septa thickening, ground glass opacity, honey combing and cyst, subpleural line, bronchiolectasis, micro nodules and bronchovascular bundles (P=0.831, 0.209, 0.265, 0.133, 0.576, 0.148, 0.082). The subjective image quality of intralobular interstitial thickening was higher in VHRCT scan mode than CHRCT mode (4.56±0.51; 3.88±0.89, P=0.019). VHRCT imaging revealed higher subjective image quality of respiratory artefact (4.42±0.96; 3.68±0.87;P=0.000). CT value of the left ventricle, musculus erector spinae and thoracic spine were not significantly different between the two groups(P=0.668,0.327,0.479,P>0.05).Significant differences in noise of left ventricular (36.47±4.93; 31.46±7.83, P=0.000), musculus erector spinae (38.72±5.66; 32.07±6.40, P=0.000) and vertebral (65.51±21.57;49.53±13.45, P=0.001) between VHRCT and CHRCT.*Conclusions There was no significant differences in subjective image quality between VHRCT and CHRCT. VHRCT scans were considered to be significantly better than CHRCT scans for interstitial interlobular septa thickening and respiratory artefact*Clinical Relevance/Application VHRCT has a comparable diagnostic capability with CHRCT. It is potentially feasible to replace a separate CHRCT with VHRCT.

RESULTS

CHRCT and VHRCT had no significant difference in recognising interstitial interlobular septa thickening, ground glass opacity, honey combing and cyst, subpleural line, bronchiolectasis, micro nodules and bronchovascular bundles (P=0.831, 0.209, 0.265, 0.133, 0.576, 0.148, 0.082). The subjective image quality of intralobular interstitial thickening was higher in VHRCT scan mode than CHRCT mode (4.56±0.51; 3.88±0.89, P=0.019). VHRCT imaging revealed higher subjective image quality of respiratory artefact (4.42±0.96; 3.68±0.87;P=0.000). CT value of the left ventricle, musculus erector spinae and thoracic spine were not significantly different between the two groups(P=0.668,0.327,0.479,P>0.05).Significant differences in noise of left ventricular (36.47±4.93; 31.46±7.83, P=0.000), musculus erector spinae (38.72±5.66; 32.07±6.40, P=0.000) and vertebral (65.51±21.57;49.53±13.45, P=0.001) between

VHRCT and CHRCT.

CLINICAL RELEVANCE/APPLICATION

VHRCT has a comparable diagnostic capability with CHRCT. It is potentially feasible to replace a separate CHRCT with VHRCT.

SDP-PH-79   Evaluation Of Various Non-Gaussian Diffusion Models For The Classification Of Peripheral Nerve Sheath Tumors In Patients With Neurofibromatosis Type 1

Participants
Michael G. Kaul, Hamburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Diffusion weighted imaging (DWI) can classify peripheral nerve sheath tumors (PNST) in patients with neurofibromatosis type 1 (NF1). The analysis of perfusion/diffusion effects maybe als of interest for therapy monitoring. The intravoxel incoherent motion (IVIM) model is known to model perfusion but also for its less numerical robustness. Therefore we evaluated six non-Gaussian models regarding the numerical stability and their feasibility of distinguishing between benign and malignant PNST using small and middle ranged b-values that are commonly scanned for an IVIM-analysis.*Methods and Materials In a retrospective study 29 examinations of 26 patients were examined in a 3T MRI scanner. DWI-data was fitted to a monoexponential apparent-diffusion-coefficient (ADC) model using b-values of 0,300,400,600,800s/mm². Aditional b-values 10,20,30,50,70,100 were included to be sensitiv for perfusion when fitting six non-Gaussian models (IVIM, kurtosis, stretched-exponential, and the statistical models based on truncated Gaussian, gamma, and beta distributions). Tests for significance and receiver-operating-characteristic (ROC) analysis were performed. Numerical aspects of the fitting processes were evaluated.*Results All fitted models provided at least one parameter that showed significant difference between the two entities. Diffusion coefficients were generally significantly higher in benign than in malignant tumors. Malignant tumors showed a stronger deviation from a monoexponential behavior than in benign tumors as the stretch-exponent of the stretched-exponential model was smaller. The non-Gaussian model with the lowest values for AIC and BIC using all eleven b-values was the stretched exponential model. Except of the IVIM model R² values and the analyzable area of the other models were on a similar high level but the ADC model performed the best. The ADC model provided an area-under-the-curve (AUC) of 0.91 with sensitivity of 94% and specificity of 74%. The AUC values for the multi-variant regressions of the statistical models exceed the AUC of the ADC model, but their ROC curves differed not significantly.*Conclusions Non-Gaussian models did not perform significantly better in differentiation than the ADC model with a reduced number of b-values. The IVIM model performed worst. The other non-Gaussian models provide with the kurtosis and stretch exponent additional parameters, which are sensitive to the perfusion effects imaged by small b-values.*Clinical Relevance/Application As PET/CT comes with a radiation burden it is of interest to improve the diagnostic value of MRI. This is to importance especially in children and young adults where a PET examination is only given after a strong indication.

RESULTS

All fitted models provided at least one parameter that showed significant difference between the two entities. Diffusion coefficients were generally significantly higher in benign than in malignant tumors. Malignant tumors showed a stronger deviation from a monoexponential behavior than in benign tumors as the stretch-exponent of the stretched-exponential model was smaller. The non-Gaussian model with the lowest values for AIC and BIC using all eleven b-values was the stretched exponential model. Except of the IVIM model R² values and the analyzable area of the other models were on a similar high level but the ADC model performed the best. The ADC model provided an area-under-the-curve (AUC) of 0.91 with sensitivity of 94% and specificity of 74%. The AUC values for the multi-variant regressions of the statistical models exceed the AUC of the ADC model, but their ROC curves differed not significantly.

CLINICAL RELEVANCE/APPLICATION

As PET/CT comes with a radiation burden it is of interest to improve the diagnostic value of MRI. This is to importance especially in children and young adults where a PET examination is only given after a strong indication.

SDP-PH-8   Robustness Of CT Radiomics Features: Did SECT And DECT Match To Each Other?

Participants
Jingyu Zhong, MD, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To identify the robust radiomics features (RFs) for single-energy (SE) CT and dual-energy (DE) CT.*Methods and Materials A standardized phantom with sixteen rods of different density was used to test the RF robustness by using test-retest analysis, by using intra-scanner analysis of different scan modes, and by comparing ten different scanners. The acquisition parameters were selected to present classical abdomen-pelvic examination with fixed field of view, reconstruction matrix, slice thickness. Images of SE scan at 120 kV, DE scan at mixed energy 120 kV and virtual monoenergetic imaging (VMI) at 70 keV were used for analysis. Sixteen ROIs for according rods were drawn with a rigid registration was made to avoid variations in segmentation. RFs were extracted via Pyradiomics platform. RFs repeatability was assessed by Bland-Altman analysis. Robust RFs were selected by using the intraclass correlation coefficient (ICC), concordance correlation coefficient (CCC), both with a cutoff of 0.90, and coefficient of variation (CV) with a cutoff of 10%.*Results A total of 94 RFs including 19 first order RFs and 75 texture RFs were assessed. The test-retest analysis presented that 91.5% of the RFs are repeatable. The intra-scanner analysis within sixteen rods demonstrated that only 15.9%, 11.8%, and 9.6% of the RFs were with ICC > 0.90, while 14.8%, 10.8%, and 9.6% were with CCC > 0.90 for SE 120 kV vs. DE mixed 120 kV, DE mixed 120 kV vs DE VMI 70 keV, and SE 120 kV vs. DE VMI 70 keV comparison, respectively. The inter-scanner analysis showed that percentage of RFs with CV < 10% extracted from each of sixteen rods were from 5.3% to 23.4%, from 10.6% to 31.9%, and from 8.5% to 26.6%, on SE 120 kV, DE mixed 120 kV, and DE VMI 70 keV, respectively.*Conclusions The majority of RFs from the same CT scanner with different scan modes were not reproducible. The RFs extracted from SE 120 kV, DE mixed 120 kV, and DE VMI 70 keV did not matched to each other, even multiple acquisition parameters were fixed. RFs involving multiple CT scanners with the same scan mode were of low reproducibility, and indicated large material differences.*Clinical Relevance/Application Radiomics results from multiple CT scanners with various scan modes must be interpreted with caution because of potential for nonreproducible data.

RESULTS

A total of 94 RFs including 19 first order RFs and 75 texture RFs were assessed. The test-retest analysis presented that 91.5% of the RFs are repeatable. The intra-scanner analysis within sixteen rods demonstrated that only 15.9%, 11.8%, and 9.6% of the RFs were with ICC > 0.90, while 14.8%, 10.8%, and 9.6% were with CCC > 0.90 for SE 120 kV vs. DE mixed 120 kV, DE mixed 120 kV vs

DE VMI 70 keV, and SE 120 kV vs. DE VMI 70 keV comparison, respectively. The inter-scanner analysis showed that percentage of RFs with CV < 10% extracted from each of sixteen rods were from 5.3% to 23.4%, from 10.6% to 31.9%, and from 8.5% to 26.6%, on SE 120 kV, DE mixed 120 kV, and DE VMI 70 keV, respectively.

CLINICAL RELEVANCE/APPLICATION

Radiomics results from multiple CT scanners with various scan modes must be interpreted with caution because of potential for nonreproducible data.

SDP-PH-80 Non-contrast Lung Functional Imaging: T2*, Ventilation, And Perfusion

Participants
Mitsue Miyazaki, PhD, La Jolla, California (*Presenter*) Research Grant, Canon Medical Systems Corporation

PURPOSE

Ultra-short TE (UTE) imaging with TE of less than 0.1 ms allows visualization of lungs despite low proton density and short T2* [1]. To demonstrate the ability to measure lung volumes at both inspiration and expiration, estimate T2* maps in lungs, and visualize pulmonary vessels using free breathing 3D UTE.*Methods and Materials The study was carried out on a clinical 3T (Vantage Galan, version 6, Canon Medical, Japan) scanner on 4 healthy volunteers (46 ± 23 years) after obtaining IRB approved written informed consent. Images were acquired using a body SPEEDER coil. The scanning protocol included the following series: i) 3D UTE without fat suppression (TE/TR = 96 μ s/3.7 ms, NEX = 1, FA = 5°, in the coronal orientation FOV = 40× 40 cm, matrix size 256× 256); ii) 3D UTE same as in i) but with fat suppression: five SPectral Adiabatic Inversion Recovery (SPAIR) pulses per 64 segments were applied, resulting in approximately one SPAIR per 50 UTE lines. Both series used respiratory bellows and were scanned during the inspiratory period. Non-fat suppressed data were also acquired during expiration. For each series, 64 segments with approximately 250 lines per respiratory cycle were collected resulting in over 16000 lines and about 8% of k-space filled; and iii) multi-echo UTE (four TEs = 96 μ microseconds / 2.3/4.5/6.7 ms, TR = 12.5ms, NEX = 1, FA = 4°, in the coronal orientation FOV = 50× 50 cm, matrix size 256× 256) with the respiratory bellows set for the expiratory phase of the cycle.*Results The fat signal around the heart is suppressed demonstrating better visualization of myocardium and blood. In addition, proximal pulmonary vessels are unambiguously defined with fat suppression. Average lung volumes measured from the segmentation of the UTEs images obtained at inspiration and expiration phase were 3.25 ± 0.13 / 2.68 ± 0.08 liters respectively. The average T2* for lung was 0.90 ± 0.08 ms; an example of the colormap superimposed over first echo (TE = 0.1 ms) image is shown in Figure 1. Calculated mean specific ventilation was 0.11 ± 0.02.*Conclusions Under free breathing, lung studies of T2*, expiratory/inspiratory volume, specific ventilation and the pulmonary vasculature, are reported. These may provide useful information in patients with lung diseases.References [1] Bergin CJ, et al. Radiology. 1991; 179: 777-81. [2] Pell GS, et al. JMRI. 2006; 23: 248-252. [3] Dante PI, et al. Radiology. 2018; 287: 693-704. [4] Mueller J, et al. Eur Radiol ; 2019; 29: 1595-1606. [5] Ohno Y, et al. AJR 2011; 197: W279-85. [6] Glazier JB, et al. J. of Applied Physiol. 1967; 23: 694-705. [7] Theilmann, RJ, et al. JMRI 2009; 30: 527-534. *Clinical Relevance/Application Lung health study including lung ventilation, T2*, and perfusion can be possible under non-radiation, non-contrast, and free-breathing MRI.

RESULTS

The fat signal around the heart is suppressed demonstrating better visualization of myocardium and blood. In addition, proximal pulmonary vessels are unambiguously defined with fat suppression. Average lung volumes measured from the segmentation of the UTEs images obtained at inspiration and expiration phase were 3.25 ± 0.13 / 2.68 ± 0.08 liters respectively. The average T2* for lung was 0.90 ± 0.08 ms; an example of the colormap superimposed over first echo (TE = 0.1 ms) image is shown in Figure 1. Calculated mean specific ventilation was 0.11 ± 0.02.

CLINICAL RELEVANCE/APPLICATION

Lung health study including lung ventilation, T2*, and perfusion can be possible under non-radiation, non-contrast, and free-breathing MRI.

SDP-PH-81 Identification Of The Optimal Adaptive Statistical Iterative Algorithm Reconstruction-v Blending Level For Low Dose Chest Ct

Participants
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To assess the image quality of chest CT on with different blending levels of adaptive statistical iterative reconstruction V (ASiR-V) algorithm, and investigate the optimal blending level of ASiR-V algorithm for low dose chest CT.*Methods and Materials Thirty patients suspected thoracic disease were enrolled. All patients underwent chest CT on a 256 row wide-coverage volumetric CT (Revolution CT, GE healthcare, Milwaukee, WI). The Tube voltage was 80 kV, the automatic tube current modulation technique was used with noise index of 22. For each patient, 11 image sets were reconstructed by using lung algorithm and standard algorithm with ASiR-V blending level from 0 to 100% with 10% increasement. Two radiologists independently evaluated the image quality subjective score with 5-point scale for the image noise, artifacts and the capacity of the tiny structures of bronchovascular bundles. The image noise of aorta, lung tissue and muscle was measured. Measurement data among different groups was compared with two-way ANOVA.*Results With ASiR-V blending level increase, the image noise of aorta, lung tissue and muscle decreased gradually (p<0.05). At 70% and 80% blending levels of ASiR-V, the image scores of lung algorithm were found the highest(4.88±0.31 and 4.72±0.52), and images scores of these two image sets were found no statistical difference(P=0.102). At 60% and 70% blending levels of ASiR-V, the image scores of standard algorithm were found the highest(4.55±0.46 and 4.72±0.43), and images scores of these two image sets had no statistical difference(P=0.100). At 40%, 50%, 60%, 70%,80% and 90% levels of ASiR-V groups, the image score of lung algorithm was above 3.5 points. At 40%, 50%, 60%, 70% and 80%, the image score of standard algorithm was above than 3.5 points.*Conclusions ASiR-V algorithm could reduce image noise of low dose chest CT. At 70% and 80% blending levels of ASiR-V, image quality were found best for lung algorithm,and at 60% and 70% blending levels of ASiR-V, image quality were best for standard algorithm. High blending level of ASiR-V may cause "fuzzy" effects in the images.*Clinical Relevance/Application ASiR-V algorithm could reduce image noise of low dose chest CT. At 70% and 80% blending levels of ASiR-V, image quality were found best for lung algorithm,and at 60% and 70% blending levels of ASiR-V, image quality were best for standard algorithm.

RESULTS

With ASiR-V blending level increase, the image noise of aorta, lung tissue and muscle decreased gradually (p<0.05). At 70% and

80% blending levels of ASiR-V, the image scores of lung algorithm were found the highest(4.88±0.31 and 4.72±0.52), and images scores of these two image sets were found no statistical difference(P=0.102). At 60% and 70% blending levels of ASiR-V, the image scores of standard algorithm were found the highest(4.55±0.46 and 4.72±0.43), and images scores of these two image sets had no statistical difference(P=0.100). At 40%, 50%, 60%, 70%,80% and 90% levels of ASiR-V groups, the image score of lung algorithm was above 3.5 points. At 40%, 50%, 60%, 70% and 80%, the image score of standard algorithm was above than 3.5 points.

CLINICAL RELEVANCE/APPLICATION

ASiR-V algorithm could reduce image noise of low dose chest CT. At 70% and 80% blending levels of ASiR-V, image quality were found best for lung algorithm,and at 60% and 70% blending levels of ASiR-V, image quality were best for standard algorithm.

SDP-PH-82 Pneumothorax Detection In CT Localizer Scans Using Faster R-CNN

Participants
Michael Grass, PhD, Hamburg, Germany (*Presenter*) Employee, Koninklijke Philips NV

PURPOSE

The localizer scans acquired as part of computed tomography (CT) exams are essential for planning purposes. In addition, they also offer promising options for the early detection of pathologies, especially for critical findings such as pneumothorax. Even though Deep Learning techniques have been successfully applied for a broad range of medical imaging applications, the analysis of localizer images has received limited attention. Depending on the clinical indication, localizer scan planning exhibits a considerable variability with regard to the z-coverage. Therefore, we investigate the feasibility of a joined anatomy localization, and pathology classification, using a Faster R-CNN architecture.*Methods and Materials For a case study, 576 patients with and 554 without pneumothorax were identified from radiology reports using Natural Language Processing (NLP), covering 1300 anterior-posterior (AP) and 1200 lateral (LAT) scans. Next to the report-based findings, the lung region was annotated in every localizer image. For the localization of the lung and the detection of a potential pneumothorax, a Faster R-CNN architecture was employed. Compared to a conventional CNN, this network architecture comprises multiple sub-networks, including a Region Proposal Network (RPN). The RPN predicts the object regions, which are subject to classification. For this application, the Faster R-CNN was trained to localize four classes (lung region with and without pneumothorax in PA and LAT images). For the evaluation, the Faster-RCNN was fine-tuned in a patient stratified 5-fold cross-validation scheme. The network was trained with Stochastic Gradient Decent, an initial learning rate of 0.0001 and a decay of 5% after each epoch. Furthermore, data augmentation was employed including translations, rotations, and additive noise.*Results For the identification of the lung area, average Dice values of 0.94 (AP) and 0.91 (LAT) were obtained, indicating a precise localization in both image types (see Fig. 1). Since every imaging study was associated with one or more images (including multiple PA and LAT scans), an average prediction score was computed based on all images, resulting in an average AUC of 0.85.*Conclusions In this study, we investigated the feasibility of a joined anatomy localization and pathology classification using a Faster R-CNN architecture. This architecture can handle varying fields of view, which is an important step towards the practical deployment of such technologies.*Clinical Relevance/Application The study shows promising options for the detection of pathologies using CT localizer images. Potential applications include the early diagnosis of critical and incidental findings for worklist prioritization and protocol optimization.

RESULTS

For the identification of the lung area, average Dice values of 0.94 (AP) and 0.91 (LAT) were obtained, indicating a precise localization in both image types (see Fig. 1). Since every imaging study was associated with one or more images (including multiple PA and LAT scans), an average prediction score was computed based on all images, resulting in an average AUC of 0.85.

CLINICAL RELEVANCE/APPLICATION

The study shows promising options for the detection of pathologies using CT localizer images. Potential applications include the early diagnosis of critical and incidental findings for worklist prioritization and protocol optimization.

SDP-PH-83 Accuracy Of Iodine Quantification And Image Quality With Dual-energy CT Using Deep Learning-based Image Reconstruction In Abdomen: Preliminary In Vitro And Vivo Study

Participants
Tomoki Maebayashi, Kobe, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Dual-energy CT (DECT) has potential benefit of quantitative capability of iodinated contrast agent. However, increased image noise potentially affects accurate measurement of the iodine quantification in the tissue on iodine density images. Deep learning-based image reconstruction algorithm has been recently implemented into fast-kilovoltage (kV) switching DECT to improve image quality. The purpose of this study was to determine the accuracy of iodine quantification and image quality with DECT across three different image reconstruction algorithms in a phantom experiment and abdominal clinical study.*Methods and Materials In a phantom experiment, an elliptical torso phantom containing iodine (1, 3, 5, 8, and 12 mgI/mL) was imaged with fast-kV switching DECT (Revolution CT, GE Healthcare) five times for CTDIvol levels of 9, 15, and 24 mGy. All images were reconstructed with 1.25 mm section thickness using conventional (FBP), iterative (ASiR-V 30% and 50%), and deep learning-based (True Fidelity, medium) reconstruction algorithms on iodine density images. The measured and nominal iodine concentrations were compared with the percentage of error and root mean square deviation (RMSD) among the four reconstruction algorithms for each CTDIvol level. In a clinical study, abdominal contrast-enhanced CT was acquired in 30 patients (mean age, 70.3 years; mean body mass index 22.2 kg/m2) in the same CT scanner. All images were reconstructed with 1.25 mm section thickness using ASiR-V 30%, ASiR-V 50% and True Fidelity medium. On arterial and portal venous phase images, iodine density and image noise of the artery, portal vein, liver, and pancreas were measured and compared among the three reconstruction algorithms by using one-way repeated measures ANOVA test.*Results In the phantom experiment, the measured values of the percentages of error ranged from -6.11% to 7.57%, and the RMSDs were equivalent among the four reconstruction algorithms for each level of CTDIvol. The error and RMSDs were relatively larger for CTDIvol of 9 mGy. In the clinical study, no significant differences were observed among the three reconstruction algorithms regarding iodine density in each tissue (P=.999 for all). Image noise with True Fidelity was lower than that with ASiR-V 30% (P<.001) and ASiR-V 50% (P<.1).*Conclusions Accurate iodine quantification can be achieved across different image reconstruction algorithms in fast-kV switching DECT. Deep learning-based reconstruction has potential advantages of quantitative abdominal DECT with high image quality.*Clinical Relevance/Application Fast-kV switching dual-energy CT with deep learning-based image reconstruction algorithm can offer accurate iodine quantification with controlled image noise.

RESULTS

In the phantom experiment, the measured values of the percentages of error ranged from -6.11% to 7.57%, and the RMSDs were equivalent among the four reconstruction algorithms for each level of CTDIvol. The error and RMSDs were relatively larger for CTDIvol of 9 mGy. In the clinical study, no significant differences were observed among the three reconstruction algorithms regarding iodine density in each tissue (P=.999 for all). Image noise with True Fidelity was lower than that with ASiR-V 30% (P<.001) and ASiR-V 50% (P<.1).

CLINICAL RELEVANCE/APPLICATION

Fast-kV switching dual-energy CT with deep learning-based image reconstruction algorithm can offer accurate iodine quantification with controlled image noise.

SDP-PH-84 Practical Tools For An Objective Image Quality Characterisation Of An Angiographic Equipment. Detection Of Moving Details And Contrast Media Perfusion Of Blood Vessels With Generalised Spatio-temporal Model Observers

Participants
Raffaele Villa, Monza, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To propose an objective image quality characterisation of an angiographic equipment, applying generalised spatio-temporal model observer with details in motion and simulated blood vessels perfusion of contrast media.*Methods and Materials Cerebral and cardiac protocols, characterized by different fps, dose levels and filtration, have been investigated. Contrast media flow has been simulated with the moving component of the CIRS Dynamic Thorax Phantom. Image quality of pulsed fluoroscopy has been characterised with circular details of different diameters (from 2 to 6 mm to simulate typical small vessels sizes) and moved, with a speed ranging from 2.5 to 10 mm/s, in order to simulate blood flow. Furthermore, Digital Subtraction Angiography (DSA) image quality has been characterised using cylindrical glue cylinders, with diameters of 3 and 5 mm, moved with speeds ranging from 5 to 10mm/s to simulate contrast media perfusion. Non-Prewhitening Eye filter (NPWE) with eye spatio-temporal contrast sensitivity function and Channelized Hotelling Observer (CHO) with spatio-temporal Gabor filters have been used to evaluate detection performances.*Results Effects of acquisition parameters, dose level and frame rate on pulsed fluoroscopy show consistent results especially with NPWE. CHO show less consistent results, especially comparing images with framerate and temporal resolution, suggesting the need for a deeper investigation. Simulation of Contrast media perfusion with DSA protocols shows analogous results, especially comparing the standard protocol and the low dose one.*Conclusions Results underline the potential of simulating the perceived clinical image quality with mathematical observers.*Clinical Relevance/Application Image Quality characterisation is still an open topic, especially with DSA that lack a consolidated objective approach, able to simulate contrast media perfusion that taken into account temporal resolution properties and lag.

RESULTS

Effects of acquisition parameters, dose level and frame rate on pulsed fluoroscopy show consistent results especially with NPWE. CHO show less consistent results, especially comparing images with framerate and temporal resolution, suggesting the need for a deeper investigation. Simulation of Contrast media perfusion with DSA protocols shows analogous results, especially comparing the standard protocol and the low dose one.

CLINICAL RELEVANCE/APPLICATION

Image Quality characterisation is still an open topic, especially with DSA that lack a consolidated objective approach, able to simulate contrast media perfusion that taken into account temporal resolution properties and lag.

SDP-PH-85 The Accuracy Of Vbmd Using One-stop-shop Low-dose CT Lung Screening Combined With Upper Lumbar Spine Qct Using Deep Learning Iterative Reconstruction Compared With Adaptive Statistical Iterative Reconstruction (asir-v): A European Spine Phantom Study

Participants
Ya Li I, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this phantom study is to assess the accuracy of vBMD using the above scanning protocol using DLIR compared with ASiR-V.*Methods and Materials The image acquisitions were performed on Revolution CT (GE Healthcare, Waukesha, WI) using ESP (No. 145, Germany ORM company) reconstructed with three levels of TrueFidelityTM DLIR (low, medium and high) at 0.25mGy and 0.75mGy. ESP contains three nominal trabecular BMD values of L1(50mg/cm3), L2(100mg/cm3), and L3 (200mg/cm3) of calcium hydroxypatite (HA) concentrations, respectively. The quality assurance (QA) phantom (Mindways software Inc., Austin, TX, USA) was scanned for bone densitometry calibration in this study, and the ESP was placed on top of the QA phantom. The phantoms were scanned ten times successively without repositioning. The images were transferred to the dedicated QCT PRO BMD workstation (Mindways QCT PRO workstation) and analyzed by the Mindways QCT PRO software (Mindways software Inc., Austin, TX, USA) to analyze the lumbar spine vBMD of the cancellous bone in three vertebral inserts. We firstly identified the L1, L2 and L3 vertebral inserts, manually placed three circular ROIs on sagittal images. A difference with P <0.05 was considered to be statistically significant.*Results In total, the average BMD values of L1, L2, L3 were 44.36 ±0.26, 97.48 ±0.13, 195.21± 0.17 mg/cm3, respectively, the average BMD values of three lumbar spine vertebral bodies was 111.67 ±0.15 mg/cm3. At two dose levels of 0.25mGy and 0.75mGy, for ASiR-V50% algorithm, the vBMD values of L1, L2, L3 were 43.72±0.97, 97.09±0.53, 193.80±0.46 mg/cm3, respectively; 44.12±0.83, 98.39±0.51, 195.30±0.40 mg/cm3, respectively. For DLIR-L, the vBMD values of L1, L2, L3 were 43.94±1.04, 97.42±0.44, 194.44±0.71 mg/cm3, respectively; 44.15±0.84, 96.26±0.43, 194.87±0.21 mg/cm3, respectively. For DLIR-M, the vBMD values of L1, L2, L3 were 45.12±0.45, 97.15±0.73, 195.71±0.75mg/cm3, respectively; 45.43±0.42, 96.86±0.71, 194.14±0.36mg/cm3, respectively. For DLIR-H, the vBMD values of L1, L2, L3 were 44.71±0.58, 98.92±0.55, 196.42±0.43mg/cm3, respectively; 44.41±0.45, 97.34±0.73, 197.03±0.43mg/cm3, respectively. There were no significant differences between three levels of DLIR and ASiR-V50% at two radiation dose levels (P>0.05).*Conclusions The vBMD values of L1, L2, and L3 were stable at different iterative reconstruction algorithms and radiation dose levels at 120kV tube voltage, which has high feasibility of assessing the vBMD values.*Clinical Relevance/Application The accurate measurement of osteoporosis for elderly.

RESULTS

In total, the average BMD values of L1, L2, L3 were 44.36 ±0.26, 97.48 ±0.13, 195.21± 0.17 mg/cm3, respectively, the average BMD values of three lumbar spine vertebral bodies was 111.67 ±0.15 mg/cm3. At two dose levels of 0.25mGy and 0.75mGy, for ASiR-V50% algorithm, the vBMD values of L1, L2, L3 were 43.72±0.97, 97.09±0.53, 193.80±0.46 mg/cm3, respectively; 44.12±0.83, 98.39±0.51, 195.30±0.40 mg/cm3, respectively. For DLIR-L, the vBMD values of L1, L2, L3 were 43.94±1.04, 97.42±0.44, 194.44±0.71 mg/cm3, respectively; 44.15±0.84, 96.26±0.43, 194.87±0.21 mg/cm3, respectively. For DLIR-M, the vBMD values of L1, L2, L3 were 45.12±0.45, 97.15±0.73, 195.71±0.75mg/cm3, respectively; 45.43±0.42, 96.86±0.71, 194.14±0.36mg/cm3, respectively. For DLIR-H, the vBMD values of L1, L2, L3 were 44.71±0.58, 98.92±0.55, 196.42±0.43mg/cm3, respectively; 44.41±0.45, 97.34±0.73, 197.03±0.43mg/cm3, respectively. There were no significant differences between three levels of DLIR and ASiR-V50% at two radiation dose levels (P>0.05).

CLINICAL RELEVANCE/APPLICATION

The accurate measurement of osteoporosis for elderly.

SDP-PH-86   Understanding The Role Of Imaging Factors In The Variability Of CT-based Texture Analysis (ctta) Metrics

Participants
Bino A. Varghese, PhD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the variability in CT-based texture analysis (CTTA) metrics across different 1) dose levels 2) reconstruction algorithms and 3) slice thickness*Methods and Materials A commercial anthropomorphic liver phantom CCT288 comprising of a simplified torso section with 7 cylindrical rods; four of the rods simulating liver tissue CT density within a liver morphology was imaged under a variety of routine clinical imaging protocols on a 16 cm detector GE Revolution CT scanner. We examined 3 sets of variations 1) three different slice-thicknesses: 0.625mm, 1.25mm and 2.5mm; 2) three different dose levels: standard dose of 13, 86 mGy (CTDIvol), 40 % reduction and 60 % reduction; and 3) two different reconstruction algorithms: a deep learning image reconstruction (DLIR-high) algorithm and a hybrid iterative reconstruction (IR) algorithm ASiR-V50% (AV50) were explored, with one scan for each variation. The texture panel comprised of 70 features belonging to 2 subgroups of texture extraction methods, namely histogram and intensity analysis. Generalized linear model was used to assess the linear and nonlinear change in radiomic features by each set of variation. Beta coefficients of each of the radiomic metrics were extracted from the images of all the 7 tissue rods.*Results First-order CTTA metrics including but not limited to coefficient of variation (CV), inter-quartile range (IQR) and standard deviation (SD) were observed to have a high positive beta coefficient indicative of an increase with reduction in dose and slice thickness. This is in line with current literature about CTTA being more reliable with low image noise and softer reconstruction. Lower values of CV, IQR and SD were observed in DLIR-high reconstructions compared to AV50. The lower CV is likely due to the lower image noise associated with DLIR-high compared to AV50. Understanding the association of radiomic metrics with imaging variables may help improve imaging quality by compensating one variable for another e.g., increasing dose for reducing slice thickness etc., with known physics relationships.*Conclusions Radiomics studies isolating the effects of structure vs. imaging vs. image processing are key in understanding CTTA variability.*Clinical Relevance/Application Establishing reliable associations between the CTTA metrics and imaging variables across different acquisition protocols may provide the quality assurance required for clinical radiomics.

RESULTS

First-order CTTA metrics including but not limited to coefficient of variation (CV), inter-quartile range (IQR) and standard deviation (SD) were observed to have a high positive beta coefficient indicative of an increase with reduction in dose and slice thickness. This is in line with current literature about CTTA being more reliable with low image noise and softer reconstruction. Lower values of CV, IQR and SD were observed in DLIR-high reconstructions compared to AV50. The lower CV is likely due to the lower image noise associated with DLIR-high compared to AV50. Understanding the association of radiomic metrics with imaging variables may help improve imaging quality by compensating one variable for another e.g., increasing dose for reducing slice thickness etc., with known physics relationships.

CLINICAL RELEVANCE/APPLICATION

Establishing reliable associations between the CTTA metrics and imaging variables across different acquisition protocols may provide the quality assurance required for clinical radiomics.

SDP-PH-87   Dosimetry Of Vascular And Interventional Radiology Procedures 5 Years Analysis In A Tertiary Care Institution

Participants
Ali Rajeh, MBBS, Riyadh, Saudi Arabia (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the dosimetry of vascular and interventional radiology procedures at a single tertiary care institution and compare it to the previously reported international diagnostic reference levels (DRLs).*Methods and Materials Retrospective review of the radiation doses of the vascular and interventional procedures done between Jan 2015- Dec 2019 at a tertiary care institution. A total of 18068 fluoroscopy guided procedures were screened. Radiation records were retrieved form the dose management software (DoseWatchTM) for all adult patients. Pediatric and neuro interventions procedures were excluded from the current analysis. The collected data included the age (>14 years), sex, height and weight, reference dose (RD) point air kerma (mGy), Dose area product (DAP) (Gy.cm2), and &8;uoroscopy time (sec.) of the following procedures: vascular access, dialysis interventions, axial embolization, interventional oncology, portal hypertension and transplant vascular interventions, peripheral arterial interventions, non-vascular procedures such as gastrostomy, nephrostomy and biliary procedures. Body mass index (BMI) and peak skin dose were calculated. The study cohort included 8942 adult patients (M:F=54.4%:45.6%) with mean age of 56.96 years (SD=20.14) and mean BMI of 26.86 (SD=7.97).Two independent sample t-test was used to compare this study's mean values with the previously reported values in the RAD-IR and CIRD studies.*Results TIPSS creation recorded the highest mean &8;uoroscopy time of 69.41 minutes (SD=37.82 minutes) followed by central venous recanalization with mean of 39.67 minutes (SD=40.83) and uterine fibroid embolization 32.27 minutes (SD=15.06minutes). TIPSS creation had the highest mean DAP 1161.16 Gy.cm2 (SD= 840.93) followed by trans arterial chemo embolization 500.63 Gy.cm2 (SD=346.02) and post liver transplant vascular interventions 479.42 Gy.cm2 (SD=394.10). TIPSS creation was associated with the highest PSD of 2766.81 mGy (SD=2024.54), followed by Trans arterial chemo embolization 1588.29 mGy (SD=928.98) and post liver transplant vascular interventions 1480.66 mGy (SD=1204.36). Compared to

the CIRD and RAD-IR studies, TIPS creation and TACE are associated with significantly higher DAP.*Conclusions This analysis establishes the dosimetry of the most commonly performed vascular and interventional procedures in a tertiary care center. The majority of these procedures demonstrate no significant institutional variation in dosimetry when compared to other studies.*Clinical Relevance/Application Optimization of radiation precautions is paramount to maintain exposure as low as reasonably achievable.

RESULTS

TIPSS creation recorded the highest mean &8;uoroscopy time of 69.41 minutes (SD=37.82 minutes) followed by central venous recanalization with mean of 39.67 minutes (SD=40.83) and uterine fibroid embolization 32.27 minutes (SD=15.06minutes). TIPSS creation had the highest mean DAP 1161.16 Gy.cm2 (SD= 840.93) followed by trans arterial chemo embolization 500.63 Gy.cm2 (SD=346.02) and post liver transplant vascular interventions 479.42 Gy.cm2 (SD=394.10). TIPSS creation was associated with the highest PSD of 2766.81 mGy (SD=2024.54), followed by Trans arterial chemo embolization 1588.29 mGy (SD=928.98) and post liver transplant vascular interventions 1480.66 mGy (SD=1204.36). Compared to the CIRD and RAD-IR studies, TIPS creation and TACE are associated with significantly higher DAP.

CLINICAL RELEVANCE/APPLICATION

Optimization of radiation precautions is paramount to maintain exposure as low as reasonably achievable.

SDP-PH-88 Validation Of A New Monte Carlo Radiation Transport Code Through Utilization Of The AAPM TG195 Report

Participants
Hannah Kitten, San Antonio, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Monte Carlo radiation transport (MCRT) algorithms can be applied to a broad range of applications. A new MCRT simulation code, PHENX, was developed for streamlined research in diagnostic imaging. The purpose of this paper is to present the validation of the physics model and geometry engine implemented in PHENX.*Methods and Materials PHENX was validated by comparing simulation results to those from previously validated and generally accepted MCRT software packages by utilizing the results from AAPM TG195. Cases 1, 2, and 4 allowed validation of PHENX's various capabilities. The use of monoenergetic beams and polyenergetic spectra were tested in both pencil beam and projection field configurations. Both stationary and rotating sources were simulated. Dose was scored explicitly using both a detector plane geometry and within simple phantoms. Scatter and primary components were also scored independently to one another. The scatter component was further broken down into both collective and 1st order incoherent and coherent scatter. PHENX results were compared to individual program results (Geant4, MCNP, EGSnrc, and Penelope), as well as their collective mean.*Results Each test had varying levels of agreement with both the other MCRT code packages and the overall mean. 89% of PHENX data points were within 1% of the mean values from TG195, and all were within 2%. The levels of variation seen by PHENX from the mean were comparable to the variation seen with the individual program results. For each test, PHENX was run with enough particle histories to reach a statistical uncertainty of less than 1%.*Conclusions Results from the 3 comparison cases in TG195 provide validation that the physics model utilized in PHENX is appropriate for clinical and research applications with a high level of confidence. Variation between PHENX and the other MCRT programs is likely due to differences between utilized cross section libraries. The AAPM TG195 report proved to be an excellent investigative tool in testing an entirely new MCRT software package by providing a variety of geometries and results from existing well tested and documented software to serve as benchmarks.*Clinical Relevance/Application Validation of PHENX, a Monte Carlo radiation transport code created for research in diagnostic imaging applications, will allow for its reliable use in clinically relevant research.

RESULTS

Each test had varying levels of agreement with both the other MCRT code packages and the overall mean. 89% of PHENX data points were within 1% of the mean values from TG195, and all were within 2%. The levels of variation seen by PHENX from the mean were comparable to the variation seen with the individual program results. For each test, PHENX was run with enough particle histories to reach a statistical uncertainty of less than 1%.

CLINICAL RELEVANCE/APPLICATION

Validation of PHENX, a Monte Carlo radiation transport code created for research in diagnostic imaging applications, will allow for its reliable use in clinically relevant research.

SDP-PH-89 Performance Evaluation Of Artificial Intelligence-based Technology For Fast And Accurate Bolus-tracking Process In CT Angiography

Participants
Yiran Wang, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Process of bolus-tracking scans before CT angiography usually include monitoring location selection and region-of-interest (ROI) placement to generate time-density curve (TDC) triggering the CTA scan. In this study we aimed to evaluate the performance of an artificial intelligence-based technology (SmartPlan, GE Healthcare) for fast and accurate bolus-tracking process compared with manual operation by technicians.*Methods and Materials 200 CTA scans including the abdominal, pulmonary aorta and coronary CTA performed using the SmartPrep triggering technique were prospectively collected. The monitoring location for placing ROI by CT technicians for dynamic contrast-enhancement monitoring in bolus-tracking scans and TDC generated in the ROI were recorded as the control group; The scout scans and time-resolved images were then imported into the SmartPlan software to automatically determine the monitoring location for placing ROI and to generate TDC, and the results were recorded as the experimental group. The consistency and time consuming of the location selection and the peak value of TDC curve triggering the scan between the experimental and control groups were analyzed using paired sample t-test. P < 0.05 was considered statistically significant. *Results There was significant difference in monitoring position between the experimental group and control group (P<0.05). However, monitoring locations differences were found no real clinical impact due to physicians'personal judgement variation. There was no difference in the peak value of TDC curves between the experimental group (167.99±25.54 e.g. in CCTA) and the control group (169.61±30.98 e.g. in CCTA), (P=0.784).Time consuming were found significant decreased by 19.94 second in the experimental group compared with that in the control group(P<0.05) .*Conclusions The AI-based automatic bolus-tracking technique can simplify CT scan process and physician intervention to provide reliable information for automatically triggering CTA scans.*Clinical Relevance/Application The intelligent automatic bolus-tracking technique based on deep learning neural network may reduce the manual intervention and simplify the process of automatically triggering CTA.

RESULTS

There was significant difference in monitoring position between the experimental group and control group (P<0.05). However, monitoring locations differences were found no real clinical impact due to physicians'personal judgement variation. There was no difference in the peak value of TDC curves between the experimental group (167.99±25.54 e.g. in CCTA) and the control group (169.61±30.98 e.g. in CCTA), (P=0.784).Time consuming were found significant decreased by 19.94 second in the experimental group compared with that in the control group(P<0.05) .

CLINICAL RELEVANCE/APPLICATION

The intelligent automatic bolus-tracking technique based on deep learning neural network may reduce the manual intervention and simplify the process of automatically triggering CTA.

SDP-PH-90   SAME: Fast And Accurate Algorithm For Deformable Image Registration On CT

Participants
Liu Fengze, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Image registration is widely used to relate or fuse information in different images when analyzing the longitudinal studies or comparing across multi-modality images for lesion diagnosis, treatment planning and respond assessment. Many abstracts in RSNA2020 (different categories) used or relied on registration in their studies. We propose and validate a fast and accurate dense deformable registration method on 3D CT scans based on a novel self-supervised anatomical embedding (SAM) algorithm that produces pixel-wise anatomical semantic information.*Methods and Materials We propose SAM-Enhanced registration (SAME) to find dense pixel correspondences between a pair of images. The key innovation of SAME is to use the high-level anatomical SAM features to directly predict point mapping between images, as well as to incorporate them into an unsupervised deep learning registration framework. We collected 2 datasets. 1) A chest CT dataset of 94 subjects, each with a contrast-enhanced (CE) and a non-contrast (NC) scan. For testing, we constructed 90 pairs using 10 patients for inter-subject registration, where 35 organs were manually labeled for each CT scan. We also tested on registering CE scans to NC counterparts. 2) An abdominal CT dataset of 30 patients with 13 labeled organs. For testing, 45 CT scan pairs using 10 patients were constructed for inter-subject registration. For both datasets, the atlas-based segmentation accuracy was calculated as evaluation metric.*Results In the test set of chest CT, SAME obtained 54.42% on the average Dice score (DSC) over all 35 organs when matching between CE and CE scans. Previous widely used state-of-the-art method, DEEDS, achieved 52.72% and took 45.35 seconds to match one pair of 3D scans, while SAME took 1.16 seconds. Another popular deep learning registration method, VoxelMorph, had 42.72% DSC using 4.02 seconds. On CE-to-NC registration, our result (50.96%) is comparable to DEEDS (51.15%). In the abdominal CT dataset, SAME achieved 49.78% DSC averaging over 13 organs, which is at least 3.2% higher than all previous works.*Conclusions We present a novel algorithm for 3D CT image registration with the state-of-the-art accuracy and fast inference speed. It can handle different imaging contrasts and body regions.*Clinical Relevance/Application Our proposed automated registration method is a useful tool for clinicians to align two CT volumes accurately in less than 2 seconds, which could be very helpful in various clinical and research tasks.

RESULTS

In the test set of chest CT, SAME obtained 54.42% on the average Dice score (DSC) over all 35 organs when matching between CE and CE scans. Previous widely used state-of-the-art method, DEEDS, achieved 52.72% and took 45.35 seconds to match one pair of 3D scans, while SAME took 1.16 seconds. Another popular deep learning registration method, VoxelMorph, had 42.72% DSC using 4.02 seconds. On CE-to-NC registration, our result (50.96%) is comparable to DEEDS (51.15%). In the abdominal CT dataset, SAME achieved 49.78% DSC averaging over 13 organs, which is at least 3.2% higher than all previous works.

CLINICAL RELEVANCE/APPLICATION

Our proposed automated registration method is a useful tool for clinicians to align two CT volumes accurately in less than 2 seconds, which could be very helpful in various clinical and research tasks.

SDP-PH-91   Comparison Of Dose Calculation Accuracy For Scattered Components By Heterogeneous External Radiotherapy

Participants
Takahiro Hirai, Kanagawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The accuracy of the dose calculation algorithm was compared by comparing the calculated results of the radiotherapy planning device (TPS) with the measured values for the scattered components generated from the inhomogeneous substances in the water phantom.*Methods and Materials 1. An ionization chamber dosimeter was installed in the water phantom, and inhomogeneous substances (lung equivalent, bone equivalent, titanium) were arranged concentrically around the dosimeter, and measurements were made by changing the angle and distance. 2. TPS created the same geometry as the actual measurement. The dose calculation algorithm used was the Analytical Anisotropic Algorithm (AAA) and Acuros XB (AXB). 3. The results were calculated by calculating the scattering component as a relative value from the change in dose depending on the presence or absence of the heterogeneous phantom, and comparatively evaluated based on the measured value.*Results All AXB were in agreement with the measured values within ± 2.0%. AAA showed a maximum difference from the measured value as the angle was 45 ° and the distance was closer, and a difference of 6% or more was observed with titanium. Regarding the distance, AAA matched within ± 0.3% when the distance between the ionization chamber and the heterogeneous material was 20 mm or more. In addition, when the distance was within 20 mm, the scattering component tended to be different from the measured value and AXB. This tendency was significantly affected at 6 MV for lung equivalent and 10 MV for bone equivalent and titanium.*Conclusions It was suggested that the calculation accuracy of AXB is higher than that of AAA because the scattering component generated from the inhomogeneous substance in the water phantom has the same tendency as the measured value.*Clinical Relevance/Application By using dose calculation algorithm AXB installed in TPS, it is possible to calculate the scattering component from inhomogeneous substances more accurately than AAA.

RESULTS

All AXB were in agreement with the measured values within ± 2.0%. AAA showed a maximum difference from the measured value as the angle was 45 ° and the distance was closer, and a difference of 6% or more was observed with titanium. Regarding the distance, AAA matched within ± 0.3% when the distance between the ionization chamber and the heterogeneous material was 20

mm or more. In addition, when the distance was within 20 mm, the scattering component tended to be different from the measured value and AXB. This tendency was significantly affected at 6 MV for lung equivalent and 10 MV for bone equivalent and titanium.

CLINICAL RELEVANCE/APPLICATION

By using dose calculation algorithm AXB installed in TPS, it is possible to calculate the scattering component from inhomogeneous substances more accurately than AAA.

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Abstract Archives of the RSNA, 2021

Sub-Events

IN02-B3   **Image Content Prediction Using Deep Learning For Quality Assurance Of MR Images**

Participants
Keshav Datta, PhD, Los Altos, California (*Presenter*) Employee, Subtle Medical, Inc

PURPOSE

Safely deploying AI-based prediction tools requires the input image content e.g. body part, modality and imaging plane etc. to match the expected input. Also, to ensure reliable performance it is imperative that the test data is not too different from the training data. Here, we present a deep learning based image content prediction system that detects mismatches in the DICOM header and image content.*Methods and Materials A 2D multi-task ResNet34 convolutional neural network, was trained using T1 and T2 weighted brain MRI volumes (n=2345) from multiple institutions and scanners to predict the modality (T1 vs. T2) and imaging plane (axial, sagittal, coronal), using the DICOM header as the ground-truth. To discriminate brain images from non-brain, 4 models trained using different random seeds, were used to detect out-of-distribution (OOD) data using the variance of the predicted probabilities as an uncertainty estimate. Three separate test sets were used. The first contained (n=118) volumes from the same sites as the training data. The open IXI dataset (n=581 T1, n=577 T2) was used to test generalizability to new sites and a third set of n=535 spine images from the L-spine open dataset were used to assess the discrimination of spine from brain data. Performance of the algorithm was assessed using classification accuracy for brain vs spine discrimination, modality and imaging plane prediction.*Results The deep learning model achieved overall accuracies of 100%, 99.9% and 100%, respectively, in predicting the modality, imaging plane and OOD task. On the first test set, there was only a single case of mismatch in imaging plane identification between the DICOM header and the predicted image content, likely due to the poor image quality. There was one misclassification error also on the imaging plane prediction task in the IXI test set, indicating that the model generalized well to new site data. On the OOD task, the uncertainty measurement was able to distinguish between the OOD spine data from the in-distribution brain data with 100% accuracy.*Conclusions Deep learning based image content identification can automatically detect mismatch between the DICOM header and information in the image with a high level of accuracy.*Clinical Relevance/Application Deep learning based image content prediction can potentially identify mismatches between image headers and content, which can significantly improve the reliability of AI based image analysis.

RESULTS

The deep learning model achieved overall accuracies of 100%, 99.9% and 100%, respectively, in predicting the modality, imaging plane and OOD task. On the first test set, there was only a single case of mismatch in imaging plane identification between the DICOM header and the predicted image content, likely due to the poor image quality. There was one misclassification error also on the imaging plane prediction task in the IXI test set, indicating that the model generalized well to new site data. On the OOD task, the uncertainty measurement was able to distinguish between the OOD spine data from the in-distribution brain data with 100% accuracy.

CLINICAL RELEVANCE/APPLICATION

Deep learning based image content prediction can potentially identify mismatches between image headers and content, which can significantly improve the reliability of AI based image analysis.

Printed on: 06/28/22

Sub-Events

BR02-A1   MR Screening For Breast Cancer: DWI-based Short Protocols In Comparison To Full Length Clinical Protocols With Contrast Enhancement

Participants
Sabine Ohlmeyer, Erlangen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Purpose of this study was to evaluate the capability to detect and characterize suspicious breast lesions with an abbreviated, non-contrast-enhanced MRI protocol featuring ultra-high b-value diffusion-weighted imaging (DWI) compared to a full clinical protocol with dynamic contrast enhanced (DCE) images.*Methods and Materials The study was approved by the local ethics committee. MRI examinations (advanced DWI with b-values ??1500 s/mm2 and 2500 s/mm2, T1w / T2w native and DCE, 1.5 and 3T.) of 254 breasts were subjected to a four-stage evaluation, each separately for b1500 and b2500: (A) MIP evaluation only, (B) DWI data including ADC, (C) DWI data including ADC with T1w / T2w native and (D) DWI data including ADC with T1w / T2w native and DCE (full-length standard protocol). The evaluation was performed by two blinded independend readers (4 and 16 years of experience in breast MRI). Histological confirmation for conspicuous lesions served as reference standard, DCE-MRI for inconspicuous and clearly benign lesions (e.g. cysts). Statistical analysis was performed for diagnostic accuracy and interrater agreement.*Results The cohort comprised 116 cases with BI-RADS 1 findings and 138 cases with BI-RADS =2 findings, including 38 histologically confirmed malignancies. For (A), breasts without pathological findings could be recognized with high diagnostic accuracy (negative predictive value, =97.0%; sensitivity, =92.1% for both readers), but with a limited specificity (=58.3%; positive predictive value, =28.6%). Within the native readings, approach (C) with b2500 performed best (negative predictive value, 99.5%; sensitivity, 97.4%; specificity, 88.4%). The intraclass correlation coefficient was between 0.683 (MIP b1500) and 0.996 (full protocol).*Conclusions A native short breast MRI with advanced high b-value DWIs ??seems to be nearly equivalent to DCE-breast-MRI in terms of diagnostic accuracy and appears to be suitable as a screening method.*Clinical Relevance/Application A native short breast MRI with advanced high b-value DWIs seems to be suitable as a screening method.

RESULTS

The cohort comprised 116 cases with BI-RADS 1 findings and 138 cases with BI-RADS =2 findings, including 38 histologically confirmed malignancies. For (A), breasts without pathological findings could be recognized with high diagnostic accuracy (negative predictive value, =97.0%; sensitivity, =92.1% for both readers), but with a limited specificity (=58.3%; positive predictive value, =28.6%). Within the native readings, approach (C) with b2500 performed best (negative predictive value, 99.5%; sensitivity, 97.4%; specificity, 88.4%). The intraclass correlation coefficient was between 0.683 (MIP b1500) and 0.996 (full protocol).

CLINICAL RELEVANCE/APPLICATION

A native short breast MRI with advanced high b-value DWIs seems to be suitable as a screening method.

BR02-A10   Axillary Lymph Node Evaluation After COVID-19 Vaccine In Patients With And Without COVID-19 History

Participants
Ignacio Soriano, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the axillary lymph node response to the COVID-19 vaccine (Pfizer-BioNTech) between patients who had previously passed the infection and patients who did not.*Methods and Materials Between February to April 2021, 91 volunteers (workers at our institution who participated in a COVID-19 vaccination program) were recruited to participate in a prospective study with IRB approval. All participants provided written consent to participate. Three axillary ultrasound (US) examinations of the ipsilateral vaccinated arm were performed: the first one, previous to the first dose of vaccine (basal control); the second one, performed the week after the first dose (control 1) and the last one, done the week after the second dose (control 2). Number of lymph nodes, maximum long-axis diameter and cortical thickness (in mm), Bedi's classification (grade 1 to 6) and color Doppler (grade 0 to 3, being 0 no color signal and 3 high intense color signal) were evaluated. Patients were classified according to previous infection with SARS-CoV-2 or not. Differences among groups were evaluated with the Mann-Whitney U test.*Results Out of 91 patients, 26 (28.6%) had previously passed COVID-19. No statistical differences in the basal US examination between groups were found. In control 1, a higher cortical thickness (mean 3.99 mm vs 2.89 mm; p<0.001), a higher grade of Bedi's classification (49.2% of grade 3 vs 57.7% of grade 2; p=0.004) and a greater grade of color Doppler (44.6% of grade 2 vs 42.3% of grade 1; p=0.004) were identified in the non-infected group regarding the previously infected group. Moreover, these statistically significant differences were also found in control 2, with a greater number of lymph nodes (mean 6.6 vs 5.23; p=0.006), higher cortical thickness (mean 4.98 mm vs 3.49 mm; p=0.001), major grade of Bedi's classification (43.1% of grade 3 vs 38.5% of grade 2; p=0.009) and higher grade of color Doppler (53.8% of grade 2 vs 46.2% of grade 1; p<0.001) in the group who had not passed previously the infection.*Conclusions Patients with no previous infection history by SARS-CoV-2 showed a higher axillary lymph node response with COVID-19 vaccine compared to patients who had positive infection history.*Clinical Relevance/Application Enlarged axillary lymph nodes are a common finding after COVID-19 vaccination. According to our data, patients who previously suffered the COVID-

19 infection developed less intense lymph node response after de vaccination.

RESULTS

Out of 91 patients, 26 (28.6%) had previously passed COVID-19. No statistical differences in the basal US examination between groups were found. In control 1, a higher cortical thickness (mean 3.99 mm vs 2.89 mm; p<0.001), a higher grade of Bedi's classification (49.2% of grade 3 vs 57.7% of grade 2; p=0.004) and a greater grade of color Doppler (44.6% of grade 2 vs 42.3% of grade 1; p=0.004) were identified in the non-infected group regarding the previously infected group. Moreover, these statistically significant differences were also found in control 2, with a greater number of lymph nodes (mean 6.6 vs 5.23; p=0.006), higher cortical thickness (mean 4.98 mm vs 3.49 mm; p=0.001), major grade of Bedi's classification (43.1% of grade 3 vs 38.5% of grade 2; p=0.009) and higher grade of color Doppler (53.8% of grade 2 vs 46.2% of grade 1; p<0.001) in the group who had not passed previously the infection.

CLINICAL RELEVANCE/APPLICATION

Enlarged axillary lymph nodes are a common finding after COVID-19 vaccination. According to our data, patients who previously suffered the COVID-19 infection developed less intense lymph node response after de vaccination.

BR02-A11   Challenging Breast Cryoablation Procedures and Imaging Follow-up

Participants
Celina Hsieh, Providence, Rhode Island (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To outline the mechanism and indications of cryoablation for breast cancer.2. To explain procedural steps of ultrasound-guided cryoablation.3. To discuss challenging procedural cases and how to approach them.4. To explore the use of multiple imaging modalities (US, MG, MRI, PET/CT) to evaluate cryoablation candidacy and to assess post-ablative changes.5. To review multimodality imaging findings after cryoablation, including expected evolution of benign post-ablation change, false positive fat necrosis, and true positive recurrent disease.

TABLE OF CONTENTS/OUTLINE

Introduction to Cryoablation- Mechanism- IndicationsCryoablation Procedure- Equipment and Technique- Expected Outcome-Potential ComplicationsChallenging Procedures- Present a series of challenging cryoablation cases, each addressed by a different procedural technique. Examples include asymmetric lesions and lesions too close to the skin/muscle.Challenging Follow-Up Imaging-Present a series of challenging follow-up cases where multiple complementary imaging modalities may be used to assess treatment response and to help differentiate expected benign post-ablation change from suspicious findings.Future of Cryoablation- Discuss cryoablation combined with immunotherapy

BR02-A12   Correlation Analysis Between Hyperplasic Axillary Lymph Node Reaction And Immunogenicity Of The COVID-19 Mrna Vaccine.

Participants
Alba Cristina Igual Rouilleault, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To explore the correlation between axillary lymph node response to the COVID-19 mRNA vaccine and seroprevalence of SARS-CoV-2 antibodies.*Methods and Materials Sixty-five volunteer employees from our center were prospectively ruled-out between February to April 2021. The study was conducted with the approval of our IRB and all participants provided written consent to participate. Patients recruited were Pfizer-BioNTech COVID-19 or Moderna vaccine recipients. Each patient underwent an axillary US evaluation of the ipsilateral vaccinated arm, within the week after the second dose of vaccination, and a SARS-CoV-2 serology test within the month after it. Findings recorded in our study included: the total number of visible nodes, the maximum measurements of the long-axis size and cortical thickness (mm), Bedi's classification (grade 1 to 6) and color Doppler evaluation (grade 0 to 3, being 0 no color signal and 3 high intense color signal). Serologic test was performed to detect SARS-CoV-2 antibodies in bloody components quantifying total IgM and IgG (U/mL). Data collected were analyzed using Pearson correlation coefficient for quantitative continuous variables (number of nodes, long-axis size and cortical thickness) and Spearman's rank-order correlation coefficient for ordinal variables (Bedi's classification and Doppler scale). Variables with a p value < 0.05 were considered statistically significant.*Results Pfizer-BioNTech was administered in 64.6% of the volunteers. Correlation analysis of US findings and antibodies quantification (IgM + IgG U/mL) evidenced weak negative correlation in cortical thickness (-0.305) and Bedi's grade classification (-0,344) with statistically significant differences (p=0.013 and p=0,005, respectively). Not statistically significant differences were found between quantified IgM and IgG antibodies with the total number of visible nodes, long-axis size measurement and Doppler signal scale.*Conclusions Hyperplasic axillary lymphadenopathy induced by recent vaccination didn't associate a higher seroprevalence of SARS-CoV-2 IgG antibodies response.*Clinical Relevance/Application In patients with axillary lymphadenopathy, recent vaccination should be ruled out. However, not enlarged axillary lymph nodes could be a normal response to COVID-19 vaccine.

RESULTS

Pfizer-BioNTech was administered in 64.6% of the volunteers. Correlation analysis of US findings and antibodies quantification (IgM + IgG U/mL) evidenced weak negative correlation in cortical thickness (-0.305) and Bedi's grade classification (-0,344) with statistically significant differences (p=0.013 and p=0,005, respectively). Not statistically significant differences were found between quantified IgM and IgG antibodies with the total number of visible nodes, long-axis size measurement and Doppler signal scale.

CLINICAL RELEVANCE/APPLICATION

In patients with axillary lymphadenopathy, recent vaccination should be ruled out. However, not enlarged axillary lymph nodes could be a normal response to COVID-19 vaccine.

BR02-A4   Systematic Surveillance Of Women After Breast Conserving Treatment Using Breast MRI Alone

Participants
Vanessa Raaff, PhD, Aachen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Current recommendations for follow up after breast conserving treatment (BCT) recommend serial two-view mammography, possibly accompanied by targeted ultrasound. Breast MRI has been shown to be useful to improve detection of recurrence in this situation. Our aim was to investigate the utility of MRI as a standalone imaging method for this purpose.*Methods and Materials Between 01/2011 and 03/2021, a total 426 women who, after breast conserving surgery plus RT, underwent MRI alone (without mammogram) for routine follow-up. Contrast enhanced MRI was performed at 1.5T using a dedicated multichannel breast coil according to a standardized protocol that took 11 minutes to complete. Women started MRI screening at variable intervals (median: 2 years; range: 1-28 years) after treatment and underwent MRI screening annually. Validation of the respective last negative MRI study was achieved by tomosynthesis plus clinical examination (137/426) and/or by clinical follow-up for at least 2 years (289/426).*Results Women were followed by 1,553 MRI studies (on average 3.6 MRI studies per patient), covering a total 1,727 women years (on average 4.06 years per patient). Follow-up MRI was positive in 108/1,553 examinations (6.9%) and in 85/426 women (19.9%) across the entire follow-up period. Recurrent breast cancer was confirmed in 64/108 MRI studies and in 55/85 women (8 women had more than one recurrence), for a PPV of 59.3% per positive MRI study and 64.7% per patient. Cancer-detection-rate was 37.0 per 1000 women years. Recurrent cancers were detected on average 8.9 (1-28) years after BCT. Recurrent cancers were DCIS in 11/64 (17.2%), invasive in 53/64 (82.8%). Mean size of invasive recurrent cancer was 11.4 mm, range 4-50 mm, staged as T1a in 5/53; T1b in 24/53; T1c in 16/53; T2 in 5/53; T3 or T4 in 0/53; stage was unknown in 3/53. None of the women received a diagnosis of breast cancer in between MRI screening rounds, or within the 2-year follow up after the respective last negative MRI, or upon DBT after the last study MRI.*Conclusions MRI alone is a powerful method for the follow-up of women after breast conserving treatment and ensures early detection of recurrent cancer.*Clinical Relevance/Application Women in the follow up after breast cancer who have access to breast MRI may safely forgo additional mammographic or DBT follow up.

RESULTS

Women were followed by 1,553 MRI studies (on average 3.6 MRI studies per patient), covering a total 1,727 women years (on average 4.06 years per patient). Follow-up MRI was positive in 108/1,553 examinations (6.9%) and in 85/426 women (19.9%) across the entire follow-up period. Recurrent breast cancer was confirmed in 64/108 MRI studies and in 55/85 women (8 women had more than one recurrence), for a PPV of 59.3% per positive MRI study and 64.7% per patient. Cancer-detection-rate was 37.0 per 1000 women years. Recurrent cancers were detected on average 8.9 (1-28) years after BCT. Recurrent cancers were DCIS in 11/64 (17.2%), invasive in 53/64 (82.8%). Mean size of invasive recurrent cancer was 11.4 mm, range 4-50 mm, staged as T1a in 5/53; T1b in 24/53; T1c in 16/53; T2 in 5/53; T3 or T4 in 0/53; stage was unknown in 3/53. None of the women received a diagnosis of breast cancer in between MRI screening rounds, or within the 2-year follow up after the respective last negative MRI, or upon DBT after the last study MRI.

CLINICAL RELEVANCE/APPLICATION

Women in the follow up after breast cancer who have access to breast MRI may safely forgo additional mammographic or DBT follow up.

BR02-A6   Power Spectrum Analysis Of Breast Parenchyma With Digital Breast Tomosynthesis Images In A Longitudinal Screening Cohort From Different Vendors

Participants
Kai Yang, PhD, Boston, Massachusetts (*Presenter*) Research Consultant, Malcova, LLC.

PURPOSE

To quantitatively compare breast parenchymal texture between two Digital Breast Tomosynthesis (DBT) vendors using images from the same patients.*Methods and Materials This retrospective study included consecutive patients who had normal screening DBT exams performed on a GE unit in January 2018 and normal screening DBT exams in adjacent years from a Hologic unit. Power spectrum analysis was performed within the breast tissue region, followed by a linear fit of log-frequency to log-power in the anatomical spatial frequency range 0.15 mm-1 to 0.8 mm-1. The slope of that linear function, ß, was used as a quantitative measure of breast texture and compared within and across vendors along with secondary parameters (laterality, view, year, image format, and breast density) with correlation tests and t-tests.*Results A total of 24,339 DBT slices or 2D synthetic images from 85 exams in 25 women (mean age, 58 years ± 10 [standard deviation]) were included. Strong power-law behavior was verified (R2>0.99) from all images. Values of ß do not differ significantly for laterality, view, or year. Significant (P<0.01) differences of ß were observed across vendors for DBT images (Hologic: 3.4±0.2 vs. GE: 3.1±0.2, 95% CI on difference: 0.27 to 0.30) and synthetic 2D images (Hologic: 2.7±0.3 vs. GE: 3.0±0.2, 95% CI on difference: -0.36 to -0.27), and density groups with each vendor: scattered (GE 3.0±0.3, Hologic 3.3±0.3) vs. heterogeneous (GE 3.2±0.2, Hologic 3.4±0.1), 95% CI (-0.27, -0.08) and (-0.21, -0.05), respectively.*Conclusions There are quantitative differences in the presentation of breast imaging texture between DBT vendors and across breast density categories observed in this cohort. Our findings have relevance and importance for external validation across vendors in AI and other automated density assessment programs.*Clinical Relevance/Application 1. Significant differences in anatomical noise power coefficient, ß, were observed between two digital breast tomosynthesis (DBT) vendors (Hologic vs. GE, P<0.001), using images from the same 25 patients in consecutive years, quantifying different DBT imaging presentation of breast parenchymal structures between vendors. 2. Observed values of ß were significantly different between scattered and heterogeneous mammographic breast densities (P<0.01). This directly associates ß with identified risk groups that bound the criterion for mammographically dense breasts.

RESULTS

A total of 24,339 DBT slices or 2D synthetic images from 85 exams in 25 women (mean age, 58 years ± 10 [standard deviation]) were included. Strong power-law behavior was verified (R2>0.99) from all images. Values of ß do not differ significantly for laterality, view, or year. Significant (P<0.01) differences of ß were observed across vendors for DBT images (Hologic: 3.4±0.2 vs. GE: 3.1±0.2, 95% CI on difference: 0.27 to 0.30) and synthetic 2D images (Hologic: 2.7±0.3 vs. GE: 3.0±0.2, 95% CI on difference: -0.36 to -0.27), and density groups with each vendor: scattered (GE 3.0±0.3, Hologic 3.3±0.3) vs. heterogeneous (GE 3.2±0.2, Hologic 3.4±0.1), 95% CI (-0.27, -0.08) and (-0.21, -0.05), respectively.

CLINICAL RELEVANCE/APPLICATION

1. Significant differences in anatomical noise power coefficient, ß, were observed between two digital breast tomosynthesis (DBT) vendors (Hologic vs. GE, P<0.001), using images from the same 25 patients in consecutive years, quantifying different DBT imaging presentation of breast parenchymal structures between vendors. 2. Observed values of ß were significantly different between scattered and heterogeneous mammographic breast densities (P<0.01). This directly associates ß with identified risk groups that bound the criterion for mammographically dense breasts.

Analysis Of The Added Value Of An Artificial Intelligence System In Assisting Radiologists On Indeterminate BI-RADS 0 Mammograms

Participants
Jie Ma, Shenzhen, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the value of an artificial intelligence (AI) system in assisting entry- and mid-level radiologists to improve the assessment accuracy of initial BI-RADS (Breast imaging reporting and data system) 0 cases in mammograms.*Methods and Materials We included 34,654 consecutive digital mammography studies, collected between 2011 and 2019, among which, 1,088 cases from 1,010 patients with initial BI-RADS 0 assessment who were recalled during 2 years of follow-up were used in this study. In the first reader study, two mid-level radiologists retrospectively re-assessed these BI-RADS 0 cases with the assistance of an AI system developed by us previously. In the second reader study, four entry-level radiologists were split into two groups to cross-read 80 cases with and without the AI. Diagnostic performance was evaluated using the follow-up diagnosis or biopsy results as the reference standard.*Results In the first reader study, of the 1,088 cases, 626 were BI-RADS 1 and 462 were BI-RADS 2 and above according to the reference standard. Assisted by the AI, the two mid-level radiologists would have correctly identified 351 and 362 BI-RADS 1 cases respectively, and significantly reduced the false recall cases by 56% and 58% (P<0.005), respectively. However, 12 and 6 out of 70 malignant cases would have been missed for the recall, respectively. In other words, the cancer detection rate of the radiologist plus AI stands at 5.33% and 5.88%, respectively, compared to that of 6.43% based on the mammography plus other imaging and biopsy tests. In the second reader study, the inter-rater reliability of the entry-level radiologists was increased from 0.20 to 0.30 (P<0.005) by introducing the AI, and the average reading time was reduced to 85 seconds per case from 113 seconds per case (P<0.005). In terms of the F1 score, the AI system (0.53) surpassed the entry-level radiologists (0.34) (P<0.005).*Conclusions The AI system can effectively assist mid-level radiologists in substantially reducing the false recalls of BI-RADS 0 cases. The AI system can also improve the inter-rater reliability and reduce the reading time of entry-level radiologists in assessing potential lesions in BI-RADS 0 mammograms.*Clinical Relevance/Application The assessment of BI-RADS 0 is affected by the experience of the radiologists. The abuse of BI-RADS 0 (especially by entry- and mid-level radiologists) will increase the psychological and economic burden on patients. The introduction of an AI system could significantly reduce unnecessary follow-ups and improve the overall performance of entry- and mid-level radiologists. This research can lead to further development and understanding of an AI system in enhancing the clinical decision-making of indeterminate BI-RADS 0 mammograms.

RESULTS

In the first reader study, of the 1,088 cases, 626 were BI-RADS 1 and 462 were BI-RADS 2 and above according to the reference standard. Assisted by the AI, the two mid-level radiologists would have correctly identified 351 and 362 BI-RADS 1 cases respectively, and significantly reduced the false recall cases by 56% and 58% (P<0.005), respectively. However, 12 and 6 out of 70 malignant cases would have been missed for the recall, respectively. In other words, the cancer detection rate of the radiologist plus AI stands at 5.33% and 5.88%, respectively, compared to that of 6.43% based on the mammography plus other imaging and biopsy tests. In the second reader study, the inter-rater reliability of the entry-level radiologists was increased from 0.20 to 0.30 (P<0.005) by introducing the AI, and the average reading time was reduced to 85 seconds per case from 113 seconds per case (P<0.005). In terms of the F1 score, the AI system (0.53) surpassed the entry-level radiologists (0.34) (P<0.005).

CLINICAL RELEVANCE/APPLICATION

The assessment of BI-RADS 0 is affected by the experience of the radiologists. The abuse of BI-RADS 0 (especially by entry- and mid-level radiologists) will increase the psychological and economic burden on patients. The introduction of an AI system could significantly reduce unnecessary follow-ups and improve the overall performance of entry- and mid-level radiologists. This research can lead to further development and understanding of an AI system in enhancing the clinical decision-making of indeterminate BI-RADS 0 mammograms.

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Abstract Archives of the RSNA, 2021

Sub-Events

GU04-C2   **Muscle-invasive Bladder Cancer: Pretreatment Prediction Of Response To Neoadjuvant Chemotherapy With Diffusion-weighted MR Imaging**

Participants
Xinxin Zhang, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the performance of diffusion-weighted (DW) MR imaging for predicting the neoadjuvant chemotherapy (NAC) response in patients with muscle-invasive bladder cancer (MIBC).*Methods and Materials Fifty-eight patients with clinical T2-4a MIBC underwent DW-MR imaging before and after NAC followed by surgery. The evaluation of response to NAC was based on the change in tumor maximum diameter between pre- and posttreatment. The apparent diffusion coefficient value (2D-ADC value) measured from a single section region of interest and ADC histogram parameters derived from whole-tumor volume were compared between responders and non-responders. The Mann-Whitney-U test, the independent-samples t test, receiver operating characteristic curve with area under the curve (AUC) analysis were performed.*Results After NAC, 33 (57%) patients were classified as responders, and 25 (43%) were classified as non-responders. 2D-ADC values were significantly different between responders ([1.30(±0.17)] ×10-3mm2/s) and non-responders ([1.09(±0.14)] ×10-3mm2/s) (p < .001). The mean percentage increase in ADC of responders was higher than that of non-responders (29.3%±27.0 vs 16.2%±30.5, p=.051). Some ADC histogram parameters (ADCmean, ADCmax ADC50th ADC75th, ADC90th, Entropy, Kurtosis, Uniformity, Skewness)were significantly different between responders and non-responders (P = .042). The AUC was highest for the 2D-ADC value (0.842).*Conclusions The 2D-ADC value and ADC histogram parameters were useful for predicting tumor response to NAC in patients with MIBC. And the 2D-ADC value was superior to ADC histogram parameters in predicting the therapeutic response.*Clinical Relevance/Application In patients with MIBC, baseline 2D-ADC value and ADC histogram parameters before NAC have potential for predicting the treatment response to NAC, and it is helpful for providing appropriate treatment for individuals.

RESULTS

After NAC, 33 (57%) patients were classified as responders, and 25 (43%) were classified as non-responders. 2D-ADC values were significantly different between responders ([1.30(±0.17)] ×10-3mm2/s) and non-responders ([1.09(±0.14)] ×10-3mm2/s) (p < .001). The mean percentage increase in ADC of responders was higher than that of non-responders (29.3%±27.0 vs 16.2%±30.5, p=.051). Some ADC histogram parameters (ADCmean, ADCmax ADC50th ADC75th, ADC90th, Entropy, Kurtosis, Uniformity, Skewness)were significantly different between responders and non-responders (P = .042). The AUC was highest for the 2D-ADC value (0.842).

CLINICAL RELEVANCE/APPLICATION

In patients with MIBC, baseline 2D-ADC value and ADC histogram parameters before NAC have potential for predicting the treatment response to NAC, and it is helpful for providing appropriate treatment for individuals.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Sub-Events

PH05-B2   **Application Of Low-dose And Low-flow Contrast Agent Injection Program With Dual-energy CT In Head And Neck CTA**

Participants
Yu Ziting, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the feasibility of using dual-energy CT to head and neck angiography, optimize the contrast injection protocol, and reduce the dosage and flow rate of contrast agent.*Methods and Materials Sixty patients underwent head and neck CT angiography scans were prospectively enrolled in 2019 with the approval of the Ethics Committee. All patients signed informed consent before their examinations, and randomly divided into two groups (A&B, A is normal scan and B is dual-energy scan). 370mgI/mL was used as the contrast agent in both two groups. The two groups used different injection protocol, group A with the flow rate of 5mL/s and 0.8 mL/kg of contrast medium(CM),automatic tube voltage, automatic tube current; group B with 2.5mL/s flow rate and 0.4 mL/kg of contrast medium, dual energy data acquisition mode (fast kV switching of 100/sn140kVp) was used and monochromatic images reconstructed at 50 keV. The left common carotid artery bifurcates (below 1cm) as the region of interest, and the sternocleidomastoid muscles in the same layer are selected as the background tissue. The CT value, noise value (SD) of the ROI and the background tissue are measured and recorded respectively. The SNR and CNR are calculated according to the formula, and the differences between the two groups of data are compared.*Results The CT value of the ROI in the group A and B can both reach more than 350 Hu, meeting the diagnostic requirements; and there was no significant difference in the two groups' imaging quality (P > 0.05).*Conclusions The image quality in the group A and B both can meeting the diagnostic requirements, but the group B with dual energy scan can significantly reduce the 50% CM and 50% flow rate of contrast agent, more safety.*Clinical Relevance/Application It is clinical possible to apply very low flow rate such as 2.5mL/s and low dosage contrast medium in dual-energy CT for some patients so that obtained safety of diagnosis and treatment.

RESULTS

The CT value of the ROI in the group A and B can both reach more than 350 Hu, meeting the diagnostic requirements; and there was no significant difference in the two groups' imaging quality (P > 0.05).

CLINICAL RELEVANCE/APPLICATION

It is clinical possible to apply very low flow rate such as 2.5mL/s and low dosage contrast medium in dual-energy CT for some patients so that obtained safety of diagnosis and treatment.

PH05-B3   **Study On the Effect Ofadaptivestatistical Iterative Reconstruction-veo Algorithmon Image Quality in Thyroid CT Scans**

Participants
Jie Sun, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the effect of different adaptive statistical iterative reconstruction-Veo (ASiR-V) algorithm level on the image quality of thyroid non-spectrum CT scanning.*Methods and Materials Twenty-five patients prepared for enhanced CT scan of the neck examination in our hospital were collected prospectively. Enhanced scanning used 120 kV tube voltage and automatic tube current (440 mA), noise index(NI) 11, thickness 1.25 mm. Six groups of ASiR-V images with different levels (1:0%,2:20%,3:40%,4:60%,5:80% and 6:100%) were reconstructed for comparative analysis. Region of interest (ROI) were placed at the maximum level of thyroid parenchyma, the same level of trapezius muscle and the subcutaneous fat of anterior. CT values, background noise (SD) of ROI in monochromatic images of 74keV in six groups were measured and compared respectively. The subjective image scores were assessed blindly by two experienced physicians using a 5-point system. The dose length product (DLP) of each scan was recorded after scanning, and the value of effective dose (ED) was calculated according to the formula: ED(mSv)=k(mSv*mGy-1*cm-1)*DLP(mGy*cm). The differences of SD among different ASiR-V groups were compared by one-way analysis of variance, and the differences of subjective scoring between two observers were compared by Kappa test.*Results SD values of different ASiR-V level were (29.94±5.62)HU,(26.13±5.24)HU,(22.70±5.07)HU,(19.27±4.78)HU,(15.56±4.69)HU, (11.83±4.07)HU respectively .With the level of ASiR-V increase, image noise (SD) decreased gradually. The average DLP of thyroid scan of 25 patients was (279.58±39.89)mGy*cm, ED was (1.65±0.23)mSv. The result of subjective score between observer A and observer B showed that both too high and too low ASiR-V would reduce the diagnostic confidence. Observer A and B believed that 80% ASiR-V can obtain the best image quality , and the Kappa value of consistency between the two observers was 0.78 respectively, indicating good consistency.*Conclusions Iterative reconstruction can effectively affect the image quality of non-spectral scan, and both too high and too low ASiR-V will affects the diagnostic confidence of images. Based on the results of subjective scores and objective indicators, this study confirmed that 80% ASiR-V can obtain the best image quality of thyroid scan.*Clinical Relevance/Application By exploring the application value of the ASiR-V with different levels in the optimization of image quality of thyroid non-spectral scan, it provides more choices for the clinical application of the ASiR-V to optimize the image quality of other examination sites, and has guiding significance for the selection of different levels of ASiR-V algorithm.

RESULTS

SD values of different ASiR-V level were (29.94±5.62)HU,(26.13±5.24)HU,(22.70±5.07)HU,(19.27±4.78)HU,(15.56±4.69)HU, (11.83±4.07)HU respectively .With the level of ASiR-V increase, image noise (SD) decreased gradually. The average DLP of thyroid scan of 25 patients was (279.58±39.89)mGy*cm, ED was (1.65±0.23)mSv. The result of subjective score between observer A and observer B showed that both too high and too low ASiR-V would reduce the diagnostic confidence. Observer A and B believed that 80% ASiR-V can obtain the best image quality , and the Kappa value of consistency between the two observers was 0.78 respectively, indicating good consistency.

CLINICAL RELEVANCE/APPLICATION

By exploring the application value of the ASiR-V with different levels in the optimization of image quality of thyroid non-spectral scan, it provides more choices for the clinical application of the ASiR-V to optimize the image quality of other examination sites, and has guiding significance for the selection of different levels of ASiR-V algorithm.

PH05-B4   Radiation Dose Reduction For CT Assessment Of Urolithiasis Using Deep Learning Reconstruction Algorithm -a Prospective Intra-individual Study

Participants
Xiaohu Li, MD, Hefei, China (*Presenter*) Nothing to Disclose

PURPOSE

To assess the performance of ASIR-V and Deep learning reconstruction algorithm(DL) in patients with urolithiasis at ultralow-dose CT*Methods and Materials 36 patients scheduled for unenhanced abdominal CT for follow-up of urolithiasis were prospectively included. Routine dose acquisition was followed by two low-dose acquisitions at 60% and 90% reduced doses. All images were reconstructed with FBP, ASIR-V and DL. Urolithiasis detection rates, gall bladder, appendix and rectosigmoid evaluation and overall subjective image quality were evaluated by two observers.*Results 114stones were present in 36 patients. 70% stones were not detected on FBP at the lowest dose level, but this improved with DL to a sensitivity of 100%. ASIR-V resulted in a slight decrease in sensitivity at the lowest dose to 85 %, but out performed FBP. Evaluation of other structures with ASIR-V at 60% and with DL at 90% dose reductions was comparable to FBP at routine dose, but 80% and 90% dose reduction resulted in non-evaluable images.*Conclusions CT radiation dose for urolithiasis detection can be safely reduced by 60(ASIR-V)-90(DL)% without affecting assessment of urolithiasis, possible extra-urinary tract pathology or overall image quality.*Clinical Relevance/Application The most frequent cause of acute flank pain is urolithiasis, which affects 3-5% of the population.Technical advancements like iterative reconstruction (IR) algorithms have resulted in substantial radiation dose reduc- tions. IR results in reduced noise, allowing acquisition ofim- ages at reduced radiation dose levels without intrinsically hampering image quality.

RESULTS

114stones were present in 36 patients. 70% stones were not detected on FBP at the lowest dose level, but this improved with DL to a sensitivity of 100%. ASIR-V resulted in a slight decrease in sensitivity at the lowest dose to 85 %, but out performed FBP. Evaluation of other structures with ASIR-V at 60% and with DL at 90% dose reductions was comparable to FBP at routine dose, but 80% and 90% dose reduction resulted in non-evaluable images.

CLINICAL RELEVANCE/APPLICATION

The most frequent cause of acute flank pain is urolithiasis, which affects 3-5% of the population.Technical advancements like iterative reconstruction (IR) algorithms have resulted in substantial radiation dose reduc- tions. IR results in reduced noise, allowing acquisition ofim- ages at reduced radiation dose levels without intrinsically hampering image quality.

PH05-B5   Clinical Application Of Coronary CT Angiography Fractional Flow Reserve Based On Different Reconstruction Algorithms In Normal Coronary Arteries

Participants
Hongjing Zhang, Shizuishan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the clinical application of coronary CT angiography flow reserve fraction (FFRCT) software independently developed by Xingmai Technology in China to normal coronary arteries in different reconstruction algorithms.*Methods and Materials 10 patients with suspected myocardial ischemia underwent coronary CT angiography with the GE Revolution wide-body detector,No positive lesions were found.The images are divided into three groups based on different reconstruction algorithms:Group A: Soft algorithm, Group B: Stnd algorithm, Group C:Detail algorithm. 90 blood vessels (240 images) were reconstructed, and the images of each group were sent to the GE AW 4.7 workstation to analyze and compare the differences in the coronary artery SD values between the groups. The Region of Interest(ROI) was placed on the anterior chest wall muscle and the root of the right coronary artery. Region of interest was placed to avoid blood vessels and lesions,CT value, SD, signal-to-noise ratio (SNR=CTvessel/SD vessel) and contrast-to-noise ratio [CNR=(CTvessel-CT muscle)/SDmuscle] was measured and calculated. FFR value of each group was calculated using Xingmai software, and the FFRCT value=0.8 was taken as the positive result. The positive rate of the two groups of FFRCT was counted at the segment level, patient level and blood vessel level.SPSS 23.0 software was used, and one-way ANOVA analysis was used for comparison among multiple groups.Pearson chi-squarewas used for comparison between the two groups, and p<0.05 was statistically different.*Results The SD values of the three different reconstruction algorithms are 25.77±2.87, 31.40±3.12 and 41.07±4.27HU, the difference was statistically significant (P<0.05). The difference between SNR and CNR is statistically significant (p<0.05). The positive rates of FFR at the image segment level of the three groups were3.75%, 6.25% and 7.5%,the difference was not statistically significant (P>0.05). The positive rates of FFRCT in patients were 20%, 40% and 40%,the difference was not statistically significant(P>0.05). There was no statistically significant difference in the positive rate of FFRCT at the vascular level(P>0.05).*Conclusions Flow reserve fraction (FFRCT) software was used to analyze the coronary arteries of different reconstruction algorithms without affecting the FFRCT value of patients, showing good robustness.*Clinical Relevance/Application Use Fractional Flow Reserve (FFR) software to analyze coronary artery FFRCT value will not change with the change of reconstruction algorithm during scanning,Shows good robustness.In order to clinically judge whether there is ischemia in normal coronary arteries, it is of guiding significance.

RESULTS

The SD values of the three different reconstruction algorithms are 25.77±2.87, 31.40±3.12 and 41.07±4.27HU, the difference was statistically significant (P<0.05). The difference between SNR and CNR is statistically significant (p<0.05). The positive rates of FFR

at the image segment level of the three groups were3.75%, 6.25% and 7.5%,the difference was not statistically significant (P>0.05). The positive rates of FFRCT in patients were 20%, 40% and 40%,the difference was not statistically significant(P>0.05). There was no statistically significant difference in the positive rate of FFRCT at the vascular level(P>0.05).

CLINICAL RELEVANCE/APPLICATION

Use Fractional Flow Reserve (FFR) software to analyze coronary artery FFRCT value will not change with the change of reconstruction algorithm during scanning,Shows good robustness.In order to clinically judge whether there is ischemia in normal coronary arteries, it is of guiding significance.

PH05-B9   Deep Silicon-based Photon Counting CT: Improved Estimation Accuracy Of Radiomics Features For Lung Lesions

Participants
Shobhit Sharma, MSc, BEng, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To quantify the impact of improved spatial resolution performance of a prospective deep silicon-based photon-counting CT (Si-PCCT) on the estimation accuracy of morphological radiomics features of lung lesions.*Methods and Materials Computational models for lung lesions ("ground truth") across three spiculation categories - low, medium, and high - were generated using a dynamic nutrient-access-based stochastic growth model. The lesion models were inserted into high resolution computational human models (0.1 mm voxel size) that incorporate detailed lung architecture including airways, vasculature, and parenchymal structures. A CT simulation platform (DukeSim) was extended to model the scanner-specific geometry and components for a prospective Si-PCCT system. The simulation process involved incorporating response and crosstalk characteristics of the Si detector (pixel size: 0.2-0.4 mm in x, 0.5-0.7 mm in z), energy-binning of photon counts, addition of Poisson noise, generation of energy-summed grayscale images, and correcting for effects of beam hardening. The human models with lesions were "imaged" using helical scans (120 kV, pitch 1) with the largest pixel size (0.4 mm in x, 0.7 mm in z) at clinically representative dose levels and the resulting sinograms were reconstructed using typical specifications (FOV: 150 mm, size: 512x512, slice thickness: 0.4 mm). The lesions were segmented from the simulated images using Advantage Workstation (GE Healthcare). A series of 21 morphological radiomics features were estimated for both "ground truth" and imaged lesions using repeated simulated acquisitions, and the resulting bias from truth was quantified as relative differences. To compare performance to conventional CT, corresponding features from images simulated for an energy-integrating (ECT) system (Revolution CT, GE Healthcare) (slice thickness: 0.6 mm) were also estimated and the improvement in estimation accuracy from Si-PCCT was quantified as differences of biases from "ground truth".*Results The simulations revealed noted improvements in estimation accuracy for Si-PCCT over ECT, with mean differences (averaged over all radiomics features) at 43.47%, 30.71%, and 41.53% for low, medium, and high spiculation categories, respectively.*Conclusions The quantitative imaging performance of Si-PCCT for estimation of morphological radiomics features was superior to ECT with noted improvements in estimation accuracy for most features across all lesion categories.*Clinical Relevance/Application Shape-based morphological radiomics features serve as imaging biomarkers for a variety of malignancies. The improved spatial resolution performance of Si-PCCT has the potential to enhance the measurement accuracy of such features.

RESULTS

The simulations revealed noted improvements in estimation accuracy for Si-PCCT over ECT, with mean differences (averaged over all radiomics features) at 43.47%, 30.71%, and 41.53% for low, medium, and high spiculation categories, respectively.

CLINICAL RELEVANCE/APPLICATION

Shape-based morphological radiomics features serve as imaging biomarkers for a variety of malignancies. The improved spatial resolution performance of Si-PCCT has the potential to enhance the measurement accuracy of such features.

Abstract Archives of the RSNA, 2021

Sub-Events

NR03-D1   Brain Tumor Connectomics: Mapping The Intra-tumoral Complex Interaction Network Using Graph Theoretic Machine Learning

Participants

Michael A. Jacobs, PhD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Brain tumors are heterogeneous with intratumoral microenvironments. Functional brain networks have been studied using both task- and resting state-based fMRI with applications in brain cancer for presurgical brain mapping and therapeutic planning. To better understand brain tumor microenvironments, we developed a tumor connectomics framework (TCF) based on advanced graph theory with unsupervised machine learning to model the interactions within the brain tumor microenvironment.*Methods and Materials The brain tumor TCF was modeled using a nonlinear machine learning with advanced graph theoretic metrics to map complex intratumoral networks. This allows for unbiased evaluation of the tumor microenvironment without assumption of a fixed classes or segmentation boundaries. The graph metrics were centrality measures, average path length, and clustering from a multiparametric MRI (T1, T2, FLAIR, DWI, and post contrast images from brain subjects (n=24) in a retrospective study. Quantitative mpMRI and graph metrics were calculated. A two-sided t-test was performed to compare the tumor grades. We computed the area under the receiver operating characteristic curve (AUC) for each of the graph metrics for tumor grade separation. Statistical significance was set at p<0.05.*Results The mean age of the patients was 51±15 years (13 male,11 female). Nine patients with WHO grade II (37.5%) and fifteen patients (62.5%) with WHO grade IV tumor. The Grade IV tumors demonstrated lower clustering coefficient (0.84±0.06) and degree centrality (0.56±0.17) compared to Grade II (0.90±0.04,0.74±0.15). Grade IV demonstrated greater betweenness centrality and average path length than Grade II tumors. The most predictive metric for classifying Grade II from Grade IV tumors was the average path length (AUC=0.85 (95% CI=0.69-1.00)) with sensitivity and specificity values of 60% and 100%. For tumor segmentation with peri-tumoral edema, there were no significant differences between the ADC values for Grade IV (1.38±0.34x10-3mm2/s) and Grade II tumors(1.54±0.29x10-3mm2/s). However, the ADC values for brain tumor segmentations without peritumoral edema were significantly different (p=0.002) between Grade II (1.58±0.29x10-3mm2/s) and Grade IV tumors (1.13±0.25x10-3mm2/s).*Conclusions We have developed a brain TCF for classification, visualization, and analysis of the tumor environments by using complex graph network theory based on mpMRI permitting regional analysis of the lesions.*Clinical Relevance/Application The TCF features derived from mpMRI of brain tumors reveal the complex interactions of brain tumor core and peritumoral environments. These features will help in improving diagnostics and treatment planning in clinical decision-making.

RESULTS

The mean age of the patients was 51±15 years (13 male,11 female). Nine patients with WHO grade II (37.5%) and fifteen patients (62.5%) with WHO grade IV tumor. The Grade IV tumors demonstrated lower clustering coefficient (0.84±0.06) and degree centrality (0.56±0.17) compared to Grade II (0.90±0.04,0.74±0.15). Grade IV demonstrated greater betweenness centrality and average path length than Grade II tumors. The most predictive metric for classifying Grade II from Grade IV tumors was the average path length (AUC=0.85 (95% CI=0.69-1.00)) with sensitivity and specificity values of 60% and 100%. For tumor segmentation with peri-tumoral edema, there were no significant differences between the ADC values for Grade IV (1.38±0.34x10-3mm2/s) and Grade II tumors(1.54±0.29x10-3mm2/s). However, the ADC values for brain tumor segmentations without peritumoral edema were significantly different (p=0.002) between Grade II (1.58±0.29x10-3mm2/s) and Grade IV tumors (1.13±0.25x10-3mm2/s).

CLINICAL RELEVANCE/APPLICATION

The TCF features derived from mpMRI of brain tumors reveal the complex interactions of brain tumor core and peritumoral environments. These features will help in improving diagnostics and treatment planning in clinical decision-making.

NR03-D2   Multiphase Computed Tomography Angiography In Acute Ischemic Stroke, Beyond Collaterals: Can It Obviate The Need For Computed Tomography Perfusion?

Participants

Aanchal Gupta, MD, Jodhpur, India (*Presenter*) Nothing to Disclose

PURPOSE

Multimodal imaging has been in use in patients presenting with an acute ischemic stroke which comprises of Non-contrast Computed Tomography (NCCT), Computed Tomography Angiography (CTA), and Computed Tomography Perfusion (CTP). Our study aims to evaluate the correlation between source images derived from multiphase CTA with CTP parameters.*Methods and Materials After the approval of the institutional ethics committee, a prospective study included all patients presenting with acute ischemic stroke within 24 hours of onset who had anterior circulation major vessel occlusion. All images were acquired on Siemens, Somatom Definition Flash Dual Energy 128x2 Slice Multidetector CT. ASPECTS (Alberta Stroke program early CT score) was calculated for each: NCCT, 3 phases of CTA, Cerebral blood flow (CBF), and cerebral blood volume (CBV) color maps of CTP. Data analysis was done by using IBM, SSPS statistical software version 23. Pearson's correlation coefficient (r) was derived and p-value <0.01 was considered statistically significant.*Results The study included 55 patients with 40 males and 15 females. The mean duration of

presentation from the onset of ictus was 4.7 + 4.98 hours, mean NIHSS score was 12.4 + 5.09. The mean ASPECTS on NCCT was 8.16 + 1.77. Significant positive correlation was found between CBF with 1st and 2nd phase of CTA (r=0.845, p=<0.01 and r=0.842, p=<0.01 respectively). CBV correlated significantly with 3rd phase of CTA (r=0.904, p=<0.01). The 3rd phase of CTA correlated significantly with NCCT (r=0.737, p=<0.01).*Conclusions Multiphase CTA, apart from depicting collateral status and true clot length, can be used similar to CBV and CBF in determining the penumbra and infarcted core and can obviate the need for obtaining CTP.*Clinical Relevance/Application Multiphase CTA requires no additional contrast bolus and provides valuable information regarding major vessel occlusion, true clot length, and collateral status in the ischemic zone. Our study casts light on how the source images derived from multiphase CTA correlate with CTP parameters and can be valuable in determining the penumbra and infarcted core and guide the decision for mechanical thrombectomy.

RESULTS

The study included 55 patients with 40 males and 15 females. The mean duration of presentation from the onset of ictus was 4.7 + 4.98 hours, mean NIHSS score was 12.4 + 5.09. The mean ASPECTS on NCCT was 8.16 + 1.77. Significant positive correlation was found between CBF with 1st and 2nd phase of CTA (r=0.845, p=<0.01 and r=0.842, p=<0.01 respectively). CBV correlated significantly with 3rd phase of CTA (r=0.904, p=<0.01). The 3rd phase of CTA correlated significantly with NCCT (r=0.737, p=<0.01).

CLINICAL RELEVANCE/APPLICATION

Multiphase CTA requires no additional contrast bolus and provides valuable information regarding major vessel occlusion, true clot length, and collateral status in the ischemic zone. Our study casts light on how the source images derived from multiphase CTA correlate with CTP parameters and can be valuable in determining the penumbra and infarcted core and guide the decision for mechanical thrombectomy.

NR03-D3 Is The RSNA Challenge-winner's Deep Learning Model Generalizable?: Intracranial Hemorrhage Detection For Independent Population Datasets

Participants
Changwon Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To verify if the RSNA-challenge-winner deep learning model could work equally well for independent patient populations despite the potential differences in CT scan protocols and disease patterns in cerebral hemorrhage detection.*Methods and Materials We used the deep learning model (DLM) publicly released from the 1st place winner in the machine learning challenge for RSNA 2019 intracranial hemorrhage detection (ICH) challenge. The DLM is a unique composite of 2D CNN, LSTM, and 1D CNN integrating information on CT image sequences and meta data. We repeated the training and testing of the DLM with the challenge dataset. We tested the trained DLM with two independent population datasets: CQ500 dataset from Indian population with scan protocols of standard and high dose (120 ~ 140 kV, 178 ~ 610 mAs); Korea University Medical Center (KUMC) dataset from Korean population with low dose scan protocol (100 ~ 120 kV, 59 ~ 100 mAs). Both datasets contained ICH subtypes similar to those of RSNA challenge dataset. Gold stands for both datasets were established by experienced neuroradiologists. Sensitivity and specificity were obtained for two datasets and compared with that of RSNA dataset.*Results While the RSNA DLM produced an overall good performance for CQ500 dataset with 84.9% sensitivity and 95.4% specificity which were comparable to the RSNA test dataset (93.2% sensitivity, 98.8% specificity), the performance was much lower for the KUMC dataset with 43.3% sensitivity and 81.3% specificity.*Conclusions The RSNA challenge winner DLM showed different performances for independent population datasets. Even though a DLM was proven in a challenge contest, care should be taken when applying the model to a different clinical environment especially with lower dose scan settings.*Clinical Relevance/Application This study is to be a basis for pre-processing studies of intracranial hemorrhage detection using artificial intelligence in non-contrast enhanced head CT images.

RESULTS

While the RSNA DLM produced an overall good performance for CQ500 dataset with 84.9% sensitivity and 95.4% specificity which were comparable to the RSNA test dataset (93.2% sensitivity, 98.8% specificity), the performance was much lower for the KUMC dataset with 43.3% sensitivity and 81.3% specificity.

CLINICAL RELEVANCE/APPLICATION

This study is to be a basis for pre-processing studies of intracranial hemorrhage detection using artificial intelligence in non-contrast enhanced head CT images.

NR03-D5 Post-mortem Correlates Of Virchow-robin Spaces Detected On In-vivo MRI

Participants
Lukas Haider, MD,PhD, Vienna, Austria (*Presenter*) Nothing to Disclose

PURPOSE

To quantify the extent, to which Virchow-Robin spaces (VRS) detected on in-vivo MRI can be found post-mortem.*Methods and Materials Double Echo Steady State MRIs were acquired post-mortem in 49 double- and 32 single-hemispheric formalin-fixed brain sections from 12 control subjects at 3T, who underwent conventional diagnostic 1.5 or 3T MRI within 5 months before death.VRS were manually segmented in in-vivo and post-mortem. The post-mortem MRIs were manually co-registered with the corresponding in-vivo MRIs based on anatomical landmarks with Freesurfer. The overlap of in-vivo- and post-mortem VRS segmentations was manually determined for each tissue-block. Histological validation of post-mortem VRS was obtained in on a double hemispheric section.*Results The median age at death was 62 years (25% to 75%: 50 to 77). The time from MRI to death was in median 22 days (25% to 75%: 12 to 134). The formalin fixation-time at post-mortem MRI acquisition was in median 236 days (25% to 75%: 136 to 407). Subjects died in the course of various conditions including malignant/metastatic disease (n=7), interventional complications (n=2), cardio-pulmonary resuscitation (n=1), tuberculosis (n=1) and amyloid angiopathy (n=1).In the supratentorial white matter, in median 80% (25% to 75%: 60 to 100) of VRS found on in-vivo MRI were reproduced by post-mortem imaging, in total numbers in median 15 VRS/ patient (25% to 75%: 9 - 36). A lower percentage was reproduced in the basal ganglia, in median 47% (25% to 75%: 30 to 50).In the supratentorial white matter, in median 44 VRS/patient (25% to 75%: 17 - 87) were detected on post-mortem MRI without in-vivo correlate and in the basal ganglia in median 1.5 VRS/patient (25% to 75%: 0 - 5.8).Post-mortem VRS segmentations were histologically confirmed in one double hemispheric section.*Conclusions The majority of VRS found on in-vivo MRI was stable throughout death and formalin fixation.*Clinical Relevance/Application Post-mortem MRI can guide tissue dissection to further investigate the histological and biological correlates of VRS.

RESULTS

The median age at death was 62 years (25% to 75%: 50 to 77). The time from MRI to death was in median 22 days (25% to 75%: 12 to 134). The formalin fixation-time at post-mortem MRI acquisition was in median 236 days (25% to 75%: 136 to 407). Subjects died in the course of various conditions including malignant/metastatic disease (n=7), interventional complications (n=2), cardio-pulmonary resuscitation (n=1), tuberculosis (n=1) and amyloid angiopathy (n=1).In the supratentorial white matter, in median 80% (25% to 75%: 60 to 100) of VRS found on in-vivo MRI were reproduced by post-mortem imaging, in total numbers in median 15 VRS/ patient (25% to 75%: 9 - 36). A lower percentage was reproduced in the basal ganglia, in median 47% (25% to 75%: 30 to 50).In the supratentorial white matter, in median 44 VRS/patient (25% to 75%: 17 - 87) were detected on post-mortem MRI without in-vivo correlate and in the basal ganglia in median 1.5 VRS/patient (25% to 75%: 0 - 5.8).Post-mortem VRS segmentations were histologically confirmed in one double hemispheric section.

CLINICAL RELEVANCE/APPLICATION

Post-mortem MRI can guide tissue dissection to further investigate the histological and biological correlates of VRS.

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Abstract Archives of the RSNA, 2021

Sub-Events

IN03-A1   Local And Contextual Information Used By A Deep Learning Model For Carina Detection

Participants
Alec Baenen, Waukesha, Wisconsin (*Presenter*) Employee, General Electric Company

PURPOSE

The carina serves as a key anatomical reference point in chest x-rays. In some images, the carina is clearly visible where the trachea bifurcates into the left and right main bronchi. In other cases, the local features of the carina may be obscured by foreign objects or pathology. In such cases, carina location can be estimated based on contextual information (e.g., location of vertebrae or aortic arch). This study investigates how a deep learning model trained for carina detection can use local and contextual information to detect the location of the carina in chest X-rays.*Methods and Materials A carina detection model within a commercially available AI algorithm was evaluated on a test set of 400 frontal chest X-ray images. Within this test set, a synthetic, circular patch of constant intensity and varying widths was included to cover the carina and assess the impact of the patch on localization accuracy. Note that during model development the synthetic patch was not applied in any form.*Results Results showed that the model detected the carina with consistent robustness in the presence of the patch. When increasing the patch radius from 0cm to 2cm, the detection success rate dropped slightly from 100% to 98.8%, and the average detection error increased from 0.44 cm to 0.96 cm, indicating that in most cases the detected carina was inside the patch. Additionally, the histogram of detection errors showed carina detection was pushed to the edge for small patches. For larger patches, a second histogram peak became dominant which corresponded to a detection inside the patch. Our initial interpretation suggests that for small patches the area around the patch still offers reasonable carina locations, consistent with both local and contextual information. If the patch is too large and points outside the patch become inconsistent with the contextual information, then the model ignores the local information and picks a point inside the patch. The saliency maps highlighting the areas contributing to the selected carina location are consistent with the initial interpretation.*Conclusions This study supports the conclusion that a deep learning AI model can accurately determine carina location based on contextual information even when all local information is erased, mirroring the estimation practices currently in place with radiologists interpreting chest X-rays.*Clinical Relevance/Application Given the variability in X-ray imaging (i.e., presence of foreign objects, pathology, and image quality), deep learning models must maintain robust performance in the presence of local disturbing factors. This study offers one method of evaluating this robustness, however additional methodologies for assessing deep learning models in real-world clinical context are needed.

RESULTS

Results showed that the model detected the carina with consistent robustness in the presence of the patch. When increasing the patch radius from 0cm to 2cm, the detection success rate dropped slightly from 100% to 98.8%, and the average detection error increased from 0.44 cm to 0.96 cm, indicating that in most cases the detected carina was inside the patch. Additionally, the histogram of detection errors showed carina detection was pushed to the edge for small patches. For larger patches, a second histogram peak became dominant which corresponded to a detection inside the patch. Our initial interpretation suggests that for small patches the area around the patch still offers reasonable carina locations, consistent with both local and contextual information. If the patch is too large and points outside the patch become inconsistent with the contextual information, then the model ignores the local information and picks a point inside the patch. The saliency maps highlighting the areas contributing to the selected carina location are consistent with the initial interpretation.

CLINICAL RELEVANCE/APPLICATION

Given the variability in X-ray imaging (i.e., presence of foreign objects, pathology, and image quality), deep learning models must maintain robust performance in the presence of local disturbing factors. This study offers one method of evaluating this robustness, however additional methodologies for assessing deep learning models in real-world clinical context are needed.

IN03-A2   Machine Learning Based CT Texture Analysis For Assessing Acute Pulmonary Radiation Injury

Participants
Shayan Shafiee, MSc,MSc, Wauwatosa, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

While CT density of lungs is projected to be a marker of radiation pneumonitis, robust quantitative metrics that are not sensitive to image acquisition or scanner variability do not exist. We propose the use of machine learning enhanced noninvasive methods to track the lung morphology changes caused by acute radiation injury, only using the non-contrast-enhanced X-ray CT imaging data. We implemented and quantitatively assessed state-of-the-art CT image texture-based radiomic measures with Machine Learning (ML) algorithms to determine their efficacy in classifying a subject's radiation injury status.*Methods and Materials A validated rat model of radiation injury was employed with rats treated with partial body 13Gy radiation and lungs assessed with periodic micro-CT measurements. Rats were randomized into blinded control and injury groups. Auto-segmented lung images were analyzed to extract five texture-type groups, including First-order histogram (or global), Gray-level co-occurrence matrix, Gray-level run-length matrix, Gray-level size zone matrix, and Neighborhood gray-tone difference matrix resulting in 334 different radiomics features. To develop

an accurate yet optimal prognosis model, we used supervised ML algorithms to refine and extract features with significant correlation with progressive pulmonary radiation injury. We used this algorithm to classify endpoint events to determine if the case was radiated or not.*Results The accuracy of the classification of a subject into control or radiated was up to 98% in a separate validation cohort of animals. The algorithm computed p-values for Pearson's correlation by transforming the correlation to create a t-statistic with 14 degrees of freedom and p-values for the Kendall rank correlation using the exact permutation distributions for small sample size approximations. In both cases, the feature selection and classification were performed based on p-values<0.001.*Conclusions The high accuracy of this method, validated on an unobserved group study, indicates the potential of machine learning approaches in assessing pulmonary radiation injury and other diagnostic assessments.*Clinical Relevance/Application Quantitative assessment of radiation toxicity is critical for indicating treatment strategies for accidental radiation and cancer patients. Such an assessment can help with the prognosis of the clinical outcomes and likelihood of developing adverse cardiovascular conditions due to radiotherapy. Our proposed method uses machine learning-enhanced noninvasive methods to track the pulmonary system changes caused by radiation, only using the non-contrast-enhanced X-ray CT imaging data.

RESULTS

The accuracy of the classification of a subject into control or radiated was up to 98% in a separate validation cohort of animals. The algorithm computed p-values for Pearson's correlation by transforming the correlation to create a t-statistic with 14 degrees of freedom and p-values for the Kendall rank correlation using the exact permutation distributions for small sample size approximations. In both cases, the feature selection and classification were performed based on p-values<0.001.

CLINICAL RELEVANCE/APPLICATION

Quantitative assessment of radiation toxicity is critical for indicating treatment strategies for accidental radiation and cancer patients. Such an assessment can help with the prognosis of the clinical outcomes and likelihood of developing adverse cardiovascular conditions due to radiotherapy. Our proposed method uses machine learning-enhanced noninvasive methods to track the pulmonary system changes caused by radiation, only using the non-contrast-enhanced X-ray CT imaging data.

IN03-A3   Not So Smart - What To Consider If You Think The AI Has Made The Wrong Call

Participants
Kobi Fogel, MD, Bronx, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

• AI algorithms in Radiology make mistakes, both misses (false negatives) and incorrect calls (false positives). Radiologists need to develop the skills to recognize AI mistakes so that they do not reach patients, and do not influence the read.• The smart assistant is like having a resident to read out with. While it is nice to have an extra set of eyes and an opinion on the findings, the radiologist is ultimately responsible for the final interpretation of the case.• Radiologists should always read the study 1st without looking at the AI results, to avoid bias.• If there is significant artifact in a study, and the call is likely based on that artifact, disregard the call. • If the call AI call is discrepant from your initial read but the result is not clear to the reader: o Consider the test characteristics of the algorithm (on local cases if available). Should we expect false positives or false negatives by design? o Consider other factors about the study that may be influencing the algorithm. Would this case have been in the test set? o Take clinical context and prior images into account. The algorithm usually does not use this information. o When in doubt, ask another human.• Keep an open mind. Did your biases cause you to miss a call? Always learn from your mistakes. AI can also teach us.

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• Discrepant AI output - a new type of interpretative error• Situations where you should dismiss an AI call• Framework to handle a discrepancy.

Abstract Archives of the RSNA, 2021

Sub-Events

NR04-A1   Reconstruction Of Resting State Fmri On Subcortical Morphology Using Sequential Graph Variational Autoencoder.

Participants
Yunan Wu, Evanston, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

To develop a graph-based variational autoencoder (gVAE) with a sequential Long Short Term Memory (LSTM) to learn the patterns of resting state functional MRI (rsfMRI) subcortical activity in healthy subjects from the mesh representations of subcortical structures.*Methods and Materials Fully preprocessed rsfMRI from 195 healthy subjects from the UK Biobank were included. Each rsfMRI session included 480 time points with a repetition time of 0.735s. Seven subcortical structures per hemisphere were modeled as surface meshes and converted to graphs where nodes (N =14848) of the graphs were surface vertices and edges were links across vertices. rsfMRI intensities sampled at each vertex and each time point were used as input features. The gVAE model consisted of an encoder and a decoder, where the encoder represented low-dimensional rsfMRI activities (N = 256) using latent vectors, and the decoder reconstructed those vectors back to the original signals. The LSTM was used within the gVAE to extract the temporal representations of rsfMRI signals by training six time points at a time. Mean Square Error (MSE) and Pearson's coefficient of correlation (R) measured the spatial and temporal reconstruction performances. Our gVAE was trained on 80 healthy subjects and validated on 20 subjects to learn the representations of rsfMRI activities. The 95 remaining subjects composed the testing set and were used to map the average reconstruction error at each vertex and each time point to quantify the reconstruction performance across the subcortical structures.*Results The reconstruction performance of rsfMRI on the 95 healthy subjects of the testing set yielded an average spatial MSE = 0.399 ± 0.115 and R = 0.756 ± 0.102, and an average temporal MSE = 0.405 ± 0.129 and R = 0.752 ± 0.040. Excellent reconstruction maps were obtained for seven subcortical structures with the exception of moderate performance in the pallidum and nucleus accumbens.*Conclusions Our novel gVAE method is capable of successfully reconstructing patterns of normal subcortical activity with good reconstruction performance. This paves the way to develop this as a tool for investigating subcortical rsfMRI activity in the context of neurologic disorders. Additional development can also lead to application for gVAE rsfMRI analysis of the cortical surface.*Clinical Relevance/Application Our novel gVAE approach can predict subcortical rsfMRI signal in healthy subjects. Further development can impact the clinical investigation of a variety of neurologic conditions. Of particular interest is epilepsy whereby reconstruction "errors" may potentially reflect underlying perturbations within the epilepsy network, yielding a novel tool for use in the presurgical evaluation of patients with refractory seizures.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Our novel gVAE approach can predict subcortical rsfMRI signal in healthy subjects. Further development can impact the clinical investigation of a variety of neurologic conditions. Of particular interest is epilepsy whereby reconstruction "errors" may potentially reflect underlying perturbations within the epilepsy network, yielding a novel tool for use in the presurgical evaluation of patients with refractory seizures.

NR04-A4   Altered Brain Network Centrality In Patients With Non-npsle: A Resting-state Functional Magnetic Resonance Imaging Study

Participants
XiaoLou Li, DaLian, China (*Presenter*) Nothing to Disclose

PURPOSE

Neuropsychiatric manifestations are highly prevalent in systemic lupus erythematosus (SLE) patients. However, it is hard to diagnose&the potential pathogenic mechanisms are still unclear. The aim of this study was to explore potential changes in brain function network activity in SLE patients without major neuropsychiatric manifestations (non-NPSLE) using the voxel-wise degree centrality (DC) method.*Methods and Materials A total of 32 non-NPSLE patients&28 healthy controls (HCs) were recruited in this study. Degree centrality (DC)—a graph theory-based measurement of global connectivity at the voxel level by measuring the number of instantaneous functional connections between one region and the rest of the brain—can map brain hubs with high sensitivity, specificity, reproducibility. Independent twos ample t-test&receiver operating characteristic (ROC) curve analysis were performed to compare the difference of DC values between the two groups, so as to distinguish the accuracy of non-NPSLE diagnosis. Spearman's linear regression correlation analysis was used to examine the relationships between mean DC values in various brain regions&clinical features in non-NPSLE patients.*Results Compared to the HCs group, the non-NPSLE patients showed remarkably increased DC values in the bilateral postcentral gyrus,decreased in the left frontal mid orb (p<0.05, AlphaSim corrected). There were no significant differences in other gray matter regions. ROC curve analysis indicated that the area under the curve

(AUC) of some cerebral region studied had a perfect diagnostic value (AUC=0.812 and 0.865, respectively). The sensitivity of the DC of the bilateral postcentral gyrus was 0.714 ,0.786 respectively, while the specificity of those parameters was 0.926,0.815 respectively. In addition, linear analysis indicated that the DC values of the left frontal mid orb were positively correlated with SLE disease activity index (SLEDAI) (r = 0.503, p<0.05) ,the IgA of non-NPSLE patients were positively correlated with the DC values of the right postcentral gyrus&left frontal mid orb (r =0.513, p<0.05; r=0.469, p<0.05, respectively).*Conclusions Non-NPSLE patients exhibit abnormal brain network activity in various brain regions, indicating that rs-fMRI is a promising tool for detecting the brain function disorders in non-NPSLE patients.*Clinical Relevance/Application These changes of DC may be useful to underlie the pathological mechanism of non-NPSLE&provide new ideas for monitoring&treating non-NPSLE patients.

RESULTS

Compared to the HCs group, the non-NPSLE patients showed remarkably increased DC values in the bilateral postcentral gyrus,decreased in the left frontal mid orb (p<0.05, AlphaSim corrected). There were no significant differences in other gray matter regions. ROC curve analysis indicated that the area under the curve (AUC) of some cerebral region studied had a perfect diagnostic value (AUC=0.812 and 0.865, respectively). The sensitivity of the DC of the bilateral postcentral gyrus was 0.714 ,0.786 respectively, while the specificity of those parameters was 0.926,0.815 respectively. In addition, linear analysis indicated that the DC values of the left frontal mid orb were positively correlated with SLE disease activity index (SLEDAI) (r = 0.503, p<0.05) ,the IgA of non-NPSLE patients were positively correlated with the DC values of the right postcentral gyrus&left frontal mid orb (r =0.513, p<0.05; r=0.469, p<0.05, respectively).

CLINICAL RELEVANCE/APPLICATION

These changes of DC may be useful to underlie the pathological mechanism of non-NPSLE&provide new ideas for monitoring&treating non-NPSLE patients.

NR04-A7 Deep Learning-aided Prediction Of Stereotactic Neurosurgical Resection Status: Analysis Of Preoperative Magnetic Resonance Imaging Data Of Intracranial Meningiomas

Participants
Manoj Mannil, Muenster, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Meningiomas are the most frequently encountered extra-axial tumors of the central nervous system and are usually treated by surgical resection. Incomplete surgical removement is a risk factor for tumor progression and recurrence. In this retrospective analysis we investigated the predictive ability of transfer deep learning regarding incomplete Meningioma resection status in a multicenter cohort trial.*Methods and Materials In this study we analyzed 287 of 413 patients with intracranial meningiomas. Included patients had pre- and post-treatment diagnostic magnetic resonance T1 post-contrast sequence images. Tumor resection status was evaluated based on surgical assessment according to the Simpson classification and postoperative imaging. As a deep learning framework we used PyTorch in its fast.ai implementation and for transfer learning 'VGG19 bn' was utilized. The images were split into training, testing and validation data sets.*Results Based on the unseen validation data set out deep learning model was able to correctly predict meningioma resection status with a sensitivity of 81%, a specificity of 80%, a precision of 0.91 and an accuracy of 0.8.*Conclusions A deep learning analysis of preoperative MR imaging of Meningiomas may add value by identifying patients in risk of incomplete resection.*Clinical Relevance/Application Possible identification of patients with high risk of incomplete Meningioma resection and support in further therapy planning.

RESULTS

Based on the unseen validation data set out deep learning model was able to correctly predict meningioma resection status with a sensitivity of 81%, a specificity of 80%, a precision of 0.91 and an accuracy of 0.8.

CLINICAL RELEVANCE/APPLICATION

Possible identification of patients with high risk of incomplete Meningioma resection and support in further therapy planning.

NR04-A9 Comprehensive Fully Automated Intracranial Occlusion Detection On Multiphase CT Angiography

Participants
Luis Souto Maior Neto, MSc, Calgary, Alberta (*Presenter*) Developer, Circle Cardiovascular Imaging Inc

PURPOSE

This study aims to develop and validate a data driven fully automated approach that differentiates large vessel occlusions (LVO), medium vessel occlusions (MeVO), and distal occlusions from each other on multiphase CT Angiography (mCTA) and CT Perfusion (CTP).*Methods and Materials A total of 346 cases (173 LVO, 91 MeVO, 82 distal occlusions) with mCTA and CTP were used as the reference database. The data was uniformly split 80%/20% for training/validation purpose. Tmax maps were extracted by the StrokeSENS mCTA Perfusion software, which estimates CT Perfusion (CTP) parameters from mCTA using convolutional neural networks. Hand engineered features were derived from these Tmax maps for each of 20 ASPECTS brain regions and used to train a logistic regression model for detecting occlusion type. To evaluate performance, validation metrics were reported in comparison to ground-truth CTP Tmax maps.*Results The validation scores for the three differentiations, namely, "LVO vs. not", "MeVO vs. not", "Distal occlusion vs. not" respectively for the mCTA perfusion model were the following i.e. AUC: 0.901, 0.857, 0.971; Sensitivity [95% CI]: 0.71 [0.55, 0.869], 0.6 [0.387, 0.781], 1 [0.806, 1.0]; Specificity [95% CI]: 0.917 [0.782, 0.971], 0.872 [0.777, 0.968], 0.843 [0.743, 0.943]. Comparative results for the ground truth CTP models were the following i.e. AUC: 0.873, 0.838, 0.997; Sensitivity [95% CI]: 0.645 [0.477, 0.814], 0.7 [0.481, 0.855], 0.938 [0.717, 0.989]; Specificity [95% CI]: 0.861 [0.713, 0.939], 0.787 [0.67, 0.904], 0.941 [0.841, 0.98].*Conclusions An automated mCTA perfusion-based method was able to achieve excellent performance in differentiation of LVO, MeVO and distal occlusions when compared to assessment of ischemia extent on CTP.*Clinical Relevance/Application Timely, efficient and reliable detection of different types of intracranial vessel occlusions are critical in helping physicians determine what therapy (if required) can be effective in patients with acute ischemic stroke.

RESULTS

The validation scores for the three differentiations, namely, "LVO vs. not", "MeVO vs. not", "Distal occlusion vs. not" respectively for the mCTA perfusion model were the following i.e. AUC: 0.901, 0.857, 0.971; Sensitivity [95% CI]: 0.71 [0.55, 0.869], 0.6 [0.387, 0.781], 1 [0.806, 1.0]; Specificity [95% CI]: 0.917 [0.782, 0.971], 0.872 [0.777, 0.968], 0.843 [0.743, 0.943]. Comparative results for the ground truth CTP models were the following i.e. AUC: 0.873, 0.838, 0.997; Sensitivity [95% CI]: 0.645

[0.477, 0.814], 0.7 [0.481, 0.855], 0.938 [0.717, 0.989]; Specificity [95% CI]: 0.861 [0.713, 0.939], 0.787 [0.67, 0.904], 0.941 [0.841, 0.98].

CLINICAL RELEVANCE/APPLICATION

Timely, efficient and reliable detection of different types of intracranial vessel occlusions are critical in helping physicians determine what therapy (if required) can be effective in patients with acute ischemic stroke.

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Sub-Events

SDP-NMMI-1 Outcome Prediction In Hodgkin Lymphoma - Utility Of Pre-treatment FDG PET/CT Derived Machine Learning Models

Participants
Russell Frood, MBBCh, Leeds, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

2-[18F]fluoro-D-glucose (FDG) positron emission tomography/computed tomography (PET/CT) plays an integral role in staging, response assessment and treatment stratification of classical Hodgkin lymphoma (cHL), with therapy adaptation based on imaging after 2 cycles of chemotherapy. However, even with this strategy, approximately 20% will recur or relapse. The aim of the study was to explore the utility of machine learning (ML) models using features derived from pre-treatment PET/CT for prediction of 2-year event free survival (2-EFS) in cHL patients.*Methods and Materials All patients who underwent baseline PET/CT for staging of cHL at our institution between January 2008 and January 2018 were retrospectively identified. Patients were excluded if they received treatment prior to imaging, had primary cutaneous or central nervous system involvement, were aged < 16 years or had stage 1 disease. A semi-automated contour with a threshold of 1.5 times mean liver standardised uptake value was applied to the PET and the contour translated to and adjusted to the soft tissue on the CT. Feature extraction was performed using PyRadiomics with neuroCombat subsequently applied. Cases were split into training (80%) and testing (20%) cohorts, stratified around 2-EFS, age, gender and disease stage. Four ML models (logistic regression, random forest, k-nearest neighbour, support vector machine (SVM)) were trained and hyperparameters tuned on the training cohort using stratified 4-fold cross validation. The optimum number of features were selected using a forward wrapper method. The model with the highest mean area under the curve (AUC) derived from the receiver operator characteristic (ROC) curve from the training cohort cross validation with the smallest difference between the mean training and validation AUCs was tested once on the unseen test cohort.*Results 261 patients (126 female, 135 male, median age 36 years (range 16-88 years)) were included in the study. There was no significant difference in patient characteristics between the training cohort (n= 208) and test cohorts (n=53) (p-value > 0.05). The SVM model provided the best results within the cross validated training set with a mean training AUC of 0.78 (std 0.02), mean validation AUC of 0.75 (std 0.06) and test AUC of 0.72 with age, least length in axis on PET and PET grey level dependence matrix - low grey level emphasis selected as features.*Conclusions Outcome prediction using features derived from pre-treatment FDG PET/CT in cHL patients is feasible, although further external validation is required.*Clinical Relevance/Application The ability to predict patient outcome pre-treatment aids clinical prognostication and in the future may help guide personalised therapy and improve survival.

RESULTS

261 patients (126 female, 135 male, median age 36 years (range 16-88 years)) were included in the study. There was no significant difference in patient characteristics between the training cohort (n= 208) and test cohorts (n=53) (p-value > 0.05). The SVM model provided the best results within the cross validated training set with a mean training AUC of 0.78 (std 0.02), mean validation AUC of 0.75 (std 0.06) and test AUC of 0.72 with age, least length in axis on PET and PET grey level dependence matrix - low grey level emphasis selected as features.

CLINICAL RELEVANCE/APPLICATION

The ability to predict patient outcome pre-treatment aids clinical prognostication and in the future may help guide personalised therapy and improve survival.

SDP-NMMI-10 Optimal Cut-off On Standardized Static 18F-FET PET CT Imaging For Differentiating Recurrence From Post Treatment Changes In Who High Grade Glioma.

Participants
Indraja Dev, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

PURPOSE

To assess the utility of 18F FET PET/CT and derive an optimal cut-off of T-Wm ratio in differentiating recurrence from post treatment changes in WHO grade III and IV glioma.*Methods and Materials We retrospectively analyzed 72 patients of post treatment high grade glioma (WHO grade III, IV) with equivocal features on follow up MRI. Patients were injected with 5-6 mCi (185-222MBq) of 18F O-(2-[18F]fluoroethyl)-l-tyrosine (FET). Dedicated static imaging of the brain was performed at 20 minutes post injection. T-Wm ratio was used as semi quantitative parameter. It is ratio of SUVmax at the tumor divided by SUVmean of contralateral white matter. Cutoff of 2.5 was used for image interpretation. Imaging findings were confirmed with either histopathological diagnosis in a multidisciplinary joint clinic or based on clinicoradiological follow up of patients.*Results Out of 72 patients, 41 were reported as recurrent disease, on follow up, 35 of them were confirmed as having recurrent disease and remaining 6 patients were interpreted as false positive. 31 patients were reported to have post treatment change, on follow up, 27 were confirmed as post treatment changes and 4 patients had confirmed recurrence on subsequent MR imaging. A cut-off of 2.65 with Youden's index of 0.7 was derived based on Receiver operating characteristic curve (ROC) analysis with sensitivity of 80% & specificity of 87.5%.*Conclusions Single point static 18F FET PET/CT can be used as specific imaging modality with optimal cut-off of 2.65 for T-Wm ratio to differentiate recurrence from post treatment changes in WHO grade III, IV Glioma with equivocal MRI

features.*Clinical Relevance/Application 18F FET PET/CT Imaging can help in early detection of recurrence & guide further treatment management and prognostication.

RESULTS

Out of 72 patients, 41 were reported as recurrent disease, on follow up, 35 of them were confirmed as having recurrent disease and remaining 6 patients were interpreted as false positive. 31 patients were reported to have post treatment change, on follow up, 27 were confirmed as post treatment changes and 4 patients had confirmed recurrence on subsequent MR imaging. A cut-off of 2.65 with Youden's index of 0.7 was derived based on Receiver operating characteristic curve (ROC) analysis with sensitivity of 80% & specificity of 87.5%.

CLINICAL RELEVANCE/APPLICATION

18F FET PET/CT Imaging can help in early detection of recurrence & guide further treatment management and prognostication.

SDP-NMMI-11   Impact Of Regularized Ordered Subsets Expectation-maximization Reconstruction Algorithm On Total-body 68Ga-FAPI-04 PET/CT

Participants
Yanchao Huang, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the impact of the regularized ordered subsets expectation-maximization (R-OSEM) reconstruction algorithm in total-body 68Ga-FAPI-04 PET/CT imaging and compare to OSEM reconstruction algorithm.*Methods and Materials Eleven patients (age 58.6± years, BMI 28.2±17.8 kg) with lung cancer have been enrolled in this study. They underwent a single-bed total-body 68Ga-FAPI PET examination (10 min) with standard administered dose (0.05±0.01 mCi/kg) using a 194-cm long axial field-of-view digital PET/CT scanner (uEXPLORER, United Imaging Healthcare). A series of PET images with various durations (e.g., 40 s, 60 s, 180 s, 300 s) were reconstructed using R-OSEM (Hyper Iterative, United Imaging Healthcare) and OSEM. To evaluate image quality, the overall image quality, lesion conspicuity, and image noise were scored using 5-point Likert scale. For quantitative assessment, we tracked the evolution of the time and regularization strength (ß) dependent PET-images (ß = 0.1, 0.25, 0.5, 0.75, and 1) where the objective metrics, for instance, the SUVmax at lesions, the SUVmean and SD at muscle and lesion-to-background ratio (LBR) were systematically analyzed and compared with OSEM.*Results Based on the reconstructed images of 68Ga-FAPI PET/CT, we revealed that the use of the R-OSEM reconstruction algorithm suppressed image noise and increased SUVmax at lesions. Although in 40-s PET images, the SUVmax at lesions and LBR did not show a significant difference than OSEM (T-test with/without Bonferroni correction, p > 0.2), SD at muscle illustrated an obvious difference (p < 0.05). Such improvement increased the image quality, consistent with the subjective evaluations. Specifically, R-OSEM-TOF with ß = 0.25 enables 60-s 68Ga-FAPI PET imaging to achieve a better anatomic profile and lesion conspicuity than that of OSEM.*Conclusions Combining both the R-OSEM and state-of-the-art PET/CT scanner, one can yield a PET with better image quality even at a short acquisition time.*Clinical Relevance/Application The regularized OSEM reconstruction algorithm has the potential to shorten the PET acquisition time while retaining the image quality.

RESULTS

Based on the reconstructed images of 68Ga-FAPI PET/CT, we revealed that the use of the R-OSEM reconstruction algorithm suppressed image noise and increased SUVmax at lesions. Although in 40-s PET images, the SUVmax at lesions and LBR did not show a significant difference than OSEM (T-test with/without Bonferroni correction, p > 0.2), SD at muscle illustrated an obvious difference (p < 0.05). Such improvement increased the image quality, consistent with the subjective evaluations. Specifically, R-OSEM-TOF with ß = 0.25 enables 60-s 68Ga-FAPI PET imaging to achieve a better anatomic profile and lesion conspicuity than that of OSEM.

CLINICAL RELEVANCE/APPLICATION

The regularized OSEM reconstruction algorithm has the potential to shorten the PET acquisition time while retaining the image quality.

SDP-NMMI-12   F-18 Amyvid PET CT In Asymptomatic Patients: Manual Versus Automated Analysis And Association With Patients' Global Cognitive Function

Participants
Riham El Khouli, MD,PhD, Nicholasville, Kentucky (*Presenter*) Nothing to Disclose

PURPOSE

Amyloid (Aß) deposition occurs years or even decades before the start of cognitive decline (preclinical Alzheimer's disease [pAD]). Amyloid (Aß)-PET imaging has been reliably used to detect pAD across numerous studies. Although visual assessment of Aß-PET imaging is considered gold standard, it is subject to inter-reader variability. Various software packages have been created to provide quantitative analysis to support clinical interpretation. The present study sought to (1) explore the correlation between the fully automated analysis using the commercial image analysis tool available at University of Kentucky- Siemens Syngo.via® Neurology software package with manual analysis using Mirada (version XD3, Mirada Medical Ltd, New Road, Oxford, UK) and (2) evaluate the performance of each method in reference to the Montréal Cognitive Assessment (MoCA) test performance as global cognitive function*Methods and Materials 90 participants with normal cognition or mild cognitive impairment underwent Aß-PET imaging and cognitive testing using MOCA. Regional and global standardized uptake value ratio (SUVr) were determined using the Siemens Syngo.via® and manually using Mirada. Pearson correlation was used to assess agreement between the two software readings . Relationships between global SUVr and MoCA test performance were analyzed using adjusted linear regression models.*Results Participants included 58 women and 32 men with a mean age of 73.9±6.1 years, education 16.4±2.7 years, MoCA 25.7± 2.9, Global Aß-PET SUVr using Mirada 1.27± .27 and Global Aß-PET SUVr using Syngo.via 1.31± .24. There was significant correlation between the two methods (Pearson correlation coefficient 0.7 p value <.001). Age, gender and education adjusted linear regression analysis demonstrated that both manual and automated segmentation were significantly associated with the MoCA score (P-value 0.025 & 0.034, respectively).*Conclusions Very good agreement between the manual and fully automated analysis of F-18 Amyvid PET images. In normal and mild cognitive impairment patients, there was significant association between global amyloid SUVr and global cognitive function.*Clinical Relevance/Application In preclinical Alzheimer's disease patients, global SUVr was significantly associated with global cognitive function assessed with MoCA test.

RESULTS

Participants included 58 women and 32 men with a mean age of 73.9±6.1 years, education 16.4±2.7 years, MoCA 25.7± 2.9, Global Aß-PET SUVr using Mirada 1.27± .27 and Global Aß-PET SUVr using Syngo.via 1.31± .24. There was significant correlation between the two methods (Pearson correlation coefficient 0.7 p value <.001). Age, gender and education adjusted linear regression analysis demonstrated that both manual and automated segmentation were significantly associated with the MoCA score (P-value 0.025 & 0.034, respectively).

CLINICAL RELEVANCE/APPLICATION

In preclinical Alzheimer's disease patients, global SUVr was significantly associated with global cognitive function assessed with MoCA test.

SDP-NMMI-13   IVIM-DWI And DTI In Pancreatic Cancer: Comparison With Normal Pancreas And Multiparametric PET/MR Imaging Biomarkers

Participants
Bang Bin Chen, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose

PURPOSE

To compare intravoxel incoherent motion (IVIM) diffusion-weighted imaging (DWI) and diffusion tensor imaging (DTI) biomarkers between pancreatic cancer and normal pancreas, and correlate with clinical stages and other PET/MR imaging biomarkers*Methods and Materials Twenty-four patients (mean age 62.30 ± 12.3 years, 11 men, 13 women) with pancreatic ductal adenocarcinoma were prospectively enrolled in this study. All of them received PET/MR before treatment. The imaging biomarkers from IVIM (D*, D, f) and DTI [axial, radial, mean diffusivity, fractional anisotropy (FA) from DTI] were obtained from pancreatic cancer and normal pancreas respectively. Besides, these biomarkers were correlated with clinical TNM stages and other PET/MR imaging biomarkers of pancreatic cancer, including dynamic contrast-enhanced MRI (Peak, AUC, Ktrans, Kep, Ve), DWI (ADCmin), MR spectroscopy (Creatine, NAA, Choline, Glutamine and Glutamate(Glx), and Lipid) and PET parameters [SUVmax, SUVmean, MTV (metabolic tumor volume), TLG (total lesion glycolysis]. The paired t-test, Pearson correlation test and t-test were used for statistical analysis.*Results When compared with normal pancreatic parenchyma, pancreatic cancer had significantly decreased f (P < .001). DCE-MRI parameters, Ktrans and Ve, were significantly correlated with f, mean diffusivity, axial diffusivity, and radial diffusivity. ADCmin was correlated with D*, D, and axial diffusivity. MRS metabolites, creatine and lipid, were negatively correlated with f and D, respectively. PET parameters, SUVmean and SUVmax, were correlated with FA, mean diffusivity and axial diffusivity (all P < 0.05). No differences were found in the IVIM and DTI parameters with clinical TNM stages.*Conclusions IVIM and DTI parameters may reflect tumor vascular permeability, interstitial space, cellularity, metabolites and metabolic activity in pancreatic cancer.*Clinical Relevance/Application IVIM and DTI biomarkers may be used to detect and evaluate pancreatic cancer aggressiveness noninvasively.

RESULTS

When compared with normal pancreatic parenchyma, pancreatic cancer had significantly decreased f (P < .001). DCE-MRI parameters, Ktrans and Ve, were significantly correlated with f, mean diffusivity, axial diffusivity, and radial diffusivity. ADCmin was correlated with D*, D, and axial diffusivity. MRS metabolites, creatine and lipid, were negatively correlated with f and D, respectively. PET parameters, SUVmean and SUVmax, were correlated with FA, mean diffusivity and axial diffusivity (all P < 0.05). No differences were found in the IVIM and DTI parameters with clinical TNM stages.

CLINICAL RELEVANCE/APPLICATION

IVIM and DTI biomarkers may be used to detect and evaluate pancreatic cancer aggressiveness noninvasively.

SDP-NMMI-14   PSMA PET/CT To Decrease Futile Interventions In High-risk And Biochemically Recurrent Prostate Cancer

Participants
Guillaume Chausse, MD, Montreal, Quebec (*Presenter*) Nothing to Disclose

PURPOSE

High-risk and biochemically recurrent prostate cancers are challenging to diagnose and therefore to treat optimally, in part due to the lack of sensitivity of conventional imaging (CT abdomen and pelvis and bone scintigraphy) for metastases. Prostate-specific membrane antigen (PSMA) PET/CT is the most accurate available imaging tool to image prostate cancer metastases. We aimed to determine the impact on patient management of 18F-DCFPyL (PSMA) PET/CT and thereby quantify the number of futile therapies avoided and what replaced them.*Methods and Materials Patients referred for high-risk staging (HRS) and biochemical recurrence (BCR) of prostate cancer underwent PSMA PET/CT as part of a prospective clinical trial (NCT03459820). Treating physicians completed a standardized questionnaire of planned treatment prior to PET/CT referral and a second questionnaire of final treatment after PETCT results. All planned treatments before PSMA PET/CT that were cancelled after PSMA PET/CT results were considered "futile". Final treatments that were not initially planned were considered "added".*Results One hundred forty-two (142) patients (91 biochemical recurrences; 51 high-risk staging) underwent 18F-DCFPyL PET/CT. Change of management by PSMA PET/CT was 44% for BCR and 45% for HRS. In total for HRS and BCR, 7 surgeries (radical prostatectomy/pelvic lymph node dissection), 14 radiation therapies (salvage prostate or pelvic radiation) were spared; 23 planned systemic therapies (ADT, NAAD, chemotherapy) and two targeted radiation treatments to metastases were cancelled. Added treatments were 5 surgeries, 22 radiation therapies, 13 systemic therapies, 14 metastases-targeted radiation treatments. Four patients opted for follow-up only. Surgeries were cancelled when unresectable lesions were found, and added when false-positive metastases outside the pelvis on conventional imaging were considered true-negative on PSMA PET/CT. Deferral of androgen deprivation therapy was a common management change after PSMA PET for BCR patients (n=16, 18%) while addition of pelvic radiation was a common treatment plan change in the HRS group (added n=9, 18%; futile n = 5, 10%).*Conclusions Many futile therapies can be avoided with more accurate staging and restaging through PSMA PET/CT. Its use, as suggested by high change of management, may eventually lead to improved quality of care. Further analysis will reveal the cost related PSMA PET and treatment changes.*Clinical Relevance/Application Clinical use of PSMA PET/CT is rapidly increasing and quantification of its pertinence is paramount in improving cost-efficiency of medical procedures.

RESULTS

One hundred forty-two (142) patients (91 biochemical recurrences; 51 high-risk staging) underwent 18F-DCFPyL PET/CT. Change of management by PSMA PET/CT was 44% for BCR and 45% for HRS. In total for HRS and BCR, 7 surgeries (radical

prostatectomy/pelvic lymph node dissection), 14 radiation therapies (salvage prostate or pelvic radiation) were spared; 23 planned systemic therapies (ADT, NAAD, chemotherapy) and two targeted radiation treatments to metastases were cancelled. Added treatments were 5 surgeries, 22 radiation therapies, 13 systemic therapies, 14 metastases-targeted radiation treatments. Four patients opted for follow-up only. Surgeries were cancelled when unresectable lesions were found, and added when false-positive metastases outside the pelvis on conventional imaging were considered true-negative on PSMA PET/CT. Deferral of androgen deprivation therapy was a common management change after PSMA PET for BCR patients (n=16, 18%) while addition of pelvic radiation was a common treatment plan change in the HRS group (added n=9, 18%; futile n = 5, 10%).

CLINICAL RELEVANCE/APPLICATION

Clinical use of PSMA PET/CT is rapidly increasing and quantification of its pertinence is paramount in improving cost-efficiency of medical procedures.

SDP-NMMI-15 Diagnostic Performance Of CT, MRI, And FDG PET For Detection Of Liver Metastases In Rectal Cancer Patients Under Primary Staging: A PET/MRI Comparative Study

Participants
Poliana Zampieri, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic performance of fluorine 18 fluorodeoxyglucose (FDG) positron emission tomography (PET), abbreviated (T2w and DWI) liver magnetic resonance imaging (MRI), and abdominopelvic contrast-enhanced computed tomography (ceCT) for detection of liver metastasis in patients with rectal cancer under primary staging.*Methods and Materials Retrospective analysis of ninety patients that underwent PET/MRI and abdominopelvic CT within 2 weeks between October/2016 and December/2018 for primary rectal cancer staging. Six readers (two in consensus for each method) analyzed FDG-PET, MRI, and ceCT images for detection of liver metastases. For ceCT, three categories were defined (positive, negative, or indeterminate). Indeterminate lesions on ceCT were independently reclassified on MRI and PET. Number of lesions (at a maximum of five) was recorded for ceCT and MRI. Standard of reference was biopsy and/or clinical follow-up. McNemar test and ROC curves were used to calculate diagnostic accuracy.*Results A total of 97 liver metastases were confirmed in 24 (27%) of the 90 patients. The detection rate of liver lesions was 77/97 (79.4%), 93/97 (95.9%), and 90/97 (92.8%) on ceCT, MRI, and FDG-PET. On a patient-based analysis, the sensitivity/specificity of CT, MR and FDG PET for detection of liver metastasis were 66.7%/98.5%, 91.7%/97.0%, and 87.5%/98.5%, respectively. AUC was 82.6% for ceCT, 93.0% for PET, and 94.3% for MRI. Twelve patients presented indeterminate lesions on CT, which 5 were true positive on FDG-PET and MRI, 1 was true positive of MRI (and false positive on FDG-PET), and 6 were true negative on FDG-PET and MRI.*Conclusions MRI presented the highest detection rate, sensitivity and specificity to detect liver metastases of rectal cancer under primary staging in comparison to ceCT and FDG-PET. MRI more accurately reclassified indeterminate lesions on ceCT.*Clinical Relevance/Application MRI is the preferred imaging modality to evaluate liver metastases of rectal cancer in patients under primary staging.

RESULTS

A total of 97 liver metastases were confirmed in 24 (27%) of the 90 patients. The detection rate of liver lesions was 77/97 (79.4%), 93/97 (95.9%), and 90/97 (92.8%) on ceCT, MRI, and FDG-PET. On a patient-based analysis, the sensitivity/specificity of CT, MR and FDG PET for detection of liver metastasis were 66.7%/98.5%, 91.7%/97.0%, and 87.5%/98.5%, respectively. AUC was 82.6% for ceCT, 93.0% for PET, and 94.3% for MRI. Twelve patients presented indeterminate lesions on CT, which 5 were true positive on FDG-PET and MRI, 1 was true positive of MRI (and false positive on FDG-PET), and 6 were true negative on FDG-PET and MRI.

CLINICAL RELEVANCE/APPLICATION

MRI is the preferred imaging modality to evaluate liver metastases of rectal cancer in patients under primary staging.

SDP-NMMI-16 Effects Of Liver Diseases On Liver And Blood Pool As Metabolic References In FDG PET/CT

Participants
Kwok Sing Ng, PhD,MBBS, Hong Kong, Hong Kong (*Presenter*) Nothing to Disclose

PURPOSE

The liver and the bloodpool activity are commonly referred as metabolic standards in FDG PET/CT for lesion characterization, including lymphoma, solid tumors and vasculitis. This study aims to evaluate the effects of different liver diseases on the liver and bloodpool activity.*Methods and Materials A total of 168 patients who underwent FDG PET/CT for tumor staging were included, all without evidence of liver tumor. Their clinical background, blood results, radiological images and endoscopic findings were reviewed. Each subject was categorized into one of the five groups accordingly: the control (N = 50), hyperbilirubinemia (N = 29), cirrhosis (N = 27), fatty liver (N = 52) and polycystic liver disease (N = 10). The mean Standardized Uptake Values (SUV) of liver and blood pool of each subject were measured. The SUVliver/SUVbloodpool ratio, an analogue of visual interpretation, of each subject was evaluated. Statistical analyses were performed, including two-sample t tests and linear regressions.*Results The control had a mean SUVliver/SUVbloodpool ratio of 1.39, with all of the subjects having liver activity greater than bloodpool activity (i.e. SUV ratio > 1). For hyperbilirubinemia group, the serum bilirubin levels of the 29 subjects ranged from 23 to 667μmol/L, and 89.7% of the subjects had elevated bilirubin as well as other liver enzyme(s). Hyperbilirubinemia group had mean SUV ratio of 1.49, which was greater than that in the control with statistical significance (p=0.0053). Subsequent linear regression analysis showed that the SUV ratio increased for increasing serum bilirubin level. For cirrhosis group, 59.3% of the subjects had cirrhotic features documented in at least two modalities (e.g. USG, CT and OGD). Its mean SUV ratio of 1.29 was less than that of the control and the difference was statistically significant (p=0.0003). For fatty liver group, the mean SUV ratio of 1.28 is less than that of the control and this difference was statistically significant (p=0.0002). Linear regression analysis showed that the more fatty became the liver, the less the SUV ratio was. For polycystic liver disease group, the mean SUV ratio was 0.75. This striking finding was in opposite to the control and other groups which all had ratios =1.*Conclusions This study showed that different liver diseases could alter liver and bloodpool activity in FDG PET/CT. As the liver diseases were more severe, their effects on the metabolic reference became more prominent.*Clinical Relevance/Application Many FDG PET/CT guidelines recommend to characterize a lesion using visual interpretation, based on liver and bloodpool activity as metabolic reference. This study demonstrates the importance of reviewing hepatic condition before referring liver and blood pool in visual interpretation.

RESULTS

The control had a mean SUVliver/SUVbloodpool ratio of 1.39, with all of the subjects having liver activity greater than bloodpool

activity (i.e. SUV ratio > 1). For hyperbilirubinemia group, the serum bilirubin levels of the 29 subjects ranged from 23 to 667μmol/L, and 89.7% of the subjects had elevated bilirubin as well as other liver enzyme(s). Hyperbilirubinemia group had mean SUV ratio of 1.49, which was greater than that in the control with statistical significance (p=0.0053). Subsequent linear regression analysis showed that the SUV ratio increased for increasing serum bilirubin level. For cirrhosis group, 59.3% of the subjects had cirrhotic features documented in at least two modalities (e.g. USG, CT and OGD). Its mean SUV ratio of 1.29 was less than that of the control and the difference was statistically significant (p=0.0003). For fatty liver group, the mean SUV ratio of 1.28 is less than that of the control and this difference was statistically significant (p=0.0002). Linear regression analysis showed that the more fatty became the liver, the less the SUV ratio was. For polycystic liver disease group, the mean SUV ratio was 0.75. This striking finding was in opposite to the control and other groups which all had ratios =1.

CLINICAL RELEVANCE/APPLICATION

Many FDG PET/CT guidelines recommend to characterize a lesion using visual interpretation, based on liver and bloodpool activity as metabolic reference. This study demonstrates the importance of reviewing hepatic condition before referring liver and blood pool in visual interpretation.

SDP-NMMI-17 Appropriate B Value For Computed DWI Results In Superior Capability For N-stage Assessment Of Non-small Cell Lung Cancer Patients Than That Of Actual DWI, STIR Imaging Or FDG-PET/CT

Participants
Yoshiharu Ohno, MD,PhD, Toyoake, Japan (Presenter) Research Grant, Canon Medical Systems Corporation;Research Grant, DAIICHI SANKYO Group

PURPOSE

Computed DWI (cDWI) using an appropriate b value may result in better malignant lesion detection capability than actual DWI (aDWI) in oncologic patients. The purpose of this study was to prospectively determine the appropriate b value for cDWI to attain a better diagnostic capability for N-staging of non-small cell lung cancer (NSCLC) patients than can be attained with aDWI, short inversion time inversion recovery (STIR) imaging or FDG-PET/CT.*Methods and Materials aDWI with b values of 0 and 1000 (aDWI1000) s/mm2, STIR imaging and FDG-PET/CT were administered to 245 NSCLC patients (127 men, 118 women; mean age 75 years). Each subject generated cDWIs using 400 (cDWI400), 600 (cDWI600), 800 (cDWI800) and 2000 (cDWI2000) s/mm2. Based on pathological examination results, 114 metastatic nodes and 114 non-metastatic nodes were selected for evaluation of contrast ratio (CR) for each cDWI and aDWI, ADC, lymph node to muscle ratio (LMR) on STIR imaging and SUVmax, as well as probability of lymph node metastasis score of each method. ROC analysis was performed to determine threshold value on a per node basis. Accuracy (AC) of each method for N-stage classification on a per patient basis was also compared by using McNemar's test.*Results Area under the curve (AUC) of CR600 (AUC=0.86) was significantly higher than that of other quantitative indexes (0.69=AUC=0.81, p<0.0001). Moreover, AUCs (0.80=AUC=0.82) of qualitatively assessed cDWI600, cDWI800, ADC map, aDWI1000 and STIR imaging were significantly higher than those of cDWI400 (AUC=0.76: p<0.05), cDWI2000 (AUC=0.76: p<0.05) and PET/CT (AUC=0.75: p<0.05). ACs for N-stage classification of CR600 (AC=90.2%) and CR800 (AC=89.4%) were significantly higher than those of others (p<0.05). In addition, ACs of qualitatively assessed cDWI600 (AC=86.5%) and cDWI800 (AC=86.1%) were significantly higher than those of cDWI400, cDWI2000 and PET/CT (p<0.05).*Conclusions Computed DWI using an appropriate b value can result in significantly superior N-staging accuracy compared to that of actual DWI and PET/CT and can be considered at least as effective as STIR imaging for NSCLC patients.*Clinical Relevance/Application cDWI using an appropriate b value can result in significantly superior N-staging accuracy compared to that of aDWI and PET/CT and can be considered at least as effective as STIR imaging for NSCLC.

RESULTS

Area under the curve (AUC) of CR600 (AUC=0.86) was significantly higher than that of other quantitative indexes (0.69=AUC=0.81, p<0.0001). Moreover, AUCs (0.80=AUC=0.82) of qualitatively assessed cDWI600, cDWI800, ADC map, aDWI1000 and STIR imaging were significantly higher than those of cDWI400 (AUC=0.76: p<0.05), cDWI2000 (AUC=0.76: p<0.05) and PET/CT (AUC=0.75: p<0.05). ACs for N-stage classification of CR600 (AC=90.2%) and CR800 (AC=89.4%) were significantly higher than those of others (p<0.05). In addition, ACs of qualitatively assessed cDWI600 (AC=86.5%) and cDWI800 (AC=86.1%) were significantly higher than those of cDWI400, cDWI2000 and PET/CT (p<0.05).

CLINICAL RELEVANCE/APPLICATION

cDWI using an appropriate b value can result in significantly superior N-staging accuracy compared to that of aDWI and PET/CT and can be considered at least as effective as STIR imaging for NSCLC.

SDP-NMMI-18 The Usefulness Of Machine Learning Approach Using 18F-FDG-PET-based Radiomic And Deep Learning Features For Differentiating Between Thymic Cancer And Thymoma

Participants
Masatoyo Nakajo, MD, PhD, Kagoshima, Japan (Presenter) Nothing to Disclose

PURPOSE

Pretreatment differentiation between thymic cancer and thymoma is important, as their treatment strategies and prognoses are markedly different. The purpose of this study was to determine whether the machine learning (ML) approach using 18F-FDG-PET-based radiomic and deep learning features is useful for differentiating thymic cancer from thymoma.*Methods and Materials Included in this retrospective study were 79 patients with pathologically diagnosed thymic epithelial tumors (TETs) who underwent 18F-FDG-PET/CT before treatment. The patients were classified into thymic cancer (n=21) and thymoma (n=58) groups. The PET-based 107 radiomic features including 3 conventional SUV-related parameters (SUVmax, MTV, TLG) were extracted from the pyradiomics package, and 1024 deep learning features were extracted from the convolutional neural network. These radiomics and deep learning features were used to predict thymic cancer using six different ML algorithms (random forest, k-nearest neighbors, logistic regression, decision tree, gradient boost and support vector machine) with a five-fold cross-validation and bagging method. Each ML algorithm calculated the probability for thymic cancer based on which tumor was classified as either thymic cancer (probability =0.50) or thymoma (probability <0.50). The AUCs were calculated to compare the predictive performances between the conventional parameters and the ML algorithms.*Results On the ROC analysis for conventional SUV-related parameters, the AUC for predicting thymic cancer was 0.71 for SUVmax (sensitivity 0.71, specificity 0.67, accuracy 0.68), 0.44 for MTV (sensitivity 0.52, specificity 0.31, accuracy 0.37) and 0.48 for TLG (sensitivity 0.48, specificity 0.43, accuracy 0.44), respectively. Among 6 ML algorithms, the logistic regression showed the highest AUC with 0.90 (sensitivity 0.77, specificity 0.82, accuracy 0.79). The AUC of this logistic regression model was significantly higher than that of each conventional SUV-related parameter (p<0.05,

each).*Conclusions The ML approach using 18F-FDG-PET-based radiomic and deep learning features may be useful for differentiating between thymic cancer and thymoma.*Clinical Relevance/Application The ML approach using 18F-FDG-PET-based radiomic and deep learning features may be more useful than SUV-related parameters for differentiating between thymic cancer and thymoma in patients with TET.

RESULTS

On the ROC analysis for conventional SUV-related parameters, the AUC for predicting thymic cancer was 0.71 for SUVmax (sensitivity 0.71, specificity 0.67, accuracy 0.68), 0.44 for MTV (sensitivity 0.52, specificity 0.31, accuracy 0.37) and 0.48 for TLG (sensitivity 0.48, specificity 0.43, accuracy 0.44), respectively. Among 6 ML algorithms, the logistic regression showed the highest AUC with 0.90 (sensitivity 0.77, specificity 0.82, accuracy 0.79). The AUC of this logistic regression model was significantly higher than that of each conventional SUV-related parameter (p<0.05, each).

CLINICAL RELEVANCE/APPLICATION

The ML approach using 18F-FDG-PET-based radiomic and deep learning features may be more useful than SUV-related parameters for differentiating between thymic cancer and thymoma in patients with TET.

SDP-NMMI-19 Estimation Of 123I-IMP Arterial Blood Activity Concentration By Using Neural Network; Possibility Of Omitting Arterial Blood Sampling

Participants
Tetsuro Kaga, MD, Gifu, Japan (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to estimate 123I-IMP arterial blood radioactivity concentration in dual table autoradiography (DTARG) method by using artificial neural network.*Methods and Materials This Retrospective study included 164 patients who underwent measurement of regional cerebral blood flow using DTARG method with 123I-IMP. Neural network was applied to regression problems. Objective variable was 123I-IMP arterial blood radioactivity concentration, while explanatory variable was defined as 28 numeric parameters in the first scan, including patient characteristic value, total injection 123I-IMP radiation dose, and distribution of 123I-IMP in brain. We divided the dataset into training (n = 125), validation (n = 22), and testing sets (n = 17), machine learning with neural networks was performed. Levenberg-Marquardt algorithm was used as loss function. We obtained two estimated values which were determined by our algorithm and conventional method developed by iida et al. The correlation coefficient and the root mean squared error were calculated to evaluate the goodness of fit between the estimated values and the actual measured values by arterial blood sampling.*Results The coefficient of determination of our algorithm was higher than that of conventional method (0.865 and 0.322, respectively). The root mean squared error of our algorithm was smaller than that of conventional method (8.677 and 19.788, respectively).*Conclusions Our proposed neural network-based algorithm could more accurately estimate 123I-IMP arterial blood radioactivity concentration in DTARG than conventional method.*Clinical Relevance/Application It is expected to reduce burden of patient and doctor associated with arterial blood sampling in DTARG. Not only in DTARG, our proposed method could be applied to all regional cerebral blood flow test using 123I-IMP.

RESULTS

The coefficient of determination of our algorithm was higher than that of conventional method (0.865 and 0.322, respectively). The root mean squared error of our algorithm was smaller than that of conventional method (8.677 and 19.788, respectively).

CLINICAL RELEVANCE/APPLICATION

It is expected to reduce burden of patient and doctor associated with arterial blood sampling in DTARG. Not only in DTARG, our proposed method could be applied to all regional cerebral blood flow test using 123I-IMP.

SDP-NMMI-2 Glucose Metabolic Rate By Dynamic18F-fdg Pet/ct Scan With A Silicon Photomultiplier: Detection Of Active Inflammation In Cardiac Sarcoidosis

Participants
Michinobu Nagao, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Sarcoidosis is a systemic chronic inflammatory disease characterized by the presence of noncaseating granulomas. Cardiac involvement is one of the major causes of disease-related death.Long-term fasting 18F-Fludeoxyglucose positron emission tomography (FDG-PET)has contributed to the diagnosis of active inflammation in CS. Monitoring of the standard uptake value (SUV) alone is limited in differentiating it from physiological accumulation and in diagnosing relapse during steroid therapy. Pharmacokinetic analysis of dynamic 18F-FDG PET/CT allows quantitative assessment of in vivo glucose metabolic rate (MRglc). Here, we examine the potential of MRglcestimated from dynamic18F-FDG PET/CT to detect active inflammation in CS.*Methods and Materials 32 CS patients who underwent dynamic18F-FDG PET/CT scan with a silicon photomultiplierwere enrolled in this study. After fasting for at least 18 hours, FDG (150-220 MBq) was administered. Parametric images of MRglcwere derived from tissue and plasma blood time-activity concentration curves using the Patlak linearization approach, with data acquired between 25 and 55 min after injection. Then, 60 min later, a standard scan performed to calculate SUV. The correlation between MRglc and SUV for each myocardial segment was analyzed. The area above MRglccorresponding to SUV 3 was defined as active inflammation. The contrast ratio between active inflammation and normal myocardium (CR) was compared in MRglc and SUV images.*Results MRglcin myocardial segment showed a significant positive correlation with SUV (Pearson r, 0.79; p<0.0001). The area with SUV 3 corresponded to that with MRglc12.6 nmol/mL/min. Active inflammation was observed in 12 patients in MRglc images (MRglcrange, 12.7 to 46.5 nmol/mL/min) and 13 patients in SUV images (SUV range, 3.02 to 10.9). CR of MRglcimages was significantly higher than that of SUV images (mean CR, 11.8 versus 2.9; p<0.0001).*Conclusions The MRglcrange of active inflammation is wider than in SUV range. The contrast of the active inflammation to normal myocardium is approximately four times greater in MRglc images than in SUV images.*Clinical Relevance/Application MRglcimages has a shorter scan time than standard SUV images and can detect accurately detect the location and severity of localized inflammation.

RESULTS

MRglcin myocardial segment showed a significant positive correlation with SUV (Pearson r, 0.79; p<0.0001). The area with SUV 3 corresponded to that with MRglc12.6 nmol/mL/min. Active inflammation was observed in 12 patients in MRglc images (MRglcrange, 12.7 to 46.5 nmol/mL/min) and 13 patients in SUV images (SUV range, 3.02 to 10.9). CR of MRglcimages was significantly higher

than that of SUV images (mean CR, 11.8 versus 2.9; p<0.0001).

CLINICAL RELEVANCE/APPLICATION

MRglcimages has a shorter scan time than standard SUV images and can detect accurately detect the location and severity of localized inflammation.

SDP-NMMI-20 Effects Of A New Reconstruction Method On Noise Reduction And Contrast Improvement In Digital PET/CT

Participants
YUYA SHIRAKAWA, Tokyo, Japan (*Presenter*) Research funded, Nihon Medi-Physics Co, Ltd

PURPOSE

The digital Cartesion Prime PET/CT scanner (Canon Medical Systems, Otawara, Japan) has been in clinical operation in Japan since 2020. The scanner has SiPM technology with complete coverage, 1:1 coupling to the scintillator crystals and TOF time resolution of < 280 psec. In addition to a conventional Gaussian filter, statistical noise is reduced while maintaining contrast by a new technique called, "Clear adaptive Low-noise Method" (CaLM), based on the non-local-means principle. This technology was designed to improve image quality. Therefore, this study aimed to determine whether noise is reduced and contrast is improved more effectively by CaLM than by conventional methods.*Methods and Materials The background activity of a NEMA body phantom with hot spheres (inner diameters: 10, 13, 17, 22, 28, and 37 mm) containing 18F-FDG was set at 2.53 kBq/mL(Hot/BG = 4) according to the standard Japanese imaging protocol in which images are acquired from 60 minutes after 18F-FDG (3.7 MBq/kg) is administered. Images were acquired for 30 min/bed and reconstructed between 30-300 sec/bed at intervals of 30 sec/bed under the following clinical conditions: TOF-3D-OSEM: 3 iterations, 12 subsets, PSF(-)) with filters off, Gaussian filter 4 mm, CaLM mild. Image quality was physically evaluated as QH 10 mm, N 10 mm, and QH 10 mm/N 10mm and quantified as the SUVmax of the hot spheres with data collection for 30 minutes.*Results The noise was reduced to the same degree in PET images (N10 mm) between the Gaussian filter and CaLM; the difference of < 1% between 30 and 300 seconds. The contrast (QH 10 mm) and contrast noise ratio (QH 10 mm/N 10 mm) of PET images were up to 11% at = 90 seconds, which is the clinically applied acquisition duration, and 40% in CaLM than in Gaussian at 90-300 seconds, respectively . The SUVmax was 46% and 16% higher in CaLM than in the Gaussian filter in 10- and 13-mm spheres, respectively.*Conclusions Contrast can be further enhanced and image quality can be improved more effectively using digital PET/CT with CaLM than by the conventional method.*Clinical Relevance/Application State-of-the-art digital PET/CT with novel CaLM reconstruction can further improve noise reduction and lesion contrast, thus improving the quality of PET/CT diagnosis.

RESULTS

The noise was reduced to the same degree in PET images (N10 mm) between the Gaussian filter and CaLM; the difference of < 1% between 30 and 300 seconds. The contrast (QH 10 mm) and contrast noise ratio (QH 10 mm/N 10 mm) of PET images were up to 11% at = 90 seconds, which is the clinically applied acquisition duration, and 40% in CaLM than in Gaussian at 90-300 seconds, respectively . The SUVmax was 46% and 16% higher in CaLM than in the Gaussian filter in 10- and 13-mm spheres, respectively.

CLINICAL RELEVANCE/APPLICATION

State-of-the-art digital PET/CT with novel CaLM reconstruction can further improve noise reduction and lesion contrast, thus improving the quality of PET/CT diagnosis.

SDP-NMMI-21 Prognostic Value Of Bmipp Spect And Late Gadolinium Enhancement MRI In Cardiac Sarcoidosis

Participants
Atsushi Yamamoto, Tokyo, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Sarcoidosis is a systemic chronic inflammatory disease characterized by the presence of noncaseating granulomas. Cardiac involvement is one of the major causes of disease-related death. Steroid therapy is the mainstay of treating cardiac sarcoidosis (CS). Previous studies reported that late gadolinium enhancement cardiac magnetic resonance (LGE-CMR) could predict prognosis in patients with CS. However, the evaluation of LGE was limited due to implant of cardiac device or renal dysfunction. 123I-betamethyl-p-iodophenyl-pentadecanoic acid single-photon emission computed tomography (BMIPP) was developed to evaluate fatty acid metabolism and effective in detecting myocardial damage in CS. Present study aimed to investigate the relationship between LGE and myocardial damage obtained from BMIPP SPECT, and to explore the potential of BMIPP SPECT as prognostic factors in CS patients undergoing steroid therapy.*Methods and Materials Forty-one CS patients who underwent BMIPP SPECT and LGE-CMR within 2 months were enrolled. The left ventricle was divided into 17 myocardial segments on BMIPP and LGE-CMR. BMIPP defects were assessed in each segment using a scoring system from 0 to 4 (0 normal; 1 mild; 2 moderate; 3 severe; 4 absent), and total BMIPP defect score (BDS) in the entire left ventricle were calculated. LGE in each segment was assessed using a scoring system from 0 to 2 (0 none; 1 partially positive; 2 homogeneously positive), and total LGE extent score (LES) in the entire left ventricle was also calculated. The predictability of the initial BDS and LES for major adverse cardiac events (MACE), consisting of all-cause death, hospitalization due to heart failure, and recurrence or onset of sustained ventricular tachycardia and ventricular fibrillation, was analyzed using Kaplan-Meier analysis.*Results BDS showed a significant correlation with LES (r = 0.82, p < 0.0001). Patients with LES =9 had a significantly higher MACE rate than patients with BDS <9 (log-rank test, p=0.030). Patients with BDS =16 also had a significantly higher MACE rate than patients with BDS <16 (log-rank test, p=0.016).*Conclusions Myocardial damage assessed by BMIPP SPECT correlated with LGE extent. Both BDS and LES have the predictive values of MACE in CS.*Clinical Relevance/Application In CS, many patients have cardiac devices implanted, including defibrillation, which limits the evaluation of CMR. In comparison, BMIIPP has the advantage of being performed without the influence of cardiac devices.

RESULTS

BDS showed a significant correlation with LES (r = 0.82, p < 0.0001). Patients with LES =9 had a significantly higher MACE rate than patients with BDS <9 (log-rank test, p=0.030). Patients with BDS =16 also had a significantly higher MACE rate than patients with BDS <16 (log-rank test, p=0.016).

CLINICAL RELEVANCE/APPLICATION

In CS, many patients have cardiac devices implanted, including defibrillation, which limits the evaluation of CMR. In comparison, BMIIPP has the advantage of being performed without the influence of cardiac devices.

SDP-NMMI-22 **Differentiation Of Trauma And Bone Metastasis Of RI Accumulation In The Ribs Of Bone Scintigraphy Using AI, And Visualization Of The Site Of Interest Of AI By Grad-CAM**

Participants
Shigeaki Higashiyama, MD,PhD, Osaka, Japan (*Presenter*) Nothing to Disclose

PURPOSE

There are many studies by applying deep learning technology all over the world. In recent years, in the field of diagnostic images using Deep Convolutional Neural Network (DCNN), a method for visualizing the diagnostic basis called Grad-CAM has been proposed, but there is no report of visualizing the diagnostic basis in bone scintigraphy. Our aim is to develop an algorithm that uses DCNN to classify and diagnose whether RI accumulation on the ribs is bone metastasis or trauma using only anterior chest SPOT images in bone scintigraphy. Furthermore, it is also intended to visualize the area of ??interest of DCNN for abnormal accumulation of bone scintigraphy.*Methods and Materials The subjects were 100 cases in which abnormal RI accumulation in the ribs was diagnosed as bone metastasis by bone scintigraphy performed at our hospital, and 100 cases in which it was accumulated in trauma. We equally divided all 200 cases into ten groups. Nine groups for the training dataset, one group for the testing dataset. To prevent the overfitting, 10-fold cross-validation were applied. Using the Transfer Learning method, we classified RI abnormal accumulation on the ribs, and by using Grad-CAM, we visualized the area of ??interest of DCNN.*Results Bone metastasis lesions could be detected with an accuracy of 88.2%. In addition, it was possible for DCNN to visualize bone metastases and areas of interest.*Conclusions It is possible to diagnose bone metastasis with high diagnostic accuracy using the algorithm we have developed this time.In addition, clarifying the diagnostic criteria that DCNN judged to be bone metastasis will contribute to the development of deep learning in the nuclear medicine department.*Clinical Relevance/Application Diagnosing abnormal RI accumulation on the ribs without adding oblique imaging is useful in reducing imaging time rand educing burden on patients.

RESULTS

Bone metastasis lesions could be detected with an accuracy of 88.2%. In addition, it was possible for DCNN to visualize bone metastases and areas of interest.

CLINICAL RELEVANCE/APPLICATION

Diagnosing abnormal RI accumulation on the ribs without adding oblique imaging is useful in reducing imaging time rand educing burden on patients.

SDP-NMMI-23 **Differentiation Between Sarcopenia And Nonsarcopenia In Non-small Cell Lung Cancer Patients Using Skeletal Muscle PET Radiomics**

Participants
Dong Xing, MD, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

Sarcopenia has been recognized as an independent risk factor for patients with non-small cell lung cancer (NSCLC), reducing patients' life quality and shortening overall survival. However, there are some shortages in the existing imaging diagnostic methods for sarcopenia. This article aimed to study the ability of skeletal muscle PET radiomics features combined with machine learning classifiers to identify sarcopenia in advanced NSCLC patients.*Methods and Materials This study retrospectively analyzed the clinical and imaging data of 99 patients with NSCLC who underwent 18F-FDG-PET/CT examination before treatment. The patients were randomly divided into the training set (n = 69) and the test set (n = 30). Sarcopenia was diagnosed by skeletal muscle index at the third lumbar vertebrae level (L3-SMI). Then, 474 skeletal muscle PET imaging radiomics were extracted from a single slice of PET images at the first lumbar (L1) vertebrae level. This study used 42 machine learning classification combinations (including six feature selection methods and seven machine learning classifiers) to assess the ability of skeletal muscle PET radiomics features on the differentiation of sarcopenia and non-sarcopenia in NSCLC patients. The receiver operating characteristic (ROC) area under the curve (AUC) was used as the leading indicator to evaluate the performance of different classification schemes.*Results A total of 40 sarcopenias were found in 99 patients with advanced NSCLC. Among 42 machine learning classification schemes, the LightGBM machine learning algorithm combined with the Boruta feature selection method (LGB_Bo) had optimal performance in identifying sarcopenia in NSCLC patients, with accuracy and AUC on the test set were 0.867 and 0.977, respectively. The Logistic Regression classifier (AUC, 0.956; accuracy, 0.828) and Boruta feature selection method (AUC, 0.952; accuracy, 0.829) showed excellent average performance among the classifiers and feature selection methods employed in our study, respectively.*Conclusions Based on skeletal muscle PET radiomics combined with machine learning classifiers could provide a new method for diagnosing sarcopenia in NSCLC patients.*Clinical Relevance/Application This study proves that skeletal muscle PET imaging features combined with an appropriate machine learning classification can effectively distinguish sarcopenia and non-sarcopenia patients with non-small cell lung cancer, providing a new and potential tool for the early and non-invasive diagnosis of tumor sarcopenia.

RESULTS

A total of 40 sarcopenias were found in 99 patients with advanced NSCLC. Among 42 machine learning classification schemes, the LightGBM machine learning algorithm combined with the Boruta feature selection method (LGB_Bo) had optimal performance in identifying sarcopenia in NSCLC patients, with accuracy and AUC on the test set were 0.867 and 0.977, respectively. The Logistic Regression classifier (AUC, 0.956; accuracy, 0.828) and Boruta feature selection method (AUC, 0.952; accuracy, 0.829) showed excellent average performance among the classifiers and feature selection methods employed in our study, respectively.

CLINICAL RELEVANCE/APPLICATION

This study proves that skeletal muscle PET imaging features combined with an appropriate machine learning classification can effectively distinguish sarcopenia and non-sarcopenia patients with non-small cell lung cancer, providing a new and potential tool for the early and non-invasive diagnosis of tumor sarcopenia.

SDP-NMMI-24 **Relationship Between Metabolic Status On 18F-FDG PET/CT With Expression Of Programmed Death Ligand 1 (PD-L1) And Mutation Of EGFR And KRAS In Pulmonary Invasive Mucinous Adenocarcinomas**

Participants
Zhao Long, MD, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

Pulmonary invasive adenocarcinoma (ADA) is a series of heterogeneous tumours with different genetic characteristics. Previous studies have shown that clinical stage, tumour size and histologic subtype influence 18F-fluorodoxyglucose (18F-FDG) uptake in ADA. The purpose of this study is to investigate the predictive value of 18F-FDG positron emission tomography/computed tomography (PET/CT) in evaluating PD-L1 expression and Mutation of EGFR and KRAS in invasive mucinous adenocarcinomas (IMA).*Methods and Materials From April 2016 to December 2020, IMA were retrospectively identified in 209 consecutive patients who underwent 18F-FDG PET/CT scan. All patients underwent surgical resection and the diagnosis were confirmed. The maximum standardized uptake value (SUVmax) of 18F-FDG uptake were calculated for the primary lesion. PD-L1 expression test and mutation status of EGFR and KRAS were underwent.*Results PD-L1 expression were identified in 4/64 patients (6.3%). EGFR and KRAS mutations were identified in 6/130 patients (4.6%) and 32/68 patients (47.1%), respectively. The study shown that only SUVmax was significantly associated with PD-L1 expression (P = 0.023). Using a SUVmax cut-off value of 5.5 in predicting PD-L1-positivity, the receiver operating characteristic curve analysis showed that the AUC was 0.833(95%CI, 0.728-0.938; P = 0.027). The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy in predicting PD-L1-positivity were 100.0%, 75.0%, 21.1%, 100.0%, and 76.6%, respectively.*Conclusions With a high sensitivity and negative predictive value, the SUVmax should be used for predicting PD-L1 expression in IMA. However, the SUVmax was not significant differences between the mutation status of EGFR and KRAS.*Clinical Relevance/Application For the first time, we demonstrated that the SUVmax could predict PD-L1 expression in patients with IMA, and could not predict mutation status of EGFR and KRAS.

RESULTS

PD-L1 expression were identified in 4/64 patients (6.3%). EGFR and KRAS mutations were identified in 6/130 patients (4.6%) and 32/68 patients (47.1%), respectively. The study shown that only SUVmax was significantly associated with PD-L1 expression (P = 0.023). Using a SUVmax cut-off value of 5.5 in predicting PD-L1-positivity, the receiver operating characteristic curve analysis showed that the AUC was 0.833(95%CI, 0.728-0.938; P = 0.027). The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy in predicting PD-L1-positivity were 100.0%, 75.0%, 21.1%, 100.0%, and 76.6%, respectively.

CLINICAL RELEVANCE/APPLICATION

For the first time, we demonstrated that the SUVmax could predict PD-L1 expression in patients with IMA, and could not predict mutation status of EGFR and KRAS.

SDP-NMMI-25   Imaging-visible Bioprinted Microcapsules For Beta Cell Encapsulation Treating Type I Diabetes

Participants
Yingli Fu, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To investigate whether bioprinted, perfluorinated, fibrin-alginate composite microcapsules can be generated to improve cell survival and function and enable image-guided, targeted delivery via small-bore catheters or needles.*Methods and Materials Mouse insulinoma cells were used to develop the prototype fibrin-alginate microcapsules. Cell printing was performed using a custom-made, fully automated, 3D bioprinting system equipped with a single-jet stationary piezoelectric printhead of 80 or 100 μm. The formulations of bioink consisting of fibrin, alginate, and a contrast agent, perfluorooctyl bromide (PFOB), were optimized to ensure the continuous generation of cell-encapsulated, monodisperse, imaging-visible microcapsules. The viability of bioprinted cells was assessed using a live/dead staining and cell function was analyzed by immunocytochemistry and glucose-stimulated insulin production assays. The bioprinted microcapsules were fully characterized in terms of size, permeability, X-ray visibility, and small-bore catheter/needle compatibility.*Results Using an 80 μm-sized printhead, the bioprinted microcapsules with perfluorinated fibrin-alginate hydrogel can be generated with an average size of 55.8 ± 4.1 μm. There was no significant cell viability loss after printing and the viability in both bioprinted small-sized microcapsules and conventional larger (~ 300 μm) microcapsules was maintained for up to 2 weeks (>90%). Bioprinted microcapsules were visible on X-ray and could pass 2.4 Fr catheters or 22 G needles without significant deformation or breakage. Cell function as measured by insulin secretion was preserved. The bioprinted cells had a slightly higher glucose responsiveness stimulation index (4.8 ± 0.4) than conventionally encapsulated cells (4.3 ± 0.5).*Conclusions Beta cell printing using perfluorinated fibrin-alginate hydrogel shows promise for minimally invasive, targeted treatment of diabetes.*Clinical Relevance/Application Bioprinted, X-ray-visible, small size microcapsules could facilitate targeted delivery of beta cell therapeutic via minimally invasive injections for Type I diabetes treatment.

RESULTS

Using an 80 μm-sized printhead, the bioprinted microcapsules with perfluorinated fibrin-alginate hydrogel can be generated with an average size of 55.8 ± 4.1 μm. There was no significant cell viability loss after printing and the viability in both bioprinted small-sized microcapsules and conventional larger (~ 300 μm) microcapsules was maintained for up to 2 weeks (>90%). Bioprinted microcapsules were visible on X-ray and could pass 2.4 Fr catheters or 22 G needles without significant deformation or breakage. Cell function as measured by insulin secretion was preserved. The bioprinted cells had a slightly higher glucose responsiveness stimulation index (4.8 ± 0.4) than conventionally encapsulated cells (4.3 ± 0.5).

CLINICAL RELEVANCE/APPLICATION

Bioprinted, X-ray-visible, small size microcapsules could facilitate targeted delivery of beta cell therapeutic via minimally invasive injections for Type I diabetes treatment.

SDP-NMMI-26   Brazilian Multicentric Experience Of Peptide Receptor Radionuclide Therapy In Neuroendocrine Tumors

Participants
Claudio Mesquita, MD,PhD, Niteroi, Brazil (*Presenter*) Speakers Bureau, SERVIER;Speakers Bureau, Pfizer Inc

PURPOSE

Peptide receptor radionuclide therapy (PRRT) is a well-established treatment modality for gastroenteropancreatic neuroendocrine tumors (GEPNETs). PRRT received FDA approval in 2018 for treatment of somatostatin receptor-positive GEPNETs based on NETTER-1 trial data that included grade 1 and 2 midgut neuroendocrine tumors but in the clinical practice, PRRT is used other types of NETs. We present real-world data of PRRT outcomes and implementation from four tertiary treatment centers in Brazil with PRRT. This multicenter study adds to the evidence regarding the utility of PRRT for NETs of different sites besides GEPNETs.*Methods and Materials A retrospective review of patients with NETs who received 177Lu-dotatate PRRT between January 2007 and January 2021 in 4 hospitals across Brazil was undertaken. Data from 160 histologically proven NET were evaluated. Data regarding demographics, efficacy, and toxicity was evaluated at each site by the treating clinician.*Results Hundred and sixty patients (83 female) received

a median of four 177Lu-dotatate treatments (range from 1-8). Primary tumor localizations were midgut (28%), pancreas (27.5%), foregut (17.5%), neuroendocrine CUP (11%), hindgut (7%), lung (3%), and other sites (6%). Complete follow-up was obtained in 96 patients. Median progression-free survival (PFS) was 11.9 months and 30 patients died (31%). Complete response was found in 4 patients (4%) and 18 patients had disease progression during PRRT (18%). Only four patients had significant renal toxicity. PRRT was associated with hematological toxicity in 12 patients.*Conclusions We noted a higher rate of PRRT use in non-midgut sites like the pancreas and the foregut. Median PFS was considerably lower than observed in Netter-1 trial, reflecting the higher risk tumors included. Despite this, treatment-related toxicity in our cohort was considerably low. PRRT was considered safe with minimal hematological and renal toxicity.*Clinical Relevance/Application These results demonstrate the potential benefit of PRRT in a range of NETs. PRRT was safe with very few adverse effects. Randomized clinical trials are needed to consolidate the potential impact of PRRT in other NET localizations than GEPNETS allowing the inclusion of this therapy in oncological guidelines.

RESULTS

Hundred and sixty patients (83 female) received a median of four 177Lu-dotatate treatments (range from 1-8). Primary tumor localizations were midgut (28%), pancreas (27.5%), foregut (17.5%), neuroendocrine CUP (11%), hindgut (7%), lung (3%), and other sites (6%). Complete follow-up was obtained in 96 patients. Median progression-free survival (PFS) was 11.9 months and 30 patients died (31%). Complete response was found in 4 patients (4%) and 18 patients had disease progression during PRRT (18%). Only four patients had significant renal toxicity. PRRT was associated with hematological toxicity in 12 patients.

CLINICAL RELEVANCE/APPLICATION

These results demonstrate the potential benefit of PRRT in a range of NETs. PRRT was safe with very few adverse effects. Randomized clinical trials are needed to consolidate the potential impact of PRRT in other NET localizations than GEPNETS allowing the inclusion of this therapy in oncological guidelines.

SDP-NMMI-3 18F-thk5351 Pet/ct In Patients With Newly Diagnosed High Grade Glioma

Participants
Katsuya Mitamura, Kagawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

18F-THK5351 (THK5351) has a high binding affinity and selectivity for tau. However, the potential for off-target binding with monoamine oxidase-B (MAO-B), which is a highly expressed enzyme in astrocytes, has been shown recently. The purpose of this study was to evaluate the accumulation of THK5351 PET in patients with newly diagnosed high grade glioma.*Methods and Materials Thirteen patients with newly diagnosed high grade glioma (3 WHO grade III and 10 WHO grade IV) were investigated with THK5351 PET/CT before therapy. PET emission data were acquired for 50-70 min after an intravenous injection of THK5351. The maximum standardized uptake value (SUVmax) and tumor-to-ipsilateral normal cerebellum (T/N) ratio were calculated.*Results All tumors had increased THK5351 uptake. The mean (±SD) SUVmax of the tumor in grade IV (2.34 ± 1.16) was significantly higher than that in grade III (0.54 ± 0.11) (p = 0.01). The mean (±SD) T/N ratio in grade IV (7.96 ± 3.72) was significantly higher than that in grade III (1.84 ± 0.19) (p = 0.01).*Conclusions These preliminary results suggest that THK5351 PET may be useful for the detection and differentiating WHO grade, in patients with newly diagnosed high grade glioma.*Clinical Relevance/Application THK5351 PET may be useful for the detection and differentiating WHO grade, in patients with newly diagnosed high grade glioma.

RESULTS

All tumors had increased THK5351 uptake. The mean (±SD) SUVmax of the tumor in grade IV (2.34 ± 1.16) was significantly higher than that in grade III (0.54 ± 0.11) (p = 0.01). The mean (±SD) T/N ratio in grade IV (7.96 ± 3.72) was significantly higher than that in grade III (1.84 ± 0.19) (p = 0.01).

CLINICAL RELEVANCE/APPLICATION

THK5351 PET may be useful for the detection and differentiating WHO grade, in patients with newly diagnosed high grade glioma.

SDP-NMMI-4 FDG PET-CT In Atherosclerosis: Role In Assessing Disease Activity.

Participants
Sikandar Shaikh, DMRD, Hyderabad, India (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the role of FDG PET-CT in the assessment of disease activity in large vessel atherosclerosis with associated vasculitis.*Methods and Materials 55 Whole body PET/CT scans were performed in 18 pts with known atherosclerosis and associated Large Vessel Vasculitis (giant cell arteritis, Takayasu arteritis or idiopatic aortitis). Vascular uptake evaluated and quantified by using the graded 4-point scale of evaluation (0=no uptake, 1=less than liver, 2=similar to liver, 3=higher than liver). Grade 0-1 uptake was negative, Grade 2 uptake was moderately positive and Grade 3 uptake was markedly positive. These PET/CT findings were correlated with clinical indices including ITAS (Indian Takayasu Activity Score) and Kerr/National Institute of Health (Kerr/NIH), serum acute-phase reactants (ESR, C-reactive protein [CRP]) levels as well as interleukin-6 (IL-6) and the soluble IL-6 receptor (sIL-6R). Based on these findings the assessment was quantified.*Results 43% of 55 PET-CT cases were negative, 31% were moderately positive, and 26% were markedly positive. The significant correlation between the FDG uptake and ESR and CRP levels was also found. Significantly higher ESR values were observed in pts with markedly positive PET/CT (48.4 + 35.5 mm/1st h) compared with moderately positive (26 + 20 mm/1st h, p = 0.0001) and inactive scans (21.7 + 15.9 mm/1st h, p=0.0001). The range of the CRP levels were 0.8+1.0 mg/dL in pts with inactive scans, 1.3+ 2.2 mg/dL in pts with moderately positive (p=0.001) and 3.0 + 3.6 in patients with markedly positive scans (p = 0.0001). Higher levels of IL-6 had aresulted in patients with markedly positive scans (10.0 + 8.9 pg/ml) compared to those with inactive scans (8.1+18.5 pg/ml, p=0.013). We found no association and correlation between sIL-6R levels and vascular FDG uptake. There was a significant association between vascular FDG uptake and both ITAS and Kerr/NIH scores.*Conclusions Thus Whole Body FDG PET/CT is a useful tool for evaluating disease activity in patients with atherosclerosis and associated Large Vessel Vasculitis.*Clinical Relevance/Application Thus FDG has very important role in the evaluation of the Atherosclerosis and Large Vessel vasculitis

RESULTS

43% of 55 PET-CT cases were negative, 31% were moderately positive, and 26% were markedly positive. The significant correlation between the FDG uptake and ESR and CRP levels was also found. Significantly higher ESR values were observed in pts with markedly positive PET/CT (48.4 + 35.5 mm/1st h) compared with moderately positive (26 + 20 mm/1st h, p = 0.0001) and

inactive scans (21.7 + 15.9 mm/1st h, p=0.0001). The range of the CRP levels were 0.8+1.0 mg/dL in pts with inactive scans, 1.3+ 2.2 mg/dL in pts with moderately positive (p=0.001) and 3.0 + 3.6 in patients with markedly positive scans (p = 0.0001). Higher levels of IL-6 had aresulted in patients with markedly positive scans (10.0 + 8.9 pg/ml) compared to those with inactive scans (8.1+18.5 pg/ml, p=0.013). We found no association and correlation between sIL-6R levels and vascular FDG uptake. There was a significant association between vascular FDG uptake and both ITAS and Kerr/NIH scores.

CLINICAL RELEVANCE/APPLICATION

Thus FDG has very important role in the evaluation of the Atherosclerosis and Large Vessel vasculitis

SDP-NMMI-5 Poly(n-vinyl Caprolactam) Nanogels Conjugated With Mno2And Cytosine-phosphorothioate-guanine Oligodeoxynucleotides For Radiotherapy Of Orthotopic Glioblastoma

Participants
Meijuan He, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

Multiforme glioblastoma (GBM) is among the most aggressive and fatal primary brain tumours, and many modern treatments are ineffective against GBM. We designed an immune-activated nanoplatform of poly(N-vinyl caprolactam) nanogels (PVCL NGs) loaded with MnO2 and cytosine-phosphorothioate-guanine oligodeoxynucleotides (CpG ODNs) as a theranostic platform for magnetic resonance imaging (MRI)-guided immune-activated radiotherapy for GBM.*Methods and Materials We synthesized CpG NGs (PVCL-MnO2-CpG) by combining MnO2 with CpG ODNs within PVCL NGs. The anti-tumor efficiency of CpG NGs combined with RT was determined in vitro. C6 cells were treated with irradiation combined with PBS, PVCL-CpG, PVCL-MnO2, or PVCL-MnO2-CpG. Then, the cell viability, survival fraction and generation of histone ?-H2AX (?-H2AX) were detected. Besides, the expression of stimulator of interferon genes (STING) and interferon-ß (IFN-ß) in C6 cells were detected by western blotting. To evaluate the maturation of dendritic cells (DCs), bone- marrow-derived DCs were cocultured with C6 cells. In vivo, T1-weighted magnetic resonance images were taken before and at 1h, 2h, 4h, 10h, 24h post-injection of PVCL-MnO2 on glioblastoma-bearing mice. Afterwards, we evaluated the synergistic effect of RT and PVCL-MnO2-CpG. The tumour volume was recorded every 3 days. Finally, tumors were dissected for TUNEL staining and detection of protein levels. Moreover, single-cell suspensions of lymph nodes, spleens and tumor tissues were prepared and analysed by flow cytometry.*Results According to the study in vitro, PVCL-MnO2-CpG not only activated cyclic GMP-AMP synthase (cGAS)/stimulator of interferon genes (STING) pathway based on DNA damage, but also promoted the maturation of DCs. Compared with the group of RT, PVCL-MnO2-CpG + RT reduced the tumour growth rate in mice by 3.4 times (P<0.05) in vivo. Moreover, the number of CD3+CD8+ T cells in tumour sites of RT+PVCL-MnO2-CpG was nearly 20 folds higher than that RT alone (P<0.01). Besides, RT+PVCL-MnO2-CpG-treated mice displayed stronger immune activation in lymph nodes and spleen.*Conclusions The results indicated that Mn2+ could successfully traverse the blood-brain barrier and realised T1-weighted imaging. DNA damage caused by RT strengthened the cGAS/STIN kG pathway synergistic with Mn2+, and the resulting secretion of cytokines enhanced anti-tumour immunity. Upon treatment with CpG ODNs, DCs are activated and exhibited excellent therapeutic efficacy in inhibiting glioblastoma growth.*Clinical Relevance/Application Magnetic resonance imaging (MRI)-guided immune-activated radiotherapy may serve as an effective method for improving the therapeutic efficacy of the of GBM.

RESULTS

According to the study in vitro, PVCL-MnO2-CpG not only activated cyclic GMP-AMP synthase (cGAS)/stimulator of interferon genes (STING) pathway based on DNA damage, but also promoted the maturation of DCs. Compared with the group of RT, PVCL-MnO2-CpG + RT reduced the tumour growth rate in mice by 3.4 times (P<0.05) in vivo. Moreover, the number of CD3+CD8+ T cells in tumour sites of RT+PVCL-MnO2-CpG was nearly 20 folds higher than that RT alone (P<0.01). Besides, RT+PVCL-MnO2-CpG-treated mice displayed stronger immune activation in lymph nodes and spleen.

CLINICAL RELEVANCE/APPLICATION

Magnetic resonance imaging (MRI)-guided immune-activated radiotherapy may serve as an effective method for improving the therapeutic efficacy of the of GBM.

SDP-NMMI-6 Diagnostic Algorithm To Predict Malignancy In New Nodules Detected On 18 FDG PET-CT During Follow Up Of Lung Cancer Patients

Participants
Ankush Jajodia, DMRD,MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

PURPOSE

To classify new nodules detected during follow-up imaging with 18 FDG PET-CT in treated lung cancer patients.*Methods and Materials Two radiologists with different levels of clinical experience interpreted attenuation corrected CT images, without the use of iodinated contrast and PET fused images in a cohort of 101 patients diagnosed and treated with lung cancer from Jan 2013- Jan 2019. Doubts were resolved in consensus by senior thoracic radiologists with more than 25 years of experience. Nodule diameter,morphology (round, lobulated, spiculated), attenuation, and SUV max were recorded on an excel sheet. Readers were blinded to each other's interpretation and final clinical outcome (Gold standard was tissue sampling in the majority and follow up of 1 year). Interobserver agreement was assessedwith kappa statistic. AUC was calculated for individual parameters to assess diagnostic performance. Ten-fold cross-validated, multivariate classification analysis, using the classification and regression trees (CRT) algorithm was used to develop a stratification algorithm to classify nodules.*Results Sixty-five patients had malignant nodules proven on histopathology and 36 were benign. The range of diameter of the nodule was 3-26 mm, HU was 2-59 HU and SUV max was 1.1- 38.4. The best diagnostic performance was given by SUV max (AUC = 0.87), followed by nodule diameter (AUC =0.659) and nodule attenuation (AUC = 0.507), with statistical significance between attenuation andSUV max. The interobserver agreement between readers was substantial (k?=?0.796; 95% CI, 0.67-0.91). Multivariate classification analysis using the CRT algorithm retained two variables: SUV max and morphology of nodule. Diagnostic accuracy was 84.8 % in the testing set with 100% correctidentification of all benign nodules and false downgrade to benign in 20% of malignant cases.*Conclusions Our study showed that incorporating nodule morphology with SUV max metrics could help avoid re-biopsy in lung cancer patients with new nodules.*Clinical Relevance/Application New nodules during treatment and follow-up in lung cancer patients have an impact on management. Re-biopsy can be avoided by appropriate combined interpretation of nodule morphology and SUV.

RESULTS

Sixty-five patients had malignant nodules proven on histopathology and 36 were benign. The range of diameter of the nodule was 3-26 mm, HU was 2-59 HU and SUV max was 1.1- 38.4. The best diagnostic performance was given by SUV max (AUC = 0.87),

followed by nodule diameter (AUC =0.659) and nodule attenuation (AUC = 0.507), with statistical significance between attenuation andSUV max. The interobserver agreement between readers was substantial (k?=?0.796; 95% CI, 0.67-0.91). Multivariate classification analysis using the CRT algorithm retained two variables: SUV max and morphology of nodule. Diagnostic accuracy was 84.8 % in the testing set with 100% correctidentification of all benign nodules and false downgrade to benign in 20% of malignant cases.

CLINICAL RELEVANCE/APPLICATION

New nodules during treatment and follow-up in lung cancer patients have an impact on management. Re-biopsy can be avoided by appropriate combined interpretation of nodule morphology and SUV.

SDP-NMMI-7 Dosimetry Of Absorbed Dose Using Single-Photon Emission Computed Tomography Images In I-131 Therapy For Hyperthyroidism

Participants
Haruna Ikeda, Nagoya, Japan (*Presenter*) Nothing to Disclose

PURPOSE

This study calculated the thyroid uptake rate (RIU), effective half-life (EHL), and absorbed dose after I-131 therapy using single-photon emission computed tomography (SPECT) images and compared them with the pretreatment data.*Methods and Materials Forty-five patients with Graves' disease were recruited and retrospectively evaluated. Before dosimetry, we used a phantom filled with uniform iodine-131 (78 MBq) to obtain the conversion factor for calculating radioactivity based on SPECT counts. Four uptake assessments performed at 3, 24, 96, and 168 h after oral administration of I-131 (3.7 MBq) were used to deduce the RIU and EHL before I-131 therapy. The I-131 uptake rate after therapy was calculated by setting a volume of interest on the thyroid gland on SPECT images 24 and 168 h after I-131 administration, converting the counts obtained into radioactivity and dividing the administered radioactivity. The EHL was calculated by approximating RIUs after 24 and 168 h as a mono-exponential function. The absorbed dose before and after therapy were calculated using the Marinelli-Quimby equation. We used the Bonferroni-corrected Wilcoxon-Mann-Whitney test to assess the relationship between the therapeutic outcomes (hypothyroidism, euthyroidism, and hyperthyroidism) and the thyroid-absorbed dose before and after therapy. We used Peaprerson's correlation coefficient to assess the association among EHL, 24-h RIU, and absorbed dose before and after therapy.*Results We found a positive correlation among the 24-h RIU (r=0.58), EHL (r=0.60), and absorbed dose (r=0.68) before and after therapy, but the value decreased after therapy in many cases. The absorbed doses before and after treatment were significantly higher in patients with hypothyroidism (n=28) than in those with hyperthyroidism (n=11). In those with euthyroidism (n=6), there were many cases have lower absorbed dose after therapy.*Conclusions The EHL, RIU, and absorbed dose after treatment well correlated with the pretreatment values but decreased after treatment. The absorbed dose tends to reflect the therapeutic outcome; thus, it is necessary to determine the absorbed dose after therapy.*Clinical Relevance/Application Dosimetry of absorbed dose using SPECT imaging can visualize the distribution of iodine in the thyroid gland in therapy and may be useful in I-131 therapy planning.

RESULTS

We found a positive correlation among the 24-h RIU (r=0.58), EHL (r=0.60), and absorbed dose (r=0.68) before and after therapy, but the value decreased after therapy in many cases. The absorbed doses before and after treatment were significantly higher in patients with hypothyroidism (n=28) than in those with hyperthyroidism (n=11). In those with euthyroidism (n=6), there were many cases have lower absorbed dose after therapy.

CLINICAL RELEVANCE/APPLICATION

Dosimetry of absorbed dose using SPECT imaging can visualize the distribution of iodine in the thyroid gland in therapy and may be useful in I-131 therapy planning.

SDP-NMMI-8 Simple And Cost-free Strategies For Occupational Radiation Dose Reduction In 13N-ammonia Myocardial Perfusion PET

Participants
Takahiro Yano, RT, Suita, Japan (*Presenter*) Nothing to Disclose

PURPOSE

13N-ammonia myocardial perfusion positron emission tomography (Ammonia PET) is an established modality to assess myocardial ischemia and quantitate myocardial blood flow. However, Ammonia PET procedures include complicated tasks contributing to occupational radiation exposure (ORE). The purpose of this study was to evaluate the radiation dose of medical staff and establish the feasible strategies for ORE reduction in Ammonia PET.*Methods and Materials Forty-five Ammonia PET were performed by 2 workflows. In workflow A (n=28), a rest scan was first performed, and a nuclear medicine technologist (NMT) placed electrodes for the electrocardiogram (ECG) on the patient before stress scan (n=28). In workflow B (n=17), NMT first placed ECG electrodes on the patient and rest and stress images were scanned. The total radiation dose of NMT in one examination was compared between workflow A and B. For each scan, 370-450 MBq of 13N-ammonia was filled in the infusion system by a physician (Phys) and injected into a right antecubital vein using PET shielding. During pharmacological stress, Phys monitored ECG either on the patient's cranial side (n=17) or the left side of PET gantry (n=28). The radiation dose of Phys for 13N-ammonia injection and ECG monitoring were measured separately. To find out the appropriate point of monitoring ECG, we compared the radiation dose of Phys at these 2 points. All radiation doses were measured with electric dosemeters over their chests.*Results The average total radiation dose of NMT by workflow B was significantly lower than that by workflow A (4.91 ± 2.24 µSv vs 6.58 ± 2.20 µSv, p<0.05). The radiation dose of Phys for 13N-ammonia injection was 3.50 ± 1.17 µSv per examination. Interestingly, Phys received lower ORE on the left side of PET gantry than on the patient's cranial side (0.11 ± 0.02 µSv vs 1.53 ± 0.25 µSv, p<0.05) during pharmacological stress.*Conclusions The radiation dose of NMT in Ammonia PET can be easily reduced by adjusting the workflow. ORE in Ammonia PET can be minimized by standing on the left side of PET gantry instead of the patient's cranial side. These are simple strategies for ORE reduction without additional cost.*Clinical Relevance/Application Reordering the workflow and standing on the left side of PET gantry during pharmacological stress were simple strategies to reduce ORE in Ammonia PET without additional cost.

RESULTS

The average total radiation dose of NMT by workflow B was significantly lower than that by workflow A (4.91 ± 2.24 µSv vs 6.58 ± 2.20 µSv, p<0.05). The radiation dose of Phys for 13N-ammonia injection was 3.50 ± 1.17 µSv per examination. Interestingly, Phys received lower ORE on the left side of PET gantry than on the patient's cranial side (0.11 ± 0.02 µSv vs 1.53 ± 0.25 µSv, p<0.05) during pharmacological stress.

SDP-NMMI-9 A Pilot Study Of 68Ga-PSMA11 And 68Ga-RM2 PET/MRI For Biopsy Guidance In Patients With Suspected Prostate Cancer

Participants
Heying Duan, MD, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

Targeting of lesions seen on prostate multiparametric MRI (mpMRI) improves prostate cancer (PC) detection at biopsy. However, 20-65% of highly suspicious lesions on MRI (PIRADS 4 or 5) prove to be false positives (FP) at biopsy. Here, we evaluated the potential utility of 68Ga-PSMA11 and 68Ga-RM2 PET/MRI for biopsy guidance in patients with suspected PC and prior negative biopsy or equivocal MRI.*Methods and Materials Nine men, aged 59.8±4.6 years, with suspected PC were prospectively enrolled to undergo 68Ga-PSMA11 and 68Ga-RM2 PET/MRI, including mpMRI. The prostate was divided into 12 segments (apex lateral, apex medial, base lateral, base medial, mid lateral, mid medial, left and right, respectively) using PET/MRI data and MIM software. Maximum standardized uptake values (SUVmax) of suspected PC lesions and background for each segment was collected. Biopsies after PET/MRI included 1 core through each of the 12 segments and targeted sampling of any lesions seen on PET. PET/MRI results were then compared to the gold standard biopsy.*Results PSA and PSA density were 11.07±6.57 ng/mL and 0.20±0.12 ng/mL2, respectively. Prostate biopsy prior to imaging was available in 7/9 patients of which 4 were negative and 3 showed Gleason score (GS) 7. mpMRI was negative in 4 patients, 4 showed PIRADS 4 and 1 patient PIRADS 5. 68Ga-PSMA11 and 68Ga-RM2 PET/MRI each identified 18 lesions, however 6 lesions in 3 patients were incongruent. PET/MRI guided biopsy led to the additional finding of 3 clinically significant tumors with GS 7 in 3 patients as well as 2 with GS 6 in 2 patients. Suspected lesions concordant between mpMRI and both radiotracers were seen in 2 patients: PET/MRI guided biopsy confirmed GS 7 in one patient and GS 6 for the other patient, whereas 1 GS 7 lesion was missed by all modalities. All other biopsy verified GS 7 and GS 6 lesions were identified by both radiotracers. Mean SUVmax for true positives (TP) was slightly higher than FP, however not statistically significant (Mean SUVmax for TP (GS 7) vs. FP lesions: 10.64±8.07 vs. 6.44±4.64 [P=0.38] for 68Ga-PSMA11, and 19.24±17.8 vs. 12.5±13 [P=0.47] for 68Ga-RM2).*Conclusions Our preliminary results show that both 68Ga-PSMA11 and 68Ga-RM2 PET/MRI are not only feasible for biopsy guidance in suspected PC, but also identified additional cancers not seen on mpMRI. However, larger studies are needed to shed light on the different expression patterns of PSMA and gastrin releasing peptide receptor in PC.*Clinical Relevance/Application Molecular imaging with 68Ga-PSMA11 and 68Ga-RM2 PET/MRI are feasible for biopsy guidance in suspected PC and may identify additional cancers not seen on mpMRI.

RESULTS

PSA and PSA density were 11.07±6.57 ng/mL and 0.20±0.12 ng/mL2, respectively. Prostate biopsy prior to imaging was available in 7/9 patients of which 4 were negative and 3 showed Gleason score (GS) 7. mpMRI was negative in 4 patients, 4 showed PIRADS 4 and 1 patient PIRADS 5. 68Ga-PSMA11 and 68Ga-RM2 PET/MRI each identified 18 lesions, however 6 lesions in 3 patients were incongruent. PET/MRI guided biopsy led to the additional finding of 3 clinically significant tumors with GS 7 in 3 patients as well as 2 with GS 6 in 2 patients. Suspected lesions concordant between mpMRI and both radiotracers were seen in 2 patients: PET/MRI guided biopsy confirmed GS 7 in one patient and GS 6 for the other patient, whereas 1 GS 7 lesion was missed by all modalities. All other biopsy verified GS 7 and GS 6 lesions were identified by both radiotracers. Mean SUVmax for true positives (TP) was slightly higher than FP, however not statistically significant (Mean SUVmax for TP (GS 7) vs. FP lesions: 10.64±8.07 vs. 6.44±4.64 [P=0.38] for 68Ga-PSMA11, and 19.24±17.8 vs. 12.5±13 [P=0.47] for 68Ga-RM2).

CLINICAL RELEVANCE/APPLICATION

Molecular imaging with 68Ga-PSMA11 and 68Ga-RM2 PET/MRI are feasible for biopsy guidance in suspected PC and may identify additional cancers not seen on mpMRI.

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RI04-A

Reproductive Imaging Wednesday Poster Discussions

Sub-Events

RI04-A1   **Role Of Biplanar Evaluation Of The Fetal Palate In The 11-14 Weeks' Sonogram**

Participants
Divya Singh, MBBS, MD, Chandigarh, India (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the role of analysing the fetal palate in the coronal and sagittal planes in the 11-14 weeks' sonogram*Methods and Materials 15 cases of fetal facial clefts diagnosed between 11-14 weeks were included in the study. 200 normal fetuses were included. Coronal and sagittal scanning of the face in B mode was used in screening for palatine clefts. The sagittal plane was the same as that used for assessing the nuchal translucency. Besides the traditional anterior coronal plane of retronasal triangle used for assessing the primary hard palate, a posterior coronal plane was sought for to assess the secondary hard palate. Diagnosis of cleft palate was confirmed on postnatal evaluation in all cases.*Results Cleft palate was seen in the anterior coronal plane in more than 90 per cent cases. In one case of isolated cleft of secondary hard palate, posterior coronal plane was useful. Mid-sagittal plane revealed clefts in more than 60 per cent cases. Parasagittal plane showed cleft in 30 percent cases. There were two false positive calls of cleft palate in the sagittal plane which were clarified in the coronal plane.*Conclusions Antenatal screening for clefts of the hard palate at 11-14 weeks is accurate using a biplanar approach. Mid-sagittal plane that has been used traditionally for nuchal translucency needs to be supplemented with coronal plane for comprehensive evaluation of fetal palate. Posterior coronal plane has an additional advantage of assessing for isolated cleft in secondary hard palate.*Clinical Relevance/Application A biplanar approach using coronal and sagittal scanning of the palate in the 11-14 weeks' scan improves the detection rate for facial clefts. First trimester is an optimal time for screening as the shadowing from facial bones is negligible. Also, early detection helps the couple to make a timely informed decision regarding further management.

RESULTS

Cleft palate was seen in the anterior coronal plane in more than 90 per cent cases. In one case of isolated cleft of secondary hard palate, posterior coronal plane was useful. Mid-sagittal plane revealed clefts in more than 60 per cent cases. Parasagittal plane showed cleft in 30 percent cases. There were two false positive calls of cleft palate in the sagittal plane which were clarified in the coronal plane.

CLINICAL RELEVANCE/APPLICATION

A biplanar approach using coronal and sagittal scanning of the palate in the 11-14 weeks' scan improves the detection rate for facial clefts. First trimester is an optimal time for screening as the shadowing from facial bones is negligible. Also, early detection helps the couple to make a timely informed decision regarding further management.

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Abstract Archives of the RSNA, 2021

Sub-Events

NMMI04-C1 Evaluation Of Catabolism In Patients With Cancer-associated Cachexia By PET/CT

Participants
Yang Jiang, Nanjing, China (*Presenter*) Nothing to Disclose

PURPOSE

We investigated the differences in clinical characteristics and fluorine-18-labelled fluoro-2-deoxy-d-glucose (18F-FDG) uptakes in different metabolism organs of cancer patients who developed cachexia versus those who did not. *Methods and Materials Two thousand two hundred thirty-one positron emission tomography/computed tomography (PET/CT) scans of two thousand one hundred forty-four patients with known or suspected malignancy as training set were retrospectively analyzed. When we measured fluoro-2-deoxy-d-glucose (FDG) uptakes in metabolism organs, different slices were selected and delineated with the volume of interest (VOI) of the corresponding size. Baseline characteristics, laboratory examination results, and FDG uptakes of the various organs among cachexia group (n = 200, e = 204) and non-cachexia group (n = 96, e = 106) were compared in the training set. In the validation set, we include one hundred and eleven examinations of one hundred and ten patients to confirm the reliability and feasibility of risk factors derived from the training set.*Results In the training set, the FDG uptakes of the visceral fat and subcutaneous fat in the cachexia group were all higher than those in the non-cachexia group. We finally included white blood cell count and minimum standardized uptake value of lean body mass of subcutaneous fat into the multivariate logistic regression analysis.*Conclusions A multiple logistic regression model incorporating clinical variables and positron emission tomography (PET) metabolic features was better able to predict the risk of cachexia in cancer patients.*Clinical Relevance/Application When reviewing PET/CT images of cancer patients, a nuclear medicine physician may focus on changes in FDG uptake values in subcutaneous fat, which will be beneficial in the clinical assessment of the risk of cachexia in cancer patients.

RESULTS

In the training set, the FDG uptakes of the visceral fat and subcutaneous fat in the cachexia group were all higher than those in the non-cachexia group. We finally included white blood cell count and minimum standardized uptake value of lean body mass of subcutaneous fat into the multivariate logistic regression analysis.

CLINICAL RELEVANCE/APPLICATION

When reviewing PET/CT images of cancer patients, a nuclear medicine physician may focus on changes in FDG uptake values in subcutaneous fat, which will be beneficial in the clinical assessment of the risk of cachexia in cancer patients.

NMMI04-C3 FDG-PET/MRI In Graft-versus-host-disease (gvhd)

Participants
Wolfgang Roll, Muenster, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Graft versus host disease (GvHD) is a frequent complication of allogeneic stem cell transplantation (alloSCT), significantly increasing mortality. Previous imaging studies focused on the assessment of intestinal GvHD with contrast-enhanced MRI/CT or 18F-FDG-PET imaging alone. This pilot study aimed to elucidate the diagnostic value of a combined 18F-FDG-PET-MRI protocol in patients with acute intestinal GvHD.*Methods and Materials Between 2/2015 and 8/2019, 21 patients with acute intestinal GvHD underwent 18F-FDG-PET-MRI. PET, MRI and PET-MRI datasets were independently reviewed. Readers assessed the reliability of the diagnosis on a 5-point Likert scale (1="no GvHD", to 5="definitely GvHD"). Quantitative PET (SUVmax, SUVpeak, metabolic volume (MV)) and MRI parameter (wall thickness), were correlated to clinical staging of acute intestinal GvHD.*Results The detection rate for acute intestinal GvHD was 56.8 % for PET, 61.4 % for MRI and 100% for PET-MRI. PET-MRI (median Likert-scale value: 5; range: 4-5) offers a significantly higher reliability of the diagnosis compared to PET (median: 4; range: 2-5; p=0.01) and MRI alone (median: 4; range: 3-5; p=0.03). The number of affected segments in PET-MRI (rs=0.677; p<0.001) and the MV (rs=0.703; p<0.001) correlated significantly with clinical stage. SUVmax (rs=0.345; p=0.14), SUVpeak (rs=0.276; p=0.24) and wall thickness (rs=0.174; p=0.17) did not correlate with clinical stage.*Conclusions In this pilot study combined 18F-FDG-PET-MRI allows for a highly reliable assessment of acute intestinal GvHD. 18F-FDG-PET-MRI parameters add information indicating clinical severity.*Clinical Relevance/Application 18F-FDG-PET-MRI allows for advanced assessment of acute intestinal GvHD combining advantages of molecular and morphological imaging. Quantitative 18F-FDG-PET-MRI parameter correlate with clinical stage and thus add information indicating clinical severity.

RESULTS

The detection rate for acute intestinal GvHD was 56.8 % for PET, 61.4 % for MRI and 100% for PET-MRI. PET-MRI (median Likert-scale value: 5; range: 4-5) offers a significantly higher reliability of the diagnosis compared to PET (median: 4; range: 2-5; p=0.01) and MRI alone (median: 4; range: 3-5; p=0.03). The number of affected segments in PET-MRI (rs=0.677; p<0.001) and the MV (rs=0.703; p<0.001) correlated significantly with clinical stage. SUVmax (rs=0.345; p=0.14), SUVpeak (rs=0.276; p=0.24) and wall thickness (rs=0.174; p=0.17) did not correlate with clinical stage.

CLINICAL RELEVANCE/APPLICATION

18F-FDG-PET-MRI allows for advanced assessment of acute intestinal GvHD combining advantages of molecular and morphological imaging. Quantitative 18F-FDG-PET-MRI parameter correlate with clinical stage and thus add information indicating clinical severity.

Abstract Archives of the RSNA, 2021

Sub-Events

PH03-A2   Influence Of Administered Contrast Agents On The Water Equivalent Diameter For CT Abdomen

Participants

An Dedulle, MSc, Leuven, Belgium (*Presenter*) Researcher, Qaelum NV;Research Grant, VLAIO

PURPOSE

A commonly used metric for patient size in personalized dosimetry is the water equivalent diameter (WED). Considering that this metric is attenuation-based and its calculation comes from the Hounsfield units in the CT image, the WED might be affected by injected contrast. The purpose of this study was to investigate the impact of administered contrast on the WED for three abdominal CT protocols.*Methods and Materials Data from three abdominal CT protocols, namely aorta (446 exams), kidney (498 exams) and upper abdomen (498 exams) protocols, were acquired with a dose management software. All exams had a non-contrast series and an arterial phase. The WED of the two series was compared with a paired t-test (significance level 0.05) for each protocol. The scan length and the tube voltage were also considered in the analysis, as they could influence the region used for the WED calculation, and the Hounsfield units, respectively.*Results For the exams under study, the mean injected volume of contrast in our hospital is 86±18ml. With the scan length being only marginally different between the non-contrast and arterial phase (mean of respectively 57cm and 57cm for the aorta, 28cm and 27cm for the kidney and 37cm and 37cm for the abdomen exams), comparison of the WED in terms of impact of administered contrast is possible without any adaptation of the WED algorithms. The mean WED for all the exams of the non-contrast series was 30±4cm. For all protocols, the WED from the two series (non-contrast and arterial phase) was found significantly different (p<0.01 for all three). The difference in WED was however less than 1cm for 85%, 91% and 95% of the aorta, kidney and upper abdomen exams respectively. From the overall dataset, only <1% of aorta, 40% of kidney and 40% of upper abdominal exams had the same tube potential and scan length between the two phases. From this smaller subset, it was found that the WED between the two phases (non-contrast and arterial phase) was again significantly different for the kidney and upper abdominal protocol (p<0.01 for both). The mean differences were respectively 0.3±0.3cm and 0.3±0.8cm. The aorta subset was excluded from this second analysis, due to the limited number of exams with constant tube voltage.*Conclusions In scans with similar scan length, the differences in WED due to contrast enhancement were small and will not be clinically relevant in most applications.*Clinical Relevance/Application When using WED as a patient size metric (e.g. for size-specific dosimetry), the impact of any non-size parameter has to be ruled out. Administered contrast does not have to be taken into account.

RESULTS

For the exams under study, the mean injected volume of contrast in our hospital is 86±18ml. With the scan length being only marginally different between the non-contrast and arterial phase (mean of respectively 57cm and 57cm for the aorta, 28cm and 27cm for the kidney and 37cm and 37cm for the abdomen exams), comparison of the WED in terms of impact of administered contrast is possible without any adaptation of the WED algorithms. The mean WED for all the exams of the non-contrast series was 30±4cm. For all protocols, the WED from the two series (non-contrast and arterial phase) was found significantly different (p<0.01 for all three). The difference in WED was however less than 1cm for 85%, 91% and 95% of the aorta, kidney and upper abdomen exams respectively. From the overall dataset, only <1% of aorta, 40% of kidney and 40% of upper abdominal exams had the same tube potential and scan length between the two phases. From this smaller subset, it was found that the WED between the two phases (non-contrast and arterial phase) was again significantly different for the kidney and upper abdominal protocol (p<0.01 for both). The mean differences were respectively 0.3±0.3cm and 0.3±0.8cm. The aorta subset was excluded from this second analysis, due to the limited number of exams with constant tube voltage.

CLINICAL RELEVANCE/APPLICATION

When using WED as a patient size metric (e.g. for size-specific dosimetry), the impact of any non-size parameter has to be ruled out. Administered contrast does not have to be taken into account.

PH03-A4   Does Energy Spectral CT Scanning Require More Radiation Dose Than Non-spectral CT Scanning?

Participants

Zhenhua Wang, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the effects of energy spectral CT scanning and non-spectral CT scanning on the image quality and radiation dose of head and neck CT examination.*Methods and Materials 30 patients with clinical multi-stage CT angiography imaging of head and neck in our hospital using spectral CT (Revolution CT, GE Healthcare) were collected. Non-spectral scanning was used for non-contrast scanning, and energy spectral imaging (GSI) was used for multi-stage CT angiography (arterial phase, venous phase and late venous phase) enhanced scan.The weight of pre-ASIR-V of both non-spectral scan and energy spectral scan (venous phase) were 40%, the non-spectral scanning protocol were as follows: tube voltage 120kV, automatic modulation tube voltage (Smart mA, range 140-740mA,the energy spectral scanning protocol were as follows: tube voltage fast kV switch (80/140 kV), tube current 200mA, noise index (NI) of both non-spectral scan and energy spectrum scan (venous phase) was 9. The CT values and SD values of the bifurcation of common carotid artery, frontal parenchyma and sternocleidomastoid muscle in non-spectral CT images and

120kVp-like energy spectral scanning (venous phase) images were measured and compared. The Dose Length Product (DLP) of non-spectral scan and spectral scan (venous phase) was recorded, and the effective dose (ED) was calculated. One-way ANOVA was used to compare the difference of SD and radiation dose between non-spectral scan and energy spectral scan (venous phase) with p<0.05 being statistically significant difference.*Results The SD of common carotid artery bifurcation, frontal lobe and sternocleidomastoid muscle in non-spectral and spectral images were 13.86±3.40, 17.19±3.01, 11.91±2.50 HU and 14.98±4.38, 18.67±6.24, 14.09±3.87 HU, respectively, with no significant difference(P>0.05).The DLP and ED of non-spectral and spectral scan were(304.94±44.96)mGy*cm,(0.94±0.13)mSv and(284.77±45.38)mGy*cm,(0.88±0.14) mSv, respectively with significant difference(P<0.05). The DLP and ED of energy spectral scan were reduced by 6.6% and 6.4%, respectively, compared with non-spectral scan.*Conclusions The image quality of head and neck were not affected by energy spectral scan and non-spectral scan, but the radiation dose of energy spectral scan was lower than that of non-spectral scan.*Clinical Relevance/Application Some scholars often believe that energy spectral scan will produce a lot of radiation dose, but this study found that energy spectral scan, on the premise of maintaining the same image quality, the radiation dose is lower than non-spectral scan, and can provide more information than non-spectral scan, so as to improve the efficiency of disease diagnosis.

RESULTS

The SD of common carotid artery bifurcation, frontal lobe and sternocleidomastoid muscle in non-spectral and spectral images were 13.86±3.40, 17.19±3.01, 11.91±2.50 HU and 14.98±4.38, 18.67±6.24, 14.09±3.87 HU, respectively, with no significant difference(P>0.05).The DLP and ED of non-spectral and spectral scan were(304.94±44.96)mGy*cm,(0.94±0.13)mSv and(284.77±45.38)mGy*cm,(0.88±0.14) mSv, respectively with significant difference(P<0.05). The DLP and ED of energy spectral scan were reduced by 6.6% and 6.4%, respectively, compared with non-spectral scan.

CLINICAL RELEVANCE/APPLICATION

Some scholars often believe that energy spectral scan will produce a lot of radiation dose, but this study found that energy spectral scan, on the premise of maintaining the same image quality, the radiation dose is lower than non-spectral scan, and can provide more information than non-spectral scan, so as to improve the efficiency of disease diagnosis.

PH03-A5   A Novel CT Tube Current Modulation Technique That Minimizes Patient Risk

Participants
Laura Klein, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To propose a novel tube current modulation (TCM) technique optimized for modern reconstruction methods that minimizes the effective dose as measure for patient risk in comparison to classical TCM algorithms that minimize the mAs-product.*Methods and Materials The exposure to ionizing radiation in computed tomography (CT) examinations is a concern to public health and should be kept at a minimum. Several methods for dose reduction have been proposed in scope of automatic exposure control (AEC) methods. A popular example are TCM algorithms that minimize the mAs-product (mAsTCM) but not the actual patient risk. We herein propose riskTCM, a novel TCM that minimizes effective dose as measure of risk. Based on a coarse, initial reconstruction of the patient, e.g. obtained from the topogram(s), dose can be estimated in real-time on a per-view basis using the deep dose estimation (DDE) algorithm. Combined with a segmentation, organ doses can be estimated and the effective dose per view can be computed. The optimization of a novel cost function allows for the estimation of a TCM curve that minimizes the effective dose of the CT examination. We retrospectively applied riskTCM to 20 patients covering all relevant anatomical regions and tube voltages from 70 kV to 150 kV. The resulting effective dose is compared to the dose administered without TCM (noTCM) and using mAsTCM.*Results All evaluated anatomical regions, e.g. neck, thorax, abdomen and the pelvis, benefit from riskTCM. On average, a reduction of effective dose of about 19% for the thorax, 45% for the abdomen, 26% for the pelvis, and 23% for the neck have been observed compared to today's state-of-the-art mAsTCM. Compared to noTCM, riskTCM achieves a dose reduction of about 48% on average over all considered anatomical regions.*Conclusions Risk-specific TCM allows for a reduction of effective dose and hence of patient risk in modern CT scanners. Since it modulates tube current similar to mAsTCM, an implementation of this technique on actual scanners would be straight forward and requires changes in software only. Furthermore, the cost function could be adapted to account for other risk measures besides effective dose.*Clinical Relevance/Application riskTCM can reduce the exposure to x-rays in CT examinations, particularly for organs sensitive to ionizing radiation.

RESULTS

All evaluated anatomical regions, e.g. neck, thorax, abdomen and the pelvis, benefit from riskTCM. On average, a reduction of effective dose of about 19% for the thorax, 45% for the abdomen, 26% for the pelvis, and 23% for the neck have been observed compared to today's state-of-the-art mAsTCM. Compared to noTCM, riskTCM achieves a dose reduction of about 48% on average over all considered anatomical regions.

CLINICAL RELEVANCE/APPLICATION

riskTCM can reduce the exposure to x-rays in CT examinations, particularly for organs sensitive to ionizing radiation.

PH03-A7   Single-Volume Quantitative CT Myocardial Perfusion Measurement

Participants
Logan Hubbard, BS, Irvine, California (*Presenter*) Nothing to Disclose

PURPOSE

Dynamic CT myocardial perfusion imaging enables accurate physiological assessment of coronary artery disease (CAD). However, its routine clinical use remains limited by the high radiation dose attributed to serial acquisition of 10 or more volume scans per exam. Hence, the purpose of this study was to validate a novel, low-dose, single-volume quantitative CT myocardial perfusion technique in a cardiovascular perfusion phantom, using ultrasound flow probe measurement as the reference standard.*Methods and Materials The single-volume quantitative CT perfusion technique was retrospectively validated over a range of perfusion rates (0.97 to 2.45 mL/min/g). For each perfusion rate, 15 mL of contrast material was injected (5 mL/s) with a saline chaser, followed by dynamic imaging at 100 kVp and 200 mA with a 320-slice CT scanner to capture the entire aortic enhancement curve. The image data were then used retrospectively to simulate prospective 2-mm-slice dynamic bolus tracking with aortic triggering at 150 HU followed by "acquisition" of a single whole-heart volume scan six cardiac cycles later. Importantly, the dynamic bolus tracking, trigger, and single volume scan data were then used as analytical inputs in a novel first-pass analysis compartment model to derive quantitative perfusion in mL/min/g. The error of single-volume quantitative CT perfusion measurement versus reference standard ultrasound perfusion measurement was then determined after which regression was performed.*Results The average error of single-volume

quantitative CT perfusion measurement was -0.02 ± 0.09 mL/min/g (-1.2 ± 6.3%), with a corresponding root-mean-square-error of 0.09 mL/min/g (0.11%). The CT measurements (PCT) were also related to reference standard ultrasound flow probe measurements (PUS) by PCT = 1.04 PUS - 0.1 (Pearson's r = 0.98). The average CT dose index of the technique was only 5.4 mGy.*Conclusions Using bolus tracking data and only one whole-heart volume scan, the single-volume quantitative CT perfusion technique provides accurate, low-dose, myocardial perfusion measurement in mL/min/g.*Clinical Relevance/Application The technique incorporates bolus tracking data to dramatically reduce the dose of dynamic CT perfusion. It may also be used simultaneously as a CT angiogram if acquired at a diagnostic tube current.

RESULTS

The average error of single-volume quantitative CT perfusion measurement was -0.02 ± 0.09 mL/min/g (-1.2 ± 6.3%), with a corresponding root-mean-square-error of 0.09 mL/min/g (0.11%). The CT measurements (PCT) were also related to reference standard ultrasound flow probe measurements (PUS) by PCT = 1.04 PUS - 0.1 (Pearson's r = 0.98). The average CT dose index of the technique was only 5.4 mGy.

CLINICAL RELEVANCE/APPLICATION

The technique incorporates bolus tracking data to dramatically reduce the dose of dynamic CT perfusion. It may also be used simultaneously as a CT angiogram if acquired at a diagnostic tube current.

PH03-A9   Preliminary Study Of DECT Imaging With Limited-angular-range Data

Participants
Buxin Chen, PHD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Dual-energy computed tomography (DECT) usually collects low- and high-kVp data with two full rotations. DECT with limited-angular-range (LAR) data can potentially reduce radiation dose and scan time, and avoid collision with patient. In this work, we investigate image reconstruction for DECT imaging with data of LAR that is smaller than 180o.*Methods and Materials We design scan configurations with overlapping scanning arcs of LAR for low- and high-kVp data. An array of LARs, spanning from 14o to 180o, is investigated. We then formulate the Image reconstruction problem from LAR data as a convex optimization problem with constraints on image's directional-total-variations (DTVs) along orthogonal axes, together with a data-l2 objective function. A first-order primal-dual algorithm is tailored, referred to as the DTV algorithm, and used to solve the optimization problem and reconstruct images. Numerical studies are carried out using a digital breast phantom with iodine contrast agent enhancement, where reconstructed images are visually assessed for artifact reduction and quantitatively analyzed for iodine concentration estimation.*Results Monochromatic images at 34 keV, as well as low- and high-kVp images, obtained with the DTV algorithm from LAR data show substantially reduced artifacts, which are observed often in images reconstructed with existing algorithms, such as FBP, in DECT. In addition, iodine-contrast concentrations can be estimated from LAR data as accurately as those from the full-scan data with 360o.*Conclusions The preliminary study reveals that it may be possible to obtain, from low- and high-kVp data of LAR, monochromatic images visually, and to estimate iodine-contrast concentration quantitatively, comparable to their counterparts obtained from full-angular-range data in DECT.*Clinical Relevance/Application The results acquired in the study may engender insights into the design of DECT with LAR scan configurations of practical application significance, for reducing radiation dose and scan time, and/or avoiding patient collision, e.g., in a C-arm CBCT.

RESULTS

Monochromatic images at 34 keV, as well as low- and high-kVp images, obtained with the DTV algorithm from LAR data show substantially reduced artifacts, which are observed often in images reconstructed with existing algorithms, such as FBP, in DECT. In addition, iodine-contrast concentrations can be estimated from LAR data as accurately as those from the full-scan data with 360o.

CLINICAL RELEVANCE/APPLICATION

The results acquired in the study may engender insights into the design of DECT with LAR scan configurations of practical application significance, for reducing radiation dose and scan time, and/or avoiding patient collision, e.g., in a C-arm CBCT.

Abstract Archives of the RSNA, 2021

Sub-Events

PH01-A1   Clinical Cadmium-Telluride-Based Photon-Counting Detector In Cadaveric Wrist Imaging

Participants
Jan Grunz, MD, Wuerzburg, Germany (*Presenter*) Research Consultant, Siemens AG

PURPOSE

Detailed display of bone microarchitecture is essential for evaluating subtle wrist fractures in computed tomography. The goal of this study was to assess the performance of a novel CT with clinical cadmium-telluride-based photon-counting detector (PCD-CT) compared to a third-generation dual-source CT scanner with energy-integrating detector build (EID-CT).*Methods and Materials Eight cadaveric wrists were examined with both systems using radiation dose equivalent acquisition protocols (low-/standard-/full-dose: CTDIvol=1.5/5.8/8.7 mGy). All wrists were scanned with the two operating modes of the photon-counting CT (standard-resolution mode, ultra-high-resolution mode). After reformation with comparable convolution kernels, three radiologists performed subjective evaluation of image quality for each dataset. In order to estimate the interrater agreement, the intraclass correlation coefficient was calculated (based on absolute agreement in a two-way random-effects model). Signal-to-noise and contrast-to-noise ratios were computed based on CT number measurements in predefined regions of interest to provide an additional semiquantitative measure of image quality.*Results Subjective image quality of standard-dose PCD-CT scans in ultra-high-resolution mode was superior compared to full-dose EID-CT (p=.040) and full-dose PCD-CT in standard-resolution mode (p=.016). No difference was ascertained between low-dose PCD-CT in ultra-high-resolution mode and standard-dose scans with either EID-CT (p=.470) or PCD-CT in standard-resolution mode (p=.108). Observer evaluation of EID-CT and standard-resolution PCD-CT delivered similar results in full-dose and standard-dose examinations (p=.248/.509). Intraclass correlation coefficient was 0.876 (95% confidence interval: 0.744-0.925; p<.001), indicating good reliability. Between dose equivalent studies, signal-to-noise and contrast-to-noise ratios were substantially higher in photon-counting CT examinations (all p<.001).*Conclusions Superior visualization of fine anatomy can be achieved with a clinical PCD-CT system in cadaveric wrist scans. The ultra-high-resolution scan mode suggests potential for considerable dose reduction over conventional EID-CT.*Clinical Relevance/Application High-resolution imaging of the appendicular skeleton is feasible with a cadmium-telluride-based photon-counting detector. Compared to energy-integrating detector builds, the novel technique enables superior image quality, hence allowing for dose reduction.

RESULTS

Subjective image quality of standard-dose PCD-CT scans in ultra-high-resolution mode was superior compared to full-dose EID-CT (p=.040) and full-dose PCD-CT in standard-resolution mode (p=.016). No difference was ascertained between low-dose PCD-CT in ultra-high-resolution mode and standard-dose scans with either EID-CT (p=.470) or PCD-CT in standard-resolution mode (p=.108). Observer evaluation of EID-CT and standard-resolution PCD-CT delivered similar results in full-dose and standard-dose examinations (p=.248/.509). Intraclass correlation coefficient was 0.876 (95% confidence interval: 0.744-0.925; p<.001), indicating good reliability. Between dose equivalent studies, signal-to-noise and contrast-to-noise ratios were substantially higher in photon-counting CT examinations (all p<.001).

CLINICAL RELEVANCE/APPLICATION

High-resolution imaging of the appendicular skeleton is feasible with a cadmium-telluride-based photon-counting detector. Compared to energy-integrating detector builds, the novel technique enables superior image quality, hence allowing for dose reduction.

PH01-A10   Feasibility Of A New 3D Resolution Phantom As An Investigative Tool For Protocol Selection On CT

Participants
Joshua Levy, Salem, New York (*Presenter*) Stockholder, The Phantom Laboratory;President, The Phantom Laboratory ;Stockholder, Image Owl, Inc;CEO, Image Owl, Inc;

PURPOSE

As CT has moved into even more 3D approaches, awareness of volumetric resolution has become more critical. We investigate a novel phantom for measurement of 3D spatial resolution in CT as a tool for protocol selection in an optimization setting.*Methods and Materials A Catphan 700 (The Phantom Laboratory, Salem NY) phantom, equipped with a 3D resolution module (CTP721) was scanned on two CT scanners; GE Revolution CT and Siemens Somatom Force. The module, CTP721, contains two oppositely angled wave ramps that create waveform profiles in the CT image. These waveform profiles will vary depending on scanning parameters, reflecting the spatial resolution in three dimensions. Initial testing performed on the GE Revolution scanner focused on confirmation and reproducibility of the results. A set of standard parameters were chosen, and for subsequent scans one and one parameter was changed in order to compare the change in effect on spatial resolution when changing slice thickness, pitch, ASiR-V, kernels and scan modes. To assess the phantom as a tool for protocol selection, it was scanned with ultra-fast scan (HyperDrive (GE) and Turbo Flash (Siemens)) in addition to standard scans. Images were analyzed using the SMARI® software (The Phantom Laboratory), where in-plane modulation transfer function (MTFxy) and the harmonics of the wave pattern was obtained. From this we derived combined MTF (MTFxyz) and z-axis MTF (MTFz).*Results Changes in resolution from the initial testing were as expected, and the results reproducible. 0.6mm slice thickness had superior resolution compared to 1.2mm slice thickness in z-

direction. Varying pitch had only minor impact on the resolution, and varying ASiR-V level did not impact the resolution. Axial scan showed superior resolution compared to helical scan in z-direction, and of the chosen kernels, detail kernel gave the best resolution, and soft kernel had the lowest resolution in z-direction. The analyses of the HyperDrive and Turbo Flash scans are WIP.*Conclusions The results show that the phantom can be useful for assessment of 3D resolution and changes in z-axis resolution when optimizing protocols.*Clinical Relevance/Application A reliable phantom that can evaluate resolution in all dimensions, both mathematically and visually, is an important tool in protocol optimization with the increasing number of 3D approaches in CT.

RESULTS

Changes in resolution from the initial testing were as expected, and the results were reproducible. 0.6mm slice thickness had superior resolution compared to 1.2mm slice thickness in z-direction. Varying pitch had only minor impact on the resolution, and varying ASiR-V level did not impact the resolution. Axial scan showed superior resolution compared to helical scan in z-direction, and of the chosen kernels, detail kernel gave the best resolution, and soft kernel had the lowest resolution in z-direction. The analyses of the HyperDrive and Turbo Flash scans are WIP.

CLINICAL RELEVANCE/APPLICATION

A reliable phantom that can evaluate resolution in all dimensions, both mathematically and visually, is an important tool in protocol optimization with the increasing number of 3D approaches in CT.

PH01-A12 Dependency Of TrueFidelity On Acquisition And Reconstruction Parameters Using NMR-CFR

Participants
Akira Hasegawa, PhD, Chapel Hill, North Carolina (*Presenter*) Employee, AlgoMedica, Inc

PURPOSE

In recent years, several deep learning CT image noise reduction techniques have been commercialized. These techniques, designed from learning of their own training data, are black boxes to the users. We had proposed the metrics of noise magnitude ratio and central frequency ratio (NMR-CFR) from noise power spectrum (NPS) as a tool for evaluation and comparison of noise reduction techniques. The purpose of this study was to investigate the dependence of GE's TrueFidelity (TF) on acquisition and reconstruction parameters using NMR-CFR, and to find the acquisition and reconstruction parameters optimal for the TF.*Methods and Materials An ACR phantom was scanned at 120 kVp, 10, 20, 40, 80, 120 and 160 mA, and each was reconstructed using FBP and all strengths of TF with the slice thicknesses of 1.25, 2.5 and 3.75 mm and FOVs of 250 and 350 mm. From each acquisition and reconstruction, NMR-CFR was calculated and compared. CFR is defined as the NPS center frequency ratio between noise reduction and FBP, and NMR is defined as the area under NPS between noise reduction and FBP. In an ideal noise reduction, both the xy- and z- CFRs should be close to 1 (less blur or texture change in the xy and z directions) and the NMR close to 0 (more noise reduction).*Results In the xy-plane, we found- the 1.25mm not only has less dependence on radiation dose but also has less blur and higher noise reduction than the 2.5mm or 3.75mm,- the noise reduction is higher for = 40mA than < 40mA, and- the change on noise texture was almost the same for the FOV 200mm and 350mm, but the noise reduction was more for the FOV 350mm than FOV 200mm.On the other hand, in the z-axis direction,- the change on noise texture was almost the same for 120mA and 160mA,- the thicker the slice, the less change on noise texture in the z-axis direction, and- the change on noise texture was less on FOV 350mm than 200mm.The data suggested that higher noise reduction and less change on noise texture in the xy and z directions can be achieved at tube current > 120 mA and reconstructed with a slice thickness of 1.25 mm with FOV 350 mm.*Conclusions In TF, a larger FOV and a thinner slice thickness, at tube current > 120 mA, would result in less blur or change of noise texture, and more noise reduction for imaging the ACR phantom.*Clinical Relevance/Application The results are useful for optimizing protocols using TrueFidelity. This method can also be applied to other denoising techniques.

RESULTS

In the xy-plane, we found- the 1.25mm not only has less dependence on radiation dose but also has less blur and higher noise reduction than the 2.5mm or 3.75mm,- the noise reduction is higher for = 40mA than < 40mA, and- the change on noise texture was almost the same for the FOV 200mm and 350mm, but the noise reduction was more for the FOV 350mm than FOV 200mm.On the other hand, in the z-axis direction,- the change on noise texture was almost the same for 120mA and 160mA,- the thicker the slice, the less change on noise texture in the z-axis direction, and- the change on noise texture was less on FOV 350mm than 200mm.The data suggested that higher noise reduction and less change on noise texture in the xy and z directions can be achieved at tube current > 120 mA and reconstructed with a slice thickness of 1.25 mm with FOV 350 mm.

CLINICAL RELEVANCE/APPLICATION

The results are useful for optimizing protocols using TrueFidelity. This method can also be applied to other denoising techniques.

PH01-A2 CT/CT-Fluoroscopy And FDG-PET Contributions To Patient And Staff Radiation Dose In FDG-PET/CT-Guided Interventions

Participants
Liwei Jiang, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

PET/CT scanners with an installed CT-fluoroscopy option can be used to guide biopsies and tumor ablations. Adding FDG-PET guidance to CT guidance alone could increase radiation dose to patients and staff. Of potential concern for operators, 0.5mm lead-equivalent aprons do not attenuate 511 keV photons from FDG. This study assesses radiation dose to patients, operators, and room personnel during procedures performed using a PET/CT scanner equipped with CT-fluoroscopy.*Methods and Materials An IRB-approved, prospective, single-institution study enrolled 10 consecutive patients referred for 10 PET/CT-guided tumor ablations from January to March of 2021. An attending radiologist and trainee performed the procedures using PET/CT, CT and intermittent CT-fluoroscopy acquisitions. Mean injected FDG activity was 192 MBq. Patient radiation dose was estimated using published conversion factors for injected FDG activity and CT dose-length-product. Personnel radiation dose was estimated using 11 direct-ion storage dosimeters at fixed and wearable locations (Figure). Operators worked behind a custom 1-inch-thick lead rolling floor shield raised to mid-chest level (positioned 2 feet from patient). To differentiate FDG-related dose from CT/CT-fluoroscopy scatter dose, two dosimeters were placed in front of the 1" lead shield near the operator, with one behind a 0.5mm lead equivalent thyroid shield.*Results The mean procedural doses to patients from FDG and CT were 3.7 (SD ±0.2) and 29.5 (±19.3) mSv, respectively. Dose (FDG+CT) behind the 1" lead shield was unmeasurable (less than 0.03 mSv) cumulatively and for every procedure. Continuous, unshielded mean total (FDG+CT) dose at 2 feet from the patient was 0.18 (±0.10) mSv with FDG contributing 0.03 mSv (15%) and

CT contributing 0.15 mSv (85%). The primary operator's mean collar dose (FDG+CT) was 0.02 (±0.04) mSv and mid chest dose 0.01 (±0.03) mSv. The secondary operator's doses were comparable to the primary. Operator doses were higher at the collar than at the chest, primarily due to positioning of the rolling 1" lead shield. Collar doses for the circulating nurses and anesthesiologist were unmeasurable for every procedure.*Conclusions CT contributed much more to patient radiation dose (87.5%) than FDG. No radiation dose to operators was measurable behind the 1" lead shield. Operator dose (FDG+CT) at the neck collar level (above the 1" lead shield) was very small.*Clinical Relevance/Application During PET/CT-guided interventions, FDG dose to patients and operators is minimal, compared to CT dose, and should not be a barrier to using PET/CT guidance.

RESULTS

The mean procedural doses to patients from FDG and CT were 3.7 (SD ±0.2) and 29.5 (±19.3) mSv, respectively. Dose (FDG+CT) behind the 1" lead shield was unmeasurable (less than 0.03 mSv) cumulatively and for every procedure. Continuous, unshielded mean total (FDG+CT) dose at 2 feet from the patient was 0.18 (±0.10) mSv with FDG contributing 0.03 mSv (15%) and CT contributing 0.15 mSv (85%). The primary operator's mean collar dose (FDG+CT) was 0.02 (±0.04) mSv and mid chest dose 0.01 (±0.03) mSv. The secondary operator's doses were comparable to the primary. Operator doses were higher at the collar than at the chest, primarily due to positioning of the rolling 1" lead shield. Collar doses for the circulating nurses and anesthesiologist were unmeasurable for every procedure.

CLINICAL RELEVANCE/APPLICATION

During PET/CT-guided interventions, FDG dose to patients and operators is minimal, compared to CT dose, and should not be a barrier to using PET/CT guidance.

PH01-A4   Virtual Unenhanced Images Obtained From Spectral Dual Energy Ct: Which Phase Is More Suitable For The Detection And Measurement Of Urinary Stones?

Participants
Yannan Cheng, BS,BS, Xi'an, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the detection and quantification of urinary stones using virtual unenhanced (VUE) images at nephrographic phase (VUE(NP)) and excretory phase (VUE(EP) in dual-energy CT Urography (DECTU) with different image slice thicknesses in comparison with true unenhanced (TUE) images.*Methods and Materials 112 patients with urinary stones who required unenhanced and contrast-enhanced DECTU were prospectively included. TUE, VUE(NP) and VUE(EP) images were generated with 1.25 and 5mm slice thicknesses. Stone location, diameter and CT number on different image types were recorded by two radiologists. Stones were divided into =5mm and <5mm groups. Stone detection rates were evaluated using Chi-square test. Wilcoxon signed rank and repeated measures analysis of variance (ANOVA) with Bonferroni correction was performed to compare stone quantitative measurements. P <0.05 was considered statistically significant.*Results 163 and 67 urinary stones with size =5mm and <5mm were detected on the 1.25mm TUE images, respectively. Correspondingly, 163(52), 158(25), 140(31) and 131(16) stones were detected on the VUE(NP)_1.25mm, VUE(NP)_5mm; VUE(EP)_1.25mm and VUE(EP)_5mm images, resulting in detection rates of 100%(77.6%), 96.9(37.3%), 85.9(46.3%) and 80.4(23.9%), respectively (Figure 1). VUE(NP) images significantly improved the stone detection rate and CT number measurement accuracy compared with the VUE(EP) images (Table 1 and 2, Figure 2-4). In general, VUE images presented stones with smaller sizes, but thinner slice thickness images reduced the inaccuracy to about 10%.*Conclusions VUE(NP) images in DECTU with 1.25mm thickness detects 100% and 77.6% of urinary stones with size =5mm and <5mm, respectively with accurate CT number. Stone size measurement in VUE images needs 10% systematic correction.*Clinical Relevance/Application Virtual unenhanced images of 1.25mm obtained at the nephrographic phase in dual-energy CT urography provides a high detection rate and accurate measurement for urinary stones.

RESULTS

163 and 67 urinary stones with size =5mm and <5mm were detected on the 1.25mm TUE images, respectively. Correspondingly, 163(52), 158(25), 140(31) and 131(16) stones were detected on the VUE(NP)_1.25mm, VUE(NP)_5mm; VUE(EP)_1.25mm and VUE(EP)_5mm images, resulting in detection rates of 100%(77.6%), 96.9(37.3%), 85.9(46.3%) and 80.4(23.9%), respectively (Figure 1). VUE(NP) images significantly improved the stone detection rate and CT number measurement accuracy compared with the VUE(EP) images (Table 1 and 2, Figure 2-4). In general, VUE images presented stones with smaller sizes, but thinner slice thickness images reduced the inaccuracy to about 10%.

CLINICAL RELEVANCE/APPLICATION

Virtual unenhanced images of 1.25mm obtained at the nephrographic phase in dual-energy CT urography provides a high detection rate and accurate measurement for urinary stones.

PH01-A5   Machine Learning Decision Support For Predicting Metabolic Syndrome In Japanese Adults Associate With Chest Radiographs Obtained In Annual Health Examinations

Participants
Tadahiro Sakamoto, Kumamoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

In annual health examinations for Japanese adults, metabolic syndrome is usually determined by measuring visceral fat area using CT or abdominal circumference. The former is more accurate than the latter, but involves radiation exposure. On the other hand, in health examinations, a chest radiograph is taken for the purpose of preventing tuberculosis and lung cancer, irrespective of the prediction of metabolic syndrome. Therefore, focusing on the fact that fat at the cardiac apex is related to visceral fat, we assumed that metabolic syndrome would be predicted by using the image information of the cardiac apex in chest radiograph and patient information.*Methods and Materials In this study, 1216 patients who underwent chest radiography, CT visceral fat area measurement, and blood test were included. For each chest radiograph, a sample image of ROI size 192×192 was cropped to include the region of cardiac apex from a heart area which was automatically extracted by machine learning (U-Net). We used patient information (age, gender, height, weight, and blood pressure), the area ratio of the heart and lung fields obtained by automatic extraction using U-Net, and the sample images as input data to predict metabolic syndrome using another machine learning (DCNN). The gold standard for training the DCNN was determined from blood pressure, blood test results, and the visceral fat area obtained from CT scans according to the diagnostic criteria for metabolic syndrome (the Japanese committee of the criteria for metabolic syndrome in 2005). For the evaluation of metabolic syndrome judgment by DCNN, we used a 10-fold cross-validation method and a binormal ROC analysis.*Results The prediction accuracy for the metabolic syndrome performed by the DCNN

showed an AUC of 0.865, which was higher than CT only (0.854) and abdominal circumference (0.749).*Conclusions By using chest radiograph and patient information as the input of the DCNN, the metabolic syndrome could be predicted without unnecessary patient radiation due to CT visceral fat area measurement and invasive blood test.*Clinical Relevance/Application This proposed method required no additional equipment and examination time, but would yield precise decision without unnecessary radiation exposure and the cost of CT examination.

RESULTS

The prediction accuracy for the metabolic syndrome performed by the DCNN showed an AUC of 0.865, which was higher than CT only (0.854) and abdominal circumference (0.749).

CLINICAL RELEVANCE/APPLICATION

This proposed method required no additional equipment and examination time, but would yield precise decision without unnecessary radiation exposure and the cost of CT examination.

PH01-A6   Diagnostic Value Of A Deep Learning-based Ai Detection System In Chest Ldct Imaging For The Detection Of Pleural Nodules (PN)

Participants
Fang Wang, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

The missed diagnosis rate of Pleural Nodules (PN)is high. The purpose of this study was to assess the diagnostic performance of deep learning based artificial intelligence (AI) diagnostic system for the detection of PN on chest LDCT images.*Methods and Materials 104 healthy patients underwent low-dose chest CT screening using a 256 slice wide-detector CT(Revolution,GE Healthcare)were enrolled. Protocols were adjusted so that effective dose was set to approximately 1.5 mSv. Readings by two residents were conducted to detect PNs: use Deep Learning-Based AI detection System (InferRead CT Lung Research) and without using AI. The total number and location of nodules in each patient detected were recorded. Two senior chief radiologists' consensus readings were used as the gold standard. The detection rate and false positive rate in each reading were calculated accordingly.*Results 176 PNs were confirmed as gold standard. The pooled diagnostic sensitivity of PNs for two residents (96.59%, 170/176) with AI was significantly higher than without using AI (82.95%, 146/176). Without using AI, the detection sensitivity of PNs near the mediastinum pleura for residents was 37.5% (6/16) and the false positive rate was 2.9% (3/104). When AI was used, the sensitivity was increased to 87.5% (14/16) and the false positive rate was 1.0% (1/104).*Conclusions Deep learning-based AI detection system significantly improves detection performance of Pleural Nodules in LDCT scans for residents.*Clinical Relevance/Application It is recommended to use deep learning assisted lung nodule detection system to improve the detection efficiency of pleural nodules which are easily missed due to its proximity to pleural.

RESULTS

176 PNs were confirmed as gold standard. The pooled diagnostic sensitivity of PNs for two residents (96.59%, 170/176) with AI was significantly higher than without using AI (82.95%, 146/176). Without using AI, the detection sensitivity of PNs near the mediastinum pleura for residents was 37.5% (6/16) and the false positive rate was 2.9% (3/104). When AI was used, the sensitivity was increased to 87.5% (14/16) and the false positive rate was 1.0% (1/104).

CLINICAL RELEVANCE/APPLICATION

It is recommended to use deep learning assisted lung nodule detection system to improve the detection efficiency of pleural nodules which are easily missed due to its proximity to pleural.

PH01-A8   A Fast Geometric Approximation Of Water Equivalent Diameter For Calculating Size-specific Dose Estimate In Computed Tomography

Participants
Jan Pachon, chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study is to provide an accurate and automated calculation of water-equivalent diameter (DW) from axial CT images using a novel geometric approximation. AAPM Report 204 shows that the SSDE is the product of CTDIvol and a conversion factor based on either effective diameter (Deff) or water equivalent diameter (Dw). Dw has long been adopted as a more accurate patient size surrogate because it accounts for patient attenuation; however, calculating Dw is computationally expensive, requiring long runtimes and memory. We demonstrate a fast and novel geometric approximation of Dw using axial CT images.*Methods and Materials Axial Images were obtained from a clinical CT scanner including 22 adult abdomen, 34 pediatric abdomen, and 23 adult head exams. Each axial image was contoured automatically using thresholding to remove the patient table. The second step was to determine the AP and lateral dimensions by bounding the anatomy. These dimensions were used as the major and minor axes of the elliptical approximation of the contour. The third step was to determine the largest rectangle that could be inscribed in the ellipse from step 2. The mean HU and area were then determined within the pixel array defined by the coordinates of the rectangle. A Riemann sum approximation was used to estimate the mean and area outside the rectangle and within the ellipse by partitioning this region into rectangles of one pixel in width. The geometric mean (μ) and area (A) approximation were calculated using the following equations: μgeo approx.= μlarge rect. in ellipse + S(mean(f(xi) + ?Xi)Ageo approx.= Alarge rect. in ellipse + S(f(xi) + ?XiWhere the summation in each equation represents the Riemann sum of the rectangles (one pixel in width) outside of the large rectangle and within the ellipse. Dw can then be calculated as: Dw = 2* (1/1000 * (μgeo approx +1) * (Ageo approx./p))0.5 (AAPM 204)p*Results The results of the geometric DW approximation were compared to those calculated manually where the contouring was done by freehand. These two measurements are in good agreement with differences of 2.96% ±1.44% for abdomen images and 5.26±2.52% for head images. Furthermore, the runtime of the DW geometric approximation is less than 0.1 msecs per axial slice on a Win10 16GB CPU with an intel i5 processor.*Conclusions The geometric approximation of Dw gives an accurate estimate of patient size and can be used for accurate SSDE calculations. The advantage of this approximation is that it provides real-time SSDE measurements and is not computationally expensive.*Clinical Relevance/Application The geometric approximation of Dw is particularly useful in the case of modern CT scanners that produce more than 500 images (slices) for every exam.

RESULTS

The results of the geometric DW approximation were compared to those calculated manually where the contouring was done by

freehand. These two measurements are in good agreement with differences of 2.96% ±1.44% for abdomen images and 5.26±2.52% for head images. Furthermore, the runtime of the DW geometric approximation is less than 0.1 msecs per axial slice on a Win10 16GB CPU with an intel i5 processor.

CLINICAL RELEVANCE/APPLICATION

The geometric approximation of Dw is particularly useful in the case of modern CT scanners that produce more than 500 images (slices) for every exam.

PH01-A9   Physics Image Quality Evaluation Of A High Resolution Computed Tomography (CT) Scanner With Denoising Deep Learning Reconstruction Vs Normal Resolution CT With Hybrid Iterative Reconstruction For Lung

Participants
Kirsten Lee Boedeker, PHD, Los Angeles, California (*Presenter*) Employee, Canon Medical Systems Corporation

PURPOSE

To evaluate a Denoising Deep Learning Reconstruction algorithm (AiCE DLR) applied to a commercial High Resolution Computed Tomography (HR-CT) scanner for a Lung protocol using physics-based image quality performance metrics, with a focus on the potential for quantitative precision. Results are compared to Normal Resolution CT (NR-CT) with hybrid iterative reconstruction (AIDR). A variety of dose levels are examined.*Methods and Materials A 20cm Catphan was scanned on a High Resolution CT scanner (Canon Aquilion Precision) with a Lung protocol and tube current range 10-500mA. The data was reconstructed with AiCE DLR and AIDR. The raw data was then downsampled to generate simulated NR-CT data and reconstructed with AIDR. The AiCE DLR was trained using high-dose HR-CT images as the training target and simulated low dose images as the training input. The contrast-dependent modulation transfer function (MTF), Noise Power Spectra (NPS), and Noise Equivalent Quanta (NEQ) were determined via Fourier analysis. The Standard Deviation of Noise (SD) was measured for all conditions. The NEQ was applied to estimate Low Contrast (LCD) detectability index and Size Change detectability index, i.e. the ability for an observer to distinguish a 1mm change in diameter; a Non-Prewhitening Model Observer was used for both tasks.*Results HR-CT with AiCE DLR has the same or improved standard deviation of noise and LCD compared to NR-CT with AIDR for the Lung protocol examined for all dose levels. NEQ was increased across all frequencies, with new NEQ generated in the high frequencies for HR-CT with AiCE vs NR-CT with AIDR. The ability to distinguish a 1mm change in diameter increased by 107% (range 54-152%) across mA values for HR-CT with AiCE vs NR-CT with AIDR. When AIDR is used for both HR-CT and NR-CT reconstruction the ability to distinguish a 1mm change in diameter increased by 34% (range 14-51%) across mA values.*Conclusions For the protocols examined, High resolution CT with Denoising DLR improves image quality across dose levels and the potential for quantitative lung applications relative to normal resolution CT with hybrid iterative reconstruction.*Clinical Relevance/Application High resolution CT combined with Denoising Deep Learning reconstruction increases the potential of diagnostic and quantitative Lung applications.

RESULTS

HR-CT with AiCE DLR has the same or improved standard deviation of noise and LCD compared to NR-CT with AIDR for the Lung protocol examined for all dose levels. NEQ was increased across all frequencies, with new NEQ generated in the high frequencies for HR-CT with AiCE vs NR-CT with AIDR. The ability to distinguish a 1mm change in diameter increased by 107% (range 54-152%) across mA values for HR-CT with AiCE vs NR-CT with AIDR. When AIDR is used for both HR-CT and NR-CT reconstruction the ability to distinguish a 1mm change in diameter increased by 34% (range 14-51%) across mA values.

CLINICAL RELEVANCE/APPLICATION

High resolution CT combined with Denoising Deep Learning reconstruction increases the potential of diagnostic and quantitative Lung applications.

Abstract Archives of the RSNA, 2021

BR04-D

Breast Wednesday Poster Discussions

Sub-Events

BR04-D4   Volumetric Breast Density Is A Strong Predictor Of Breast Tumour Size In A US Screening Population

Participants
Stamatia Destounis, MD, Rochester, New York (*Presenter*) Medical Advisory Committee, Hologic, Inc;Medical Advisory Board, iCAD, Inc

PURPOSE

To investigate the associations of mammographic density (MD) and breast tumour characteristics (TC) with tumour size in a US screening setting.*Methods and Materials All screen-detected (SD) and interval (IC) breast cancers (BC; n=2,312) diagnosed at our breast imaging clinic from 2009-2012 were identified. After exclusions (outside screening interval, missing size, prior biopsy/surgery/BC, implants, bilateral BC, women <40 y), the final dataset comprised of 406 BC. TC and risk factors were extracted from clinical records. MD metrics included quartiles (Q1-4) of volumetric breast density (VBD)/dense volume (DV)/breast volume (BV)/fat volume (FV), and Volpara Density Grades (VDG). BI-RADS&VDG categories were dichotomized to non-dense vs dense (VDG&BI-RADS 1+2 vs 3+4). Size associations with MD, risk factors and TC were tested using linear regression and non-parametric tests. Multivariate logistic regression modelled the association between the binary outcome size>2cm and MD, adjusting for age, menopausal status, mode of detection (SD/IC), and FV as a surrogate for BMI.*Results Size ranged from 1-130mm (median=15mm) and differed for SD vs IC (median=14/18 mm, p<0.001). Size was associated with age (r=-.17,p<0.001), VBD (r=0.51,p<0.001) and DV (r=0.08,p<0.001). Medians differed for menopausal status (p<0.001), estrogen/HER2 receptor status (p<0.02), molecular subtype (p<0.02), and grade (p<0.001). In logistic regression models, age and menopausal status were no longer associated with size>2cm. VBD measures had the strongest associations, with odds ratios (OR) of 3.1-fold comparing Q4:Q1 for both VBD and dense volume (p<0.02). Comparing VDG 4 vs combined VDG 1/2, OR were 3.8-fold (p<0.01). Compared to non-dense women, BI-RADS 4 was not significant and OR=1.9 (p<0.03) for BI-RADS 3. Stratified by SD or IC, ORs tended to increase for all MD measures but lost significance for IC. Comparing VBD or FGV Q4 vs Q1, women with SD were 5-fold more likely to be diagnosed with size>2cm (p<0.02).*Conclusions For SD, but not IC, MD is a strong predictor of breast tumour size>2cm. Strategies to improve earlier detection in women with denser breasts could improve prognostic factors at diagnosis.*Clinical Relevance/Application Larger tumour size is an important factor in the evaluation of patient outcomes after BC diagnosis. Understanding associations with mammographic density can be beneficial to inform better strategies for screening women with dense breasts.

RESULTS

Size ranged from 1-130mm (median=15mm) and differed for SD vs IC (median=14/18 mm, p<0.001). Size was associated with age (r=-.17,p<0.001), VBD (r=0.51,p<0.001) and DV (r=0.08,p<0.001). Medians differed for menopausal status (p<0.001), estrogen/HER2 receptor status (p<0.02), molecular subtype (p<0.02), and grade (p<0.001). In logistic regression models, age and menopausal status were no longer associated with size>2cm. VBD measures had the strongest associations, with odds ratios (OR) of 3.1-fold comparing Q4:Q1 for both VBD and dense volume (p<0.02). Comparing VDG 4 vs combined VDG 1/2, OR were 3.8-fold (p<0.01). Compared to non-dense women, BI-RADS 4 was not significant and OR=1.9 (p<0.03) for BI-RADS 3. Stratified by SD or IC, ORs tended to increase for all MD measures but lost significance for IC. Comparing VBD or FGV Q4 vs Q1, women with SD were 5-fold more likely to be diagnosed with size>2cm (p<0.02).

CLINICAL RELEVANCE/APPLICATION

Larger tumour size is an important factor in the evaluation of patient outcomes after BC diagnosis. Understanding associations with mammographic density can be beneficial to inform better strategies for screening women with dense breasts.

BR04-D6   Repeat Breast Ultrasound Demonstrates Utility For Added Cancer Detection In Patients Following Breast Imaging Second Opinion Recommendations

Participants
Robert J. Weinfurtner, MD, Tampa, Florida (*Presenter*) Nothing to Disclose

PURPOSE

For patients pursuing breast imaging second opinions, the aim of our study was to determine ultrasound review discrepancy frequency and the subsequent utility and impact on patient management.*Methods and Materials An IRB-approved retrospective chart review was conducted on 400 consecutive patients with second opinion radiology interpretations which included mammograms and sonograms. These second opinion interpretations were performed by subspecialized breast radiologists at a designated cancer center. The outside institution imaging reports were compared with second opinion reports to categorize ultrasound review discrepancies which were defined as any BI-RADS category change. The discrepancy frequency, relevant alterations in patient management, and incremental cancer detection were measured.*Results Discrepant second opinion breast and axillary ultrasound review was seen in 108/400 patients (27%). Discrepancies included 70 repeat ultrasounds for better characterization of a breast lesion, 11 repeat ultrasounds of a negative region, 20 repeat ultrasounds for benign axillary lymph nodes, 5 downgrades from BI-RADS 3 to BI-RADS 2, and 2 upgrades from BI-RADS 2 to BI-RADS 4. Repeat ultrasounds of the axilla in 19 patients resulted in 13 biopsy recommendations, and 4 were metastatic (PPV3 31%). In the breast, repeat ultrasounds in 81 patients resulted in 14 upgrades to BI-RADS 4 or BI-RADS 5. Of these, 5 yielded malignancy (PPV3 36%). In addition, one patient was upgraded from a BI-

RADS 2 to a BI-RADS 4 category based on the outside image, with pathology revealing malignancy. Breast lesion BI-RADS category downgrades in 27 patients resulted in 10 avoided biopsies. Ultimately, second opinion ultrasound review resulted in altered management in 12 % of patients (47/400). This included discovery of additional breast malignancies in 6 patients, metastatic lymph nodes in 4 patients, excisional biopsy for atypia in 1 patient, 4 patients proceeding to mastectomy, 10 patients who avoided biopsies, and 22 patients who avoided follow-up of benign findings.*Conclusions Subspecialized second opinion ultrasound review discrepancies resulted in detection of additional breast malignancy in 7% (6/82). Similarly, recommendations for repeat axillary ultrasound yielded additional metastatic cancer detection in 21% (4/19). Finally, the discrepancy downgrade frequency was 30% (32/108) eliminating additional follow-up or unnecessary percutaneous biopsies.*Clinical Relevance/Application The overall incremental cancer detection rate in both the breast and axilla as well as downgrade frequency show that second opinion review of outside ultrasound examinations are of value when performed by subspecialized breast imagers at a dedicated cancer center.

RESULTS

Discrepant second opinion breast and axillary ultrasound review was seen in 108/400 patients (27%). Discrepancies included 70 repeat ultrasounds for better characterization of a breast lesion, 11 repeat ultrasounds of a negative region, 20 repeat ultrasounds for benign axillary lymph nodes, 5 downgrades from BI-RADS 3 to BI-RADS 2, and 2 upgrades from BI-RADS 2 to BI-RADS 4. Repeat ultrasounds of the axilla in 19 patients resulted in 13 biopsy recommendations, and 4 were metastatic (PPV3 31%). In the breast, repeat ultrasounds in 81 patients resulted in 14 upgrades to BI-RADS 4 or BI-RADS 5. Of these, 5 yielded malignancy (PPV3 36%). In addition, one patient was upgraded from a BI-RADS 2 to a BI-RADS 4 category based on the outside image, with pathology revealing malignancy. Breast lesion BI-RADS category downgrades in 27 patients resulted in 10 avoided biopsies. Ultimately, second opinion ultrasound review resulted in altered management in 12 % of patients (47/400). This included discovery of additional breast malignancies in 6 patients, metastatic lymph nodes in 4 patients, excisional biopsy for atypia in 1 patient, 4 patients proceeding to mastectomy, 10 patients who avoided biopsies, and 22 patients who avoided follow-up of benign findings.

CLINICAL RELEVANCE/APPLICATION

The overall incremental cancer detection rate in both the breast and axilla as well as downgrade frequency show that second opinion review of outside ultrasound examinations are of value when performed by subspecialized breast imagers at a dedicated cancer center.

BR04-D8   Covid Vaccine-Related Lymphadenopathy - What We Know

Participants
Vidhi Kacharia, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Breast radiologists are faced with diagnostic dilemmas every day regarding axillary lymphadenopathy with the new Covid vaccines. The Centers for Disease Control and Prevention report lymphadenopathy as an unsolicited adverse event in the arm and neck region in 1.1% of subjects who received the Moderna vaccine and 58 more cases in the vaccine group than the placebo group for the Pfizer vaccine. The median duration of lymphadenopathy was 1 to 2 days for the Moderna vaccine and 10 days for the Pfizer vaccine. Adding data to the literature after the first few months of vaccine administration will help clinicians provide data-driven reassurance and avoid unnecessary imaging with confidence. The primary purpose of this study is to assess the duration of Covid-vaccine related lymphadenopathy at our institution. Secondary endpoints include prevalence and presenting symptoms.*Methods and Materials This retrospective HIPAA-compliant study was approved by the Institutional Review Board. Electronic medical record review was performed to identify patients with ipsilateral axillary lymphadenopathy detected during screening or diagnostic breast imaging from December 1, 2020 to March 31, 2021 after recent Covid vaccination (within 4 weeks of initial imaging.) We examined the charts of all patients > 18 years old diagnosed with axillary lymphadenopathy at our institution's breast radiology department. We collected data from any follow-up imaging or biopsy performed for the purpose of evaluating axillary lymphadenopathy.*Results A total of 73 female patients were evaluated for axillary lymphadenopathy ipsilateral to the vaccinated arm on screening or diagnostic imaging. Of the 18 patients assigned BIRADS 0 and the 14 patients assigned BIRADS 3, a total of 23 patients had follow-up imaging. Of these 23 patients, 7 patients had resolved axillary lymphadenopathy in less than 3 weeks and 6 patients had resolved axillary lymphadenopathy in less than 6 weeks. These patients were assigned BIRADS 1 or 2 and no longer followed. A total of 9 patients had unchanged axillary lymphadenopathy at first follow-up < 6 weeks since the initial study. 1 patient had worsened axillary lymphadenopathy at first follow-up for which biopsy was recommended and showed benign tissue.*Conclusions The length of Covid-vaccine related lymphadenopathy is variable, with the majority of cases resolving within 6 weeks. Most patients were asymptomatic and diagnosed on screening mammograms.*Clinical Relevance/Application Lymphadenopathy from the Covid vaccine may last longer than expected. While appropriate work-up such as ultrasound and biopsy should be performed when needed, it is important to keep benign causes such as vaccine-related lymphadenopathy in our differential to reduce patient anxiety.

RESULTS

A total of 73 female patients were evaluated for axillary lymphadenopathy ipsilateral to the vaccinated arm on screening or diagnostic imaging. Of the 18 patients assigned BIRADS 0 and the 14 patients assigned BIRADS 3, a total of 23 patients had follow-up imaging. Of these 23 patients, 7 patients had resolved axillary lymphadenopathy in less than 3 weeks and 6 patients had resolved axillary lymphadenopathy in less than 6 weeks. These patients were assigned BIRADS 1 or 2 and no longer followed. A total of 9 patients had unchanged axillary lymphadenopathy at first follow-up < 6 weeks since the initial study. 1 patient had worsened axillary lymphadenopathy at first follow-up for which biopsy was recommended and showed benign tissue.

CLINICAL RELEVANCE/APPLICATION

Lymphadenopathy from the Covid vaccine may last longer than expected. While appropriate work-up such as ultrasound and biopsy should be performed when needed, it is important to keep benign causes such as vaccine-related lymphadenopathy in our differential to reduce patient anxiety.

Abstract Archives of the RSNA, 2021

SDP-VA

Vascular Pre-recorded Scientific Posters

Sub-Events

SDP-VA-1   Acute Left Iliofemoral Vein Thrombosis: Revisiting With Bony May-thurner Syndrome Variant

Participants
Eu Hyun Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the underlying causes of acute left iliofemoral deep vein thrombosis (DVT) using computed tomography (CT) and discuss their clinical significance for diagnosis and prognosis.*Methods and Materials We retrospectively analyzed 57 patients with acute left iliofemoral DVT from 2015 to 2020. By CT evaluation, patients were divided into absence or presence of left common iliac vein (LCIV) stenosis. The number and site of stenosis were recorded as proximal and distal portion of LCIV. The causes of LCIV stenosis were categorized to simple May-Thurner syndrome (sMTS) and bony MTS related to lumbar degeneration (bMTS). We excluded other causes of LCIV stenosis. Initial CT scans regarding location and extent of thrombus, and fibrotic change of LCIV were evaluated. Medical chart was reviewed for onset age, symptom duration, and treatment. Follow-up CT scans were assessed for therapeutic effect.*Results Among the 54 patients, LCIV stenosis was present in 53 patients (92.9%), and the cause of stenosis were sMTS in 27 patients (50.9%) and bMTS in 26 patients (49.1%). There was no significant difference in gender distribution between the sMTS and bMTS groups (p=0.925). The mean onset age of was significantly younger in sMTS than bMTS (52.8 ± 20.1 vs. 72.5 ± 10.4, p< 0.001). There was no significant difference in symptom duration (3.9 ± 3.8 vs. 6.4 ± 5.3, p=0.050). Based on the results of image analysis, most of sMTS showed stenosis occurred only in the proximal segment of LCIV (24/27, 88.9%) and most of bMTS showed stenosis in both proximal and distal segments of LCIV (17/26, 65.4%) (p<0.001), while the diameter of stenotic segment showed no significant difference in both groups at proximal (4.5 ±1.4 vs. 4.7 ±2.3, p=0.774) and distal segments (6.2±3.6 vs. 4.9±1.5, p=0.484). The chronic fibrotic change of LCIV was observed 6 out of 27 patients (22.2%) in sMTS group and 14 out of 26 patients (53.8%) in bMTS, showing statistical significance (p=0.037). However, there was no significant difference in the extent of DVT centered on popliteal vein level (p=1.000) and treatment response (p=0.950) between the two groups.*Conclusions LCIV stenosis is an important predisposing factor of iliofemoral DVT and it can be caused by both sMTS and bMTS. Compared to sMTS, bMTS occurs in older patients, presenting more than one stenosis at LCIV, and inducing more chronic fibrotic change of LCIV.*Clinical Relevance/Application Clinical attention is needed to bMTS, which is often overlooked. DVT CT might be recommended for the elderly patients with severe lumbar spine degeneration among the patients who are expected to have immobilized condition such as surgery.

RESULTS

Among the 54 patients, LCIV stenosis was present in 53 patients (92.9%), and the cause of stenosis were sMTS in 27 patients (50.9%) and bMTS in 26 patients (49.1%). There was no significant difference in gender distribution between the sMTS and bMTS groups (p=0.925). The mean onset age of was significantly younger in sMTS than bMTS (52.8 ± 20.1 vs. 72.5 ± 10.4, p< 0.001). There was no significant difference in symptom duration (3.9 ± 3.8 vs. 6.4 ± 5.3, p=0.050). Based on the results of image analysis, most of sMTS showed stenosis occurred only in the proximal segment of LCIV (24/27, 88.9%) and most of bMTS showed stenosis in both proximal and distal segments of LCIV (17/26, 65.4%) (p<0.001), while the diameter of stenotic segment showed no significant difference in both groups at proximal (4.5 ±1.4 vs. 4.7 ±2.3, p=0.774) and distal segments (6.2±3.6 vs. 4.9±1.5, p=0.484). The chronic fibrotic change of LCIV was observed 6 out of 27 patients (22.2%) in sMTS group and 14 out of 26 patients (53.8%) in bMTS, showing statistical significance (p=0.037). However, there was no significant difference in the extent of DVT centered on popliteal vein level (p=1.000) and treatment response (p=0.950) between the two groups.

CLINICAL RELEVANCE/APPLICATION

Clinical attention is needed to bMTS, which is often overlooked. DVT CT might be recommended for the elderly patients with severe lumbar spine degeneration among the patients who are expected to have immobilized condition such as surgery.

SDP-VA-3   Possibilities Of Computed Tomographic Angiography In Management Of Patients With Aortic Dissection After Surgery

Participants
Eugenii Kobelev, MD, Novosibirsk, Russian Federation (*Presenter*) Nothing to Disclose

PURPOSE

To assess the thoracoabdominal aorta's remodeling by the method of volumetric aortic calculation after hybrid and endovascular prosthetics for aortic dissections.*Methods and Materials ?re-, postoperative, and at least one 1-year follow-up computed tomography data sets were available for 12 patients. The median follow-up was 18 months. CTA of the thoracic and abdominal aorta was performed from the lungs' apex to the femoral heads' middle. In the aorta, three segments were identified: "A" - the level of the stent-graft, "B" - from the distal end of the stent-graft to the celiac trunk, segment "C" from the celiac trunk to the aortic bifurcation. In each segment, the total aortic volumes, the volume of the true lumen (TL), and the false lumen (FL) volume were calculated.*Results The average ages of the patients treated were 50.5±7. Positive or stable remodeling was found in segments A (50% - after surgery, 83% - one year after surgery), B (83% - after surgery, 66.7% - one year after surgery), and C (83% - after surgery, 58.3% - one year after surgery), and the FL thrombosis rate was 100% in A, 73.5% in B and 38% in C during the first

year. Statistically significant increase in the volume of TL in "A" segment (p = 0.002), decrease in perfused false lumen (PFL) (p = 0.001). Statistically significant increase in the volume of TL in "B" segment (p = 0.015), decrease in PFL (p = 0.041) and an increase in thrombosed false lumen (TFL) (p = 0.041). Statistically significant increase in the volume of TFL in the "C" segment (p = 0.004). The median area of residual fenestrations in B and C was 2.25 cm2 [1.54-4.53].*Conclusions In segment A in all patients after surgical intervention, positive aortic remodeling in the form of FL thrombosis is determined. Residual FL perfusion results from entries in the thoracoabdominal segment, which is frequently essential for the visceral, renal, spinal, or peripheral perfusion. This study demonstrated the possibility of using a volume-measuring method of the true and false lumen aortic lumen.*Clinical Relevance/Application We believe that the measurement of the volume has the advantage before measuring the maximum diameter of the aorta to clarify the dynamics of the postoperative period.

RESULTS

The average ages of the patients treated were 50.5±7. Positive or stable remodeling was found in segments A (50% - after surgery, 83% - one year after surgery), B (83% - after surgery, 66.7% - one year after surgery), and C (83% - after surgery, 58.3% - one year after surgery), and the FL thrombosis rate was 100% in A, 73.5% in B and 38% in C during the first year. Statistically significant increase in the volume of TL in "A" segment (p = 0.002), decrease in perfused false lumen (PFL) (p = 0.001). Statistically significant increase in the volume of TL in "B" segment (p = 0.015), decrease in PFL (p = 0.041) and an increase in thrombosed false lumen (TFL) (p = 0.041). Statistically significant increase in the volume of TFL in the "C" segment (p = 0.004). The median area of residual fenestrations in B and C was 2.25 cm2 [1.54-4.53].

CLINICAL RELEVANCE/APPLICATION

We believe that the measurement of the volume has the advantage before measuring the maximum diameter of the aorta to clarify the dynamics of the postoperative period.

SDP-VA-4   Machine Learning Of The Patient Characteristics And Of Vascular Features Observed On Pre-procedural Computed Tomography Angiographs Helps To Predict Endovascular Leaks After Thoracic Endovascular Aneurysm Repair

Participants
Takanori Masuda, Okayama, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To predict endoleaks after thoracic endovascular aneurysm repair (TEVAR) we submitted patient characteristics and vessel features observed on pre-procedural computed tomography angiography (CTA) to machine-learning.*Methods and Materials We evaluated the effect of machine learning of the patient age, sex, weight, and height, plus 22 vascular features on the ability to predict post-TEVAR endoleaks. We calculated their importance by applying XGBoost to machine learning and calculated the area under the curve (AUC) of our receiver operating characteristic analysis of machine learning and compared our findings with those of conventional vessel measurement-based methods.*Results There was a significant difference between the two methods with respect to the vessel angle (p < 0.05). With machine learning, the AUC was 0.97, accuracy was 97.5%, the 95% confidence interval (CI) was 97.5%, sensitivity was 0.941 - 1.0, and specificity was 0.95. With the conventional method these values were 0.88, 84.0%, 0.81 - 0.96, 0.82, and 0.84. for the vessel angle and 0.74, 87.5%, 0.61-0.88, 0.45, and 0.95 for the diameter between the subclavian artery and the aneurysm. Machine-learning yielded a significantly higher AUC than the conventional vessel measurement-based method (p = 0.01).*Conclusions To predict the risk for post-TEVAR endoleaks, machine learning was superior to the conventional vessel measurement cut-off method when factors such as patient characteristics, and vascular features (vessel length, diameter, and angle) were evaluated on pre-TEVAR thoracic CTA images.*Clinical Relevance/Application Machine learning using the patient age, sex, and body habitus and specific vascular features observed on pre-TEVAR thoracic CT angiographs helps to predict post-procedural endoleaks.

RESULTS

There was a significant difference between the two methods with respect to the vessel angle (p < 0.05). With machine learning, the AUC was 0.97, accuracy was 97.5%, the 95% confidence interval (CI) was 97.5%, sensitivity was 0.941 - 1.0, and specificity was 0.95. With the conventional method these values were 0.88, 84.0%, 0.81 - 0.96, 0.82, and 0.84. for the vessel angle and 0.74, 87.5%, 0.61-0.88, 0.45, and 0.95 for the diameter between the subclavian artery and the aneurysm. Machine-learning yielded a significantly higher AUC than the conventional vessel measurement-based method (p = 0.01).

CLINICAL RELEVANCE/APPLICATION

Machine learning using the patient age, sex, and body habitus and specific vascular features observed on pre-TEVAR thoracic CT angiographs helps to predict post-procedural endoleaks.

SDP-VA-5   Diagnostic Ability Of Fresh Blood Imaging At 3T In Peripheral Artery Disease In Comparison With Angiography

Participants
Katsumi Nakamura, MD, Kitakyushu, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic ability of Fresh Blood Imaging at 3T (3T-FBI) in peripheral artery disease (PAD) using angiography (AG) as the gold standard. In cases where CT angiography (CTA) was performed, the diagnostic ability of FBI and CTA is compared according to the TASC II criteria.*Methods and Materials Twenty-nine patients (17 males and 12 females, mean age 75.9 years) who had enrolled in both 3T-FBI and AG examinations from November 2017 to March 2021 were included. All AG examination was performed at the time of endovascular treatment, and thus not including the bilateral entire lower limbs arteries in most cases. Nine cases also underwent CTA. The pelvis-lower extremity arteries were divided into 17 arteries, and the diagnostic ability of FBI to diagnose the hemodynamically significant stenosis (more than 50%) was evaluated against AG as a gold standard. In the cases of CTA, the classifications using FBI and CTA were compared according to the TASC II criteria in aorto-iliac (AI) and femoral-popliteal region (FP). The diagnostic ability of the below-the-knee (BK) region was also compared.*Results The 344 arteries were evaluated where AG was performed. Of these, 97 arteries (10 in AI, 37 is FP, and 50 in BK) showed significant stenosis. The overall diagnostic ability of 3T-FBI showed sensitivity 98.9%, specificity 94.6%, positive predictive value (PPV) 88.1%, negative predictive value (NPV) 99.6%, and accuracy 95.6%. In AI, there were some false positives due to signal reduction at sharp bending portions. In TASC II classification, the correlation between 3T-FBI and CTA was good. However, it was difficult to determine by 3T-FBI in a

case of type C in AI because that requires to evaluate the presence of heavily calcification. Some CTA showed to be difficult to accurately evaluate the lumen even with the original images and curved multi-planar reconstruction images when the arterial wall was heavily calcified. In the BK region, arterial visualization was excellent due to the high signal intensity at 3T-FBI, and the diagnostic ability was relatively good.*Conclusions 3T-FBI shows excellent diagnostic ability in evaluation of PAD. Having the high specificity and NPV is suitable as a screening examination. 3T-FBI improves the diagnostic ability in the BK region because of its high signal intensity, as compared to our previous experience at 1.5T.*Clinical Relevance/Application 3T-FBI shows excellent diagnostic ability in evaluation of patients with PAD in comparison with conventional angiography. Considering its high specificity and NPV, FBI is suitable for the screening examination.

RESULTS

The 344 arteries were evaluated where AG was performed. Of these, 97 arteries (10 in AI, 37 is FP, and 50 in BK) showed significant stenosis. The overall diagnostic ability of 3T-FBI showed sensitivity 98.9%, specificity 94.6%, positive predictive value (PPV) 88.1%, negative predictive value (NPV) 99.6%, and accuracy 95.6%. In AI, there were some false positives due to signal reduction at sharp bending portions. In TASC II classification, the correlation between 3T-FBI and CTA was good. However, it was difficult to determine by 3T-FBI in a case of type C in AI because that requires to evaluate the presence of heavily calcification. Some CTA showed to be difficult to accurately evaluate the lumen even with the original images and curved multi-planar reconstruction images when the arterial wall was heavily calcified. In the BK region, arterial visualization was excellent due to the high signal intensity at 3T-FBI, and the diagnostic ability was relatively good.

CLINICAL RELEVANCE/APPLICATION

3T-FBI shows excellent diagnostic ability in evaluation of patients with PAD in comparison with conventional angiography. Considering its high specificity and NPV, FBI is suitable for the screening examination.

Printed on: 06/28/22

PD03-B

Pediatric Tuesday Poster Discussions

Sub-Events

PD03-B1   **Clinical And MR Imaging Findings In Children With Myelin Oligodendrocyte Glycoprotein (MOG) Antibody-associated Disease**

Participants
Elizabeth George, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To describe the clinical and MRI findings in children with MOG-antibody associated disease.*Methods and Materials From our institutional pediatric demyelinating disease cohort (1998-2019), 32 patients with positive MOG titers and MRI at presentation were identified. Demographics, clinical symptoms, and MRI at presentation and first imaging follow-up were reviewed.*Results The median age at presentation was 6 years (IQR: 4-10). 50% (16/32) of patients presented with visual symptoms and 25% (8/32) presented with myelopathy. Other presenting symptoms were fever (22%), headache (38%), and seizure (9%).The median time from presentation to initial MRI was 14 days (IQR: 1-31). Brain involvement was seen in 78% (25/32, Table), most commonly affecting frontal lobes (84%, 21/25) and subcortical white matter (88%, 22/25). Deep gray nuclei were involved in 64% (16/25). 96% (24/25) had supratentorial and 76% (19/25) had infratentorial involvement. Pons was the most common infratentorial location (48%, 12/25). Reduced diffusion was rare (1/25, 4%) and none had susceptibility artifact. 52% (13/25) demonstrated enhancement, most frequently solid or ill-defined (both 28%, 7/25), followed by linear (24%, 6/25). Orbital involvement was seen in 50% (16/32). Involvement was bilateral in 75% (12/16) and most commonly of the anterior segments in 81% (13/16). Spine involvement was seen in 22% (7/32) and was multifocal in 57% (4/7). The most common imaging pattern was an ADEM-like brain pattern with optic neuritis (ON) (9/32, 28%) (Figure), followed by isolated ADEM-like brain pattern (8/32, 25%) and isolated ON (5/32, 16%). The median time to first follow-up MRI was 75.5 days (IQR: 27.5-241.5). At the time of follow-up, brain lesions demonstrated mixed response in 35% (10/29) and improvement in 24% (7/29). The overall imaging pattern was same (or resolved) at the time of follow-up in 78% (25/32), while 22% (7/32) demonstrated a new pattern of involvement.*Conclusions The most common imaging pattern of MOG antibody-associated disease at presentation was ADEM-like brain involvement with optic neuritis. At follow-up, 22% demonstrated a new pattern of involvement.*Clinical Relevance/Application Recognizing the MRI patterns of disease involvement in children with MOG antibody-associated disease at initial presentation and follow-up will assist with diagnosis and treatment.

RESULTS

The median age at presentation was 6 years (IQR: 4-10). 50% (16/32) of patients presented with visual symptoms and 25% (8/32) presented with myelopathy. Other presenting symptoms were fever (22%), headache (38%), and seizure (9%).The median time from presentation to initial MRI was 14 days (IQR: 1-31). Brain involvement was seen in 78% (25/32, Table), most commonly affecting frontal lobes (84%, 21/25) and subcortical white matter (88%, 22/25). Deep gray nuclei were involved in 64% (16/25). 96% (24/25) had supratentorial and 76% (19/25) had infratentorial involvement. Pons was the most common infratentorial location (48%, 12/25). Reduced diffusion was rare (1/25, 4%) and none had susceptibility artifact. 52% (13/25) demonstrated enhancement, most frequently solid or ill-defined (both 28%, 7/25), followed by linear (24%, 6/25). Orbital involvement was seen in 50% (16/32). Involvement was bilateral in 75% (12/16) and most commonly of the anterior segments in 81% (13/16). Spine involvement was seen in 22% (7/32) and was multifocal in 57% (4/7). The most common imaging pattern was an ADEM-like brain pattern with optic neuritis (ON) (9/32, 28%) (Figure), followed by isolated ADEM-like brain pattern (8/32, 25%) and isolated ON (5/32, 16%). The median time to first follow-up MRI was 75.5 days (IQR: 27.5-241.5). At the time of follow-up, brain lesions demonstrated mixed response in 35% (10/29) and improvement in 24% (7/29). The overall imaging pattern was same (or resolved) at the time of follow-up in 78% (25/32), while 22% (7/32) demonstrated a new pattern of involvement.

CLINICAL RELEVANCE/APPLICATION

Recognizing the MRI patterns of disease involvement in children with MOG antibody-associated disease at initial presentation and follow-up will assist with diagnosis and treatment.

Printed on: 06/28/22

HN04-C

Head and Neck Wednesday Poster Discussions

Sub-Events

HN04-C1   **Quantitative Analysis Of Dual-energy Computed Tomography For Detection Of Cartilage Invasion By Laryngeal Squamous Cell Carcinoma**

Participants
Hillary R. Kelly, MD, Boston, Massachusetts (*Presenter*) Investigator, Bayer AG;Institutional research agreement, Bayer AG

PURPOSE

The purpose of this study is to identify quantitative metrics on dual energy computed tomography (DECT) to differentiate laryngeal cancer, cancer in thyroid cartilage (CIC), non-ossified cartilage (NOC) and ossified thyroid cartilage.*Methods and Materials DECT data acquired on a single source rapid-switching platform on 30 patients (26 men, 4 women, mean age 64± 10.2 years) with histopathology-confirmed squamous cell carcinoma involving the larynx were retrospectively evaluated. 540 regions of interests were drawn within tumor and cartilage to determine the calculated HU of these structures at virtual monoenergetic images (VMIs) of 40keV and140keV, differences between HU measured on 40keV and 140keV VMIs, iodine density, and water density. Normalization of HU (on 40keV and 140keV VMIs) and iodine density was also performed using the internal jugular vein as the reference standard.*Results Water density, absolute and normalized iodine densities, absolute and normalized HU (on 40keV and 140keV VMIs), were significantly different between all the structures (p= 0.0012), except for cancer versus CIC. In comparing CIC to NOC, all characteristics were statistically significant (p=0.0002). ROC curve analysis showed that both absolute water density and normalized HU (on 40keV and 140keV VMIs) can differentiate CIC from NOC with AUC of 1. Absolute iodine density, normalized iodine density and HU (on 40keV and 140keV VMIs) were also excellent differentiators (AUC =0.918).*Conclusions Thyroid cartilage invaded by cancer has distinctly different iodine density, water density, and HU ranges on 40keV and 140keV VMIs compared to normal cartilage. The addition of water density derived images ("water maps") to iodine density ("iodine maps") and VMIs may increase the accuracy of DECT for differentiating cartilage invaded by laryngeal cancer from normal non-ossified cartilage.*Clinical Relevance/Application Accurate assessment of laryngeal cancer for cartilage invasion is important for staging and management, as it is a major factor in stratifying patients to surgery (total laryngectomy) or nonoperative management (radiation +/- chemotherapy). However, it can be difficult to differentiate normal non-ossified cartilage from cancer invading cartilage on conventional single energy CT. Quantitative information derived from DECT as demonstrated in this study shows that laryngeal squamous cell carcinoma, its invasion into thyroid cartilage, normal non-ossified cartilage and ossified thyroid cartilage have distinctly different characteristics, which can be objectively measured.

RESULTS

Water density, absolute and normalized iodine densities, absolute and normalized HU (on 40keV and 140keV VMIs), were significantly different between all the structures (p= 0.0012), except for cancer versus CIC. In comparing CIC to NOC, all characteristics were statistically significant (p=0.0002). ROC curve analysis showed that both absolute water density and normalized HU (on 40keV and 140keV VMIs) can differentiate CIC from NOC with AUC of 1. Absolute iodine density, normalized iodine density and HU (on 40keV and 140keV VMIs) were also excellent differentiators (AUC =0.918).

CLINICAL RELEVANCE/APPLICATION

Accurate assessment of laryngeal cancer for cartilage invasion is important for staging and management, as it is a major factor in stratifying patients to surgery (total laryngectomy) or nonoperative management (radiation +/- chemotherapy). However, it can be difficult to differentiate normal non-ossified cartilage from cancer invading cartilage on conventional single energy CT. Quantitative information derived from DECT as demonstrated in this study shows that laryngeal squamous cell carcinoma, its invasion into thyroid cartilage, normal non-ossified cartilage and ossified thyroid cartilage have distinctly different characteristics, which can be objectively measured.

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GI03-D

Gastrointestinal Tuesday Poster Discussions

Sub-Events

GI03-D10 CT-body Composition Of Sarcopenia And Sarcopenic Obesity: Predictors Of Postoperative Complications And Survival In Patients With Locally Advanced Esophageal Adenocarcinoma

Participants
Timo Auer, MD, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To assess the impact of body composition markers in computed tomography (CT) on perioperative morbidity and survival after surgery for patients with esophageal cancer (EC).*Methods and Materials Eighty-five patients who underwent esophagectomy for locally advanced EC between 2014 and 2019 were retrospectively enrolled. Pre- and postoperative CT scans were used to assess body composition markers (visceral [VAT] and subcutaneous adipose tissue [SAT] areas, psoas muscle area [PMA] and volume [PMV], total abdominal muscle area [TAMA]). Sarcopenia was defined as lumbar skeletal muscle index (LSMI) =38.5 cm2/m2 for women and =52.4 cm2/m2 for men. Patients with a body mass index (BMI) of =30 were considered obese. These imaging markers were correlated to major complications, anastomotic leakage, postoperative pneumonia, length of hospitalization, disease-free survival (DFS), and overall survival (OS).*Results Preoperatively, sarcopenia was identified in 58 patients (68.2%) and sarcopenic obesity was present in 7 patients (8.2%). Sarcopenic patients showed an elevated risk for the occurrence of major complications (OR: 2.587, p=0.048). Neither sarcopenia nor sarcopenic obesity was an independent risk factor for the occurrence of anastomotic leakage (p>0.05). Patients with sarcopenic obesity had a significantly higher risk for postoperative occurrence of pneumonia (OR: 6.364 p=0.018) and a longer hospital stay after surgery (71d vs. 24d, p=0.003). A decrease in PMV and TAMA in the follow-up period showed a significant correlation to shorter DFS and OS (beta coefficient: -0.291 to -0.356; p=0.018 to 0.044).*Conclusions Sarcopenic patients with locally advanced esophageal cancer undergoing surgery are at increased risk for major complications and patients with sarcopenic obesity are more prone to postoperative pneumonia and prolonged hospitalization. Decreasing muscle mass during postoperative follow-up is associated with lower DFS and OS.*Clinical Relevance/Application Preoperative staging examinations are carried out on every patient and the image data contain valuable information about the patient's physical condition in addition to the routinely assessed tumor extension. Our analysis showed that sarcopenic patients with low muscle mass were more likely to have major complications and that hospitalization was prolonged, especially in patients with sarcopenic obesity. A decrease in muscle mass during the follow-up also indicated poorer overall survival. CT-body composition parameters should therefore be assessed routinely in the imaging work-up.

RESULTS

Preoperatively, sarcopenia was identified in 58 patients (68.2%) and sarcopenic obesity was present in 7 patients (8.2%). Sarcopenic patients showed an elevated risk for the occurrence of major complications (OR: 2.587, p=0.048). Neither sarcopenia nor sarcopenic obesity was an independent risk factor for the occurrence of anastomotic leakage (p>0.05). Patients with sarcopenic obesity had a significantly higher risk for postoperative occurrence of pneumonia (OR: 6.364 p=0.018) and a longer hospital stay after surgery (71d vs. 24d, p=0.003). A decrease in PMV and TAMA in the follow-up period showed a significant correlation to shorter DFS and OS (beta coefficient: -0.291 to -0.356; p=0.018 to 0.044).

CLINICAL RELEVANCE/APPLICATION

Preoperative staging examinations are carried out on every patient and the image data contain valuable information about the patient's physical condition in addition to the routinely assessed tumor extension. Our analysis showed that sarcopenic patients with low muscle mass were more likely to have major complications and that hospitalization was prolonged, especially in patients with sarcopenic obesity. A decrease in muscle mass during the follow-up also indicated poorer overall survival. CT-body composition parameters should therefore be assessed routinely in the imaging work-up.

GI03-D2 Overlooked Area Of Abdomen CT: Utilization Of AI Lung Nodule Detection And Characterization System For Basal Lung Metastasis In Colon Cancer Patients

Participants
Eun Kyoung Hong, MD, Gwangmyeong-Si, Korea, Republic Of (*Presenter*) Research Consultant, VUNO Inc

PURPOSE

Even though the basal lung area covered in the abdomen CT can be easily overlooked by abdominal radiologists, nodules in this area can have important clinical significance, especially if they are malignant. In this study, we aim to assess the performance of an AI system for the detection of lung metastasis on abdomen CTs in colon cancer patients.*Methods and Materials This retrospective study consecutively included 261 colon cancer patients who received primary surgical resection of colon tumors with no definite evidence of lung metastasis on pre-surgical CT evaluation. Portal-venous phase images of preoperative abdomen CTs reconstructed at 2.5-3 mm slice thickness were used for analysis. A fully automated AI lung nodule detection system was utilized for the detection and characterization of lung nodules in the basal lung area that is covered on abdomen CT. Lung nodules detected with the AI system were re-evaluated by one radiologist to confirm the location and characteristics of the nodules. Thereafter, follow-up chest, abdomen or both CTs and the reports from the follow-up scans were reviewed. Nodules in the initial abdomen CT that 1) showed an increment in size and number and 2) reported as metastasis in the follow-up imaging were considered as metastasis.

LungRADS scores were automatically calculated with the AI system and compared between patients with metastatic and benign nodules using a Chi-squared test.*Results Of 216 scans of patients with no previously diagnosed lung metastasis, a total of 294 lung nodules were detected in 71 patients (metastasis = 12, benign = 55, unconfirmed = 4 patients) using the AI system; automatically calculated LungRADS score of 2 (n = 41), 3 (n = 7), 4a (n = 16), 4b (n = 3), 4x (n = 4). For the patients with lung metastasis detected by the AI system (n = 12), LungRADS scores were 2 (n = 2), 4a (n = 6), 4b (n = 3), 4x (n = 1). On the other hand, patients with benign nodules detected by the AI system (n = 55) presented with LungRADS scores of 2 (n = 37), 3 (n = 6), 4a (n = 9), 4x (n = 3). There was a significant difference in LungRADS scores of patients with AI-detected metastatic and benign nodules (p < 0.001).*Conclusions The AI lung nodule detection system was able to automatically identify and characterize basal lung metastasis on abdomen CT.*Clinical Relevance/Application Detection and characterization of lung metastasis in the basal lung covered on abdomen CT with the use of AI system can aid in treatment decision making and prognosis prediction of colon cancer patients. We carefully propose the utilization of an AI system for the detection of lung nodules in abdomen CT for better personalized medicine of colon cancer patients.

RESULTS

Of 216 scans of patients with no previously diagnosed lung metastasis, a total of 294 lung nodules were detected in 71 patients (metastasis = 12, benign = 55, unconfirmed = 4 patients) using the AI system; automatically calculated LungRADS score of 2 (n = 41), 3 (n = 7), 4a (n = 16), 4b (n = 3), 4x (n = 4). For the patients with lung metastasis detected by the AI system (n = 12), LungRADS scores were 2 (n = 2), 4a (n = 6), 4b (n = 3), 4x (n = 1). On the other hand, patients with benign nodules detected by the AI system (n = 55) presented with LungRADS scores of 2 (n = 37), 3 (n = 6), 4a (n = 9), 4x (n = 3). There was a significant difference in LungRADS scores of patients with AI-detected metastatic and benign nodules (p < 0.001).

CLINICAL RELEVANCE/APPLICATION

Detection and characterization of lung metastasis in the basal lung covered on abdomen CT with the use of AI system can aid in treatment decision making and prognosis prediction of colon cancer patients. We carefully propose the utilization of an AI system for the detection of lung nodules in abdomen CT for better personalized medicine of colon cancer patients.

GI03-D4   Feasibility Of Compressed Sensing-sensitivity Encoding In Magnetic Resonance Imaging Of The Rectum

Participants
Serin Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of compressed sensing-sensitivity encoding (CS-SENSE) in patients with anorectal cancer, focused on the image quality and acquisition time.*Methods and Materials Sixty-one anorectal cancer patients (56.7 years ± 8.9 [standard deviation]) who underwent anorectal MR were included in this retrospective study. T2 weighted axial rectal MRI with SENSE (acceleration factor, 2) and CS-SENSE (acceleration factor, 3) were compared in each patient by two experienced radiologists. Margin sharpness, image noise, artifacts, synthetic appearance, lesion conspicuity, and overall image quality were assessed using 5-point Likert scale (1, inferior; 3, similar; 5, superior) and compared using Wilcoxon signed-rank test between two image sets. Interobserver agreement was measured using PABAK-OS. In addition, acquisition time were compared using paired t test between two groups.*Results Acquisition time of CS-SENSE (mean ± SD, 119.6 ± 21.4 s) was 25.1% shorter than that of SENSE (mean ± SD, 159.6 ± 19.9 s; P < 0.001). Artifact was less observed on CS-SENSE than SENSE significantly in both upper (Reader 1; 3.34 ± 0.48, P < 0.001, Reader 2; 3.38 ± 0.66, P < 0.001, Average; 3.36 ± 0.57, P < 0.001) and lower levels (Reader 1; 3.11 ± 0.36, P =0.011, Reader 2; 3.18 ± 0.51, P =0.008, Average; 3.14 ± 0.44, P < 0.001). For image noise, reader 2 evaluated CS-SENSE more valuable than SENSE (3.05 ± 0.28, P =0.025). No significant differences were found in margin sharpness, synthetic appearance, lesion conspicuity, and overall image quality. Interobserver agreement was mostly moderate to almost perfect for each image quality assessment.*Conclusions Compressed sensing with SENSE is clinically feasible in patients with anorectal patients, resulting in significant reduction in acquisition time without deteriorating image quality.*Clinical Relevance/Application Abbreviations CS = compressed sensing, SENSE = sensitivity encoding, PI = parallel imaging, SNR = signal-to-noise ratio Summary Rectal MR with CS-SENSE can reduce acquisition time without deteriorating image quality.Implications for Patient Care l In T2-weighted axial image, CS-SENSE reduces acquisition time by 25.1%, compared with SENSE. l CS-SENSE could reduce artifact without significant decreasing lesion conspicuity in T2-wgithed image anorectal MR images.

RESULTS

Acquisition time of CS-SENSE (mean ± SD, 119.6 ± 21.4 s) was 25.1% shorter than that of SENSE (mean ± SD, 159.6 ± 19.9 s; P < 0.001). Artifact was less observed on CS-SENSE than SENSE significantly in both upper (Reader 1; 3.34 ± 0.48, P < 0.001, Reader 2; 3.38 ± 0.66, P < 0.001, Average; 3.36 ± 0.57, P < 0.001) and lower levels (Reader 1; 3.11 ± 0.36, P =0.011, Reader 2; 3.18 ± 0.51, P =0.008, Average; 3.14 ± 0.44, P < 0.001). For image noise, reader 2 evaluated CS-SENSE more valuable than SENSE (3.05 ± 0.28, P =0.025). No significant differences were found in margin sharpness, synthetic appearance, lesion conspicuity, and overall image quality. Interobserver agreement was mostly moderate to almost perfect for each image quality assessment.

CLINICAL RELEVANCE/APPLICATION

Abbreviations CS = compressed sensing, SENSE = sensitivity encoding, PI = parallel imaging, SNR = signal-to-noise ratio Summary Rectal MR with CS-SENSE can reduce acquisition time without deteriorating image quality.Implications for Patient Care l In T2-weighted axial image, CS-SENSE reduces acquisition time by 25.1%, compared with SENSE. l CS-SENSE could reduce artifact without significant decreasing lesion conspicuity in T2-wgithed image anorectal MR images.

GI03-D6   Quantitative Evaluation Of Gastric Cancer Lauren Classification Using CT Perfusion Imaging

Participants
Zhang Min, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the value of quantitative parameters of CT Perfusion imaging in Lauren classification of gastric cancer.*Methods and Materials From July 2018 to November 2019,fifty-twopatients(44 men, 8 women; mean age 58±4.8, range 44-85) with gastric cancer confirmed by gastroscopy were enrolled in our study. All patients underwent preoperative CT perfusion (CTP) and curative gastrectomy. The enrolled cases were divided into intestinal type group, diffuse type group and mixed type group according to Lauren classification. Perfusion parameters including blood-flow (BF), blood volume (BV), mean transmit time (MTT), time to peak (TTP) and permeability surface (PS) were calculated. One-way analysis of variance (ANOVA) were performed between Lauren

groups for each perfusion parameter. A receiver operating characteristic (ROC) analysis was applied to evaluate the diagnostic performance of perfusion parameters.*Results The patient number in intestinal type, diffuse type and mixed type were 19, 13 and 20, respectively. PS and BV of mixed type group were significantly higher than intestinal and diffuse type groups(all p<0.05).To distinguish mixed type group with the other Lauren groups, PS showed the largest area under ROC curve (AUC) of 0.962 (sensitivity, 94.7%; specificity, 93.9%)with a cut-off value of 45.23ml/100g/min. BV had AUC of 0.735, sensitivity of 94.7% and specificity of 84.8% with the cut-off value of 5.04 ml/100g. PS and BV of intestinal group were significantly lower than other Lauren types and PS showed the largest area under ROC curve (AUC) of 0.922 (sensitivity, 80.0%; specificity, 93.7%).*Conclusions PCT can accurately evaluate the Lauren types of gastric cancer with certain perfusion parameters.*Clinical Relevance/Application The PCT can serve as alternative diagnosis method to distinguish different Lauren types.

RESULTS

The patient number in intestinal type, diffuse type and mixed type were 19, 13 and 20, respectively. PS and BV of mixed type group were significantly higher than intestinal and diffuse type groups(all p<0.05).To distinguish mixed type group with the other Lauren groups, PS showed the largest area under ROC curve (AUC) of 0.962 (sensitivity, 94.7%; specificity, 93.9%)with a cut-off value of 45.23ml/100g/min. BV had AUC of 0.735, sensitivity of 94.7% and specificity of 84.8% with the cut-off value of 5.04 ml/100g. PS and BV of intestinal group were significantly lower than other Lauren types and PS showed the largest area under ROC curve (AUC) of 0.922 (sensitivity, 80.0%; specificity, 93.7%).

CLINICAL RELEVANCE/APPLICATION

The PCT can serve as alternative diagnosis method to distinguish different Lauren types.

GI03-D9   Reduction Of Peristalsis-related Streak Artifacts In The Liver With Dual-Layer Spectral CT

Participants
Sergio Grosu, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To assess the performance of dual-layer spectral detector CT image reconstructions for the reduction of intestinal peristalsis-related streak artifacts in the liver.*Methods and Materials We retrospectively evaluated 220 contrast-enhanced abdominal CT scans in 131 consecutive patients (mean age: 68±10 years, 120 men) who underwent routine clinical dual-layer spectral CT imaging. Conventional 120 kVp images, 40 keV and 200 keV monoenergetic image reconstructions, water and iodine material decomposition image reconstructions were analyzed. Two independent readers recorded the presence and severity of peristalsis-related streak artifacts in the right and left liver lobes qualitatively on a five-point Likert scale (1=none to 5=severe) and quantitatively by the depth of streak artifact extension into the liver in mm and ROI measurements of Hounsfield Unit and iodine concentration differences from normal liver. Artifact severity between image reconstructions were compared by Wilcoxon signed-rank and paired t-tests.*Results Intestinal peristalsis-related streak artifacts in the liver were seen in 51/208 (25%) CT scans and involved the left lobe only in 49/51 (96%), the right lobe only in 0/51 (0%), and both lobes in 2/51 (4%) CT scans. The frequency of artifacts was significantly lower in iodine than in 120 kVp image reconstructions (scans 18/208 vs. 51/208, p<0.001). Artifact severity was significantly less in iodine than in 120 kVp image reconstructions (median score 1 vs. 3, p<0.001). The depth of streak artifact extension into the liver was shorter in iodine than 120 kVp image reconstructions (mean length 2±4 vs. 12±5 mm, p<0.001). ROI measurements were significantly different between bright streak artifacts and the neighboring unaffected liver parenchyma in 120 kVp, 40 keV, 200 keV and water image reconstructions (p<0.001, each), but not in iodine image reconstructions (p=0.23).*Conclusions Intestinal peristalsis-related streak artifacts commonly affect the left liver lobe at 120 kVp and can be substantially reduced by viewing iodine DECT image reconstructions.*Clinical Relevance/Application Iodine DECT image reconstructions substantially reduce common peristalsis-related streak artifacts in the liver, particularly for the left lobe by the stomach, at dual layer spectral CT.

RESULTS

Intestinal peristalsis-related streak artifacts in the liver were seen in 51/208 (25%) CT scans and involved the left lobe only in 49/51 (96%), the right lobe only in 0/51 (0%), and both lobes in 2/51 (4%) CT scans. The frequency of artifacts was significantly lower in iodine than in 120 kVp image reconstructions (scans 18/208 vs. 51/208, p<0.001). Artifact severity was significantly less in iodine than in 120 kVp image reconstructions (median score 1 vs. 3, p<0.001). The depth of streak artifact extension into the liver was shorter in iodine than 120 kVp image reconstructions (mean length 2±4 vs. 12±5 mm, p<0.001). ROI measurements were significantly different between bright streak artifacts and the neighboring unaffected liver parenchyma in 120 kVp, 40 keV, 200 keV and water image reconstructions (p<0.001, each), but not in iodine image reconstructions (p=0.23).

CLINICAL RELEVANCE/APPLICATION

Iodine DECT image reconstructions substantially reduce common peristalsis-related streak artifacts in the liver, particularly for the left lobe by the stomach, at dual layer spectral CT.

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Sub-Events

PH04-C1   Organ-based And Dlp-based Effective Dose As Representations Of Radiation Risk In A Population Of 8946 Patients With Cumulative Effective Dose Greater Than 100 Milli Sievert

Participants
Francesco Ria, DMP, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

Recent studies have shown that it is not uncommon for a patient to undergo multiple CT exams resulting in high cumulative dose above 100 mSv, the radiation risk associated with which is not negligible. The purpose of this study was to compare the estimated radiation risk in a large population of such cases based on effective dose to estimates of risk index including patient age.*Methods and Materials This IRB-approved study included 8946 patients who underwent multiple CT exams over 5 years resulting in a cumulative effective dose over 100 mSv. Organ doses were estimated using Monte Carlo methods. DLP-based effective dose (Ek) and organ dose-based effective dose (EOD) were calculated following ICRP 102 and ICRP 103 publications. The organ dose-based risk index (RI) was calculated according to BEIR VII risk coefficients. A linear regression was applied to assess each metric's dependency to RI, assumed to be the closest patient risk surrogate. The relative sensitivity of EOD and Ek to the estimated risk was calculated in six age groups (30 to 80 years old) in terms of a Risk Sensitivity Index (RSI) computed as a normalized fit slope by the ratio of the mean value of RI for each metric.*Results Across all patients, EOD for the 100 mSv+ cohort ranged between 100.2 and 1184.7 mSv, Ek between 54.1 and 1031.9 mSv, and RI between 152.9 and 7785.1 cancers per 105 patients. Per each age group, the fit R2 was <0.004 for the linear regression of Ek vs. RI and between 0.72 and 0.97 for EOD vs. RI implying that RI and EOD are linearly related. As anticipated, the fit slope increased with patient age. The RSI was <3.15×10-4 for Ek and ranged between 0.01 and 0.26 for EOD.*Conclusions For patient exposed to high cumulative dose (>100 mSv), care should be exercised to properly assess the risk figures and to draw risk predictions from metrics unrepresentative of population risk. Compared to effective dose drawn from DLP, effective dose based on organ doses provides a closer representation of patient and population risk, provided stratification by specific age groups.*Clinical Relevance/Application When patients undergo recurring CT exams, the radiation induced risks should be carefully estimated using metrics that incorporate organ dose and patient age.

RESULTS

Across all patients, EOD for the 100 mSv+ cohort ranged between 100.2 and 1184.7 mSv, Ek between 54.1 and 1031.9 mSv, and RI between 152.9 and 7785.1 cancers per 105 patients. Per each age group, the fit R2 was <0.004 for the linear regression of Ek vs. RI and between 0.72 and 0.97 for EOD vs. RI implying that RI and EOD are linearly related. As anticipated, the fit slope increased with patient age. The RSI was <3.15×10-4 for Ek and ranged between 0.01 and 0.26 for EOD.

CLINICAL RELEVANCE/APPLICATION

When patients undergo recurring CT exams, the radiation induced risks should be carefully estimated using metrics that incorporate organ dose and patient age.

PH04-C10   Feasibility Study Of Spectral CT Virtual Unenhanced Technique In Chest Enhanced CT Imaging

Participants
Dandan Niu, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the feasibility of Revolution CT virtual unenhanced CT(VUE) images replacing conventional unenhanced CT(TUE) images.*Methods and Materials Thirty patients underwent conventional un-enhanced CT scan with 120kVp tube voltage,automatic current(200-500mA) and contrast enhanced spectral CT scan with GSI-Assist mode during the arterial phase(AP) and venous phase(VP) were prospectively collected. All the patients were scanned on a 256-row CT scanner (Revolution,healthcare) with the following parameters: 0.092 pitch, noise index(NI)12,detector width 80mm,rotate speed 0.5s,pre-ASiR-V 40%.The images (AP-VUE,VP-VUE)were reconstructed after scan..CT value of lesions in various sites(including thoracic aorta,pulmonar artery,subcutaneous fat and erector spinae),image noise of chest subcutaneous fat(SD) ,effective dose (ED) in all the patients were recorded. CT value of the arterial phase(AP) and venous phase(VP) relative to TUE and AP-VUE,VP-VUE were calculated, respectively. Contrast-to-noise ratio(CNR) of pulmonar artery and thoracic aorta and the lesion net added Subjective image quality were assessed by two radiologists using a 5-point scale (from 1=unaccepted to 5=excellent) in a double -blinded and randomized manner. A score of 3 was required to fulfil minimal clinical diagnose. ANOVA and Kruskal-Wallis H were used to determine the difference of image quality and radiation dose between groups.*Results There was no significant differences in CT value(thoracic aorta(42.22±3.78,41.05±5.38,43.28±5.27,F=1.582,p=0.212),pulmonar artery(48.46±5.00,46.22±4.55,47.92±4.71,F=1.818,p=0.169)) and SD(7.56±1.76,8.30±1.60,8.08±2.10,F=1.313,p=0.274)between AP-VUE,VP-VUE and TUE images.There was no difference in subjective score of three groups.The total radiation dose(DLP) before and after TUE were 525.79±156.97 mGy.cm,725.28±215.43 mGy.cm,The effective dose (ED) before and after TUE were 7.36±2.20mSv,10.15±3.02mSv,respectively.The ED could reduced by 27.58% by using VUE images .*Conclusions The VUE technique can provide the accurate CT value of the lesion in various sites while reducing radiation dose,obtain better image quality,and meet clinical diagnostic requirements.*Clinical Relevance/Application Better image quality can be obtained while reducing radiation dose by using VUE images.

RESULTS

There was no significant differences in CT value(thoracic aorta(42.22±3.78,41.05±5.38,43.28±5.27,F=1.582,p=0.212),pulmonar artery(48.46±5.00,46.22±4.55,47.92±4.71,F=1.818,p=0.169)) and SD(7.56±1.76,8.30±1.60,8.08±2.10,F=1.313,p=0.274)between AP-VUE,VP-VUE and TUE images.There was no difference in subjective score of three groups.The total radiation dose(DLP) before and after TUE were 525.79±156.97 mGy.cm,725.28±215.43 mGy.cm,The effective dose (ED) before and after TUE were 7.36±2.20mSv,10.15±3.02mSv,respectively.The ED could reduced by 27.58% by using VUE images .

CLINICAL RELEVANCE/APPLICATION

Better image quality can be obtained while reducing radiation dose by using VUE images.

PH04-C12   Feasibility Study Of Energy Spectralct Virtual Non-contrast Scansto Replace True Non-contrast Scansin Ctu

Participants
Jie Sun, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the feasibility of energy spectral CT virtual non-contrast scans (VNC) to replace true non-contrast (TNC) scans in computed tomography urography(CTU) examination.*Methods and Materials Twenty-eight patients prepared for CTU examination were collected prospectively. All patients received conventional TNC scanning and spectrum enhanced scan. The protocol of conventional TNC scan: tube voltage 120 kVp, automatic tube current (100-740mA). The energy spectrum enhanced scanning adopts tube voltage fast kV switch (80/140 kV) the tube current 440mA. The energy spectrum images in venous phase were reconstructed by post-processing workstation ADW4.7 to generate virtual non-contrast scanning (VNC) images. CT values, background noise (SD), signal noise ratio (SNR=HUtissue/SDtissue), contrast signal noise ratio (CNR=HUtissue-HUmuscule)/SDfat) of liver, spleen, pancreas, right renal cortex, renal medulla, abdominal aorta , erector spinae and abdominal fat in VNC and TNC image were measured and compared respectively. The subjective image scores were assessed blindly by two experienced physicians using a 5-point system. The dose length product (DLP) of each scan was recorded after scanning, and the value of effective dose (ED) was calculated according to the formula: ED(mSv)=k(mSv*mGy-1*cm-1)*DLP(mGy*cm). The differences of CNR,SNR and SD among VNC and TNC were compared by one-way analysis of variance, and the differences of subjective scoring between two observers were compared by Kappa test.*Results The SD values of liver, spleen, pancreas, abdominal aorta, renal cortex, medulla and abdominal fat were(18.24±2.24)HU,(19.27±2.61)HU,(21.01±2.38)HU,(22.00±2.51)HU,(19.43±2.61)HU,(19.63±2.77)HU,(17.40±1.46)HU respectively in the VNC image , and there were significantly different from the corresponding SD values in TNC image(P <0.05). Similarly, the CNR and SNR of tissue in VNC image were significantly different from the corresponding TNC image(P<0.05). Compared with the DLP of TNC scanning, the DLP decreased by 48% after the application of energy spectrum CT VNC technology. The subjective scores of TNC and VNC imaging was no statistical significance between the two groups (P>0.05).*Conclusions Both VNC images and TNC images can meet the requirements of diagnosis. The VNC scans can replacing TNC in CTU examination, which can significantly reduce the radiation dose while ensuring the requirements of image diagnosis.*Clinical Relevance/Application The material suppressed iodine (MSI) technology provides new ideas and guidance for clinical examination, which can be applied to the examination of all clinical sites and the examination of radiation-sensitive people (children, patients with hyperthyroidism, etc).

RESULTS

The SD values of liver, spleen, pancreas, abdominal aorta, renal cortex, medulla and abdominal fat were(18.24±2.24)HU,(19.27±2.61)HU,(21.01±2.38)HU,(22.00±2.51)HU,(19.43±2.61)HU,(19.63±2.77)HU,(17.40±1.46)HU respectively in the VNC image , and there were significantly different from the corresponding SD values in TNC image(P <0.05). Similarly, the CNR and SNR of tissue in VNC image were significantly different from the corresponding TNC image(P<0.05). Compared with the DLP of TNC scanning, the DLP decreased by 48% after the application of energy spectrum CT VNC technology. The subjective scores of TNC and VNC imaging was no statistical significance between the two groups (P>0.05).

CLINICAL RELEVANCE/APPLICATION

The material suppressed iodine (MSI) technology provides new ideas and guidance for clinical examination, which can be applied to the examination of all clinical sites and the examination of radiation-sensitive people (children, patients with hyperthyroidism, etc).

PH04-C3   Characterization of a New Investigational Dual-source Photon-counting CT System Based on AAPM Task Group 233 Metrology

Participants
Ehsan Samei, PhD, Durham, North Carolina (*Presenter*) Researcher, General Electric Company;Royalties, General Electric Company;Consultant, General Electric Company;Advisory Board, General Electric Company;Researcher, Siemens AG;Researcher, Bracco Grouip;Royalties, medInt Holdings, LLC;Consultant, medInt Holdings, LLC;Advisory Board, medInt Holdings, LLC;Royalties, 12 Sigma Technologies;Royalties, Sun Nuclear Corporation;Royalties, IBM Corporation;Royalties, Metis Health;Consultant, Nano-X Imaging Ltd;Advisory Board, Nano-X Imaging Ltd;;;

PURPOSE

To assess the foundational image quality characteristics of a new investigational dual-source photon-counting CT (PCCT) system according to the standardized metrology of AAPM Task Group 233.*Methods and Materials The ACR phantom was scanned on an investigational full-field of view PCCT system (NAEOTOM Alpha, Siemens Healthineers) using the standard protocols of TG233-F1-6 (120 kV, CTDIvol of 24, 12, 6, 3, 1.5 and 0.79 mGy), in quantum plus mode (M4, 2 energy thresholds of 20 and 65 keV, 352 μm pixel size), and reconstructed as 70 keV mono-energetic image set with 1.5 and 5.0 mm slice thickness and standard body kernel (Br40). An additional data set was acquired at TG233-F6 in quantum high resolution mode (S1, 2 energy thresholds of 20 and 65 keV, 176 μm pixel size), reconstructed with 0.2 and 5.0 mm slice thicknesses with kernels Br78, Br89, and Br98. The images were processed using the TG233 metrology in terms of spatial resolution (TTFn,C, f50 and f10), noise (n, NPSn, and fA), and detectability index (d' for 5mm lesion at 15 HU). The results were compared across acquisitions.*Results The metrics offered superior performance compared to competing CT technologies. Noise magnitudes (n) ranged from 2.0-24.6 HU for 0.79-24 CTDIvol in M4 mode with average noise texture (fA) largely intact. Resolution was also stable across dose levels at 0.33 0.37 mm-1 for f50. This value was markedly increased in the S1 mode to 0.36-1.39 mm-1 with noise correspondingly increasing to 1.8 to 15.6 HU across the three applied recon kernels.*Conclusions PCCT technology offers superior noise and resolution performance compared to other CT systems in either energy integrating or dual energy modes. The technology offers notable potential for improved

diagnostic performance and d' across clinical tasks.*Clinical Relevance/Application Photon-counting CT is rapidly emerging as a viable clinical imaging modality with potential to offer improved resolution, noise, and task performance across diverse clinical applications.

RESULTS

The metrics offered superior performance compared to competing CT technologies. Noise magnitudes (n) ranged from 2.0-24.6 HU for 0.79-24 CTDIvol in M4 mode with average noise texture (fA) largely intact. Resolution was also stable across dose levels at 0.33 0.37 mm-1 for f50. This value was markedly increased in the S1 mode to 0.36-1.39 mm-1 with noise correspondingly increasing to 1.8 to 15.6 HU across the three applied recon kernels.

CLINICAL RELEVANCE/APPLICATION

Photon-counting CT is rapidly emerging as a viable clinical imaging modality with potential to offer improved resolution, noise, and task performance across diverse clinical applications.

PH04-C4   Study On The Difference Of CT Value Between Virtual Plain Scan And True Non-contrast(TNC) In Neck CT Examination

Participants
Wang Xinhui, Shizuishan, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the difference in CT values between virtual plain scan (VUE) and conventional plain scan in Revolution energy spectrum CT neck imaging, and to explore the feasibility of virtual plain scan (VUE) instead of conventional plain scan.*Methods and Materials Collected 30 newly diagnosed patients who needed neck plain scan and enhancement, and GE Revolution CT was used to perform true non-contrast neck scan and energy spectrum enhanced scan (arterial phase, venous phase).All patients signed an informed consent form before the examination.True non-contrast scan tube voltage is 120kV, tube current is auto mA, pitch 0.984:1, NI index 9, tube speed 0.5 s/rot, detector width 80mm, layer thickness and layer spacing 5mm, reconstruction layer thickness and layer the spacing is 0.625 mm, the reconstruction matrix is 512×512, and the iterative reconstruction level ASIR-V weight is 30%.The energy spectrum enhancement scan mode (GSI) tube voltage is 80kV-140kV instantaneous switching, the tube current is the energy spectrum automatic milliampere (GSI Assist), the NI index is 9, and the other scan parameters are consistent with the true non-contrast scan. Post-processing to obtain VUE images in arterial phase and venous phase. The AW4.7 workstation was used to measure the CT value of the common carotid artery and the CT value of the sternocleidomastoid muscle.Using SPSS 20.0 software, the CT values of the 3 groups of images were compared by one-way ANOVA analysis.*Results The CT values of common carotid artery in true non-contrast, arterial and venous phases of VUE were 48.10±5.67, 67.35±12.36, 56.12±11.69, respectively, with little change but statistical difference (p<0.05).The CT values of sternocleidomastoid muscle were 57.52±12.65, 54.37±9.38, 58.52±10.1, no statistical difference (p>0.05); Conventional plain scan CTDIvol (10.86±1.44) mSv, energy spectrum arterial and venous enhancement CTDIvol are each (9.99±1.30) mSv, virtual plain scan and energy spectrum enhancement are 35.21% lower than conventional plain scan and energy spectrum enhancement CTDIvol.*Conclusions Although there is a difference between the VUE and the true non-contrast scan blood vessel CT value in the arterial and venous phase, there is little change,there is no significant difference in the CT value of soft tissue, and it has the potential to replace true non-contrast scan images. The effect of VUE in the venous phase is better, so as to effectively reduce the patient's radiation dose.*Clinical Relevance/Application VUE image quality has the potential to replace true non-contrast scan images. The effect of intravenous VUE is better, which can effectively reduce the patient's radiation dose. It can be popularized in patients with neck tumors that require multiple reexaminations.

RESULTS

The CT values of common carotid artery in true non-contrast, arterial and venous phases of VUE were 48.10±5.67, 67.35±12.36, 56.12±11.69, respectively, with little change but statistical difference (p<0.05).The CT values of sternocleidomastoid muscle were 57.52±12.65, 54.37±9.38, 58.52±10.1, no statistical difference (p>0.05); Conventional plain scan CTDIvol (10.86±1.44) mSv, energy spectrum arterial and venous enhancement CTDIvol are each (9.99±1.30) mSv, virtual plain scan and energy spectrum enhancement are 35.21% lower than conventional plain scan and energy spectrum enhancement CTDIvol.

CLINICAL RELEVANCE/APPLICATION

VUE image quality has the potential to replace true non-contrast scan images. The effect of intravenous VUE is better, which can effectively reduce the patient's radiation dose. It can be popularized in patients with neck tumors that require multiple reexaminations.

PH04-C6   Dose Reduction Potential In Cone-beam CT Imaging Of Upper Extremity Joints With A Twin Robotic X-ray System

Participants
Karsten Luetkens, MD, Wuerzburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Cone-beam computed tomography is a powerful tool for 3D imaging of the appendicular skeleton, facilitating detailed visualization of bone microarchitecture. This study evaluated various combinations of acquisition and reconstruction parameters for the cone-beam CT mode of a twin robotic x-ray system in cadaveric wrist and elbow scans, aiming to define the best possible trade-off between image quality and radiation dose.*Methods and Materials Images were acquired with different combinations of tube voltage and tube current-time product, resulting in five scan protocols with varying volume CT dose indices: full-dose (17.4 mGy), low-dose (4.5 mGy), ultra-low-dose (1.15 mGy), modulated low-dose (0.6 mGy) and modulated ultra-low-dose (0.29 mGy). Each set of projection data was reconstructed with three convolution kernels (very sharp, sharp, intermediate). Five radiologists subjectively assessed the image quality of cortical bone, cancellous bone and soft tissue using seven-point scales.*Results Irrespective of the reconstruction kernel, overall image quality of every full-dose, low-dose and ultra-low-dose scan was deemed suitable for diagnostic use in contrast to modulated low-dose (very sharp/sharp/intermediate: 60/55/70%) and modulated ultra-low-dose studies (0/3/5%). Superior depiction of cortical and cancellous bone was achieved in very sharp full-dose and low-dose examinations (p<0.001) with low-dose scans also providing favorable bone visualization compared to sharp and intermediate full-dose studies (p<0.001). Fleiss' kappa was 0.618 (0.594 - 0.641; p<0.001), indicating substantial interrater reliability.*Conclusions In this study, we demonstrate that the radiation exposure in upper extremity joint scans can be substantially reduced while maintaining diagnostic image quality with the cone-beam CT mode of a twin robotic x-ray system. Application of very sharp

convolution kernels for image reconstruction facilitates superior display of bone microarchitecture, hence maximizing the dose reduction potential.*Clinical Relevance/Application Dose reduction of more than 90% compared standard clinical protocols is feasible for certain imaging tasks, while maintaining diagnostic image quality with a dedicated ultra-low-dose scan protocol.

RESULTS

Irrespective of the reconstruction kernel, overall image quality of every full-dose, low-dose and ultra-low-dose scan was deemed suitable for diagnostic use in contrast to modulated low-dose (very sharp/sharp/intermediate: 60/55/70%) and modulated ultra-low-dose studies (0/3/5%). Superior depiction of cortical and cancellous bone was achieved in very sharp full-dose and low-dose examinations (p<0.001) with low-dose scans also providing favorable bone visualization compared to sharp and intermediate full-dose studies (p<0.001). Fleiss' kappa was 0.618 (0.594 - 0.641; p<0.001), indicating substantial interrater reliability.

CLINICAL RELEVANCE/APPLICATION

Dose reduction of more than 90% compared standard clinical protocols is feasible for certain imaging tasks, while maintaining diagnostic image quality with a dedicated ultra-low-dose scan protocol.

PH04-C9   Influence Of Different Reconstruction Methods Of 256-row Detector CT On Image Quality Of Coronary Stent

Participants
Yongpei Cao, Yinchuan, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare the image quality of 256-row detector CT in different reconstruction kernel of coronary stent.*Methods and Materials CT images of 24 patients (28 stents) were collected from April 2020 to October 2020. All patients were divided into group A and group B. group A: coronary artery images were reconstructed with standard. Group B: coronary artery images were reconstructed with detail. Tube voltage: 120kv, tube current: 250-475mA, noise index: 24.0, rotational speed: 0.28s, ASiR-V: 50%, contrast agent: 370mg/ml, dosage: 0.8 * kg body weight. According to the fixed protocol, the CT value of the stent vessel, the inner diameter of the proximal, middle and distal segments of the stent and the inner diameter of the proximal, middle and distal segments of the stent were measured, The average CT value, SD value and the display rate of the stent inner diameter were calculated. Paired T-test was used to compare the average CT value, subjective image quality and display rate of stent inner diameter in two different reconstruction modes. Two radiologists with more than five years of experience in imaging diagnosis of cardiovascular and thoracic vascular groups scored the reconstructed images of group A and group B subjectively.*Results The average CT value in stent lumen of standard and detail reconstruction mode was (381 ± 71.53) and (380.75 ± 80), the difference was not statistically significant (P = 0. 443). The display rate of stent diameter in the two reconstruction modes was (33.00%± 9.56%) and (45.00% ± 10.23%), the display rate of stent diameter in detail reconstruction mode was higher than that in standard (P = 0. 000). The subjective scores of detail and standard reconstruction models were (2. 83 ± 0.43) and (3.37 ± 0.28), the subjective scores in detail reconstruction mode were significantly higher than those in standard (P = 0. 011).*Conclusions 256-row detector ultra high end CT in detail reconstruction mode can improve the image quality of coronary stent.*Clinical Relevance/Application 256-row detector CT in detail reconstruction mode can improve the image quality of coronary stent, and has important clinical application value in the evaluation of coronary stent image.

RESULTS

The average CT value in stent lumen of standard and detail reconstruction mode was (381 ± 71.53) and (380.75 ± 80), the difference was not statistically significant (P = 0. 443). The display rate of stent diameter in the two reconstruction modes was (33.00%± 9.56%) and (45.00% ± 10.23%), the display rate of stent diameter in detail reconstruction mode was higher than that in standard (P = 0. 000). The subjective scores of detail and standard reconstruction models were (2. 83 ± 0.43) and (3.37 ± 0.28), the subjective scores in detail reconstruction mode were significantly higher than those in standard (P = 0. 011).

CLINICAL RELEVANCE/APPLICATION

256-row detector CT in detail reconstruction mode can improve the image quality of coronary stent, and has important clinical application value in the evaluation of coronary stent image.

Abstract Archives of the RSNA, 2021

Sub-Events

IN02-A1   Radiomic P-hacking: Corrupting The Training/validation/test Split

Participants
Mishka Gidwani, BS, Cleveland, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Radiomic imaging literature frequently contains methodological flaws and inconsistencies that can inflate statistical significance. Specifically, the inadvertent leakage of information between training, validation and test splits can occur in many commonly used workflows. This study attempts to highlight these commonly observed methodological issues by assessing their prevalence and demonstrating their effect through spurious associations in randomly generated data.*Methods and Materials Random facsimile radiomic features are generated by synthetic minority over-sampling (SMOTE) two existing radiomic datasets, extracted from publicly available images: The Cancer Genome Atlas Low-Grade Glioma (TCGA-LGG) and MD Anderson Head and Neck Squamous Cell Carcinoma (HNSCC). In order to examine the effects of inconsistent Training/Validation/Test split, experiments on the Random Data are conducted using conventional machine learning (ML) models fit to data with and without a held-out test set. The effect of three kinds of data leakage were studied: harmonizing features and performing feature selection prior to splitting data, optimizing model hyperparameters using cross-validation of the full dataset, and selecting a final model using the "test" set. Additionally, a random sample of 25 radiomic publications published from 2017-2021 were reviewed for variations of this mistake.*Results We observe performance enhancement resulting from the three areas studied: p = 0.030, p = 0.120, and p = 0.002, respectively. In the subset of studies reviewed, we found these mistakes occurring in 60%, 24%, and 44% papers respectively. When compounded experimentally, these errors result in a 1.49x final performance enhancement.*Conclusions This study reports on the prevalence of common methodological errors in radiomics research and provides a checklist for a more rigorous evaluation for proposed radiomic studies, one that critically evaluates the statistical methodology for accidental leakage of information between training and test data sets.*Clinical Relevance/Application Radiomic studies that rely on flawed statistical methods overpromise the medical relevance of image-derived features. This poses a risk to the affected patient populations and hinders the progress of more discerning methods.

RESULTS

We observe performance enhancement resulting from the three areas studied: p = 0.030, p = 0.120, and p = 0.002, respectively. In the subset of studies reviewed, we found these mistakes occurring in 60%, 24%, and 44% papers respectively. When compounded experimentally, these errors result in a 1.49x final performance enhancement.

CLINICAL RELEVANCE/APPLICATION

Radiomic studies that rely on flawed statistical methods overpromise the medical relevance of image-derived features. This poses a risk to the affected patient populations and hinders the progress of more discerning methods.

IN02-A2   Deep Learning Detection Of Large Vessel Occlusion On CTA Head Using Small Datasets: Comparison Of 2D And 3D Neural Network Approaches

Participants
Paul Yi, MD, Baltimore, Maryland (*Presenter*) Consultant, FH Orthopedics SAS;Consultant, BunkerHill Health

PURPOSE

Deep learning methods to identify large vessel occlusion (LVO) on CTA of the head have been described using 2D and 3D convolutional neural networks (CNN). However, the relative advantages of one approach over the other has not been well established, particularly when using small datasets <1000 images described in prior work. Although 2D CNN transfer learning approaches have been well described in radiology, the use of 3D CNNs is less well established.The purpose of this study was to compare the performance of CNNs for detection of LVO on CTA of the head using 2D and 3D CNN transfer learning approaches on a relatively small dataset.*Methods and Materials Our dataset consisted of 876 single-phase CTAs of the head, of which 438 (50%) had a LVO (66.5% anterior circulation & 33.5% posterior circulation). Standard neuroimaging preprocessing was performed, including registration to template normal CT head and skull stripping.The images were divided at the patient level into 70/10/20% train/validation/test splits and used to train both 2D and 3D CNNs. For 2D CNNs, we created a single 2D RGB image for each CTA consisting of 3 non-overlapping maximum intensity projection (MIP) axial images spanning the brain. These 2D MIP 'slab' images were used to train a variety of 2D CNN classifiers pretrained on ImageNet for identification of LVO.For the 3D CNNs, we used the entire CTA volumes to train three different models: 1) ResNeXt-101 CNN pretrained on Jester video data (human hand gestures), 2) TenCent's MedicalNet CNN pretrained on body CT and MR images for segmentation, and 3) Stanford's PENet CNN pretrained for identification of pulmonary embolism on CTA of the chest.We evaluated CNN performance using AUC and statistically compared them using DeLong's parametric method. Grad-CAM heatmaps were generated to evaluate LVO localization ability of the CNNs.*Results The best performing 2D CNN was a ResNeXt-50 CNN, which achieved an AUC of 0.99. The 3D CNN approaches all achieved AUCs of 0.75 to 0.76 (p<0.001 for all compared to 2D CNN).Grad-CAM heatmaps showed that both 2D CNNs and 3D CNNs could appropriately localize LVOs (Figure 1), although less consistently for the 3D CNNs.*Conclusions Using a relatively small dataset of 876 CTA heads, a 2D CNN trained on 2D MIP images outperformed 3D CNNs trained on 3D CTA head volumes for the

detection of LVO. Although 3D CNNs more closely mimic a radiologist's visual search pattern for volumetric CTA data, in the setting of small amounts of data, 2D CNNs appear to have an advantage in performance at the expense of heavy image preprocessing to 'convert' 3D images into 2D MIP images.*Clinical Relevance/Application With relatively small imaging datasets of CTA head, 2D CNN approaches outperform 3D CNN approaches at the expense of heavy image preprocessing.

RESULTS

The best performing 2D CNN was a ResNeXt-50 CNN, which achieved an AUC of 0.99. The 3D CNN approaches all achieved AUCs of 0.75 to 0.76 ($p<0.001$ for all compared to 2D CNN).Grad-CAM heatmaps showed that both 2D CNNs and 3D CNNs could appropriately localize LVOs (Figure 1), although less consistently for the 3D CNNs.

CLINICAL RELEVANCE/APPLICATION

With relatively small imaging datasets of CTA head, 2D CNN approaches outperform 3D CNN approaches at the expense of heavy image preprocessing.

IN02-A3   Radibot, Instant Messaging Based Radiologist Decision Support

Participants
John Burns, BS, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

There is a clear need for human-machine interfaces supporting clinical decision support systems (CDSS) and radiologists. With respect to the variety of systems radiologists interact with, there is not a best fit for any solution presented in the literature. No currently implemented system can interact with a radiologist real-time in a desirable format. We propose a novel solution, developing a conversational agent (CA) capable of engaging clinicians with CDSS as an assistant using existing instant messaging (IM) systems supporting hospital communications.We develop a sample intervention using IM for CDSS. The User Acceptance of Information Technology: Toward a Unified View (UTAUT) framework was utilized to test radiologist acceptance of this intervention.H1: Radiologists business intent to use (BI) an IM based conversational agent, and is moderated by expected performance (PE), expected effort (EOU), anxiety (ANX), age, experience with general consumer/domain specific tools, attitude towards the system.H2: Radiologists attitude toward (AF) the IM based conversational agent is positive, and is moderated by factors in H1.*Methods and Materials Electronic survey of 98 radiologists at large academic health center. Partial Least Squares Structured Equation Modeling was utilized to investigate the relationship between constructs.*Results Within our sample group, we found that radiologists' have a BI and a positive AF towards this intervention. We found deviations from the standard UTAUT model, suggesting that clinical professional's acceptance of software tools differs from the standard user.*Conclusions The largest moderating factor for BI is PE. Development efforts for this intervention should focus on speed, reducing clinical stopping, and providing simple interventions. The second largest moderator is AF, which is strongly influenced by PE. EE is a weak moderating factor.*Clinical Relevance/Application Prior efforts argue that radiologist CDSS must be embedded in dictation software. We present an alternative to embedded CDSS in dictation. We have measured a high intent to use an IM based CDSS while still meeting expected capability requirements. The findings surrounding expected EOU and AF are novel. PE significantly outweighs other factors, and we anticipate that this is due to the clinical nature of radiologist's work. This suggests that burdens surrounding EOU and AF are less important to radiologists than clinical outcomes.

RESULTS

Within our sample group, we found that radiologists' have a BI and a positive AF towards this intervention. We found deviations from the standard UTAUT model, suggesting that clinical professional's acceptance of software tools differs from the standard user.

CLINICAL RELEVANCE/APPLICATION

Prior efforts argue that radiologist CDSS must be embedded in dictation software. We present an alternative to embedded CDSS in dictation. We have measured a high intent to use an IM based CDSS while still meeting expected capability requirements. The findings surrounding expected EOU and AF are novel. PE significantly outweighs other factors, and we anticipate that this is due to the clinical nature of radiologist's work. This suggests that burdens surrounding EOU and AF are less important to radiologists than clinical outcomes.

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Abstract Archives of the RSNA, 2021

Sub-Events

MK04-C1   **Magnetic Resonance Imaging Evaluation Of Osteochondral Allografts In The Knee Using The OCAMRISS Score**

Participants
Benjamin Tintaya, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To correlate Osteochondral Allograft MRI Scoring System (OCAMRISS) in patients undergoing Osteochondral Allograft (OCA) transplantation in the knee with clinical outcomes.*Methods and Materials A retrospective observational study was performed in our center of a cohort of 37 patients that underwent OCA transplantation in the knee from August 2017 to November 2019 and received a postoperative MRI nine months after. Clinical outcomes were evaluated. Correlation between the OCAMRISS and clinical outcomes was calculated using Spearman's correlation coefficients.*Results International Knee Documentation Committee (IKDC) total score was correlated with OCAMRISS cartilage score (? = 0.396, P = 0,015) and total score (? = 0.476, P = 0,003).Kujala score was correlated with OCAMRISS cartilage score (? = 0.339, P = 0,04) and total score (? = 0.467, P = 0,004).Western Ontario Meniscal Evaluation (WOMET) score was correlated with OCAMRISS ancillary score (? = 0.403, P = 0,013).No correlation was observed with Western Ontario Meniscal Evaluation (WOMET) score and OCAMRISS total score.No correlation was observed with Tegner activity score and OCAMRISS total score.*Conclusions The MRI scoring system (OCAMRISS) is a useful, objective, reproducible, and non-invasive monitoring tool for postoperative assessment after osteochondral allograft transplantation surgery.*Clinical Relevance/Application Osteochondral allograft transplantation is indicated for selected cases of cartilage injuries, especially in young patients with lesions that involve subchondral bone, resulting from a variety of pathologies including osteochondritis, traumatic articular fractures with substance loss, avascular necrosis, and focal cystic osteoarthritis. Therefore, is an increasingly available option for treating symptomatic osteochondral lesions.MRI is a non-invasive, objective, and reproducible monitoring tool for postoperative assessment after cartilage repair procedures. It can assess cartilage repair morphology, cartilage volume, peripheral integration, and subchondral bone changes. The present study showed that the OCAMRISS is a reliable scoring system to evaluate patients after osteochondral allograft transplantation.

RESULTS

International Knee Documentation Committee (IKDC) total score was correlated with OCAMRISS cartilage score (? = 0.396, P = 0,015) and total score (? = 0.476, P = 0,003).Kujala score was correlated with OCAMRISS cartilage score (? = 0.339, P = 0,04) and total score (? = 0.467, P = 0,004).Western Ontario Meniscal Evaluation (WOMET) score was correlated with OCAMRISS ancillary score (? = 0.403, P = 0,013).No correlation was observed with Western Ontario Meniscal Evaluation (WOMET) score and OCAMRISS total score.No correlation was observed with Tegner activity score and OCAMRISS total score.

CLINICAL RELEVANCE/APPLICATION

Osteochondral allograft transplantation is indicated for selected cases of cartilage injuries, especially in young patients with lesions that involve subchondral bone, resulting from a variety of pathologies including osteochondritis, traumatic articular fractures with substance loss, avascular necrosis, and focal cystic osteoarthritis. Therefore, is an increasingly available option for treating symptomatic osteochondral lesions.MRI is a non-invasive, objective, and reproducible monitoring tool for postoperative assessment after cartilage repair procedures. It can assess cartilage repair morphology, cartilage volume, peripheral integration, and subchondral bone changes. The present study showed that the OCAMRISS is a reliable scoring system to evaluate patients after osteochondral allograft transplantation.

MK04-C3   **Sonographic Finding Of Medial Ankle Subcutaneous Edema And Its Association With Posterior Tibial Tenosynovitis**

Participants
Kyle Dammeyer, MD, Detroit, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate if the sonographic finding of medial ankle subcutaneous (subQ) edema is associated with posterior tibial tenosynovitis (PTTS).*Methods and Materials Sonographic images of the medial ankle soft tissues from 40 patients with PTTS and 37 patients with a normal posterior tibial tendon (PTT) were randomized and independently evaluated by 2 musculoskeletal radiologists for the presence or absence of subQ edema. Both were blinded to the images and status of the PTT and the patient's history. The association between the presence or absence of medial ankle subQ edema and the presence or absence of PTTS was evaluated. Demographic comparisons of age and gender, in addition to body mass index and body weight were performed between those with PTTS and those with a normal PTT. Comparisons were done using chi-square tests for categorical data and 2-sided sample t-tests for numerical data. The sensitivity and specificity were calculated. Cohen Kappa statistics were used for inter-observer agreement. This sample size resulted in a statistical power of 99%.*Results A statistically significant association was seen for the presence of medial ankle subQ edema and PTTS among both radiologists' findings. Of the 40 patients with PTTS, 33 (82.5%) were found positive by the first radiologist for medial ankle subQ edema, while no subQ edema was found in 28 of the 37 (75.7%) patients with a normal PTT (P < 0.001). Similarly, the second radiologist found that 33 of the 40 (82.5%) with PTTS were positive for subQ edema, while

no subQ edema was found in 24 of the 37 (64.9%) patients with a normal PTT (P < 0.001). There was also substantial inter-observer agreement between the 2 radiologists (?-value = 0.79; 95% CI: 0.65, 0.93).*Conclusions A statistically significant association was present for the association of the sonographic finding of medial ankle subQ edema and the presence of PTTS. Further studies could evaluate if the sonographic finding of medial ankle subQ edema is an early predictor of PTT dysfunction, which if detected early could allow prompt intervention to prevent further complications and healthcare costs related to the progression of PTT dysfunction.*Clinical Relevance/Application The sonographic finding of medial ankle subcutaneous edema is significantly associated with the presence of posterior tibial tenosynovitis, an early indication of posterior tibial tendon dysfunction.

RESULTS

A statistically significant association was seen for the presence of medial ankle subQ edema and PTTS among both radiologists' findings. Of the 40 patients with PTTS, 33 (82.5%) were found positive by the first radiologist for medial ankle subQ edema, while no subQ edema was found in 28 of the 37 (75.7%) patients with a normal PTT (P < 0.001). Similarly, the second radiologist found that 33 of the 40 (82.5%) with PTTS were positive for subQ edema, while no subQ edema was found in 24 of the 37 (64.9%) patients with a normal PTT (P < 0.001). There was also substantial inter-observer agreement between the 2 radiologists (?-value = 0.79; 95% CI: 0.65, 0.93).

CLINICAL RELEVANCE/APPLICATION

The sonographic finding of medial ankle subcutaneous edema is significantly associated with the presence of posterior tibial tenosynovitis, an early indication of posterior tibial tendon dysfunction.

MK04-C4   Musculoskeletal Manifestations Of Covid-19: A Pictorial Review Of Currently Described Clinical Symptoms With Multimodality Imaging Correlations

Awards
Identified for RadioGraphics
Cum Laude

Participants
Imran M. Omar, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

Many patients with COVID-19 have experienced musculoskeletal symptoms that can linger for months after the initial respiratory syndrome has resolved. We aim to discuss emerging musculoskeletal manifestations of COVID-19 through diagnostic imaging cases and reviewing the proposed pathogenesis of these conditions. After viewing this exhibit, the learner should be able to: • Describe currently known musculoskeletal conditions associated with COVID-19. • Review the possible mechanisms that can lead to these conditions, which may help identify additional disease targets. • Discuss imaging findings that have been seen with these conditions. • Evaluate the future role of imaging in characterizing COVID-19 involvement in the musculoskeletal system.

TABLE OF CONTENTS/OUTLINE

I. Introduction- Impact of COVID-19 on the Musculoskeletal System II. Currently described musculoskeletal conditions associated with COVID-19, with emphasis on reported imaging findings III. Review of the general biochemical pathways present in COVID-19 patients that may result in multisystem involvement IV. Discussion of musculoskeletal conditions associated with COVID-19, including assessment of proposed pathogenesis and imaging examples: A. Peripheral neuropathies B. Myopathies C. Post-COVID reactive synovitis/arthritis D. Hypercoagulability and osteonecrosis E. Heterotopic ossification V. Potential future role of diagnostic imaging in detecting and characterizing sites of disease VI. Summary

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Abstract Archives of the RSNA, 2021

RI02-B

Reproductive Imaging Monday Poster Discussions

Sub-Events

RI02-B1   Fetal Weight Percentile Curves Are Significantly Skewed

Participants
Garvit Khatri, MBBS, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

Background: The fetal percentile is based on three parameters: estimated fetal weight, gestational age and ethnic growth charts. All the three parameters are prone to errors, and can overdiagnose growth retardation (IUGR) and macrosomia. However, weight percentiles are generally reported without any error. The calculation of error in fetal weight percentiles has never been assessed. In an attempt to do so, we reviewed the weight percentile distribution of all second and third trimester fetal US exams to determine what the error in weight percentile would be.Aims: Demonstrate that there is significant skew in the assessment of fetal weight percentiles towards the high and low ends of the distribution. This is a cause of false positive diagnoses of IUGR and macrosomia.*Methods and Materials After IRB approval the radiology information system data base was searched for all obstetrical US reports obtained during the late second and third trimesters from 7/1/2014 until 7/1/2020. Demographic information as well as fetal weight and weight percentile information were obtained from these reports and graphed. The resulting data was then integrated by the method of rectangles to determine the number and percent of fetuses 1 and 2 standard deviations from the mean. A graph showing the results if the expected weight percentile distributions were truly Gaussian versus what we actually observed were constructed. This process was repeated by dividing the data by gestational age at the time of the exam, and by ethnicity.*Results Demographic data:- Total:6259, White:3434, Black:403, Asian:91, Native American:499,Hispanics:29, Not available:1803. Mean age : 31.68 years. Distribution of fetal weight were skewed significantly at the tail ends. The graphs of observed to expected weight percentiles for all the data, and by gestational age and ethnicity also add the error.*Conclusions Fetal weight percentiles are significantly skewed at the tails and they should also be reported in a range, and the error should be documented so as to improve screening of such fetus. Mid third trimester ultrasound exams are the best time to evaluated fetal weight and weight percentile and perhaps these should not be reported earlier in gestation.*Clinical Relevance/Application The recognition of the large error associated with the assignment of weight percentile is very important in those clinical situations where the absolute weight and Dopplers suggest a healthy baby but an erroneous weight percentile suggest IUGR or macrosomia.Knowledge of which can potentially save them from overutilization of resources, interventions and reduce maternal stress.

RESULTS

Demographic data:- Total:6259, White:3434, Black:403, Asian:91, Native American:499,Hispanics:29, Not available:1803. Mean age : 31.68 years. Distribution of fetal weight were skewed significantly at the tail ends. The graphs of observed to expected weight percentiles for all the data, and by gestational age and ethnicity also add the error.

CLINICAL RELEVANCE/APPLICATION

The recognition of the large error associated with the assignment of weight percentile is very important in those clinical situations where the absolute weight and Dopplers suggest a healthy baby but an erroneous weight percentile suggest IUGR or macrosomia.Knowledge of which can potentially save them from overutilization of resources, interventions and reduce maternal stress.

RI02-B2   Radiomic Features Of Peritoneal Carcinomatosis On CECT Predict Overall Survival In Recurrent High Grade Serous Ovarian Cancer: Preliminary Findings

Participants
Sepideh Azarianpour Esfahani, Cleveland, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

High-grade serous carcinoma (HGSC) is the most common type of ovarian cancer. It presents in an advanced stage with peritoneal carcinomatosis and portends a poor prognosis despite surgical and medical therapeutic intervention. On CT scans, HGSC has a heterogeneous phenotype with no reliable imaging-based biomarkers to assess tumor aggression, biological behavior, predict disease recurrence, or predict survival following definitive therapy. We investigated texture-based radiomic features of bulky peritoneal lesions on contrast-enhanced CT (CECT) to help stratify patients with low and high-risk of survival.*Methods and Materials This was a single-institution retrospective review of CECT scans, histology data, and overall survival (OS) of HGSC patients from TCIA database, who were treated with cytoreductive surgery and/or platinum-based chemotherapy, but recurred with bulky peritoneal disease. Three separate 1cm regions of interest (ROI) from solid peritoneal deposits on CT scans of 18 patients were obtained and analyzed in consensus with a board-certified abdominal radiologist. Total 181 intratumoral radiomic textural features (raw (1), Gray (20), Haralick (65), Gabor (35), Laws (34), and CoLlAGe (26) features) were extracted from these ROIs. Four statistics (median, variance, kurtosis, and skewness) were applied on 181 pixel-wise radiomic features to construct 724 ROI-based features and the model is trained based on the LASSO Cox regression model.*Results The five most prognostic radiomic features were included in the Cox regression model and resulted in a radiomic risk score (RRS) representing textural heterogeneity inside the ROI, including one Gray feature, two Haralick, and two Gabor features. A threshold was obtained based on the RRS which successfully separated high

and low-risk patients in a cross-validation fashion validation set (p=0.0007, hazard ratio=3.80, 95% confidence interval= [1.76-8.23]).*Conclusions Radiomic features on CT scans of HGSC patients with recurrent peritoneal disease correlated with a low or high risk of survival. Validating these findings on an independent, multi-site test set is warranted. Further, a combination of radiomic features and histology-driven signatures can be a robust surrogate biomarker tool and may predict response to therapy.*Clinical Relevance/Application Radiomic features of peritoneal deposits on CECT scans of recurrent HGSC ovarian cancer patients could predict survival.

RESULTS

The five most prognostic radiomic features were included in the Cox regression model and resulted in a radiomic risk score (RRS) representing textural heterogeneity inside the ROI, including one Gray feature, two Haralick, and two Gabor features. A threshold was obtained based on the RRS which successfully separated high and low-risk patients in a cross-validation fashion validation set (p=0.0007, hazard ratio=3.80, 95% confidence interval= [1.76-8.23]).

CLINICAL RELEVANCE/APPLICATION

Radiomic features of peritoneal deposits on CECT scans of recurrent HGSC ovarian cancer patients could predict survival.

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Abstract Archives of the RSNA, 2021

Sub-Events

IN03-D1   Hip Knee Ankle Angle Prediction On Postoperative Radiographs By Using A Deep Learning Method

Participants
Shi Yan, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To predict Hip Knee Ankle Angle (HKAA) on post-operative full-limb radiographs of patients who underwent total knee arthroplasty (TKA) by using deep learning techniques.*Methods and Materials We retrieved postoperative full-limb radiographs of 1899 patients who underwent primary TKA at a single academic institution from January 2000 to August 2017. First, we annotated all full-limb radiographs and applied YOLOv3 to detect hip, knee and ankle areas. Second, we annotated the center of hip, knee and ankle and extracted the detected area from step one. Third, we resized the Region of Interest (RoI) with resolution of 512 x 512, and generated heatmaps from annotated coordinates by using Gaussian function. Fourth, we leveraged fine-tuned U-Net model to predict the heatmaps and then transformed the predicted heatmaps back to coordinates. Last, we calculated the HKAA and compared our prediction with annotation.*Results In the stage of U-Net prediction, full-limb radiographs were split into train, validation and test with 562, 187 and 188 images, respectively. We calculated the difference of the predicted HKAA and annotated HKAA and calculated the mean and standard deviation of the differences. Mean (standard deviation) of the difference between human-level and machine-level measurements was 0.645° (0.820). In 95% of the cases, the difference was smaller than 1.5°.*Conclusions We applied YOLOv3 model to detect hip, knee and ankle joints and fine-tuned U-Net model for HKAA prediction on full-limb radiographs. Our model could accurately and precisely predict center of hip, knee, and ankle joints and measure HKAA.*Clinical Relevance/Application This automated tool holds promise as a clinical application if integrated with radiology software.

RESULTS

In the stage of U-Net prediction, full-limb radiographs were split into train, validation and test with 562, 187 and 188 images, respectively. We calculated the difference of the predicted HKAA and annotated HKAA and calculated the mean and standard deviation of the differences. Mean (standard deviation) of the difference between human-level and machine-level measurements was 0.645° (0.820). In 95% of the cases, the difference was smaller than 1.5°.

CLINICAL RELEVANCE/APPLICATION

This automated tool holds promise as a clinical application if integrated with radiology software.

IN03-D2   Impact Of Image Processing On The Efficacy Of Deep Convolutional Neural Networks.

Participants
Paras Lakhani, MD, Media, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Assess the impact of different image processing methods on the accuracy of an artificial intelligence algorithm for pneumothorax assessment.*Methods and Materials A previously validated and published AI algorithm for pneumothorax detection on chest radiographs was used for this study. The algorithm had a specificity of 98.9% and sensitivity of 100.0% on a hold-out test set of 949 consecutive portable chest radiographs at an academic medical center. The algorithm was then assessed on 311 chest radiographs (161 pneumothorax, 150 normal) from another institution in a different country. The DICOM images from the external institution were preprocessed in four different ways, including two different types of contrast limited adaptive histogram equalization (CLAHE1, CLAHE2), and 8-bit PNGs and JPEGs without histogram equalization. The algorithm accuracy was then assessed on all four preprocessing methods.*Results The areas under the curve (AUCs) were 0.90, 0.92, 0.93, and 0.93 for CLAHE1, CLAHE2, PNG and JPEG respectively. The AUCs for the PNG and JPEG images were statistically significantly greater compared to CLAHE1 (P<0.008). No other significant differences were found for all other comparisons. In 38/311 cases (12.2%), there were discordant results among the different preprocessed images. Of the pneumothorax cases, there were 32/161 (19.9%) discordant results.*Conclusions The accuracy of the model was affected by the image processing method in some cases. There were discordant results in up to 20% of pneumothorax cases among the different processing methods.*Clinical Relevance/Application It is important to evaluate performance of a model using many different types of preprocessing techniques prior to clinical deployment.

RESULTS

The areas under the curve (AUCs) were 0.90, 0.92, 0.93, and 0.93 for CLAHE1, CLAHE2, PNG and JPEG respectively. The AUCs for the PNG and JPEG images were statistically significantly greater compared to CLAHE1 (P<0.008). No other significant differences were found for all other comparisons. In 38/311 cases (12.2%), there were discordant results among the different preprocessed images. Of the pneumothorax cases, there were 32/161 (19.9%) discordant results.

CLINICAL RELEVANCE/APPLICATION

It is important to evaluate performance of a model using many different types of preprocessing techniques prior to clinical

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Abstract Archives of the RSNA, 2021

Sub-Events

BR04-C1   Classification Of Axillary Lymph Nodes For Metastasis On Ultrasound Using Artificial Intelligence

Participants
Aylin Tahmasebi, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate an artificial intelligence (AI) system for the classification of metastatic disease within axillary lymph nodes on ultrasound.*Methods and Materials In this IRB approved study, ultrasound images of 317 axillary lymph nodes from patients referred for ultrasound guided fine needle aspiration or core needle biopsy and corresponding pathology findings were collected. Lymph nodes were classified into benign and malignant groups with histopathological results serving as the reference. Google Cloud AutoML Vision (Mountain View, CA) was used for AI image classification. Three experienced radiologists also classified the images and gave a suspicion score (1-5). To test the accuracy of AI, an external testing dataset of 64 images from 64 independent patients was evaluated by 3 AI models and the three readers. The diagnostic performance of AI and the humans were quantified using receiver operating characteristics curves.*Results In the complete set of 317 images, AutoML achieved a sensitivity of 77.1%, positive predictive value (PPV) of 77.1% and an area under the precision and recall curve of 0.78. Within the same dataset, the three radiologists showed a sensitivity of 87.8%±8.5%, specificity of 50.3%±16.4%, PPV of 61.1%±5.4%, negative predictive value (NPV) of 84.1%±6.6% and accuracy of 67.7%±5.7%. In the three external independent test sets, AI and human readers achieved a sensitivity of 74.0%±0.14 vs. 89.9%±0.06 (p=0.25), a specificity of 64.4%±0.11 vs. 50.1±0.20 (p=0.22), PPV of 68.3%±0.04 vs. 65.4±0.07 (p=0.50), NPV of 72.6%±0.11 vs. 82.1%±0.08 (p=0.33), and accuracy of 69.5%±0.06 vs. 70.1%±0.07 (p=0.90), respectively.*Conclusions These preliminary results indicate AI has comparable performance to trained radiologists and could potentially be used to predict the presence of metastasis in ultrasound images of axillary lymph nodes.*Clinical Relevance/Application A model using AutoML that relies solely on B-mode images appears promising for the prediction of benign vs. malignant axillary lymph nodes in patients with established or suspected breast cancer. Overall, the performance of this model was similar to that of experienced radiologists and encourages future AI model building and prospective validation.

RESULTS

In the complete set of 317 images, AutoML achieved a sensitivity of 77.1%, positive predictive value (PPV) of 77.1% and an area under the precision and recall curve of 0.78. Within the same dataset, the three radiologists showed a sensitivity of 87.8%±8.5%, specificity of 50.3%±16.4%, PPV of 61.1%±5.4%, negative predictive value (NPV) of 84.1%±6.6% and accuracy of 67.7%±5.7%. In the three external independent test sets, AI and human readers achieved a sensitivity of 74.0%±0.14 vs. 89.9%±0.06 (p=0.25), a specificity of 64.4%±0.11 vs. 50.1±0.20 (p=0.22), PPV of 68.3%±0.04 vs. 65.4±0.07 (p=0.50), NPV of 72.6%±0.11 vs. 82.1%±0.08 (p=0.33), and accuracy of 69.5%±0.06 vs. 70.1%±0.07 (p=0.90), respectively.

CLINICAL RELEVANCE/APPLICATION

A model using AutoML that relies solely on B-mode images appears promising for the prediction of benign vs. malignant axillary lymph nodes in patients with established or suspected breast cancer. Overall, the performance of this model was similar to that of experienced radiologists and encourages future AI model building and prospective validation.

BR04-C7   Impact Of Previous Exams Comparison In The Final Bi-rads Assessment In Screening Mammography

Participants
Eduardo F. Fleury, PhD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

To determine the impact of previous exams comparison in the final BI-RADS assessment in screening mammography. We compare the incidence of BI-RADS 0, 1 and 2, 3, 4, and 5 before and after comparison to the previous exam, focused in the category 0. We also compared the final assessment of 2 radiologists, one with 20 years of experience and the second with 5-year experience.*Methods and Materials Prospective observational study, from August-2020 to January-2021. 3.896 consecutive mammography was interpreted independently by 2 radiologists. The final BI-RADS assessment was given for mammography blinded to previous exams and after the previous exam comparison. We also compared the radiologist's final classification according to clinical practice experience.*Results A total of 3.656 patients forward to breast mammography were evaluated. 3.532 screening mammograms were included. The final BI-RADS classification for mammograms blinded to previous exams was as follows: 389 (11.02%), 3,017 (85.44%), 35 (0.99%), 87 (2.46%) and 3 (0.08%) for categories 0, 1 and 2, 3, 4 and 5 respectively. After previous exams comparison the results were as follows: 103 (2.92%), 3.311 (93.77%), 39 (1.10%), 75 (2.12%) and 3 (0.08%) for categories 0, 1 and 2, 3, 4 and 5 respectively.When compared the final assessment category of each reader independently, reader 1 classified the mammograms as: 91 (7,10%), 1.181 (92.19%), 2 (0.16%) and 7 (0.55%) for blinded mammograms and 0, 1.261 (98.44%), 6 (0.47%), 14 (1.09%) for mammograms after previous exams comparison for categories 0, 1 and 2, 3 and 4 respectively.Reader 2 classified the mammograms as: 194 (9.27%), 1.181 (87.52%), 27 (1.29%) and 40 (1.91%) for blinded mammograms and 1 (0.05%), 2.044 (97.71%), 26 (1.24%), 21 (1.00%) for mammograms after previous exams comparison for categories 0, 1 and 2, 3 and 4 respectively.*Conclusions Comparison to previous mammograms in patients' participants for breast cancer screening programs may reduce the number of BI-RADS category 0 final classification by 75%, and may reduce the number

of positive findings final classification, especially for the less experienced reader.*Clinical Relevance/Application The comparison to previous exams directly impacts the screening mammogram final classification, reduces complementary studies and costs, and improves the screening results.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

The comparison to previous exams directly impacts the screening mammogram final classification, reduces complementary studies and costs, and improves the screening results.

BR04-C8 Breast Density Associations With Tumour Characteristics Among Screen-detected And Interval Breast Cancers Diagnosed In A US Screening Setting

Participants
Stamatia Destounis, MD, Rochester, New York (*Presenter*) Medical Advisory Committee, Hologic, Inc;Medical Advisory Board, iCAD, Inc

PURPOSE

Few studies have looked at associations of automated mammographic density (MD) measures and breast tumour characteristics (TCs), in a US screening population. We investigated the associations between several risk factors, including MD and TCs, stratified by mode of detection (screen-detected cancers (SDs) vs interval cancers (ICs)).*Methods and Materials BC cases (n=2,484) that were diagnosed at our breast imaging clinic between 2009-2012, were identified. After exclusions (women missing raw images acquired in the prior screening interval (13 months), prior biopsy/surgery/breast cancer, implants, bilateral cases, women <40 y), the final dataset comprised of 318 SDs and 100 ICs. TCs and risk factor information were extracted from clinical records. Automated MD measures included quartiles (Q1-4) of volumetric breast density (VBD)/dense volume (DV)/breast volume (BV)/fat volumes (FV), and Volpara Density Grades (VDG), as well as visual BI-RADS. Non-parametric statistical analyses were used to compare associations between risk factors, stratified by SD/IC status and MD.*Results Overall VDG was found to have stronger associations with TCs compared with BI-RADS. For all cancers VDG was associated with HER2 status and tumour size >= 2 cm. After splitting the data by mode of detection, BI-RADS showed an association with tumour size for SDs only. DV was associated with T stage, size >=2 cm and grade 3 cancers. Larger breasts and higher FVs were associated with higher grade and ER negative cancers (p<0.5). Comparing BV Q3+4 vs BV Q1+2, there were 60% vs 40% high-grade cancers, respectively, and 53% vs 47% of ER negative cancers, respectively. For ICs, only FV was associated with prognostic features, where the proportion of women in FV Q1 was 12% and 27% for tumour sizes <2 cm and =2 cm, respectively (p<0.05).*Conclusions Compared to density categories (VDG and BI-RADS), volumetric measures of MD showed stronger associations with TCs associated with poor outcomes. When comparing SDs and ICs, this association was seen more so for SDs. Utilizing volumetric MD measures can aid in offering supplemental screening for women with dense breasts which can help reduce the impact of MD on TCs associated with poorer outcomes.*Clinical Relevance/Application Volumetric breast composition metrics are associated with poor prognostic features for both SD and ICs.

RESULTS

Overall VDG was found to have stronger associations with TCs compared with BI-RADS. For all cancers VDG was associated with HER2 status and tumour size >= 2 cm. After splitting the data by mode of detection, BI-RADS showed an association with tumour size for SDs only. DV was associated with T stage, size >=2 cm and grade 3 cancers. Larger breasts and higher FVs were associated with higher grade and ER negative cancers (p<0.5). Comparing BV Q3+4 vs BV Q1+2, there were 60% vs 40% high-grade cancers, respectively, and 53% vs 47% of ER negative cancers, respectively. For ICs, only FV was associated with prognostic features, where the proportion of women in FV Q1 was 12% and 27% for tumour sizes <2 cm and =2 cm, respectively (p<0.05).

CLINICAL RELEVANCE/APPLICATION

Volumetric breast composition metrics are associated with poor prognostic features for both SD and ICs.

BR04-C9 Potential Utility Of SPRMs As A Novel Approach For Contraception And Breast Cancer Risk Reduction; A Randomized Control Trial

Participants
Richard S. Ha, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Ulipristal acetate (UPA), is a selective progesterone receptor modulator (SPRM) currently being evaluated for daily contraception. Changes in MRI background parenchymal enhancement (BPE) with the menstrual cycle correlate with breast cell proliferation based on previous studies with Ki-67 analysis. The purpose of this study is to evaluate the effect of UPA on breast tissue proliferation measured by MRI-BPE to determine potential utility of SPRMs as a novel approach for contraception and breast cancer risk reduction.*Methods and Materials This IRB approved randomized control trial took place from 2016- 2020. We recruited volunteer women aged 18-39 with a BMI <35 kg/m2, and regular menstrual cycles. We defined ovulation as at least one progesterone of >3 ng/mL. Participants, who ovulated during the baseline cycle, underwent a baseline MRI about 8-12 days following the estimated ovulation date. At about day 76 after initiating treatment, participants returned for a second MRI and a progesterone level to evaluate ovulation during the last cycle. Breast MRI scans were performed with gadolinium contrast injection using a dedicated breast coil and 1.5 T magnet. Pre-contrast T1 and three post-contrast dynamic T1 fat-suppressed sagittal images were performed. The order and treatment assignment of the images were masked before analysis. RH analyzed the pairs of anonymized images for the degree of BPE using standard BI-RADS criteria. In addition, quantitative analysis was performed using our previously developed computer generated algorithm. All statistical significance levels quoted are 2-sided.*Results Forty-nine women signed consent and

26 women completed the study undergoing both the initial and post treatment MRI. In the UPA group, the median BPE declined statistically significantly from 2.5 to 1.0 (signed-rank test, p=0.005). In the COC group, the median BPE increased from 2.5 to 3.0, but this was not statistically significant (signed-rank test, p=0.093). The comparison of UPA versus COC results for on-treatment BPE stratified on baseline BPE showed a highly statistically significant greater decline in the UPA group compared to the COC group (ranksum test, p=0.001). Spearman correlation between BPE qualitative values and BPE quantitative values were significantly correlated both at pre-treatment (Rho = 0.66, P<0.001) and at post treatment (Rho = 0.75, P<0.001).*Conclusions The effect of daily 10 mg dose of UPA on breast tissue showed a significant decrease in breast cell proliferation measured by MRI-BPE in comparison to baseline, and to the effect of a commonly prescribed COC.*Clinical Relevance/Application A SPRM agent may lead to a novel approach for contraception and breast cancer risk reduction.

RESULTS

Forty-nine women signed consent and 26 women completed the study undergoing both the initial and post treatment MRI. In the UPA group, the median BPE declined statistically significantly from 2.5 to 1.0 (signed-rank test, p=0.005). In the COC group, the median BPE increased from 2.5 to 3.0, but this was not statistically significant (signed-rank test, p=0.093). The comparison of UPA versus COC results for on-treatment BPE stratified on baseline BPE showed a highly statistically significant greater decline in the UPA group compared to the COC group (ranksum test, p=0.001). Spearman correlation between BPE qualitative values and BPE quantitative values were significantly correlated both at pre-treatment (Rho = 0.66, P<0.001) and at post treatment (Rho = 0.75, P<0.001).

CLINICAL RELEVANCE/APPLICATION

A SPRM agent may lead to a novel approach for contraception and breast cancer risk reduction.

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VA03-A

Vascular Imaging Tuesday Poster Discussions

Sub-Events

VA03-A1   **4D Flow MR Imaging For Characterization Of Abdominopelvic Venous Flow In Pelvic Venous Disease**

Participants
Christine Boone, MD, PhD, San Diego, California (*Presenter*) Nothing to Disclose

PURPOSE

Pelvic venous disease can arise from multiple etiologies. Diagnosis by conventional CT, MRI, and ultrasound imaging can be challenging. 4D Flow MRI techniques provide flow and velocity data as well as anatomy, which could facilitate differentiation of pelvic venous disease etiologies and detection and localization of venous collaterals or reflux.*Methods and Materials With IRB approval and waiver of informed consent, we retrospectively reviewed clinically indicated abdominopelvic MRI/MRA 3T 750 MRI (GE Healthcare) in 39 patients. Patients were grouped according to clinical indications and/or imaging findings: no vascular abnormalities, left common iliac vein (LCIV) compression, gonadal reflux, left renal vein compression, and venous collaterals/reflux. 4D Flow analysis software (Arterys, San Francisco, CA) was used to measure blood flow and velocity at the right and left central common iliac veins (RCIV, LCIV), LCIV under the common iliac artery crossover (retro CIA LCIV), central inferior vena cava (IVC), and peripheral IVC.*Results Distinct patterns of blood flow were observed among different patient groupings. Notably, patients with LCIV compression had significantly greater mean net flow (mean ± SD, 0.68 ± 0.14) in their RCIV compared to patients lacking venous abnormality (0.44 ± 0.09). Net flow in the upper and lower infrarenal IVC was significantly increased in patients with LCIV compression and gonadal reflux compared to those without venous abnormality. Additionally, among patients with LCIV compression, flow in the retro CIA LCIV was decreased relative to the peripheral LCIV. Further, net flow in the retro CIA L CIV was decreased in patients with LCIV compression with imaging evidence of collaterals/reflux, relative to those with LCIV compression without collaterals/reflux.*Conclusions Abdominopelvic venous 4D Flow revealed hemodynamic significance of venous compression, which can manifest as flow diversion away from the area of stenosis. Increases in net flow along the IVC and decreased blood flow at the site of LCIV compression may be due to diversion by venous collaterals/reflux. Future aims include determination of the severity of flow diversion requiring intervention.*Clinical Relevance/Application Abdominopelvic venous 4D flow may facilitate differentiation of pelvic venous disease etiologies and identification of venous collaterals, which could help guide clinical decisions and interventions.

RESULTS

Distinct patterns of blood flow were observed among different patient groupings. Notably, patients with LCIV compression had significantly greater mean net flow (mean ± SD, 0.68 ± 0.14) in their RCIV compared to patients lacking venous abnormality (0.44 ± 0.09). Net flow in the upper and lower infrarenal IVC was significantly increased in patients with LCIV compression and gonadal reflux compared to those without venous abnormality. Additionally, among patients with LCIV compression, flow in the retro CIA LCIV was decreased relative to the peripheral LCIV. Further, net flow in the retro CIA L CIV was decreased in patients with LCIV compression with imaging evidence of collaterals/reflux, relative to those with LCIV compression without collaterals/reflux.

CLINICAL RELEVANCE/APPLICATION

Abdominopelvic venous 4D flow may facilitate differentiation of pelvic venous disease etiologies and identification of venous collaterals, which could help guide clinical decisions and interventions.

Abstract Archives of the RSNA, 2021

IR03-B

Interventional Radiology Tuesday Poster Discussions

Sub-Events

IR03-B1   Comparison Of Intrahepatic Progression Patterns Of Hepatocellular Carcinoma And Colorectal Liver Metastases Following CT-guided High Dose-rate Brachytherapy

Participants
Robin Schmidt, Berlin, Germany (*Presenter*) Travel support, Berliner Krebsgesellschaft e.V.;Traval Grant, German Roentgen Society;Traval Grant, Rolf W. Günter Foundation for Radiological Sciences

PURPOSE

Given the metachronous and multifocal occurrence of hepatocellular carcinoma (HCC) and colorectal cancer metastases in the liver (CRLM), this study aimed to compare intrahepatic progression patterns after CT-guided high dose-rate brachytherapy.*Methods and Materials This retrospective analysis included 164 patients (114 HCC, 50 CRLM) treated with brachytherapy between 01/2016 and 01/2018. Patients received multiparametric MRI before and about 8 weeks after brachytherapy, then every 3 months for the first and every 6 months for the following years until progression or death. MRI scans were assessed for local or distant intrahepatic tumor progression according to RECIST 1.1 and electronic medical records were reviewed prior to therapy. The primary endpoint was progression-free survival (PFS). Specifically, local and distant intra-hepatic PFS were assessed to determine differences between the intrahepatic progression patterns of HCC and CRLM. Secondary endpoints included the identification of predictors of PFS, time to progression (TTP), and overall survival (OS). Statistics included Kaplan-Meier analysis and univariate and multivariate Cox regression modeling.*Results PFS was longer in HCC (11.30 (1.33-35.37) months) than in CRLM patients (8.03 (0.73-19.80) months, p=0.048), respectively. Specifically, local recurrence occurred later in HCC (PFS:36.83 (1.33-40.27) months) than CRLM patients (PFS:12.43 (0.73-21.90) months, p=0.001). On the contrary, distant intrahepatic progression occurred earlier in HCC (PFS:13.50 (1.33-27.80) months) than in CRLM patients (PFS:19.80 (1.43-19.80) months, p=0.456) but without statistical significance. Multivariate Cox regression confirmed tumor type and patient age as independent predictors for PFS.*Conclusions Brachytherapy proved to achieve better local tumor control and overall PFS in patients with unresectable HCC than CRLM. However, distant progression preceded local recurrence in HCC.*Clinical Relevance/Application These findings may help design disease-specific surveillance strategies and personalized treatment planning that highlight the strengths of brachytherapy and elucidate the potential benefits of combinations with other loco-regional or systemic therapies.

RESULTS

PFS was longer in HCC (11.30 (1.33-35.37) months) than in CRLM patients (8.03 (0.73-19.80) months, p=0.048), respectively. Specifically, local recurrence occurred later in HCC (PFS:36.83 (1.33-40.27) months) than CRLM patients (PFS:12.43 (0.73-21.90) months, p=0.001). On the contrary, distant intrahepatic progression occurred earlier in HCC (PFS:13.50 (1.33-27.80) months) than in CRLM patients (PFS:19.80 (1.43-19.80) months, p=0.456) but without statistical significance. Multivariate Cox regression confirmed tumor type and patient age as independent predictors for PFS.

CLINICAL RELEVANCE/APPLICATION

These findings may help design disease-specific surveillance strategies and personalized treatment planning that highlight the strengths of brachytherapy and elucidate the potential benefits of combinations with other loco-regional or systemic therapies.

IR03-B3   The Role Of Blood Pressure In Risk Of Hematoma Following Renal Biopsy: A Retrospective Study

Participants
Jesse Schwalb, Bronx, New York (*Presenter*) Nothing to Disclose

PURPOSE

Post-procedure hematoma is a common complication after percutaneous renal biopsy. Various risk factors exist for this complication. The goal of this paper is to evaluate the role of pre-procedure blood pressure (BP) as it relates to increased risk of bleeding following percutaneous renal biopsy.*Methods and Materials We performed a retrospective review of 473 patients who underwent renal biopsy procedures over a ten-year period between May 2008 and May 2018. The patients were classified based on the presence or absence of a hematoma as noted by post procedure imaging. Patients with hematomas were additionally subdivided into small, medium or large hematomas, per chart review. Student's t-tests were performed to determine if there was a significant difference in pre-procedure mean arterial pressure (MAP), systolic blood pressure (SBP), diastolic blood pressure (DBP), or hematocrit between hematoma and non-hematoma patients. Tests were also performed to determine significant differences between groups of patients with medium/large hematoma from small/no hematoma.*Results 473 patients were included in this study. 136 (28.8%) had a post-procedure hematoma based on physician notes. 51 (10.8%) patients had a medium or large hematoma. The presence of a hematoma was further substantiated by determining the average reduction in hematocrit between the two groups. Hematoma patients had an average post-procedure reduction in hematocrit of -3.02%±3.33 while non-hematoma patients had an average reduction of -1.89%±2.34, with a p-value of 0.03. In the comparison of hematoma versus non-hematoma patients, our analysis found statistically significant differences in pre-procedure MAP [101.2±13.7 mmHg vs 98.2±14.4, p=0.0368] and DBP [81.9±14.0 mmHg vs 78.0±14.4, p = 0.0072]. MAP was also found to be significantly different between small/no hematoma patients and medium/large hematoma patients [103.15±14.6 mmHg vs 98.5±14.1, p = 0.0379].*Conclusions Elevated MAP and DBP is associated with an increased risk of post-procedure hematoma following renal biopsy. Our results suggest that management of

blood pressure pre-procedure and intra-procedure may reduce risk of hematoma post-procedure. Future clinical studies are necessary to evaluate the proper approach for these high-risk patients, including pre-operative artificial lowering of BP when necessary.*Clinical Relevance/Application Post-operative hematoma is a common complication of renal biopsy procedures. However, there exists little data on risk factors for this complication. Our results suggest that management of blood pressure pre-procedure and intra-procedure may reduce risk of hematoma post-procedure.

RESULTS

473 patients were included in this study. 136 (28.8%) had a post-procedure hematoma based on physician notes. 51 (10.8%) patients had a medium or large hematoma. The presence of a hematoma was further substantiated by determining the average reduction in hematocrit between the two groups. Hematoma patients had an average post-procedure reduction in hematocrit of -3.02%±3.33 while non-hematoma patients had an average reduction of -1.89%±2.34, with a p-value of 0.03. In the comparison of hematoma versus non-hematoma patients, our analysis found statistically significant differences in pre-procedure MAP [101.2±13.7 mmHg vs 98.2±14.4, p=0.0368] and DBP [81.9±14.0 mmHg vs 78.0±14.4, p = 0.0072]. MAP was also found to be significantly different between small/no hematoma patients and medium/large hematoma patients [103.15±14.6 mmHg vs 98.5±14.1, p = 0.0379].

CLINICAL RELEVANCE/APPLICATION

Post-operative hematoma is a common complication of renal biopsy procedures. However, there exists little data on risk factors for this complication. Our results suggest that management of blood pressure pre-procedure and intra-procedure may reduce risk of hematoma post-procedure.

IR03-B4   Facet Joint US Guided Radiofrequency Ablation A Feasibility Study

Participants
Stefano Marcia, MD, Cagliari, Italy (*Presenter*) Consultant, Techlamed Srl;Consultant, Spineart;Consultant, Stryker Corporation;

PURPOSE

Imaging guided radiofrequency ablation (RFA) of medial branches is generally followed by a long lasting therapeutic efficacy in patient with lumbar facet joints syndrome (LFJ). CT or fluoroscopic guidance are commonly used for RFA. The aim of the present study was to evaluate the feasibility of RFA under ultrasonography (US) guidance and the clinical outcome.*Methods and Materials 28 patients (7 male, 21 female, age range 32-78) with double positive block test and medical or physical therapy failure were enrolled in the present study; exclusion criteria were in patients responsive to medical and physical therapy over a period <6 months. A written informed consent was obtained from all the patients. The ablation was performed for 3 minutes at 90° Celsius with an average time of 20 minutes in-room time. Visual analog scale (VAS) score and clinical evaluation has been performed before, 1 and 3 months after procedure. Technical success was define as correct placement of RFA needle at the level of the selected zygapophyseal joint joint evaluated with US and optimal response to sensory/motor stimulation.*Results The technical success was reached in all patients. No major or minor complications related to procedure were registered; all patents were discharged after a mean time of 3 hours. In 12 patients the RFA was performed at both sides and in 3 levels in the same session. All patients showed relevant improvement in symptoms with preoperatively mean VAS score of (8) dropped to (5) after 1 month and to (2) within 3 months*Conclusions RFA under US guidance can be effective and safe in patients with LFJ syndrome with positive block test without radiation exposure.*Clinical Relevance/Application The US guided RFA of medial brach has been demonstrated to be feasible Further studies on same topic would be highly desirable to investigate the possible role of US guidance in RFA in comparison with CT or fluoroscopic guidance.A cost analysis could be highly desirable to evaluate the economic impact of this procedure

RESULTS

The technical success was reached in all patients. No major or minor complications related to procedure were registered; all patents were discharged after a mean time of 3 hours. In 12 patients the RFA was performed at both sides and in 3 levels in the same session. All patients showed relevant improvement in symptoms with preoperatively mean VAS score of (8) dropped to (5) after 1 month and to (2) within 3 months

CLINICAL RELEVANCE/APPLICATION

The US guided RFA of medial brach has been demonstrated to be feasible Further studies on same topic would be highly desirable to investigate the possible role of US guidance in RFA in comparison with CT or fluoroscopic guidance.A cost analysis could be highly desirable to evaluate the economic impact of this procedure

IR03-B5   Role Of Embolization In Acquired Uterine Vascular Malformations: A Single Centre Study In India

Participants
Sunanda Nimmalapudi, MBBS, Velangi, India (*Presenter*) Nothing to Disclose

PURPOSE

To determine the efficacy of Uterine Artery Embolization in patients with bleeding acquired uterine arteriovenous malformations (AVMs).*Methods and Materials A prospective review of all patients who underwent Uterine Artery Embolization at our institution between July 2012 and December 2020 was performed. 225 patients were diagnosed with a uterine vascular malformation on doppler and corresponding MRI imaging. Serial ß-human chorionic gonadotropin levels were measured to exclude gestational trophoblastic neoplasia. All patients underwent transcatheter embolization of the uterine arteries. Embolizations were performed with use of standard 5 F Robert's Uterine catheter and 2.7 F Progret microcatheter when necessary. Embolic agents in the 375 procedures included glue only (n = 326), polyvinyl alcohol (PVA) particles and glue (n = 29), PVA particles (n = 5), Gelfoam (n = 5), coils (n = 4), PVA particles and coils (n = 3), glue and Gelfoam (n = 2), and glue and coils (n = 1). Outcomes assessed were cessation of bleeding, persistence or resolution of the AVM, complications and pregnancy after embolization. These were assessed by chart, laboratory and imaging reviews.*Results A total of 375 embolization procedures were performed in 225 patients. 90 patients required repeat embolization (14 patient underwent embolization on six occasions; 76 patients had two embolization procedures each) for recurrence of bleeding. 240 procedures were performed on an elective basis and 35 were performed on an emergent basis. The technical success rate of embolization was 100%. The clinical success rate was 92%: bleeding was controlled in 222 of 225 patients and three patients underwent a hysterectomy. 60 of the 225 patients had uneventful intrauterine pregnancies carried to term. The 210 patients who underwent successful embolization had no recurrence of bleeding at a median follow-up of 53 months (range, 5-122 months) after treatment. 15 patients were eventually lost to follow-up. One minor complication (0.4%) of non-flow-limiting dissection of the internal iliac artery occurred.*Conclusions Uterine Artery Embolization is a

safe and effective treatment for acquired AVMs. This procedure allows for preservation of uterine function with the possibility of future pregnancy and should be considered as a primary treatment option.*Clinical Relevance/Application Uterine Artery Embolization is a safe, effective, and minimally invasive method to treat uterine AVMs with long-term efficacy, which can provide the preservation of fertility.

RESULTS

A total of 375 embolization procedures were performed in 225 patients. 90 patients required repeat embolization (14 patient underwent embolization on six occasions; 76 patients had two embolization procedures each) for recurrence of bleeding. 240 procedures were performed on an elective basis and 35 were performed on an emergent basis. The technical success rate of embolization was 100%. The clinical success rate was 92%: bleeding was controlled in 222 of 225 patients and three patients underwent a hysterectomy. 60 of the 225 patients had uneventful intrauterine pregnancies carried to term. The 210 patients who underwent successful embolization had no recurrence of bleeding at a median follow-up of 53 months (range, 5-122 months) after treatment. 15 patients were eventually lost to follow-up. One minor complication (0.4%) of non-flow-limiting dissection of the internal iliac artery occurred.

CLINICAL RELEVANCE/APPLICATION

Uterine Artery Embolization is a safe, effective, and minimally invasive method to treat uterine AVMs with long-term efficacy, which can provide the preservation of fertility.

IR03-B6 **Intramuscular Imaging-guided Botulinum Toxin Injection Prior To Complex Abdominal Hernia Repair: Technique And Patient Outcomes**

Participants
Albert Jiao, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Large incisional or primary ventral hernias have up to a 24-54% recurrence rate following repair. Recurrences are due to high BMI, tension at first surgery, or mesh complications including surgical site infections. The most common technique to reduce tension of repair involves myofascial release. The injection of botulinum toxin into the musculature of the abdominal wall causes flaccid muscle paralysis and has been shown to reduce muscle tension and intraabdominal pressure facilitating adequate closure of hernia defects. The purpose of this study is to evaluate the safety and efficacy of pre-surgical image-guided botulinum toxin in complex abdominal hernia repair.*Methods and Materials An IRB approved retrospective cohort study was performed on all patients who underwent intramuscular botulinum toxin injection from July 2018-March 2021. Patient demographic data, procedural details, and surgical outcomes were collected and analyzed. For each procedure, diluted Botulinum toxin serotype A was injected under CT-guidance into the abdominal wall musculature. Bilateral injections using a 22G spinal needles were performed at three levels (superior, middle, inferior) along the anterior axillary line between the costal margin and a point anterior to the anterior superior iliac spine. At each site, the external oblique, internal oblique, and transversalis muscles were targeted so each muscular layer received the toxin dose: 8 mL per muscle (2 units/mL 0.9% normal saline), totaling 24mL per site. The full toxin dose is 144 mL (288 units).*Results A total of 32 patients received botulinum toxin injections prior to surgical hernia repair over the study period. The average BMI was 32. Twenty were male and twelve were female. Mean procedure time was 47 minutes, and mean radiation dose was 1019 mGy-cm2. Mean time between toxin administration and surgery was 36 days, and the average abdominal hernia defect size as measured in the long axis was 19 cm. There were no complications during toxin administration, and procedural success for both injections and herniorrhaphy was 100%.*Conclusions Botulinum toxin injection prior to complex abdominal hernia repair facilitates surgical closure. Interventional radiologists can perform this procedure safely and with a high rate of technical success.*Clinical Relevance/Application Imaging-guided botulinum toxin injection by interventional radiologists is a minimally invasive, low risk, and highly successful procedure that facilitates successful surgical repair.

RESULTS

A total of 32 patients received botulinum toxin injections prior to surgical hernia repair over the study period. The average BMI was 32. Twenty were male and twelve were female. Mean procedure time was 47 minutes, and mean radiation dose was 1019 mGy-cm2. Mean time between toxin administration and surgery was 36 days, and the average abdominal hernia defect size as measured in the long axis was 19 cm. There were no complications during toxin administration, and procedural success for both injections and herniorrhaphy was 100%.

CLINICAL RELEVANCE/APPLICATION

Imaging-guided botulinum toxin injection by interventional radiologists is a minimally invasive, low risk, and highly successful procedure that facilitates successful surgical repair.

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Abstract Archives of the RSNA, 2021

> ## CH03-A
>
> ## Chest Tuesday Poster Discussions

Sub-Events

CH03-A3   Interval Change Detection Of Multiple Abnormalities From Serial Chest Radiographs Using Convolutional Neural Network

Participants
Ju Nam, MD, Seoul, Korea, Republic Of (*Presenter*) Research grant from VUNO.

PURPOSE

To develop and validate a deep learning algorithm detecting interval changes (IC) from serial chest radiographs, focusing on pneumothorax, consolidation, and pleural effusion.*Methods and Materials Deep learning algorithm detecting IC of pneumothorax, consolidation, and pleural effusion (DLAD-IC) was developed using previously reported convolutional neural network developed to detect and localize multiple abnormalities using 224,268 radiographs (DLAD). By combining DLAD and lung segmentation algorithm, DLAD-IC calculates the localized area of each abnormality divided by total lung area. From the values driven from serial radiographs, decision for IC was made. To check feasibility and set thresholds of DLAD-IC, calibration datasets was prepared and labeled (n= 104-177 pairs for three abnormalities). A temporally split validation set was collected separately for pneumothorax (n= 100 pairs), consolidation (n= 114 pairs), and pleural effusion (n= 126 pairs). For clinical validation, two independent datasets were prepared and labeled: paired serial radiographs from 151 consecutive patients showing post-procedural pneumothorax after percutaneous lung biopsy (PCNB dataset; all PA) and those from 73 consecutive patients admitted to manage PCR-confirmed COVID-19 pneumonia (COVID dataset; all AP). The performance in detecting IC for each abnormality of DLAD-IC was evaluated in terms of AUROCs. Sensitivities and specificities of DLAD-IC to detect IC was evaluated for each side (left/right) and compared with those of radiologic formal reports using generalized estimating equations.*Results DLAD-IC showed AUROCs of 0.946 (pneumothorax), 0.898 (consolidation), and 0.804 (pleural effusion) in detecting IC on validation datasets. On PCNB dataset, DLAD-IC showed AUROC of 0.952 in detecting IC of post-procedural pneumothorax, exhibiting significantly higher sensitivity (79.6% [86/108] vs. 59.3% [64/108]; P<.001) and similar specificity (94.3% [183/194] vs. 93.3% [181/194]; P= .82) than radiologic formal reports. On COVID-19 dataset, DLAD-IC showed AUROC of 0.792 in detecting aggravation/improvement of consolidation. It showed substantially higher sensitivity than formal reports (71.4% [35/49] vs. 30.6% [15/49]; P< .001), but demonstrated lower specificity (71.1% [69/97] vs. 92.8% [90/97]; P<.001).*Conclusions DLAD-IC showed high performance in detecting IC of three abnormalities. It showed substantially higher sensitivities than formal radiologic reports in detecting serial change of pneumothorax after PCNB and consolidation of COVID-19 patients.*Clinical Relevance/Application By providing IC information of the abnormalities, DLAD-IC may help provide more accurate and early reporting for clinically urgent radiographs.

RESULTS

DLAD-IC showed AUROCs of 0.946 (pneumothorax), 0.898 (consolidation), and 0.804 (pleural effusion) in detecting IC on validation datasets. On PCNB dataset, DLAD-IC showed AUROC of 0.952 in detecting IC of post-procedural pneumothorax, exhibiting significantly higher sensitivity (79.6% [86/108] vs. 59.3% [64/108]; P<.001) and similar specificity (94.3% [183/194] vs. 93.3% [181/194]; P= .82) than radiologic formal reports. On COVID-19 dataset, DLAD-IC showed AUROC of 0.792 in detecting aggravation/improvement of consolidation. It showed substantially higher sensitivity than formal reports (71.4% [35/49] vs. 30.6% [15/49]; P< .001), but demonstrated lower specificity (71.1% [69/97] vs. 92.8% [90/97]; P<.001).

CLINICAL RELEVANCE/APPLICATION

By providing IC information of the abnormalities, DLAD-IC may help provide more accurate and early reporting for clinically urgent radiographs.

CH03-A4   Developing Robust Chest X-ray Models With Less Data

Participants
Andrew Sellergren, San Francisco, California (*Presenter*) Employee, Alphabet Inc;Stockholder, Alphabet Inc

PURPOSE

Developing deep learning (DL) models for radiology can be limited by the large numbers of images and labels required. Transfer learning is an effective mitigating strategy: a network is pretrained on a large dataset (often non-medical), then finetuned on a smaller, task-specific radiology dataset. In previous work, this finetuning only covered a few conditions while still requiring >100K images and extensive human and compute resources. Here, we investigate reducing these requirements with transfer learning from Supervised Contrastive (SupCon) pretraining, combining contrastive learning with supervised learning using higher-level, easy-to-obtain labels of abnormal vs. normal to improve performance on low-data clinical classification tasks for chest x-rays (CXR).*Methods and Materials We pretrain 2 DL model architectures (EfficientNet-B7 and ResNet-BiT 101x3) on 821,544 CXRs from India and US and abnormal vs. normal labels extracted from radiology reports. We finetune the network on 8 downstream tasks (airspace opacity, pneumothorax, consolidation, pleural effusion, pulmonary edema, fracture, tuberculosis (TB), and COVID-19 outcomes) using 5 datasets comprising 684,955 CXRs from India, US, and Europe, and evaluate using 3 heldout datasets from Zambia and US. As a baseline, we finetune directly from networks pretrained on non-medical datasets (ImageNet and JFT-300M). Finally, we compare retraining the network end-to-end vs. training small linear/nonlinear models (multilayer perceptrons, MLPs) on frozen embeddings. We simulate low-data settings using stratified random samples of labeled datasets.*Results SupCon

consistently improved AUROC (by 0.046—0.090) on downstream tasks across a range of training data amounts (from 64 to 32,768+ images), reducing label requirements by orders of magnitude. At the extreme low-data regime, training small linear models on frozen embeddings using only 64 CXRs yielded an AUROC of 0.82 (non-inferior to radiologist performance) in classifying microbiology-confirmed TB in an external validation set. At a more moderate data regime, SupCon followed by finetuning the network end-to-end using only 490 CXRs at hospital admission yielded an AUROC of 0.80 in predicting ICU admission for COVID-19 inpatients.*Conclusions SupCon enabled performance comparable to state-of-the-art DL models in multiple clinical tasks using as few as 64 images. This is a promising method for predictive modeling using small datasets and for predicting outcomes in shifting patient populations.*Clinical Relevance/Application Training label-efficient models is useful in cases of constrained computational resources, limited data, or distribution shifts, as with COVID-19, where populations and treatments change quickly.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Training label-efficient models is useful in cases of constrained computational resources, limited data, or distribution shifts, as with COVID-19, where populations and treatments change quickly.

CH03-A5   Artificial Intelligence Enhances Time Efficiency In Reading Chest CT Scans - A Randomized Prospective Study

Participants
Basel Yacoub, MD, Charleston, South Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To determine the impact of incorporating an artificial intelligence (AI) support platform into clinical radiology workflows on chest CT reading times by radiologists at an academic cardiothoracic practice.*Methods and Materials In this prospective study, reading times for chest CT scans by 3 board certified cardiothoracic radiologists were assessed. AI-Rad Companion Chest CT (Siemens Healthineers, Erlangen, Germany), an AI support platform was utilized. It comprising of modules for assessment of pulmonary hypodensity, pulmonary nodules, coronary calcifications, the thoracic aorta and the thoracic spine. The availability of AI results on the institutional picture archiving and communication system, for review by the reading radiologists, was randomized by the CT technologists. Consecutive contrast and non-contrast CT scans were enrolled and each reader was assigned an equal number of cases with and without AI results. Reading times were measured by the radiologists beginning after the cases have been loaded on the reporting workstations and ending prior to dictation. Cases that involved reading interruptions e.g. phone calls were excluded.*Results A total of 390 chest CT scans were included and allocated equally to the AI and non-AI assisted arms. Mean age of patients was 62.8 ± 13.3 years with 52.3 % females. Mean reading time of the radiologists was shorter in the AI arm by 92.9 seconds (s) with 95 % CI: 62.9 - 123.0 s. This accounted for a mean reduction of 22.1 % with 95 % CI: 14.9 - 29.2 % when compared to the mean non-AI reading time (AI: 328.2 ± 122.0 s; non-AI: 421.1 ± 175.0 s; p-value <0.001). This pattern of shorter mean reading times on utilizing results from the AI support platform was observed on non-contrast scans (AI: 325.1 ± 100.7 s; non-AI: 428.7 ± 173.3 s; difference: 24.2 %; p-value <0.001), as well as contrast scans (AI: 331.0 ± 139.2 s; non-AI: 413.6 ± 177.1 s; difference: 20.0 %; p-value <0.001).*Conclusions There was a mean reduction of 22.1 % in reading time of contrast and non-contrast chest CT scans by cardiothoracic radiologists when results from an AI support platform were made available to the readers.*Clinical Relevance/Application The incorporation of AI support platforms into clinical radiology workflows may increase reading efficiency for radiologists and reduce turnaround times for reports.

RESULTS

A total of 390 chest CT scans were included and allocated equally to the AI and non-AI assisted arms. Mean age of patients was 62.8 ± 13.3 years with 52.3 % females. Mean reading time of the radiologists was shorter in the AI arm by 92.9 seconds (s) with 95 % CI: 62.9 - 123.0 s. This accounted for a mean reduction of 22.1 % with 95 % CI: 14.9 - 29.2 % when compared to the mean non-AI reading time (AI: 328.2 ± 122.0 s; non-AI: 421.1 ± 175.0 s; p-value <0.001). This pattern of shorter mean reading times on utilizing results from the AI support platform was observed on non-contrast scans (AI: 325.1 ± 100.7 s; non-AI: 428.7 ± 173.3 s; difference: 24.2 %; p-value <0.001), as well as contrast scans (AI: 331.0 ± 139.2 s; non-AI: 413.6 ± 177.1 s; difference: 20.0 %; p-value <0.001).

CLINICAL RELEVANCE/APPLICATION

The incorporation of AI support platforms into clinical radiology workflows may increase reading efficiency for radiologists and reduce turnaround times for reports.

CH03-A6   Clinical Performance Of A Deep Learning Based Artificial Intelligence Model For Endotracheal Tube (ETT) Detection, Localization And Automated Measurement On Frontal Chest X-rays

Participants
Alec Baenen, Waukesha, Wisconsin (*Presenter*) Employee, General Electric Company

PURPOSE

Up to 45% of ICU patients, including severe COVID-19 cases, receive endotracheal intubation for ventilation. As many as 1 of 4 intubations result in mispositioned ETTs which may lead to severe complications. Technologies which aid in ETT positioning assessment and bring awareness to potentially misplaced ETTs can be clinically valuable and lifesaving. This study investigates the clinical performance of a deep learning model trained for ETT detection, localization, and automated measurement on 30,000 independent chest X-rays.*Methods and Materials A diverse, enriched, and clinically challenging dataset of 635 AP chest X-ray images was reviewed by two expert annotators to determine the presence of an ETT, ETT tip location, and carina location among other image characteristics. Inferencing on this dataset was then performed using a commercially available, deep learning-based AI algorithm.*Results The model achieved an AUC of 0.9999 (0.9998, 1.0000), a sensitivity of 0.9941 (0.9859, 1.0000), and a specificity of 1.0000 (1.0000, 1.0000) for ETT detection. Additionally, the model achieved an ETT tip to Carina distance measurement success rate to within 1cm of 0.9405 (0.9152, 0.9658), a carina localization success rate to within 1cm of 0.9762

(0.9599, 0.9925), an ETT tip localization success rate to within 1cm of 0.9643 (0.9444, 0.9841) and an ETT localization success rate (DICE) of 0.9881 (0.9765, 0.9997). Model ability to accurately distinguish an ETT from a tracheostomy tube (TTT) or nasogastric tube (NGT) and model performance in the presence obscured carinas and technically difficult images was also assessed. Results showed that the model maintained high accuracies for ETT detection (sensitivity and specificity above 99%) and for ETT tip and carina localization (Accuracies above 94.7%) for all local disturbing factors listed above. The model also showed a highly accurate mean distance error of only 0.58mm and absolute distance error of 3.74mm as compared to the ground truth ETT tip to carina distance.*Conclusions This ground truth analysis demonstrates that the ETT model shows very high accuracies in ETT detection, localization of ETT tip and carina, and in calculation of vertical distance between the them. The model also retains consistently high performance across various local disturbing factors within the dataset such as the presence of TTTs or NGTs, images with high technical difficulty or difficult visibility of the carina.*Clinical Relevance/Application A deep learning based algorithm for ETT detection, localization, and automated measurement can provide accurate and clinically relevant information related to potentially misplaced ETTs. Additional studies assessing the prospective clinical impact of this ETT model are warranted.

RESULTS

The model achieved an AUC of 0.9999 (0.9998, 1.0000), a sensitivity of 0.9941 (0.9859, 1.0000), and a specificity of 1.0000 (1.0000, 1.0000) for ETT detection. Additionally, the model achieved an ETT tip to Carina distance measurement success rate to within 1cm of 0.9405 (0.9152, 0.9658), a carina localization success rate to within 1cm of 0.9762 (0.9599, 0.9925), an ETT tip localization success rate to within 1cm of 0.9643 (0.9444, 0.9841) and an ETT localization success rate (DICE) of 0.9881 (0.9765, 0.9997). Model ability to accurately distinguish an ETT from a tracheostomy tube (TTT) or nasogastric tube (NGT) and model performance in the presence obscured carinas and technically difficult images was also assessed. Results showed that the model maintained high accuracies for ETT detection (sensitivity and specificity above 99%) and for ETT tip and carina localization (Accuracies above 94.7%) for all local disturbing factors listed above. The model also showed a highly accurate mean distance error of only 0.58mm and absolute distance error of 3.74mm as compared to the ground truth ETT tip to carina distance.

CLINICAL RELEVANCE/APPLICATION

A deep learning based algorithm for ETT detection, localization, and automated measurement can provide accurate and clinically relevant information related to potentially misplaced ETTs. Additional studies assessing the prospective clinical impact of this ETT model are warranted.

CH03-A7   The Thymus Revisited: Key Multimodality Imaging Features And Pitfalls With Pathological Correlation

Awards
Cum Laude

Participants
Hatice Savas, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Describe the embryologic and anatomic features of the thymus • Describe classification of non-malignant and malignant pathologies of the thymus • Describe imaging features of commonly encountered thymic lesions by CT, MRI, and PET • Correlate key imaging features with pathological features for more accurate staging on imaging

TABLE OF CONTENTS/OUTLINE

• Introduction o Embryology o ITMIG classification of mediastinal compartments o Anatomical and histological description of the normal thymus • Imaging modalities of the thymus • Imaging optimization for high risk group (pregnant women - children) • Age group based normal imaging of the thymusChest Xray - CT - MRI - PET CT • Masaoka-Koga system classification of thymic tumors • Diagnostic approach to commonly encountered thymic pathologies in daily practice • Benign conditions of Thymus o Thymic hyperplasia o True thymic hyperplasia o Thymic lymphoid hyperplasia o Thymic cysts and its mimics o Thymic cyst o Fat containing thymic lesions o Thymolipoma o Lipofibroadenoma • Thymic tumors: o Thymoma o Thymic carcinoma o Thymic lymphoma o Thymic carcinoid o Metastatic disease to the thymus • Common and rare entities for differential diagnosis o Lymphoma o Germ cell tumor o Thyroid origin tumors o Rare entities

Abstract Archives of the RSNA, 2021

Sub-Events

BR03-D2   Deep-libra: An Open-Source Artificial-intelligence Method For Robust Quantification Of Breast Density With Independent Validation In Breast Cancer Risk Assessment

Participants
Aimilia Gastounioti, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Breast density is an important risk factor for breast cancer that also affects the specificity and sensitivity of screening mammography. The purpose of our study is to introduce Deep-LIBRA, an open-source artificial intelligence (AI) method for breast density estimation, which combines deep learning with radiomic machine learning techniques to estimate breast density from digital mammograms.*Methods and Materials Our method leverages deep learning using two U-Net convolutional neural networks to remove the image background and the pectoralis muscle, and accurately segment the breast area. An AI algorithm combining superpixel generation and radiomic machine learning is then applied to differentiate dense from non-dense tissue regions within the breast, from which the total dense tissue area (DA) and the relative amount of dense tissue within the breast, also known as breast percent density (PD), are estimated. Our method was trained and validated on a multi-racial, multi-institutional dataset of 15,661 images (4,437 women), and then tested on an independent matched case-control dataset of 6,348 digital mammograms (414 cases; 1,178 controls) for both breast segmentation and breast-density-based case-control discrimination. Breast density measures from state-of-the-art research-based (LIBRA, Cumulus) and commercial software (Volpara) were also analyzed for comparison purposes.*Results On the independent dataset, Deep-LIBRA demonstrated high performance in breast density estimation, reflected in strong correlation (Spearman r = 0.90) and high overlap with expert gold-standard segmentations (Dice score = 92.5%). Moreover, in a conditional logistic regression model adjusted for age and BMI, Deep-LIBRA yielded a higher case-control discrimination performance (area under the ROC curve, AUC for PD = 0.61, 95% CI: [0.58, 0.64] and for DA = 0.64, [0.62, 0.67]) compared to other research and commercial breast density assessment methods (AUCs for PD = 0.53-0.60 and for DA = 0.58-0.63).*Conclusions Our preliminary results suggest a strong agreement of breast density estimates between Deep-LIBRA and gold-standard expert assessment of breast density, as well as similar or improved performance in breast-density-based breast cancer risk assessment to state-of-the-art research and commercial methods.*Clinical Relevance/Application With Deep-LIBRA being an open-source software, we anticipate that this study will provide instrumental evidence for Deep-LIBRA to facilitate larger studies of mammographic breast density and risk.

RESULTS

On the independent dataset, Deep-LIBRA demonstrated high performance in breast density estimation, reflected in strong correlation (Spearman r = 0.90) and high overlap with expert gold-standard segmentations (Dice score = 92.5%). Moreover, in a conditional logistic regression model adjusted for age and BMI, Deep-LIBRA yielded a higher case-control discrimination performance (area under the ROC curve, AUC for PD = 0.61, 95% CI: [0.58, 0.64] and for DA = 0.64, [0.62, 0.67]) compared to other research and commercial breast density assessment methods (AUCs for PD = 0.53-0.60 and for DA = 0.58-0.63).

CLINICAL RELEVANCE/APPLICATION

With Deep-LIBRA being an open-source software, we anticipate that this study will provide instrumental evidence for Deep-LIBRA to facilitate larger studies of mammographic breast density and risk.

BR03-D3   Initial Targeted Ultrasound In Women With Focal Breast Complaints: What About Tomosynthesis?

Participants
Carmen Siebers, Nijmegen, Netherlands (*Presenter*) Research grant, ZonMW

PURPOSE

To assess the potential of initial targeted ultrasound (US) in the diagnostic work-up of women with symptomatic localized breast disease and the supplemental value of digital breast tomosynthesis (DBT) (and synthetic digital mammography) in this setting.*Methods and Materials In this multicenter prospective study the standard breast imaging protocol (first DBT and second US) in women (>30 years), presenting with focal breast complaints in three different hospitals in the Netherlands, was reversed. Initially, US was performed and when required lesions were biopsied. Subsequently the DBT was evaluated. We assessed cancer detection related to the focal complaint based upon initial US alone and in combination with DBT. Furthermore, we evaluated the incidental findings, besides the focal complaint. After follow-up, data was linked to the Nationwide pathology database to evaluate any potential missed breast cancer during the inclusion.*Results Between September 2017 and June 2019 a total of 1961 women were enrolled (mean age 47.1 years). Based upon initial US alone, in 1587 women (80.9%) the complaints were due to normal fibroglandular tissue or benign findings (BI-RADS 1 or 2). However, in three of these women (0.2%) the DBT led to detection of a malignant lesion at the site of the complaint. In 374 women (19.1%) initial US was judged as suspicious and was followed by biopsy, yielding benign results in 182 women (48.7%) and malignant results in 192 women (51.3%) (US sensitivity 98.5%, US specificity 90.7%). In women without cancer at the site of the complaint DBT yielded incidental findings requiring additional investigations in 63 patients (3.2%); eight of these were malignant (0.4%, ductal carcinoma in situ (n=3) and invasive carcinoma (n=5)). After linking the results to PALGA, we found 18 women (age range 31-78 years, M = 55 years) diagnosed with malignancy in

the breast during the follow-up period. Seven of these cancers were in retrospect correlated to the complaint. The final sensitivity of US+DBT for cancer at the site of complaint was 96.5%, compared to 95% for US alone.*Conclusions US is an accurate stand-alone breast imaging modality in the assessment of focal breast complaints when the US shows no or a benign lesion. DBT is a necessary imaging tool only if US shows a suspicious lesion or is inconclusive. In case the DBT is omitted, there is in our opinion an acceptable very small chance that a malignant additional finding will not (yet) be detected.*Clinical Relevance/Application Focal breast complaints are a frequent problem for women, often causing fear for having breast cancer. Roughly 80% of these women would not need to undergo DBT to explain their complaint. Starting with US will reduce discomfort for the patient and save time and money in current daily practice.

RESULTS

Between September 2017 and June 2019 a total of 1961 women were enrolled (mean age 47.1 years). Based upon initial US alone, in 1587 women (80.9%) the complaints were due to normal fibroglandular tissue or benign findings (BI-RADS 1 or 2). However, in three of these women (0.2%) the DBT led to detection of a malignant lesion at the site of the complaint. In 374 women (19.1%) initial US was judged as suspicious and was followed by biopsy, yielding benign results in 182 women (48.7%) and malignant results in 192 women (51.3%) (US sensitivity 98.5%, US specificity 90.7%). In women without cancer at the site of the complaint DBT yielded incidental findings requiring additional investigations in 63 patients (3.2%); eight of these were malignant (0.4%, ductal carcinoma in situ (n=3) and invasive carcinoma (n=5)). After linking the results to PALGA, we found 18 women (age range 31-78 years, M = 55 years) diagnosed with malignancy in the breast during the follow-up period. Seven of these cancers were in retrospect correlated to the complaint. The final sensitivity of US+DBT for cancer at the site of complaint was 96.5%, compared to 95% for US alone.

CLINICAL RELEVANCE/APPLICATION

Focal breast complaints are a frequent problem for women, often causing fear for having breast cancer. Roughly 80% of these women would not need to undergo DBT to explain their complaint. Starting with US will reduce discomfort for the patient and save time and money in current daily practice.

BR03-D7   Performance Of Opto-acoustic Ultrasound With An Artificial Intelligence-based Decision Support Tool Versus Ultrasound Alone To Classify Benign Versus Malignant Breast Masses: A Pivotal Reader Study

Participants
Stephen J. Seiler, MD, Coppell, Texas (*Presenter*) Consultant, Seno Medical Instruments, Inc

PURPOSE

To evaluate the gain in specificity using opto-acoustic and ultrasound fused images (IUS+OA) and an artificial intelligence-based decision support tool (AI-DST) versus ultrasound (IUS) alone, controlling for sensitivity.*Methods and Materials Randomly selected 480 BI-RADS 3-5 masses (0.33-3.89 cm, mean diameter 1.45±0.77 cm) that underwent IUS+OA scanning as part of the multi-site PIONEER-01 trial were evaluated by 15 readers trained in IUS+OA interpretation. Readers first assigned probability of malignancy (POM) and BI-RADS category based on clinical history, mammogram and IUS. Readers then evaluated IUS+OA images, assigning IUS and OA feature scores and viewed a likelihood of malignancy (LOM) prediction score derived from a machine learning AI-DST before issuing a final POM and BI-RADS category. Mean specificity at fixed sensitivity of 98% (fSp), negative likelihood ratio (NLR), positive likelihood ratio (PLR) and partial area under the curve (pAUC) (95-100% sensitivity) of IUS+OA vs. IUS were calculated.*Results The study demonstrated a statistically significant gain in fSp of 9% (averaged over all readers) for IUS+OA compared to IUS (p=0.027, 95% CI: 1.03%, 16.9%). The mean NLR was 0.047 (95% CI: 0.032, 0.062) for IUS+OA and 0.053 (95% CI: 0.037, 0.070) for IUS alone. The mean PLR was 1.959 (95% CI: 1.870, 2.051) for IUS+OA and 1.548 (95% CI: 1.498, 1.597) for IUS alone. The pAUC was 0.0244 (95% CI: 0.0230, 0.0258) for IUS+OA and 0.0205 (95% CI: 0.0191, 0.0219) for IUS alone, a difference of 0.0039.*Conclusions IUS+OA plus an AI-DST has a statistically significantly better fSP than IUS alone. The IUS and OA feature scores can be used as combined qualitative diagnostic and predictive imaging biomarkers.*Clinical Relevance/Application IUS+OA provides useful diagnostic information and, with AI-DST, has the potential to reduce false positives, and thus biopsies of benign masses, versus IUS alone without sacrificing sensitivity.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

IUS+OA provides useful diagnostic information and, with AI-DST, has the potential to reduce false positives, and thus biopsies of benign masses, versus IUS alone without sacrificing sensitivity.

BR03-D8   3D Imaging For Intraoperative Breast Lumpectomy Specimen Assessment: A Feasibility Study During The Surgery

Participants
Mauro Hanaoka, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose

PURPOSE

Currently used 2D radiographic imaging during breast-conserving surgery (BCS) is limited in assessing positive margins in surgical specimens (reported margin sensitivity, 36-58%). Emerging volumetric specimen imager (VSI) with 3D imaging has a better correlation with pathology, but no VSI has been implemented or evaluated in the OR. Therefore, we aimed to assess the feasibility of implementing a VSI as a potential method for intraoperative specimen assessment during BCS.*Methods and Materials 21 consecutive female patients who underwent BCS for breast cancer were prospectively included (Preliminary data). Patients who had prior BCS and radiation therapy are excluded. All patients underwent ultrasound/mammography-guided localization of the lesions. After excision, each specimen was marked for orientation and imaged using 2D radiography first and then VSI during surgery. VSI imaging time and effect on clinical flow were recorded. One blinded radiologist retrospectively analyzed images acquired with both modalities. The lesion maximal dimension was measured and compared with the diagnostic images and pathology reports. Specimen margin on 3D images was marked as negative or positive and findings were compared with the final histopathological analysis. Positive margin status was defined as a tumor on ink margin for invasive cancer and <1mm for ductal carcinoma in situ (DCIS) at both imaging and pathology. Statistical analyses of the present study were performed using SPSS

software (version 22.0; IBM Corp., Armonk, NY, USA).*Results 21 subjects (age range 39-77) underwent BCT; 6 had positive margins. VSI detected all 6 positive margins (sensitivity 80%, specificity 50%, PPV 33%, NPV 88%, Accuracy 57%). Tumor size measured with VSI showed moderate correlation with pathological measurement (r=0.62, p=0.002). VSI imaging time was approximately 6 minutes and no impact on OR workflow was observed.*Conclusions VSI is a promising new technique that could potentially be used in the OR for specimen assessment during BCS without interrupting the workflow. It has better margin sensitivity than the standard 2D image. More prospective data will be collected from this ongoing study to assess VSI performance in margin assessment and its impact on surgical time and re-excision rates.*Clinical Relevance/Application VSI provides full-3D and thin-slice cross-sectional images, allowing more precise localization and orientation of the lesion and specimen margins than the commonly used 2D images. This is the first study reporting on the feasibility of implementing the VSI for breast specimen assessment during surgery. The protocol established from this study defines the guideline for a full-scale, prospective clinical trial to evaluate the VIS clinical application.

RESULTS

21 subjects (age range 39-77) underwent BCT; 6 had positive margins. VSI detected all 6 positive margins (sensitivity 80%, specificity 50%, PPV 33%, NPV 88%, Accuracy 57%). Tumor size measured with VSI showed moderate correlation with pathological measurement (r=0.62, p=0.002). VSI imaging time was approximately 6 minutes and no impact on OR workflow was observed.

CLINICAL RELEVANCE/APPLICATION

VSI provides full-3D and thin-slice cross-sectional images, allowing more precise localization and orientation of the lesion and specimen margins than the commonly used 2D images. This is the first study reporting on the feasibility of implementing the VSI for breast specimen assessment during surgery. The protocol established from this study defines the guideline for a full-scale, prospective clinical trial to evaluate the VIS clinical application.

BR03-D9   **Breast Cancer Patients Undergoing Neoadjuvant Chemotherapy; Is Axillary Response Determined By The Initial Nodal Burden?**

Participants
Ali Sever, MD, Orpington, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Axillary management in node positive breast cancer patients following neoadjuvant chemotherapy (NAC) is controversial. Depending on the baseline imaging, and response to treatment, patients with limited axillary involvement can be offered sentinel node biopsy alongside with targeted axillary dissection of the biopsy proven positive node(s). However in heavy nodal disease this is often avoided regardless post treatment response and patients undergo axillary clearance as first line treatment. The purpose of this study is to identify the role of baseline axillary imaging in biopsy-proven node positive breast cancer patients prior to NAC and to investigate the importance of initial staging in HER2-positive and HER2-negative cases.*Methods and Materials Breast cancer patients between 2017 and 2020, who were diagnosed with axillary nodal involvement following ultrasound-guided core biopsy were retrospectively identified. Breast tumor HER2 status was already determined. As per unit's protocol, all patients received baseline staging MRI and ultrasound prior to NAC and number of abnormal nodes were registered. Patients with three or less abnormal nodes (putative N1) had marker insertion into the biopsied node for eventual sentinel node biopsy and targeted axillary dissection. Axillary nodal clearance was planned for patients with four or more abnormal nodes (putative =N2) regardless their response to treatment.*Results There were 121 biopsy-proven axillary node positive patients who received NAC. Fifty patients were HER2-positive and remaining 71 patients were HER2-negative. Of the 33 N1, HER2-positive cases, 18 (55%) had complete pathological axillary response in their surgical specimen. In remaining 17 N2 cases, 9 (53%) had complete pathological response. In the 71 HER2-negative patients, 49 had N1 disease and 18 (37%) of them had complete pathological response. Only 5 of the 22 (23%) N2 cases showed complete response.*Conclusions Patients with HER2-positive tumors, axillary response is not directly determined by the initial nodal status. Depending on post treatment breast and axillary response, these patients may still benefit sentinel node biopsy (+/- targeted axillary dissection) regardless their advanced nodal involvement at initial presentation.*Clinical Relevance/Application Axillary response is not directly related to initial heavy nodal burden. In selected cases, especially in patients with HER2-positive tumors, sentinel node biopsy may still be an option.

RESULTS

There were 121 biopsy-proven axillary node positive patients who received NAC. Fifty patients were HER2-positive and remaining 71 patients were HER2-negative. Of the 33 N1, HER2-positive cases, 18 (55%) had complete pathological axillary response in their surgical specimen. In remaining 17 N2 cases, 9 (53%) had complete pathological response. In the 71 HER2-negative patients, 49 had N1 disease and 18 (37%) of them had complete pathological response. Only 5 of the 22 (23%) N2 cases showed complete response.

CLINICAL RELEVANCE/APPLICATION

Axillary response is not directly related to initial heavy nodal burden. In selected cases, especially in patients with HER2-positive tumors, sentinel node biopsy may still be an option.

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MS03-D

Multisystem Tuesday Poster Discussions

Sub-Events

MS03-D1   **Fluoroscopic Evaluation Of Spontaneous And Blunt Traumatic Pneumomediastinum**

Participants
Clayton Taylor, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

PURPOSE

Fluoroscopic evaluation (FE) of spontaneous and blunt traumatic pneumomediastinum (PM) is frequently performed in the emergency setting. Oral contrasted fluoroscopic studies have been shown to be low yield in specific pediatric and adult patient populations with PM, but they are often still performed given the high morbidity and mortality of a missed esophageal injury. We seek to determine the positivity rate of FE in patients presenting with spontaneous or blunt traumatic PM.*Methods and Materials IRB approved consecutive retrospective chart review was performed on all patients who underwent FE of imaging confirmed spontaneous or blunt traumatic PM between 2001-2019. Patients were excluded if there was a history of prior esophageal surgery, penetrating trauma, esophageal cancer or recent tracheal or recent esophageal instrumentation. For each patient, data regarding demographics, presenting history, physical exam findings, laboratory data, clinical course and imaging findings were collected.*Results A total of 252 patients met inclusion criteria during the 18 year study period, including 170 patients with spontaneous PM and 82 with blunt traumatic PM. A total of 8 fluoroscopic studies showed findings concerning for an esophageal injury, for a total positivity rate of 3.2%. All positive cases occurred in patients with spontaneous PM for a positivity rate of 4.7% in patients presenting with spontaneous PM and 0% in patients presenting with blunt traumatic PM. Of the patients found to have a positive esophagram, 75% presented with either vomiting/retching (N=4) or vomiting/retching with cough (N=2) as their primary symptoms. Pleural effusion was present in 83% (5/6) of these patients. Underlying esophageal injury was confirmed in all patients with positive fluoroscopic study who underwent surgery or endoscopy (N=7). There was one false negative esophagram (1/244, or 0.4%), in a patient who was found to have esophageal injury on subsequent endoscopy.*Conclusions FE is low yield across a broad patient population presenting with spontaneous or blunt traumatic PM. However, emergent FE for spontaneous PM may still be warranted given the positivity rate of 4.7%, especially in the setting of vomiting or retching. The practice of emergency FE of PM in the setting of blunt trauma should be discontinued.*Clinical Relevance/Application The use of FE in patients presenting with blunt traumatic PM should be discontinued. While FE positivity rate is low in patients with spontaneous PM the practice is warranted given the high morbidity and mortality of esophageal injury.

RESULTS

A total of 252 patients met inclusion criteria during the 18 year study period, including 170 patients with spontaneous PM and 82 with blunt traumatic PM. A total of 8 fluoroscopic studies showed findings concerning for an esophageal injury, for a total positivity rate of 3.2%. All positive cases occurred in patients with spontaneous PM for a positivity rate of 4.7% in patients presenting with spontaneous PM and 0% in patients presenting with blunt traumatic PM. Of the patients found to have a positive esophagram, 75% presented with either vomiting/retching (N=4) or vomiting/retching with cough (N=2) as their primary symptoms. Pleural effusion was present in 83% (5/6) of these patients. Underlying esophageal injury was confirmed in all patients with positive fluoroscopic study who underwent surgery or endoscopy (N=7). There was one false negative esophagram (1/244, or 0.4%), in a patient who was found to have esophageal injury on subsequent endoscopy.

CLINICAL RELEVANCE/APPLICATION

The use of FE in patients presenting with blunt traumatic PM should be discontinued. While FE positivity rate is low in patients with spontaneous PM the practice is warranted given the high morbidity and mortality of esophageal injury.

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Multisystem Thursday Poster Discussions

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RI05-A

Reproductive Imaging Thursday Poster Discussions

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IN03-B

Informatics Tuesday Poster Discussions

Sub-Events

IN03-B1 **Accelerating Training Data Annotation Via A Continuous AI-assisted, Human-supervised Feedback Loop In Kidney Segmentation In CT**

Participants
Gabriel Melendez-Corres, BS, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

A common issue present with AI in medical imaging is the lack of ample, curated data for training predictive models, as annotation generation is often prohibitively resource-intensive. We propose the implementation of a continuous AI-assisted feedback loop to accelerate image annotation generation, in which a starter AI model, trained on limited data, provides annotation initializations to human annotators to accelerate annotation, and the subsequent human-corrected annotations are sent back to update the AI model. This loop is run continuously with small batches of data, with each iteration improving the AI-initialized annotation, and thereby requiring even less time for human annotation. Eventually, minimal annotation is needed, requiring only a fraction of resources to generate well-annotated data. We demonstrate the utility of this approach, even with small batches (n < 10), in an initial implementation for kidney segmentation in CT images.*Methods and Materials An off-the-shelf 3D U-Net was trained on an initial set of 8 CT images with kidney annotations from an expert image analyst. This initial model was used to generate initial segmentations on unannotated images, which were sent back the analyst to aid them in annotating the kidneys. The newly annotated images were added to the training data for subsequent updating of the model. This feedback loop was repeated for 2 iterations, for a total of 16 images added to the training set. To measure performance, the median dice coefficient (DCE) was used to compare the model's predicted segmentation to the analyst corrected annotation. The analyst provided estimates for annotation times.*Results Model performance increased from 92% to 98% DCE from the first iteration to the second iteration. Analyst annotation time decreased by approximately 20% and 35%, respectively, for images with model segmentations similar to the reference truth. Annotation time doubled for images where the model yielded a poor segmentation.*Conclusions Preliminary results suggest that the feedback loop accelerates the generation of well-curated training data. With each iteration, even building a model from scratch with few cases, we see improvements in the model's segmentations and reduction in annotation times. However, more iterations, and optimized processing techniques or model architectures, are needed to maintain a consistent performance throughout all images.*Clinical Relevance/Application A continuous feedback loop approach, iterating a continuous stream of data batches, can be used to build annotated training sets at a faster rate for training AI algorithms. This in turn aids in building more robust models for computer aided diagnosis tasks, or even tasks outside of medical imaging.

RESULTS

Model performance increased from 92% to 98% DCE from the first iteration to the second iteration. Analyst annotation time decreased by approximately 20% and 35%, respectively, for images with model segmentations similar to the reference truth. Annotation time doubled for images where the model yielded a poor segmentation.

CLINICAL RELEVANCE/APPLICATION

A continuous feedback loop approach, iterating a continuous stream of data batches, can be used to build annotated training sets at a faster rate for training AI algorithms. This in turn aids in building more robust models for computer aided diagnosis tasks, or even tasks outside of medical imaging.

NPM03-B
Noninterpretive Tuesday Poster Discussions

Sub-Events

NPM03-B2 **Developing A Community-based Lung Cancer Screening Digital Outreach Intervention Tailored For Low Socioeconomic Status Communities**

Participants
Efren J. Flores, MD, Boston, Massachusetts (*Presenter*) 1. Speaker Honorarium, Medscape2. Speaker Honoraria, Grand Rounds presentations (non-profit organizations)

PURPOSE

Individuals from low socioeconomic status (SES) communities experience worse lung cancer (LC) outcomes and multilevel barriers to digital health. Community-based lung cancer screening (LCS) outreach can assist in overcoming these gaps and promote trust. The purpose of this study was to use mixed-methods research to develop a tailored digital health outreach intervention to promote LCS and understand related social needs among low SES communities.*Methods and Materials Focus Groups (FG) were conducted at an urban academic medical center with affiliated community health centers with representative PCPs (n=12), advocates (n=8), and LCS (n=7) and non-LCS (n=8) patients. Qualitative analysis guided development of 3 tailored LCS outreach videos with messaging by a: Radiologist, Patient, and Patient/Radiologist together. A national sample of 315 LCS-eligible, current smokers with Medicaid were randomized to 1 of 3 video conditions to determine satisfaction, preferred source, intent to screen, and attitudes about LC. ANOVA examined the main effect of video condition on continuous variables and bivariate correlations examined associations with a composite social needs assessment score.*Results FG with PCPs, advocates, and LCS and non-LCS patients cited transportation and fear about LC as major barriers to LCS. Patients reported confusion about LCS eligibility criteria, the LCS process, and insurance coverage. The outreach video was modified to emphasize the treatability of early LC, adopted clear language for eligibility and insurance coverage, and displayed a patient undergoing LCS and receiving results. For national testing, 67% (210/315) reported satisfaction with the video. Participants in the Patient condition reported the greatest intent to speak to a PCP about LCS, $F(2,312)=3.65=.027$. Participants reported limited social needs (M=2.09, IQR=3). However, greater social need was significantly associated with lower health literacy $r(315)=-.18$, $p=.001$, smoking-related stigma $r(315)=.22$, $p<.000$, lower confidence in arranging transport to LCS, $r(313)=-.34$, $p<.000$, greater cost concerns about LCS, $r(315)=.14$, $p=.01$, perceived severity of LC $r(315)=.12$, $p=.03$, and greater worry about developing LC $r(315)=.14$, $p=.01$.*Conclusions A community-based outreach intervention was effective at addressing salient barriers to LCS. Cost concerns, lower literacy levels, and fear of LC diagnosis from FG discussions mapped onto concerns from a national representative sample.*Clinical Relevance/Application Radiologists can partner with patients and key community stakeholders in the development of effective LCS outreach interventions aimed to increase equitable LCS participation among low SES communities.

RESULTS

FG with PCPs, advocates, and LCS and non-LCS patients cited transportation and fear about LC as major barriers to LCS. Patients reported confusion about LCS eligibility criteria, the LCS process, and insurance coverage. The outreach video was modified to emphasize the treatability of early LC, adopted clear language for eligibility and insurance coverage, and displayed a patient undergoing LCS and receiving results. For national testing, 67% (210/315) reported satisfaction with the video. Participants in the Patient condition reported the greatest intent to speak to a PCP about LCS, $F(2,312)=3.65=.027$. Participants reported limited social needs (M=2.09, IQR=3). However, greater social need was significantly associated with lower health literacy $r(315)=-.18$, $p=.001$, smoking-related stigma $r(315)=.22$, $p<.000$, lower confidence in arranging transport to LCS, $r(313)=-.34$, $p<.000$, greater cost concerns about LCS, $r(315)=.14$, $p=.01$, perceived severity of LC $r(315)=.12$, $p=.03$, and greater worry about developing LC $r(315)=.14$, $p=.01$.

CLINICAL RELEVANCE/APPLICATION

Radiologists can partner with patients and key community stakeholders in the development of effective LCS outreach interventions aimed to increase equitable LCS participation among low SES communities.

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Sub-Events

RI03-B2   **Added Value Of Diffusion-weighted Imaging And Delayed Gadolinium-enhanced Mri For Staging Of Ib-iib Cervical Cancer Treated With Neo-adjuvant Chemotherapy**

Participants
Frédéric Vanhove, Leuven, Belgium (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the added value of diffusion-weighted magnetic resonance imaging (DWI-MRI) and delayed Gadolinium-enhanced (DGE-)MRI to T2-weighted MRI (T2-MRI) for staging cervical uterine cancer after neo-adjuvant chemotherapy (NACT).*Methods and Materials This retrospective study was approved by the ethics committee and analyzed forty-two cervical cancer patients treated by NACT prior to planned surgery. All patients had received 3 Tesla MRI including T2-MRI, DWI-MRI (b0-1000 sec/mm2) and DGE-MRI [1.1 mm isotropic 3D T1-weighted gradient-echo sequence 17 minutes after Gadobutrol injection (Gadovist®)] . An expert reader scored for presence of vaginal and parametrial invasion, pelvic nodal metastases and FIGO-stage at the post-NACT T2-MRI, T2-MRI+DWI-MRI and T2-MRI+DWI-MRI+DGE-MRI with 2 weeks intervals. Diagnostic performance was compared for the 3 reading sessions in correlation to histopathology after surgery and follow-up.*Results For predicting vaginal invasion, T2-MRI showed 71.43% sensitivity and 88.57% specificity; T2-MRI+DWI-MRI showed 57.14% sensitivity and 88.57% specificity and T2-MRI+DWI-MRI+DGE-MRI showed 71.43% sensitivity and 100% specificity. For predicting parametrial invasion, T2-MRI showed 54.55% sensitivity and 93.55% specificity; T2-MRI+DWI-MRI showed 72.73% sensitivity and 100% specificity and T2-MRI+DWI-MRI+DGE-MRI showed 90.91% sensitivity and 100% specificity. For predicting pelvic nodal metastases, T2-MRI showed 7.14% sensitivity and 92.86 % specificity; T2-MRI+DWI-MRI showed 13.79% sensitivity and 76.92% specificity and T2-MRI+DWI-MRI+DGE-MRI showed 71.43% sensitivity and 92.86% specificity. T2-MRI+DWI-MRI+DGE-MRI showed higher accuracy over T2-MRI and T2+DWI-MRI for predicting parametrial invasion (97.62% versus 83.33% versus 92.86%), vaginal invasion (95.24% versus 85.71% versus 83.33%) and nodal metastases (85.71% versus 64.29% versus 64.29%) and assigned the highest number of patients to the correct FIGO stage (33 of 42 versus 13 of 42 versus 23 of 42).*Conclusions Adding delayed Gadolinium-enhanced MRI to T2-MRI and DWI-MRI improves diagnostic performance for locoregional staging of cervical cancer after NACT prior to surgery.*Clinical Relevance/Application Better detection of locoregional tumor extent after neoadjuvant chemotherapy by delayed Gadolinium-enhanced MRI may improve therapeutic decision making towards operability.

RESULTS

For predicting vaginal invasion, T2-MRI showed 71.43% sensitivity and 88.57% specificity; T2-MRI+DWI-MRI showed 57.14% sensitivity and 88.57% specificity and T2-MRI+DWI-MRI+DGE-MRI showed 71.43% sensitivity and 100% specificity. For predicting parametrial invasion, T2-MRI showed 54.55% sensitivity and 93.55% specificity; T2-MRI+DWI-MRI showed 72.73% sensitivity and 100% specificity and T2-MRI+DWI-MRI+DGE-MRI showed 90.91% sensitivity and 100% specificity. For predicting pelvic nodal metastases, T2-MRI showed 7.14% sensitivity and 92.86 % specificity; T2-MRI+DWI-MRI showed 13.79% sensitivity and 76.92% specificity and T2-MRI+DWI-MRI+DGE-MRI showed 71.43% sensitivity and 92.86% specificity. T2-MRI+DWI-MRI+DGE-MRI showed higher accuracy over T2-MRI and T2+DWI-MRI for predicting parametrial invasion (97.62% versus 83.33% versus 92.86%), vaginal invasion (95.24% versus 85.71% versus 83.33%) and nodal metastases (85.71% versus 64.29% versus 64.29%) and assigned the highest number of patients to the correct FIGO stage (33 of 42 versus 13 of 42 versus 23 of 42).

CLINICAL RELEVANCE/APPLICATION

Better detection of locoregional tumor extent after neoadjuvant chemotherapy by delayed Gadolinium-enhanced MRI may improve therapeutic decision making towards operability.

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Sub-Events

PH04-D1   Comparison Of Acoustic Noise Between Silent Sequence And Conventional Sequence MRI In Head Examinations

Participants
Shumeng Zhu, Xi'an, China (*Presenter*) Nothing to Disclose

PURPOSE

To measure the acoustic noise level of each sequence in conventional and silent MRI at 3.0T scanner (Discovery 750W; GE Medical system, Milwaukee, WI), and compare the difference between them.*Methods and Materials The acoustic noise level was detected in different locations, including the locations of the patient head, foot, and the scanner operator, and the area near the patient table where often a family member of the patient stands. The protocol package of head scan of conventional sequences includes T2 Flair Propeller, T2 Propeller, and 3D-T1 FSPGR; while the silent sequences contain Silent T2 Flair, Silent T2 Propeller, and Silent MR T1. The former two T2 sequences reduced acoustic noise by derating gradient slew rate and optimized gradient wave form of PROPELLER sequence, while the latter T1 sequence uses a different approach by eliminating the noise at the source: silent technique. Silent technique is a novel data acquisition method in which the gradients are used continuously, but are not rapidly switched on or off. Since the gradients are no longer switched on and off, mechanical vibration is eliminated and much reduced noise is generated during the acquisition. We measured the peak and equivalent of sound pressure level (SPL) of each sequence at the locations mentioned above using a special noise meter (BSWA 801; Beijing Shengwang Acoustic and Electromagnetic Technology), each of which was tested for 20 seconds and measured continuously for 3 times, and the average was measured as the result. The acoustic noise levels between conventional and silent MRI were evaluated quantitatively.*Results The peak-SPL of the silent sequence(94.87 ± 7.45dBA) is obviously lower than that of the conventional sequence noise(130.13 ± 0.40dBA), $p<0.05$. The equivalent-SPL of the silent sequence(81.57 ± 7.10dBA) is obviously lower than that of the conventional sequence noise(116.67 ± 2.72dBA), $p<0.05$. The maximum difference of peak-SPL between the two sequence is 42.7dBA and the maximum difference of equivalent-SPL between the two sequence is 45.1dBA.*Conclusions The silent sequence can significantly reduce the acoustic noise in the head MRI at 3.0T. Consequently, it should reduce the physical or psychological discomfort caused by high acoustic noise and improve the success rate of MRI scans.*Clinical Relevance/Application Reducing noise, reducing the physical or psychological discomfort and improving the success rate of MRI scans.

RESULTS

The peak-SPL of the silent sequence(94.87 ± 7.45dBA) is obviously lower than that of the conventional sequence noise(130.13 ± 0.40dBA), $p<0.05$. The equivalent-SPL of the silent sequence(81.57 ± 7.10dBA) is obviously lower than that of the conventional sequence noise(116.67 ± 2.72dBA), $p<0.05$. The maximum difference of peak-SPL between the two sequence is 42.7dBA and the maximum difference of equivalent-SPL between the two sequence is 45.1dBA.

CLINICAL RELEVANCE/APPLICATION

Reducing noise, reducing the physical or psychological discomfort and improving the success rate of MRI scans.

PH04-D11   Deep Learning-Based Motion-Resolved 4D MRI

Participants
Ramin Jafari, BS, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

Free-breathing MR imaging is an emerging technique with important clinical relevance to address limitations of breath-hold sequences and enable access to motion information. Recently, there has been interest in real-time motion-resolved free-breathing MR imaging with application in MRI-guided radiation therapy. This work proposes to use a deep learning approach named XD-Net to replace the iterative XD-GRASP reconstruction algorithm by a neural network and enable reconstruction of motion-resolved 4D MR images in seconds rather than tens of minutes.*Methods and Materials Free-breathing 3D abdominal imaging was performed on seven healthy volunteers (without contrast injection) and seven patients (post-contrast injection) on 3T scanners (Discovery MR750 and Signa Premier, GE Healthcare, Waukesha, WI). A prototype T1-weighted golden-angle stack-of-stars pulse sequence was used and a total of 900 spokes were acquired, with a total scan time of approximately 2 minutes.XD-GRASP reconstruction: Ten respiratory motion-states (90 spokes in each state) were generated by sorting the continuously acquired data and iterative XD-GRASP reconstruction was performed to generate motion-resolved artifact-free images from undersampled multi-coil radial data.XD-Net reconstruction: A 2D convolutional neural network was designed with 10 layers and the network was trained using XD-GRASP reconstruction as a reference. Several runs were performed, where one subject was selected as a test set, and the remaining cases were augmented and split into training (80%) and validation (20%).*Results Reconstruction time for XD-GRASP (60 slices) was approximately 138 minutes. Reconstruction time for the proposed XD-Net was only 10 seconds, which represents an 800-fold reduction in reconstruction time. Comparison of the proposed XD-Net with the reference XD-GRASP in a healthy subject (Fig1., left) and metastasis patient (Fig.1, right) demonstrates good qualitative and quantitative agreement.*Conclusions The proposed XD-Net can achieve an 800-fold reduction in reconstruction time compared to the current XD-GRASP reconstruction for motion-resolved 4D imaging without image quality degradation. Future work will be focused to use deep learning for the motion

sorting component and clinical application of the technique to various motion prone dynamic imaging scenarios.*Clinical Relevance/Application XD-Net is a promising approach to almost real-time reconstruction of motion-resolved data, which will enable robust clinical translation in cases where MRI results are needed shortly after finishing acquisition, including MRI-guided radiotherapy.

RESULTS

Reconstruction time for XD-GRASP (60 slices) was approximately 138 minutes. Reconstruction time for the proposed XD-Net was only 10 seconds, which represents an 800-fold reduction in reconstruction time. Comparison of the proposed XD-Net with the reference XD-GRASP in a healthy subject (Fig1., left) and metastasis patient (Fig.1, right) demonstrates good qualitative and quantitative agreement.

CLINICAL RELEVANCE/APPLICATION

XD-Net is a promising approach to almost real-time reconstruction of motion-resolved data, which will enable robust clinical translation in cases where MRI results are needed shortly after finishing acquisition, including MRI-guided radiotherapy.

PH04-D12   Research On The Application Value Of Revolution 256-slice Spectrum CT Optimal Single Energy Imaging In Hepatic Portal Vein Imaging

Participants
Junli Ma, Shizuishan, China (*Presenter*) Nothing to Disclose

PURPOSE

To Investigation of optimal monoenergetic energy image in hepatic portal vein (HPV) imaging using 256-row spectral CT.*Methods and Materials A total of 60 patients underwent enhanced upper abdominal examination were selected, 37 males and 23 females, with an average age of 59.18±16.72 years. All patients were scanned using the wide-body detector Revolution 256-row CT spectral imaging mode (GSI). The CT value and SD value of hepatic portal vein and subcutaneous fat were measured every 1 keV at the level of 40-140 keV (a total of 101 keV single energy levels) in the portal phase. CT value, SD value and signal-to-noise ratio (SNR=CTHPV/SDfat) of 101 groups of monoenergetic image (40keV-140keV) hepatic portal veins and fat were measured. SD of fat were used as background noise. Two senior physicians used double-blind methods to evaluate the portal phase single energy level images of 40-140keV on the AW workstation (GE Healthcare), fixed the window width and window level (WW=400, WL=40).*Results Two senior doctors used double-blind method to evaluate the optimal single energy of the images respectively. The consistency test was performed with the ICC intra-group correlation coefficient, ICC=0.810 (p<0.001). Taking the average value of the best monoenergetic image evaluated by two radiologists, the optimal single energy range is 62-73 keV, and the median is 68 keV. The SNR curve shows that the SNR gradually decreases with the increase of single energy 40-140kev. The CT value for HPV at 40, 62, 68, 74, 100 keV was 453.02, 207.13, 174.60, 149.43 and 90.81 HU, SD for fat was 35.92, 19.08,16.85, 15.16 and 11.23 HU,and SNR was 13.37,11.53,11.03,10.50,8.67, respectively. That is, at 40keV, the image has good signal-to-noise ratio, but high image noise is the largest, and the quality is poor; at 140keV, the image noise is low, but the image signal-to-noise ratio is poor, combined with the optimal monoenergetic energy range obtained by subjective evaluation the optimal single energy is 68 keV.*Conclusions Revolution 256-row energy spectrum CT hepatic portal vein imaging has the optimal single energy median of 68 keV (the optimal monoenergetic image range is about 62-73 keV), which significantly improves the image quality.*Clinical Relevance/Application When the optimal single energy 68keV is used for hepatic portal vein imaging, the image quality can be significantly improved, which is beneficial to observe whether the portal vein has thrombosis, cancer thrombus, and collateral circulation. In this study, the optimal single energy median of energy spectrum CT hepatic portal vein imaging is 68 keV (the optimal monoenergetic range is about 62-73 keV), which has guiding significance for the clinical application of energy spectrum in the abdomen.

RESULTS

Two senior doctors used double-blind method to evaluate the optimal single energy of the images respectively. The consistency test was performed with the ICC intra-group correlation coefficient, ICC=0.810 (p<0.001). Taking the average value of the best monoenergetic image evaluated by two radiologists, the optimal single energy range is 62-73 keV, and the median is 68 keV. The SNR curve shows that the SNR gradually decreases with the increase of single energy 40-140kev. The CT value for HPV at 40, 62, 68, 74, 100 keV was 453.02, 207.13, 174.60, 149.43 and 90.81 HU, SD for fat was 35.92, 19.08,16.85, 15.16 and 11.23 HU,and SNR was 13.37,11.53,11.03,10.50,8.67, respectively. That is, at 40keV, the image has good signal-to-noise ratio, but high image noise is the largest, and the quality is poor; at 140keV, the image noise is low, but the image signal-to-noise ratio is poor, combined with the optimal monoenergetic energy range obtained by subjective evaluation the optimal single energy is 68 keV.

CLINICAL RELEVANCE/APPLICATION

When the optimal single energy 68keV is used for hepatic portal vein imaging, the image quality can be significantly improved, which is beneficial to observe whether the portal vein has thrombosis, cancer thrombus, and collateral circulation. In this study, the optimal single energy median of energy spectrum CT hepatic portal vein imaging is 68 keV (the optimal monoenergetic range is about 62-73 keV), which has guiding significance for the clinical application of energy spectrum in the abdomen.

PH04-D3   Pulmonary Z-score: A New CT Imaging Biomarker For Quantifying Pulmonary Perfusion Defects

Participants
Ke Li, PhD, Madison, Wisconsin (*Presenter*) Research Consultant, Pulmera Inc.

PURPOSE

Iodine basis images generated from dual-energy CT (DECT) have been used to assess lung perfusion defects. The underlying assumption is that the amount of iodine signal is correlated with the amount of perfused blood volume in the lung. However, the amount of iodine measured in the iodine basis image is often confounded by the presence of high-density materials, not necessarily iodine, in the lung. As a result, the quantification accuracy of lung perfusion defects using DECT is limited. The purpose of this work was to develop and validate a new DECT-derived biomarker (Z-score) to achieve quantitative pulmonary perfusion assessment.*Methods and Materials A first-principle analysis was performed to discover a quantitative relationship between the pulmonary perfusion blood volume (PBV) and a new quantitative biomarker, i.e., Z-score value, which is defined as a power function of the effective atomic number. The proposed Z-score method was compared against the corresponding iodine quantification analysis and the results were benchmarked by the ground truth clinical diagnosis.*Results For patients with both acute pulmonary embolism (PE) and virus pneumonia, the Z-score maps clearly demonstrated regional perfusion defects in the area supplied by the embolized vessels, while the iodine images failed to demonstrate the defects because pneumonia-induced consolidations elevated

the local tissue density and counteracted the reduction of iodine uptake in the area. For patients with chronic PE or pulmonary hypertension, Z-score maps provide a much clearer depiction of the global or regional perfusion defects (mean PBV: 25 [20, 30] ml/100g). For a patient with atelectasis and pleural effusion but normal perfusion, Z-score maps show normal perfusion while the iodine basis images erroneously show an apparent perfusion disparity. For healthy control subjects, Z-score maps show uniform and normal perfusion with a mean PBV value of 40 [37, 43] ml/100g.*Conclusions The Z-score is a sensitive and specific imaging biomarker for detecting and quantifying potential pulmonary perfusion defects.*Clinical Relevance/Application The method directly benefits the diagnosis and prognosis of PE and other pulmonary diseases by enabling simultaneous vessel morphology and perfusion assessment with a single DECT acquisition.

RESULTS

For patients with both acute pulmonary embolism (PE) and virus pneumonia, the Z-score maps clearly demonstrated regional perfusion defects in the area supplied by the embolized vessels, while the iodine images failed to demonstrate the defects because pneumonia-induced consolidations elevated the local tissue density and counteracted the reduction of iodine uptake in the area. For patients with chronic PE or pulmonary hypertension, Z-score maps provide a much clearer depiction of the global or regional perfusion defects (mean PBV: 25 [20, 30] ml/100g). For a patient with atelectasis and pleural effusion but normal perfusion, Z-score maps show normal perfusion while the iodine basis images erroneously show an apparent perfusion disparity. For healthy control subjects, Z-score maps show uniform and normal perfusion with a mean PBV value of 40 [37, 43] ml/100g.

CLINICAL RELEVANCE/APPLICATION

The method directly benefits the diagnosis and prognosis of PE and other pulmonary diseases by enabling simultaneous vessel morphology and perfusion assessment with a single DECT acquisition.

PH04-D4 Evaluation Of The Chemical Composition Of Kidney Stones Using Dual-energy Spectral CT In Gout Patients

Participants
Xiaohu Li, MD, Hefei, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the prevalence of uric acid(UA) kidney stones with dual-energy spectral CT (DESCT) and explore the risk factors for nephrolithiasis in primary gout patients.*Methods and Materials 152 consecutive gout patients underwent urinary ultrasound or DESCT to confirm the existence of nephrolithiasis. Urinalysis and Blood analysis were also taken.*Results Fifty patients(32.9%)were diagnosed as urolithiasis. Fifty patients of the 152 patients underwent a DESCT scan, and 43 patients had urinary stones in DESCT. Twenty-nine patients had multiple calculi. The mean size of the calculi was 8.3 mm (range, 1.2-24.0 mm). Among them, 27.9% (12/43) of the patients had pure UA, 39.5% (17/43) of the patients had UA-based mixed stone and 32.6%(14/43) had Calcium oxalate or Calcium phosphate compositions in the stone.Gout patients with urinary stones suffered from more frequency of acute gout attacks and had longer symptom duration of gout. DESCT Shows the accumulation of MSU in jointspoly arthritis(=5joints) 32(74.4%). 39(90.7%) of all patients had at least one bone erosion in the feet/ankles. 78.9% of patients had at least one biochemical abnormality. 74 (48.7%) patients presented hypomagnesuria. 23 (15.1%) patients presented hypercalciuria. 23 (15.1%) patients presented hyperuricosuiria. 44 (28.9%) had UAU. Among two groups, lithiasic patients were more likely to have hyperuricosuiria, while other abnormities were not significantly different(P>0.05).*Conclusions Our results indicated that urinary stones were more common in gout patients, especially UA stones, which was primarily due to low urine pH. DESCT can discriminate UA stones in vivo. Higher frequency of acute gout attacks and long symptom duration more often in gout-lithiasic.*Clinical Relevance/Application UA Urinary stones with DESCT and explore the risk factors for nephrolithiasis in primary gout patients.

RESULTS

Fifty patients(32.9%)were diagnosed as urolithiasis. Fifty patients of the 152 patients underwent a DESCT scan, and 43 patients had urinary stones in DESCT. Twenty-nine patients had multiple calculi. The mean size of the calculi was 8.3 mm (range, 1.2-24.0 mm). Among them, 27.9% (12/43) of the patients had pure UA, 39.5% (17/43) of the patients had UA-based mixed stone and 32.6%(14/43) had Calcium oxalate or Calcium phosphate compositions in the stone.Gout patients with urinary stones suffered from more frequency of acute gout attacks and had longer symptom duration of gout. DESCT Shows the accumulation of MSU in jointspoly arthritis(=5joints) 32(74.4%). 39(90.7%) of all patients had at least one bone erosion in the feet/ankles. 78.9% of patients had at least one biochemical abnormality. 74 (48.7%) patients presented hypomagnesuria. 23 (15.1%) patients presented hypercalciuria. 23 (15.1%) patients presented hyperuricosuiria. 44 (28.9%) had UAU. Among two groups, lithiasic patients were more likely to have hyperuricosuiria, while other abnormities were not significantly different(P>0.05).

CLINICAL RELEVANCE/APPLICATION

UA Urinary stones with DESCT and explore the risk factors for nephrolithiasis in primary gout patients.

PH04-D9 Noise Suppression In Dual-energy Material Decomposition Using Total-variation Regularization

Participants
Qinghao Chen, PhD, St. Louis, Missouri (*Presenter*) Nothing to Disclose

PURPOSE

Dual-energy (DE) decomposition radiography that employs the non-linear model and seeks for the solution of the inverse problem is sensitive to image noise. The material decomposed images are often dominated by image noises especially when the DE x-ray beams have significant spectrum overlap. We developed an iterative DE decomposition method with noise suppression that can reduce the noise level while preserving the edges and contrast in the images.*Methods and Materials We established the non-linear DE decomposition model by the calibration of basis materials and polynomial approximation. The low and high energy x-ray images were acquired at 90 kVp and 140 kVp with a tin filter respectively. Water and bone images were obtained by minimizing a cost function with a fidelity term and a TV regularization term to suppress the noise while preserving the edges of the image feature. A monotone fast iterative shrinkage/thresholding algorithm (MFISTA) was employed to solve the inverse problem.*Results We tested the performance of the method by imaging animal cadaver. Two radiographs consisting of low energy and high energy images were acquired and decomposed to soft-tissue-only and bone-only images. Using TV regularization, the image noise was suppressed while the image edges remained sharp.*Conclusions Iterative DE decomposition based on the non-linear model and TV regularization was able to achieve improved material decomposition results. With the same dose level, the new DE decomposition algorithm is able to achieve improved visibility of anatomical features.*Clinical Relevance/Application The TV-based dual-energy decomposition method may be broadly employed in chest radiography for the diagnosis of cancer and COVID-19, as well as image-guided intervention and

radiotherapy.

RESULTS

We tested the performance of the method by imaging animal cadaver. Two radiographs consisting of low energy and high energy images were acquired and decomposed to soft-tissue-only and bone-only images. Using TV regularization, the image noise was suppressed while the image edges remained sharp.

CLINICAL RELEVANCE/APPLICATION

The TV-based dual-energy decomposition method may be broadly employed in chest radiography for the diagnosis of cancer and COVID-19, as well as image-guided intervention and radiotherapy.

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Abstract Archives of the RSNA, 2021

Sub-Events

HN03-A2   **Development And Validation Of CT-based Radiomics Nomogram For The Classification Of Benign Parotid Gland Tumors**

Participants

Menglong Zheng, Hefei, China (*Presenter*) Nothing to Disclose

PURPOSE

Accurate preoperative diagnosis of parotid tumor is essential for the formulation of optimal individualized surgical plans. The aim of this study is to investigate the diagnostic performance of radiomics nomogram based on contrast enhanced CT images in the differentiation of the two most common benign parotid gland tumors.*Methods and Materials 110 patients with parotid gland tumors including 76 with pleomorphic adenoma (PA) and 34 with adenolymphoma (AL) confirmed by histopathology were included in this study. Radiomics features were extracted from contrast enhanced CT images of venous phase. A radiomics model was established and a radiomics score (Rad-score) was calculated. Clinical factors including clinical data and CT features were assessed to build a clinical factor model. Finally, a nomogram incorporating the Rad-score and independent clinical factors was constructed. Receiver operator characteristics (ROC) curve was generated and the area under the ROC curve (AUC) was calculated to quantify the discriminative performance of each model on both the training and validation cohorts. Decision curve analysis (DCA) was conducted to evaluate the clinical usefulness of each model.*Results The radiomics model showed good discrimination in the training cohort (AUC 0.89; 95% CI, 0.80-0.98) and validation cohort (AUC 0.89; 95% CI, 0.77-1.00). The radiomics nomogram showed excellent discrimination in the training cohort (AUC, 0.98; 95% CI, 0.96-1.00) and validation cohort (AUC, 0.95; 95% CI, 0.88-1.00) and displayed better discrimination efficacy compared with the clinical factor model (AUC, 0.93; 95% CI, 0.88-0.99) in the training cohort (p < 0.05). The decision curve analysis demonstrated that the combined radiomics nomogram provided superior clinical usefulness than clinical factor model and radiomics model.*Conclusions The CT-based radiomics nomogram combining Rad-score and clinical factors exhibits excellent predictive capability for differentiating parotid PA from AL, which might hold promise in assisting radiologists and clinicians in the exact differential diagnosis and formulation of appropriate treatment strategy.*Clinical Relevance/Application In patients who were diagnosed with benign parotid tumors preoperatively, our nomogram provided a promising tool to assist radiologists and clinicians in exact differential diagnosis and formulation of appropriate treatment strategy. For patients with parotid PA, a partial superficial parotidectomy is recommended. In contrast, enucleation is sufficient for patients with AL.

RESULTS

The radiomics model showed good discrimination in the training cohort (AUC 0.89; 95% CI, 0.80-0.98) and validation cohort (AUC 0.89; 95% CI, 0.77-1.00). The radiomics nomogram showed excellent discrimination in the training cohort (AUC, 0.98; 95% CI, 0.96-1.00) and validation cohort (AUC, 0.95; 95% CI, 0.88-1.00) and displayed better discrimination efficacy compared with the clinical factor model (AUC, 0.93; 95% CI, 0.88-0.99) in the training cohort (p < 0.05). The decision curve analysis demonstrated that the combined radiomics nomogram provided superior clinical usefulness than clinical factor model and radiomics model.

CLINICAL RELEVANCE/APPLICATION

In patients who were diagnosed with benign parotid tumors preoperatively, our nomogram provided a promising tool to assist radiologists and clinicians in exact differential diagnosis and formulation of appropriate treatment strategy. For patients with parotid PA, a partial superficial parotidectomy is recommended. In contrast, enucleation is sufficient for patients with AL.

HN03-A3   **The Reproducibility Of T2 Relaxation Time For Temporomandibular Joint (TMJ) Assessment With A 3.0 T MRI**

Participants

Pongsapak Wongratwanich, DDS, Hiroshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the intra- and inter-examination reproducibility of T2 relaxation time for TMJ at 3.0 Tesla (T).*Methods and Materials Sixteen volunteers, regardless of any TMJ disorders, were enrolled in the study. MRI was performed using a 3.0 T MR imaging scanner equipped with a dStream head 32ch coil (Philips Ingenia, Philips Healthcare, Netherlands). T2 mapping was taken twice in 11 volunteers (>5 minutes between two sessions without repositioning) in the oblique sagittal planes for intra-examination reproducibility evaluation. Seven volunteers underwent two separate examinations more than six months apart for inter-examination reproducibility evaluation. The regions of interest (ROIs) for T2 mapping sequences of articular disc and retrodiscal tissue were manually selected.*Results The mean values of T2 relaxation times of articular disc in 11 volunteers were 23.4 ± 2.1 and 23.7 ± 3.1 ms for the first and second T2 mapping sequences, respectively. Retrodiscal tissue mean values were 29.6 ± 3.3 ms for the first sequence and 29.8 ± 4.2 ms for the second sequence. Intra-examination reproducibility of T2 relaxation times measured in articular disc and retrodiscal tissue showed intraclass correlation coefficients (ICCs) as good (0.707) and strong (0.904) correlation, respectively. Pearson's correlation was also conducted and found no significant differences comparing T2 relaxation times between 2 sessions for both articular disc (r = 0.758) and retrodiscal tissue (r = 0.924) (P < 0.05). Seven volunteers showed mean values of 24.7 ± 3.4 ms for the first examination and 26.4 ± 4.1 ms for the second examination of articular disc. T2 mean values of

retrodiscal tissue were 30.6 ± 4.7 and 29.6 ± 5.1 ms for the first and second examination, respectively. Inter-examination reproducibility demonstrated ICCs as good (0.758, 0.771) on both ROIs. T2 relaxation times between first and second examination were not significantly different (r = 0.745, 0.780) (P < 0.05).*Conclusions Due to good to strong ICCs of intra- and inter-examination reproducibility in volunteers, the 3.0 T MRI machine seems to be a promising tool for T2 mapping regardless of TMJ's condition.*Clinical Relevance/Application T2 relaxation time is a biochemical value used to assess TMJ pathology. A 3.0 T MRI provides a proper selection of ROIs, leading to a more accurate TMJ disorder diagnosis.

RESULTS

The mean values of T2 relaxation times of articular disc in 11 volunteers were 23.4 ± 2.1 and 23.7 ± 3.1 ms for the first and second T2 mapping sequences, respectively. Retrodiscal tissue mean values were 29.6 ± 3.3 ms for the first sequence and 29.8 ± 4.2 ms for the second sequence. Intra-examination reproducibility of T2 relaxation times measured in articular disc and retrodiscal tissue showed intraclass correlation coefficients (ICCs) as good (0.707) and strong (0.904) correlation, respectively. Pearson's correlation was also conducted and found no significant differences comparing T2 relaxation times between 2 sessions for both articular disc (r = 0.758) and retrodiscal tissue (r = 0.924) (P < 0.05). Seven volunteers showed mean values of 24.7 ± 3.4 ms for the first examination and 26.4 ± 4.1 ms for the second examination of articular disc. T2 mean values of retrodiscal tissue were 30.6 ± 4.7 and 29.6 ± 5.1 ms for the first and second examination, respectively. Inter-examination reproducibility demonstrated ICCs as good (0.758, 0.771) on both ROIs. T2 relaxation times between first and second examination were not significantly different (r = 0.745, 0.780) (P < 0.05).

CLINICAL RELEVANCE/APPLICATION

T2 relaxation time is a biochemical value used to assess TMJ pathology. A 3.0 T MRI provides a proper selection of ROIs, leading to a more accurate TMJ disorder diagnosis.

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Vascular Imaging Monday Poster Discussions

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PD05-A
Pediatric Thursday Poster Discussions

Sub-Events

PD05-A1   Automated Bone Age Assessment In A Retrospective Cohort Of German Children From The Clinical Routine: Agreement Between Ai And Expert Readers

Participants
Matthew DiFranco, Vienna, Austria (*Presenter*) Chief Scientific Officer, IB Lab GmbH

PURPOSE

In this study we evaluate the agreement between AI and expert readers for bone age (BA) assessment according to the Greulich & Pyle method.*Methods and Materials Radiographs of 259 patients were analyzed retrospectively (133 males aged 2 to 17 years, 126 females aged 2 to 16 years). Two pediatric radiologists and one pediatric endocrinologist made blind reads of BA using the Greulich & Pyle (GP) method independently, and an AI-software was subsequently used to estimate BA from the same images. Agreement of AI with readers was assessed based on mean absolute deviation (MAD) and root mean squared deviation (RMSD), as well as via comparison of Bland-Altman limits of agreement (LOA).*Results MAD and RMSD of AI vs. reader average (0.51 and 0.66 years) was less than that for the mean of three reader pairs (0.66 and 0.86 years, p<0.05 for each reader pair). Bland-Altman LOA between AI and reader average was (-1.22, 1.35 years), well within the mean LOAs of the three reader pairings (-1.62, 1.75 years).*Conclusions A fully automated AI software shows agreement with expert readers in BA assessment on a cohort of German children and adolescents, suggesting AI integration into the radiology workflow is possible and could lead to more efficient bone age reading.*Clinical Relevance/Application The radiological determination of BA from a left-hand x-ray continues to be the reference standard for skeletal maturity assessment related to short or long stature, premature or delayed puberty, and underlying conditions. Artificial intelligence (AI) algorithms are becoming more prevalent due to the subjectivity and time-consuming nature of BA assessment.

RESULTS

MAD and RMSD of AI vs. reader average (0.51 and 0.66 years) was less than that for the mean of three reader pairs (0.66 and 0.86 years, p<0.05 for each reader pair). Bland-Altman LOA between AI and reader average was (-1.22, 1.35 years), well within the mean LOAs of the three reader pairings (-1.62, 1.75 years).

CLINICAL RELEVANCE/APPLICATION

The radiological determination of BA from a left-hand x-ray continues to be the reference standard for skeletal maturity assessment related to short or long stature, premature or delayed puberty, and underlying conditions. Artificial intelligence (AI) algorithms are becoming more prevalent due to the subjectivity and time-consuming nature of BA assessment.

PD05-A2   Impact Of Patient Shielding Discontinuation On Repeat Rates And Speed Of Service In Pediatric Digital Radiography

Participants
Jan Pachon, chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study is to compare clinical repeat rates (RR) and speed of service of pediatric digital radiography before and after discontinuing the routine use of patient shielding. Many years of research have shown that shields provide negligible benefits to patients while the associated risks of shielding can be substantial. It is for this reason that the AAPM and other professional societies have recommended to eliminate the routine use of patient shields. In October 2020, we implemented this recommendation and only provided a shield at the request of the patient. We assess how the discontinuation of all routine patient shielding has impacted RR and speed of service.*Methods and Materials The RR and reasons for repeated digital radiographs were documented over the course of 19 months, 12 months during which patient shielding was routinely used and 7 months after shields were discontinued. Shielding related repeats were documented as either patient motion or artifacts whenever a shield interfered with the exam quality. We compared the RR of these repeat reasons with and without routine shielding for abdomen and pelvis exams. We also evaluated speed of service before and after shielding discontinuation by getting the difference between exam time as stamped in the RIS to the time of image availability on PACS. To minimize the time technologists spend explaining the change in practice, we developed a patient awareness campaign called "So long Shields!".*Results The average RR of digital radiographs with routine shielding due to patient motion was 10.06%±0.34 and 7.7%±0.25 due to artifacts. In the span of seven months after shielding was discontinued, the average patient motion related RR was 7.43%±0.37 and 5.84%±0.36 from artifacts. These results indicate a ~2.6% and 1.9% decrease (p<0.05) in patient motion and artifact related repeats, respectively, without shielding (figure. 1). A comparison of RR for abdomen and pelvis exams before and after shielding discontinuation shows a decrease in motion related repeats of ~9% and ~1.8% for abdomen and pelvis exams, respectively. An evaluation of speed of service indicates negligible differences (p>0.05) when shielding was discontinued (figure. 2).*Conclusions We found the overall RR without routine patient shielding significantly lower than when shielding was routinely used. This is particularly true for abdomen and pelvis exams where patient motion could cause a shield to move and obscure anatomy. We were also able to show that through a patient awareness campaign on the rationale for not shielding, speed of service was not impacted.*Clinical Relevance/Application Based on our findings, we encourage other institutions to assess their own departmental RRs and consider discontinuing all routine patient

shielding.

RESULTS

The average RR of digital radiographs with routine shielding due to patient motion was 10.06%±0.34 and 7.7%±0.25 due to artifacts. In the span of seven months after shielding was discontinued, the average patient motion related RR was 7.43%±0.37 and 5.84%±0.36 from artifacts. These results indicate a ~2.6% and 1.9% decrease (p<0.05) in patient motion and artifact related repeats, respectively, without shielding (figure. 1). A comparison of RR for abdomen and pelvis exams before and after shielding discontinuation shows a decrease in motion related repeats of ~9% and ~1.8% for abdomen and pelvis exams, respectively. An evaluation of speed of service indicates negligible differences (p>0.05) when shielding was discontinued (figure. 2).

CLINICAL RELEVANCE/APPLICATION

Based on our findings, we encourage other institutions to assess their own departmental RRs and consider discontinuing all routine patient shielding.

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Sub-Events

SDP-IR-10   **Comparing Midterm Clinical Outcomes Of Subintimal Angioplasty Vs Primary Stenting In TASC C And D Superficial Femoral Artery Disease**

Participants
Ansan Joseph, MD, Ahmedabad, India (*Presenter*) Nothing to Disclose

PURPOSE

There is still no definitive consensus regarding primary or selective stenting in TASC C and D lesions superficial femoral arterial disease (SFAD). The aim of this study was to compare clinical outcomes of subintimal angioplasty vs primary stenting in TASC C AND D SFAD.*Methods and Materials A single centre retrospective analysis was performed of all consecutive patients undergoing endovascular treatment for TASC C and D SFAD from 2018 to 2021. Primary endpoints were primary and secondary clinical patency rates. Secondary endpoints were ulcer healing, amputation free survival rate, limb salvage rate, improvement in ABPI, rest and claudication pain and occurrence of major adverse cardiac events, Kaplan-Meier curves were used to compare patency rates. Multivariable Cox regression analysis was performed to adjust for confounding variables which may affect patency rates*Results A total of 55 patients were analysed with a median follow up of 30 months. 17 patients (30.9%) were stented(PTA-S group). Primary clinical patency rates at 12,18 and 24 months were 88%, 85%, and 82% after subintimal angioplasty (PTA group)and 90%, 88%, and 86% after stent placement(PTA-S group) respectively. Secondary patency rates were also comparable for the PTA and PTA-S group. Multivariable analysis showed comparable primary and secondary clinical patency between both the groups. The re-intervention rate, amputation free survival rate, limb salvage rate did not significantly differ between the two groups.*Conclusions The clinical outcomes of patients with TASC C AND D Superficial Femoral artery disease treated with subitimal angioplasty alone is comparable with primary stenting in mid term followup. So an approach of optional stenting can be followed in these patients with cost effectiveness and good clinical outcomes.*Clinical Relevance/Application There is still no definitive consensus regarding primary or selective stenting in TASC C and D lesions superficial femoral arterial disease (SFAD). Our study suggests that by performing optional stenting only in cases with residual dissections/stenosis post angioplasty will lead to good clinical outcomes and bring down the treatment cost significantly.

RESULTS

A total of 55 patients were analysed with a median follow up of 30 months. 17 patients (30.9%) were stented(PTA-S group). Primary clinical patency rates at 12,18 and 24 months were 88%, 85%, and 82% after subintimal angioplasty (PTA group)and 90%, 88%, and 86% after stent placement(PTA-S group) respectively. Secondary patency rates were also comparable for the PTA and PTA-S group. Multivariable analysis showed comparable primary and secondary clinical patency between both the groups. The re-intervention rate, amputation free survival rate, limb salvage rate did not significantly differ between the two groups.

CLINICAL RELEVANCE/APPLICATION

There is still no definitive consensus regarding primary or selective stenting in TASC C and D lesions superficial femoral arterial disease (SFAD). Our study suggests that by performing optional stenting only in cases with residual dissections/stenosis post angioplasty will lead to good clinical outcomes and bring down the treatment cost significantly.

SDP-IR-11   **Interventional Oncolytic Therapy For Residual Tumor After Incomplete Radiofrequency Ablation**

Participants
Guanhui Zhou, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the feasibility of interventional oncolytic therapy for residual tumor after incomplete radiofrequency ablation (iRFA).*Methods and Materials This study included in vitro experiments using VX2 tumor cells and in vivo validation experiments on rabbit models with VX2 liver cancer. The content included (1) optimizing ICG dose and ICG time-window for intracellular uptake by VX2 tumor cells;; and (2) validating the feasibility using ICG-based OI to assess efficacy of RFH-enhanced oncolytic therapy (LTX-315) for treatment of same cancers. The cells treatment was divided into four groups: (1) RFH alone at 42?°C for 30?min; (2) oncolytic therapy with LTX-315 alone; (3) combination therapy of oncolytic therapy plus RFH; and (4) saline to serve as a control group. The residual tumor treatment of rabbits in three group (n=6/group) were were treated by:(1) 2-mg LTX-315; (2) 4-mg LTX-315; and (3) saline to serve as a control group. MTS assay, fluorescence microscopy, and flow cytometry were used to compare cell viabilities and apoptosis. Optical imaging of ICG was performed using Bruker optical/x-ray imaging system. For in vivo validation, LTX-315 was directly infused into rabbit residual liver cancer after iRFA treatment through a multi-functional perfusion-thermal RF electrode. Ultrasound were used to follow up size of tumors overtime, which were correlated with subsequent histology.*Results For in vitro experiments, ICG taken up by tumor cells was linearly increased from 0 to 100 μg/mL with the optimized concentration at 100 μg/mL, while ICG-SI reached the peak at 24 hours. MTS assay and apoptosis analysis demonstrated the lowest cell viability and highest apoptosis in combination therapy, compared to other three groups (p<0.001). ICG-enhanced interventional optical imaging showed a significantly decreased SI in combination therapy, which was confirmed by the optical/x-ray imaging. For in vivo experiments, ultrasound imaging showed the smaller tumor volume in 2-mg LTX-315 therapy group compared to control group (p < .05), and all the tumors were observed to disappear in the 4-mg LTX-315 treatment group, which were well correlated with

pathologic analysis.*Conclusions It is feasible of interventional oncolytic therapy of residual liver cancer after iRFA through RFH-enhanced effect and apoptotic/anti-tumor immunity pathways, which may open new avenues to prevent residual or recurrent disease of thermally ablated intermediate-to-large liver cancer.*Clinical Relevance/Application Interventional oncolytic therapy can be used for treatment of residual tumor after incomplete radiofrequency ablation (iRFA)

RESULTS

For in vitro experiments, ICG taken up by tumor cells was linearly increased from 0 to 100 μg/mL with the optimized concentration at 100 μg/mL, while ICG-SI reached the peak at 24 hours. MTS assay and apoptosis analysis demonstrated the lowest cell viability and highest apoptosis in combination therapy, compared to other three groups (p<0.001). ICG-enhanced interventional optical imaging showed a significantly decreased SI in combination therapy, which was confirmed by the optical/x-ray imaging. For in vivo experiments, ultrasound imaging showed the smaller tumor volume in 2-mg LTX-315 therapy group compared to control group (p < .05), and all the tumors were observed to disappear in the 4-mg LTX-315 treatment group, which were well correlated with pathologic analysis.

CLINICAL RELEVANCE/APPLICATION

Interventional oncolytic therapy can be used for treatment of residual tumor after incomplete radiofrequency ablation (iRFA)

SDP-IR-12   Creation Of A Novel 3D-Printed Benchtop Simulator For Percutaneous Transhepatic Cholangioscopy

Participants
David Gullotti, MD, Baltimore, Maryland (*Presenter*) Co-founder, SpineAlign Medical, Inc

PURPOSE

To create a 3D-printed benchtop simulator that enables trainees to practice endoscopic manipulation and interventions such as stone retrieval under ether direct or fluoroscopic visualization.*Methods and Materials A 3D model representing the gallbladder, cystic, hepatic, and common bile ducts was created using Solidworks computer aided design software. A hobbyist-grade 3D printer (Prusa i3 MKSS, Czech Republic) was used to print the two-part model using Prusament Polylactic Acid (PLA) filament. Screw holes were tapped to accommodate 10-32 radiolucent nylon screws . A laser cutter (Universal Laser systems, USA) cut ¼" acrylic sheets with a matching contour to the underlying 3D-printed model. A cholangioscope (Boston Scientific, USA) was used within the channels of the printed model, and fluoroscopic images were obtained.*Results The benchtop model accommodated the cholangioscope throughout its intraluminal channels and an introducer sheath within the gallbladder access site. Both anterograde and retrograde ductal access was obtained. The multiple branch design of the hepatic ducts enabled the user to practice scope location awareness and targeted navigation. The disassembling, two-part design allowed for placement of simulated obstructing stones with which retrieval could be practiced. The radiolucent build materials allowed for visualization with fluoroscopic imaging and the optional clear acrylic top allowed for direct visualization, although this resulted in minor glare from reflected light.*Conclusions This work presents the design and successful use of a novel tool for trainees to practice scope positional awareness, manipulation, and associated biliary interventions with either direct or fluoroscopic visualization.*Clinical Relevance/Application The applications of percutaneous transhepatic cholangioscopy (PTCS) are expanding within Interventional Radiology. This in-house model enables trainees to practice endoscope manipulation and treatment maneuvers.

RESULTS

The benchtop model accommodated the cholangioscope throughout its intraluminal channels and an introducer sheath within the gallbladder access site. Both anterograde and retrograde ductal access was obtained. The multiple branch design of the hepatic ducts enabled the user to practice scope location awareness and targeted navigation. The disassembling, two-part design allowed for placement of simulated obstructing stones with which retrieval could be practiced. The radiolucent build materials allowed for visualization with fluoroscopic imaging and the optional clear acrylic top allowed for direct visualization, although this resulted in minor glare from reflected light.

CLINICAL RELEVANCE/APPLICATION

The applications of percutaneous transhepatic cholangioscopy (PTCS) are expanding within Interventional Radiology. This in-house model enables trainees to practice endoscope manipulation and treatment maneuvers.

SDP-IR-13   Downstaging Locally Advanced Pancreatic Cancer To Resectability: Perivascular Ablation Using An Intra-arterial Balloon Laser Catheter In Pigs

Participants
Franz E. Boas, MD,PhD, Duarte, California (*Presenter*) Co-founder, CLARIPACS, LLC;Investor, Labdoor;Investor, Qventus, Inc;Investor, CloudMedx;Investor, Notable Labs;Investor, XGenomes Corp;Research support, Bayer AG;Research support, General Electric Company;Speaker, Guerbet SA;Research Grant, Guerbet SA;Research support, Guerbet SA;Research support, STEBA Biotech NV;Research support, Terumo Corporation

PURPOSE

In 20-30% of non-metastatic pancreatic cancer, surgical resection is not possible because of involvement of crucial arteries such as the superior mesenteric artery (SMA). Ablation of perivascular tumor could potentially downstage these patients to allow pancreatectomy. Here, we present initial pre-clinical safety data on intra-arterial vascular targeted photodynamic therapy (VTP), using a balloon laser catheter to illuminate the perivascular tissues and activate the VTP agent.*Methods and Materials Percutaneous intra-arterial VTP was performed in 2 pigs, using a balloon laser catheter. From femoral artery access, an 8 F clear silicone balloon catheter was advanced into the right external iliac artery (which is the same size as the human SMA). A laser fiber with a 1 cm cylindrical diffuser was advanced into the balloon catheter. Heparin (100 U/kg) and a photosensitizer (WST-11, 4 mg/kg) were infused intravenously. The balloon was inflated with 1 ml of 50% contrast, and the laser fiber was illuminated (753 nm, 300 mW) for 20 minutes. The balloon was periodically deflated (1 minute every 5 minutes), and the catheter was flushed, to prevent clot formation and distal ischemia. Safety was evaluated by catheter angiography and necropsy after VTP ablation. Light delivery was evaluated with the balloon laser catheter placed in either saline or the common femoral artery (1 pig).*Results Catheter angiography after intra-arterial VTP showed no thrombus or arterial injury. Gross pathology showed no injury to the arterial wall. 82% of light energy was delivered 5 mm outside the balloon in the femoral artery, compared to saline.*Conclusions Endovascular VTP can be safely performed using a balloon laser catheter. Laser energy is delivered 360° around the artery, to a depth of at least 5 mm outside the artery.*Clinical Relevance/Application An intra-arterial balloon laser catheter, combined with an intravenous photosensitizer, could be used for non-thermal ablation of pancreatic tumors encasing the SMA, to downstage to resectability.

RESULTS

Catheter angiography after intra-arterial VTP showed no thrombus or arterial injury. Gross pathology showed no injury to the arterial wall. 82% of light energy was delivered 5 mm outside the balloon in the femoral artery, compared to saline.

CLINICAL RELEVANCE/APPLICATION

An intra-arterial balloon laser catheter, combined with an intravenous photosensitizer, could be used for non-thermal ablation of pancreatic tumors encasing the SMA, to downstage to resectability.

SDP-IR-14 Effect Timing Of Endovascular Repair On Long-term Outcomes Of Uncomplicated Acute Type B Aortic Dissection

Participants
Dongqiao Xiang, MD, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To compare 5-year outcomes of acute versus subacute thoracic endovascular aortic repair (TEVAR) in patients with uncomplicated acute type B aortic dissection (ATBAD).*Methods and Materials Between March 2008 and September 2018, 238 consecutive patients with uncomplicated ATBAD received the TEVAR treatment in the acute or subacute phase were retrospectively analyzed. The primary endpoints were all-cause death and aortic-related death. The second endpoint was composite outcomes of death from any cause or dissection-related severe complications. Inverse probability treatment weighting (IPTW) was used to balance baseline characteristics. Weight-adjusted Kaplan-Meier estimate with landmark analysis and weighted Cox model were performed to assess time-to-event outcomes.*Results In the IPTW-adjusted population, the 30-day mortality was 1.5% in the acute group and 0% in the subacute group (P = 0.24). The incidence of 30-day adverse events occurred in 16.8% and 6.9% patients in the acute and subacute group, respectively (P = 0.13). At 5 years, there was no statistically significant difference in all-cause death (hazard ratio [HR], 1.50; 95% confidence interval [CI], 0.59-3.81; P = 0.39) and aortic-related death (HR, 1.11; 95% CI, 0.34-3.60; P = 0.86) between two groups. The composite outcomes occurred in 30 (23.0%) patients in the acute group and 18 (22.3%) patients in the subacute group, respectively (HR, 0.67; 95% CI, 0.36-1.25; P = 0.20). There was a significant interaction between treatment effect and time (Pinteraction = 0.01), with a significantly higher incidence of the composite outcomes in the acute group at 1 year (HR, 0.25; 95% CI, 0.08-0.79; P = 0.02) but a lower incidence between 1 and 5 years (HR, 1.25; 95% CI, 0.56-2.76; P = 0.59).*Conclusions At 5-year follow-up, no significant differences exist in the all-cause death and aortic-related death between acute and subacute TEVAR. However, acute TEVAR is associated with an increased rate of severe complications within 1 year. Waiting until the subacute stage to perform TEVAR treatment may be the best option with a low risk of early complications and a favorable long-term prognosis.*Clinical Relevance/Application TEVAR in the subacute phase was associated with lower early complications and similar long-term survival compared with acute TEVAR in patients with uncomplicated acute type B aortic dissection. Waiting until the subacute stage to perform TEVAR treatment may be the best option.

RESULTS

In the IPTW-adjusted population, the 30-day mortality was 1.5% in the acute group and 0% in the subacute group (P = 0.24). The incidence of 30-day adverse events occurred in 16.8% and 6.9% patients in the acute and subacute group, respectively (P = 0.13). At 5 years, there was no statistically significant difference in all-cause death (hazard ratio [HR], 1.50; 95% confidence interval [CI], 0.59-3.81; P = 0.39) and aortic-related death (HR, 1.11; 95% CI, 0.34-3.60; P = 0.86) between two groups. The composite outcomes occurred in 30 (23.0%) patients in the acute group and 18 (22.3%) patients in the subacute group, respectively (HR, 0.67; 95% CI, 0.36-1.25; P = 0.20). There was a significant interaction between treatment effect and time (Pinteraction = 0.01), with a significantly higher incidence of the composite outcomes in the acute group at 1 year (HR, 0.25; 95% CI, 0.08-0.79; P = 0.02) but a lower incidence between 1 and 5 years (HR, 1.25; 95% CI, 0.56-2.76; P = 0.59).

CLINICAL RELEVANCE/APPLICATION

TEVAR in the subacute phase was associated with lower early complications and similar long-term survival compared with acute TEVAR in patients with uncomplicated acute type B aortic dissection. Waiting until the subacute stage to perform TEVAR treatment may be the best option.

SDP-IR-15 Long Term Improvement In Body Composition Of Cirrhotic Patients With Sarcopenia After Transjugular Intrahepatic Portosystemic Shunt Creation

Participants
Jiacheng Liu, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

Sarcopenia is a frequent complication in patients with cirrhosis. This study was aimed to evaluate the time-course changes of CT-based body composition in cirrhotic patients after transjugular intrahepatic portosystemic shunt (TIPS) placement.*Methods and Materials We retrospectively analyzed 224 patients who underwent TIPS procedure between August 2016 and May 2020. Skeletal muscle area (SMA), skeletal muscle index (SMI), subcutaneous fat area (SFA) and subcutaneous fat thickness (SFT) were evaluated through CT images at baseline and at 1-3, 3-6 and 9-12 months after TIPS placement.*Results After TIPS insertion, increasing age (HR 1.049, 95%CI 1.023-1.077), higher model for end-stage liver disease (MELD) score (HR 1.118, 95%CI 1.055-1.186) and lower SMI (HR 0.895, 95%CI 0.849-0.945) were identified as independent risk factors for mortality. In patients with sarcopenia, SMA and SMI increased significantly at 3-6 months post-TIPS and maintained a constant level at 9-12 months post-TIPS, while SFA and SFT increased significantly in males but not in females. However, in patients without sarcopenia, no significant difference was found in the variation tendency of SMA, SMI, SFA and SFT. Additionally, the mean ascitic-free weight and body mass index (BMI) increased significantly in sarcopenia patients but nonsignificantly in non-sarcopenia patients at 12 months after TIPS placement.*Conclusions Sarcopenia was independently associated with the risk of death and could be reversed after TIPS creation. The improvement of weight, BMI, skeletal muscle and subcutaneous fat mass following TIPS was more pronounced in sarcopenia patients compared with non-sarcopenia patients.*Clinical Relevance/Application In this work, we evaluated the time-course changes of CT-based body composition included skeletal muscle area (SMA), skeletal muscle index (SMI), subcutaneous fat area (SFA), subcutaneous fat thickness (SFT), weight and body mass index (BMI) in cirrhotic patients after transjugular intrahepatic portosystemic shunt (TIPS) placement. We found that sarcopenia was independently associated with the risk of death and could be reversed after TIPS creation. Additionally, the improvement of weight, BMI, skeletal muscle and subcutaneous fat mass following TIPS was more pronounced in sarcopenia patients compared with non-sarcopenia patients.

RESULTS

After TIPS insertion, increasing age (HR 1.049, 95%CI 1.023-1.077), higher model for end-stage liver disease (MELD) score (HR 1.118, 95%CI 1.055-1.186) and lower SMI (HR 0.895, 95%CI 0.849-0.945) were identified as independent risk factors for mortality. In patients with sarcopenia, SMA and SMI increased significantly at 3-6 months post-TIPS and maintained a constant level at 9-12 months post-TIPS, while SFA and SFT increased significantly in males but not in females. However, in patients without sarcopenia, no significant difference was found in the variation tendency of SMA, SMI, SFA and SFT. Additionally, the mean ascitic-free weight and body mass index (BMI) increased significantly in sarcopenia patients but nonsignificantly in non-sarcopenia patients at 12 months after TIPS placement.

CLINICAL RELEVANCE/APPLICATION

In this work, we evaluated the time-course changes of CT-based body composition included skeletal muscle area (SMA), skeletal muscle index (SMI), subcutaneous fat area (SFA), subcutaneous fat thickness (SFT), weight and body mass index (BMI) in cirrhotic patients after transjugular intrahepatic portosystemic shunt (TIPS) placement. We found that sarcopenia was independently associated with the risk of death and could be reversed after TIPS creation. Additionally, the improvement of weight, BMI, skeletal muscle and subcutaneous fat mass following TIPS was more pronounced in sarcopenia patients compared with non-sarcopenia patients.

SDP-IR-16   Percutaneous Transesophageal Gastric-tube Placement As A Viable Option For Patients Who Cannot Receive Conventional Enteral Access

Participants
Lisa Rotellini-Coltvet, Phoenix, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

Percutaneous transesophageal gastric-tube (PTEG) placement is performed by interventional radiologists in patients with a contraindication to percutaneous gastrostomy.*Methods and Materials We retrospectively reviewed the medical records and imaging of patients who underwent PTEG placement within our multisite institution from 2014 to 2021. Demographics, clinical history, imaging, and outcomes for each patient were obtained and reviewed via electronic medical records to determine technical success rate, major and minor complications related to the procedure, relief of symptoms, time to discharge, PTEG associated readmissions, and catheter longevity.*Results Between 2014-2020, forty-six PTEG procedures were attempted. There were 23 males, 23 females with an average age of 56.3 years (range 22-83 years). Gastric venting from malignant bowel obstruction (42/46, 91.3%) was the most common indication for the procedure. The most common contraindication for percutaneous gastrostomy was peritoneal carcinomatosis (25/46, 54%) followed by ascites (23/46, 50%) and invasive gastric cancer (6/46, 13%). Median ECOG scores were 2.5 (range 1-4). Technical success in the placement of a PTEG was 44/46, 95.7%. In 1 patient, fibrosis due to radiation therapy precluded percutaneous access to the esophagus . Intraprocedural aspiration resulting from emesis during balloon inflation was reported (n=1; (2.2%)). The most common immediate post procedural issues reported were mild throat pain (n=1; 2.2%) which was resolved with oral viscous lidocaine. The most common delayed issue was migration of the PTEG (n=2). There was 1 death resulting from aspiration pneumonitis. Using the Edmonton Symptom Assessment Scale (ESAS) and the Karnofsky Performance Scale (KPS), patency rates and relief of obstructive symptoms were 100% at 0, 7, and 14 days on average post procedure.*Conclusions PTEG placement can provide symptomatic relief to terminally ill patients; ESAS and KPS scores were 100% up to 14 days post-placement. No association was identified between ECOG score and major/minor complication rates (p>0.05). PTEG is a viable option for venting given staff and patients are educated appropriately to prevent misuse.*Clinical Relevance/Application This study has introduced a novel technique to help patients gain symptomatic control of malignant small bowel obstruction who otherwise would not meet conventional criteria for traditional approaches.

RESULTS

Between 2014-2020, forty-six PTEG procedures were attempted. There were 23 males, 23 females with an average age of 56.3 years (range 22-83 years). Gastric venting from malignant bowel obstruction (42/46, 91.3%) was the most common indication for the procedure. The most common contraindication for percutaneous gastrostomy was peritoneal carcinomatosis (25/46, 54%) followed by ascites (23/46, 50%) and invasive gastric cancer (6/46, 13%). Median ECOG scores were 2.5 (range 1-4). Technical success in the placement of a PTEG was 44/46, 95.7%. In 1 patient, fibrosis due to radiation therapy precluded percutaneous access to the esophagus . Intraprocedural aspiration resulting from emesis during balloon inflation was reported (n=1; (2.2%)). The most common immediate post procedural issues reported were mild throat pain (n=1; 2.2%) which was resolved with oral viscous lidocaine. The most common delayed issue was migration of the PTEG (n=2). There was 1 death resulting from aspiration pneumonitis. Using the Edmonton Symptom Assessment Scale (ESAS) and the Karnofsky Performance Scale (KPS), patency rates and relief of obstructive symptoms were 100% at 0, 7, and 14 days on average post procedure.

CLINICAL RELEVANCE/APPLICATION

This study has introduced a novel technique to help patients gain symptomatic control of malignant small bowel obstruction who otherwise would not meet conventional criteria for traditional approaches.

SDP-IR-17   Semi-automatic MRI Feature Assessment In Small- And Medium Volume Benign Prostatic Hyperplasia After Prostatic Artery Embolization

Participants
Vanessa Schmidt, MD, Munich, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To assess the treatment response of benign prostatic syndrome (BPS) following prostatic artery embolization (PAE) using a semi-automatic analysis of magnetic resonance imaging (MRI) features and clinical indexes.*Methods and Materials In this prospective monocenter trial we analyzed MR and clinical data of n=20 patients with symptomatic BPS before and after (1, 6, 12 months) PAE. MR image analysis was performed using a dedicated semi-automatic software for segmentation of the central and the total gland (CG, TG), respectively: signal intensities (SI) of T1-weighted (T1w), T2-weighted (T2w), and diffusion weighted images (DWI), intravesical prostatic protrusion (IPP), and prostatic volumes (CGV, TGV) were evaluated at each time point. The semi-automatic calculation of TGV was compared to the conventional calculation of TGV by the ellipse formula. International prostate symptom score (IPSS) and international consultation on incontinence questionnaire-urinary incontinence short form (ICIQ-UI SF) were used as clinical indexes. Substratification analysis by baseline TGV =60 mL and >60 mL was performed. Statistical testing in form of ANOVA, pairwise comparisons using Bonferroni correction, and multiple linear correlations were conducted using SPSS with p<0.05 considered significant.*Results TGV was significantly reduced at 1, 6, and 12 months after PAE assessed by the semi-automatic approach and the conventional ellipse formula (p=0.005; p=0.025). CGV presented significantly decreased 1 month after

embolization (p=0.038). There were no significant differences in CGV before and 6 and 12 months after PAE (p=0.191; p=0.283). 90 % of the patients demonstrated IPP at baseline with a significant decrease at 1, 6, and 12 months after treatment (p=0.028; p=0.010; p=0.008). ADC values of CG significantly decreased 1 month after embolization (p<0.001). There were no significant differences in T1w- and T2w-SI before and after treatment at each time point. All patients showed significant improvement in IPSS and ICIQ-UI SF 1 (p=0.002; p=0.016) and 6 months (p<0.001; p=0.020) after embolization compared to baseline values.*Conclusions MRI is an adequate method for assessing morphological and functional changes of the prostate gland following PAE confirming the concept that PAE leads to significant reduction in TGV and CGV and a decreased IPP already 1 month after therapy.*Clinical Relevance/Application The minimal increase of prostatic volume and IPP as well as the recurrence of clinical symptoms at 12 months indicate a slightly decreased long-term success compared to the short-term results.

RESULTS

TGV was significantly reduced at 1, 6, and 12 months after PAE assessed by the semi-automatic approach and the conventional ellipse formula (p=0.005; p=0.025). CGV presented significantly decreased 1 month after embolization (p=0.038). There were no significant differences in CGV before and 6 and 12 months after PAE (p=0.191; p=0.283). 90 % of the patients demonstrated IPP at baseline with a significant decrease at 1, 6, and 12 months after treatment (p=0.028; p=0.010; p=0.008). ADC values of CG significantly decreased 1 month after embolization (p<0.001). There were no significant differences in T1w- and T2w-SI before and after treatment at each time point. All patients showed significant improvement in IPSS and ICIQ-UI SF 1 (p=0.002; p=0.016) and 6 months (p<0.001; p=0.020) after embolization compared to baseline values.

CLINICAL RELEVANCE/APPLICATION

The minimal increase of prostatic volume and IPP as well as the recurrence of clinical symptoms at 12 months indicate a slightly decreased long-term success compared to the short-term results.

SDP-IR-18 Lower Gastrointestinal Bleeding: Differences In Outcomes Between Patients Undergoing Primary Endovascular Vs Primary Endoscopic Interventions

Participants
Alexander Villalobos, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

To compare mortality and hospital length of stay (LOS) for patients with lower gastrointestinal bleeding (LGIB) treated with primary endovascular intervention (PEI) versus primary gastroenterology endoscopic intervention (PGEI).*Methods and Materials Using ICD codes, all LGIB encounters and associated diagnostic and therapeutic procedures were identified using 2005-2015 United States National Inpatient Sample databases. LGIB encounters first treated with angiography and/or embolization were classified as PEI; those first treated with diagnostic and/or therapeutic endoscopy were classified as PGEI. To reduce treatment selection bias during statistical analysis, remaining LGIB encounters first treated with surgery or conservative management were excluded. Prolonged LOS was defined as >7 inpatient days. Odds ratios (OR) for mortality and prolonged LOS were evaluated using multivariate logistic regression after propensity score matching of multiple clinically relevant baseline covariates.*Results Of the 617,735 LGIB encounters identified, PEI and PGEI were used in 4,702 and 143,718 encounters, respectively. The mean age, gender, and ethnicity of the overall study cohort was 69 ± 16 years old, 54% female, and 73% Caucasian, respectively. With PGEI set as the reference treatment group, PEI was associated with increased risk of mortality (OR=3.16 [95% CI 2.97-3.36], p<0.001) and prolonged LOS (OR=3.57 [95% CI 3.05-4.18], p<0.001).*Conclusions Compared to primary endoscopic intervention, inpatients with LGIB initially treated with primary endovascular intervention were associated with increased risk of both mortality and prolonged hospital length of stay.*Clinical Relevance/Application Inpatients with LGIB treated with primary endovascular intervention are associated with increased risk of mortality and prolonged hospital length of stay as compared to inpatients treated with primary endoscopic intervention, suggesting that primary endoscopic intervention should take precedence over primary endovascular intervention when such interventions are being considered.

RESULTS

Of the 617,735 LGIB encounters identified, PEI and PGEI were used in 4,702 and 143,718 encounters, respectively. The mean age, gender, and ethnicity of the overall study cohort was 69 ± 16 years old, 54% female, and 73% Caucasian, respectively. With PGEI set as the reference treatment group, PEI was associated with increased risk of mortality (OR=3.16 [95% CI 2.97-3.36], p<0.001) and prolonged LOS (OR=3.57 [95% CI 3.05-4.18], p<0.001).

CLINICAL RELEVANCE/APPLICATION

Inpatients with LGIB treated with primary endovascular intervention are associated with increased risk of mortality and prolonged hospital length of stay as compared to inpatients treated with primary endoscopic intervention, suggesting that primary endoscopic intervention should take precedence over primary endovascular intervention when such interventions are being considered.

SDP-IR-19 Patient Outcomes Following Upper Gastrointestinal Bleeding Vessel Embolization

Participants
J. Reed McGraw, BS, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Transcatheter arterial embolization (TAE) is frequently performed for patients with non-variceal upper gastrointestinal bleeding (UGIB) refractory to medical and endoscopic therapy. The purpose of this study was to evaluate the safety and efficacy of TAE with a particular focus on mucosal changes on post-embolization endoscopy.*Methods and Materials A retrospective review of patients undergoing arteriography for refractory non-variceal UGIB from 12/2003 - 8/2019 was performed. Patients less than 18 years old or those with UGIB secondary to acute trauma were excluded. Etiology of bleeding, embolization technique, pre- and post-embolization endoscopy results, and mortality were collected from the medical record and analyzed using multivariate logistic regressions.*Results A total of 283 patients underwent arteriography for UGIB. Of those, 277 patients underwent TAE. The most commonly treated etiologies of UGIB were ulcer (132) and bleeding mass (46). Post-TAE 30-day mortality was 26.5% (75/283). Intra-procedure complication rate was 6.4% (18/283) and was predominantly related to maldeployment. Rebleeding rate within the same admission was 22.2% (63/283). There was no correlation between the type of embolic used and mortality. Ninety-nine (99) patients underwent post-TAE endoscopy. Of those patients, 38 demonstrated new findings including 23 with macroscopic ulcer and 15 with mucosal inflammation. Sixty-one patients had no new findings in the vascular distribution of TAE. There was no correlation between the type of embolic used, performance of empiric embolization (i.e. embolization without arteriographic evidence of hemorrhage), and the vascular territory involved with post-TAE endoscopy findings. Interestingly, UGIB in the setting of bleeding

ulcer was significantly correlated with post-TAE macroscopic findings of inflammation (OR 5.32, p = .04). No patients in the study were found to have small bowel stenosis at the time of post-TAE endoscopy.*Conclusions TAE is a safe and effective intervention for patients with life-threatening UGIB. In our cohort, there were no differences in mortality or follow-up endoscopy findings based on the use of permanent (e.g. coils) or transient (e.g. Gelfoam) embolic. Further, TAE in the setting of bleeding ulcer was associated with mucosal healing as it was correlated with regression from ulcer to inflammation of the mucosa.*Clinical Relevance/Application Endoscopy findings following TAE for UGIB has remain underreported. The results of the presented study underscore the safety of TAE demonstrating that the type of embolic used and the location of embolization are not correlated with deleterious mucosal changes on endoscopic follow-up after intervention and may promote healing in some cases.

RESULTS

A total of 283 patients underwent arteriography for UGIB. Of those, 277 patients underwent TAE. The most commonly treated etiologies of UGIB were ulcer (132) and bleeding mass (46). Post-TAE 30-day mortality was 26.5% (75/283). Intra-procedure complication rate was 6.4% (18/283) and was predominantly related to maldeployment. Rebleeding rate within the same admission was 22.2% (63/283). There was no correlation between the type of embolic used and mortality. Ninety-nine (99) patients underwent post-TAE endoscopy. Of those patients, 38 demonstrated new findings including 23 with macroscopic ulcer and 15 with mucosal inflammation. Sixty-one patients had no new findings in the vascular distribution of TAE. There was no correlation between the type of embolic used, performance of empiric embolization (i.e. embolization without arteriographic evidence of hemorrhage), and the vascular territory involved with post-TAE endoscopy findings. Interestingly, UGIB in the setting of bleeding ulcer was significantly correlated with post-TAE macroscopic findings of inflammation (OR 5.32, p = .04). No patients in the study were found to have small bowel stenosis at the time of post-TAE endoscopy.

CLINICAL RELEVANCE/APPLICATION

Endoscopy findings following TAE for UGIB has remain underreported. The results of the presented study underscore the safety of TAE demonstrating that the type of embolic used and the location of embolization are not correlated with deleterious mucosal changes on endoscopic follow-up after intervention and may promote healing in some cases.

SDP-IR-2   Outpatient Percutaneous Radiofrequency Ablation Of Large, Benign, Symptomatic Thyroid Nodules: Preliminary Safety And Early Outcomes.

Participants
Michael L. Douek, MD, MBA, Santa Monica, California (*Presenter*) Nothing to Disclose

PURPOSE

To describe safety and outcomes in outpatient treatment of large, symptomatic thyroid nodules with radiofrequency ablation (RFA).*Methods and Materials Large, benign thyroid nodules (defined as nodules with estimated volumes of 20 cc or greater) were treated in 10 patients with radiofrequency ablation (RFA) between 2015 and 2021. All patients had biopsy-proven benign thyroid nodules which were causing cosmetic issues or compressive symptom and all patients declined surgery. Estimated nodule volumes, vascularity, and composition, and patient symptom and cosmetic scores were obtained on initial and follow-up visits. Number of ablation sessions, ablation technique, electrode size, and energy utilized were analyzed. Thyroid function before and after ablation and minor and major complications were recorded.*Results 11 large thyroid nodules were treated in 10 patients between 2015 and 2021. Mean pre-ablation nodule size was 54 cc (range 20 to 101 cc). In some cases, a staged, multisession approach, depending on nodule size, was used, allowing all except one case to be performed as a same-day outpatient procedure with local anesthesia only. The mean number of ablation sessions was 1.6 (range 1 to 3). All nodules were treated with real-time ultrasound guidance and the "moving shot" technique with specific avoidance and/or hydroprotection of peri-neural locations. Mean nodule volume reduction at 1, 6, and 12 months were 51%, 62%, and 86% respectively. All patients had cosmetic and/or symptomatic improvements, examples of which included improvement in hoarseness, breathing, and dysphagia. There were no minor or major complications, and no patient required thyroid hormone replacement.*Conclusions In conclusion, RFA of large thyroid nodules is technically feasible as a staged, outpatient-based procedure requiring only local anesthesia, yielding significant improvements in nodule size and patient symptoms, with a favorable risk profile. Outcomes in this series parallel those reported internationally and in other small U.S. case series.*Clinical Relevance/Application As has been seen in other countries, radiofrequency ablation is a viable, low-risk alternative to surgery for treating large symptomatic, benign thyroid nodules.

RESULTS

11 large thyroid nodules were treated in 10 patients between 2015 and 2021. Mean pre-ablation nodule size was 54 cc (range 20 to 101 cc). In some cases, a staged, multisession approach, depending on nodule size, was used, allowing all except one case to be performed as a same-day outpatient procedure with local anesthesia only. The mean number of ablation sessions was 1.6 (range 1 to 3). All nodules were treated with real-time ultrasound guidance and the "moving shot" technique with specific avoidance and/or hydroprotection of peri-neural locations. Mean nodule volume reduction at 1, 6, and 12 months were 51%, 62%, and 86% respectively. All patients had cosmetic and/or symptomatic improvements, examples of which included improvement in hoarseness, breathing, and dysphagia. There were no minor or major complications, and no patient required thyroid hormone replacement.

CLINICAL RELEVANCE/APPLICATION

As has been seen in other countries, radiofrequency ablation is a viable, low-risk alternative to surgery for treating large symptomatic, benign thyroid nodules.

SDP-IR-20   Evaluation Of Transarterial Radioembolization With Iodine-131 Lipiodol For Hepatic Metastases

Participants
Vineel Inampudi I, MD, Vijayawada, India (*Presenter*) Nothing to Disclose

PURPOSE

To analyse the response and survival benefits of TARE with Iodine- 131 Lipiodol for hepatic metastases.*Methods and Materials Prospective study of 600 patients between May 2015 to December 2020 with pathologically proven hepatic metastases referred for palliative therapy with transarterial radioembolization. At baseline (the day of the first session of intraarterial treatment), standard laboratory data including tumour marker levels and imaging characteristics of the liver and hepatic lesions from cross-sectional imaging(CT or MRI) , prior treatment history were recorded. Post procedure the patients were reviewed after one month with a follow up PET CT and tumour marker levels to evaluate response of treatment.*Results At the end of follow up period 84 patients died. The mean overall survival after TARE was 34.415±3.0 months. The mean duration of survival was found to be 38.88±5 months in patients with NET, 35.118±3.95 months in patients with GI malignancies, 27.21±8.3 months for patients with pancreatico-biliary

malignancies and 20.685±5.2 months for patients with other malignancies. (p=0.17). Overall survival after 45 months was 70%. 45 months survival in NET patients was 76% and 75% in GI malignancies, 57% in pancreatico-biliary and 50% in other malignancies. Response evaluation could not be done in 27 patients as they did not undergo follow up imaging. In the rest of the 489 patients, 266 patients showed a partial response, 155 patients showed stable disease and 66 patients showed progressive diseases. In 222 patients with NET, 169 patients showed a partial response, 30 patients showed stable disease and 23 patients showed progressive diseases. In 133 patients with GI malignancies, 95 patients showed a partial response, 25 patients showed stable disease and 13 patients showed progressive diseases. In 88 patients with pancreatico-biliary malignancies, 61 patients showed a partial response, 18 patients showed stable disease and 9 patients showed progressive diseases. All 46 patients with other malignancies showed stable disease.*Conclusions Transarterial radioembolization with I131-Lipiodol is highly effective in patients with hepatic metastases, especially in those with poor response to other treatments and has shown significant survival benefit and better quality of life. TARE with 131I-Lipiodol has an added advantage of being cost effective compared to TARE with 90Yttrium embedded microspheres in developing countries like India.*Clinical Relevance/Application All patients with hepatic metastases underwent multiple cycles of chemotherapy and other treatments with poor response / progressive disease . In this background , the treatment with 131I Lipiodol has shown improved response both clinically, biochemically and radiologically.

RESULTS

At the end of follow up period 84 patients died. The mean overall survival after TARE was 34.415±3.0 months. The mean duration of survival was found to be 38.88±5 months in patients with NET, 35.118±3.95 months in patients with GI malignancies, 27.21±8.3 months for patients with pancreatico-biliary malignancies and 20.685±5.2 months for patients with other malignancies. (p=0.17). Overall survival after 45 months was 70%. 45 months survival in NET patients was 76% and 75% in GI malignancies, 57% in pancreatico-biliary and 50% in other malignancies. Response evaluation could not be done in 27 patients as they did not undergo follow up imaging. In the rest of the 489 patients, 266 patients showed a partial response, 155 patients showed stable disease and 66 patients showed progressive diseases. In 222 patients with NET, 169 patients showed a partial response, 30 patients showed stable disease and 23 patients showed progressive diseases. In 133 patients with GI malignancies, 95 patients showed a partial response, 25 patients showed stable disease and 13 patients showed progressive diseases. In 88 patients with pancreatico-biliary malignancies, 61 patients showed a partial response, 18 patients showed stable disease and 9 patients showed progressive diseases. All 46 patients with other malignancies showed stable disease.

CLINICAL RELEVANCE/APPLICATION

All patients with hepatic metastases underwent multiple cycles of chemotherapy and other treatments with poor response / progressive disease . In this background , the treatment with 131I Lipiodol has shown improved response both clinically, biochemically and radiologically.

SDP-IR-21 Machine Learning-based Radiomic Features On Pre-ablation MRI As Predictors Of Pathologic Response In Patients With Hepatocellular Carcinoma (HCC) Who Underwent Hepatic Transplant

Participants
Azadeh Tabari, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this research was to develop a machine learning model to predict response to ablation therapy in patients with HCC, using pre-ablation MRI radiomics.*Methods and Materials This retrospective study was approved by IRB. From 2005 to 2015, 97 patients with HCC who underwent liver transplant were identified. A total of 112 radiomic features (shape, first-order, and texture) were extracted from each tumor, using contrast-enhanced MRIs that were performed within 3 months prior to ablation. Pathologic response was determined at liver transplant. The dataset was randomly partitioned into training and testing cohorts based on a 20% holdout validation. A kernel naïve bayes model was developed using minimum redundancy maximum relevance (mRMR) for feature selection. The final model included the top 46 features based on mRMR and performance was tested on the 20% holdout validation cohort. Univariate logistic regression (UVR) and ROC analysis was used to determine statistically significant features in predicting treatment response.*Results Ninety-seven patients (117 tumors, 31 (32%) microwave ablation, 66 (68%) radiofrequency ablation) were included. The mean model for end-stage liver disease (MELD) score was 10.5±3. Mean follow-up was 336.2±179 days. 38% of patients did not exhibit complete pathologic response on pathology review at the time of transplant. Two first-order and 2 GLRM features were associated with incomplete pathologic response on UVR analysis (P<0.05). The final machine-learning model included the top 46 radiomic features was predictive of incomplete pathologic response with the best AUC of 0.77, sensitivity of 100%, and specificity of 69%.*Conclusions The use of MRI radiomics with machine learning may enhance the ability to predict pathologic response to ablation therapy in patients with HCC underwent liver transplant.*Clinical Relevance/Application The machine learning based radiomics features analysis could provide a prediction model, and non-invasively explore the association between pre-ablation MRI images and pathological response in patients with HCC listed for hepatic transplant. This will allow us to personalize treatment for these patients and predict who will benefit from ablation therapy.

RESULTS

Ninety-seven patients (117 tumors, 31 (32%) microwave ablation, 66 (68%) radiofrequency ablation) were included. The mean model for end-stage liver disease (MELD) score was 10.5±3. Mean follow-up was 336.2±179 days. 38% of patients did not exhibit complete pathologic response on pathology review at the time of transplant. Two first-order and 2 GLRM features were associated with incomplete pathologic response on UVR analysis (P<0.05). The final machine-learning model included the top 46 radiomic features was predictive of incomplete pathologic response with the best AUC of 0.77, sensitivity of 100%, and specificity of 69%.

CLINICAL RELEVANCE/APPLICATION

The machine learning based radiomics features analysis could provide a prediction model, and non-invasively explore the association between pre-ablation MRI images and pathological response in patients with HCC listed for hepatic transplant. This will allow us to personalize treatment for these patients and predict who will benefit from ablation therapy.

SDP-IR-22 The Role Of Intra-arterial 177Lu-Dotatate Therapy In The Treatment Of Hepatic Metastasis From Neuroendocrine Tumors

Participants
Vineel Inampudi I, MD, Vijayawada, India (*Presenter*) Nothing to Disclose

PURPOSE

The propensity of currently practiced intravenous 177Lu therapy to produce side-effects warrants any novel techniques to reduce

the side-effects without compromising the dose delivered to the target areas. GEP-NETs have the tendency to metastasize to the liver, but seldomly to other organs. We have postulated the selective intra-arterial administration of 177Lu-DOTATATE to hepatic arteries will reduce unwanted side-effects and increasing the dose delivered to target areas due to the first-pass extraction of the radiopeptides by the tumor.*Methods and Materials A prospective evaluation of 654 patients who underwent intra-arterial Lu-177 DOTATATE therapy for hepatic neuroendocrine metastasis in our institution from June 2014 - January 2021 was done. CAPTEM-PRRT regimen based on Columbia university protocol as adopted in our study. RECIST and PERCIST crieterias were used to response evaluation based on pre-procedure and follow-up 68Ga-DOTANOC PET-CT.*Results We found that 88% (CR+PR) of patients had a significant radiological tumour response and 12% showed a stabilization of the disease. No patients were found to have progressive disease. All patients tolerated the procedure well, with none experiencing any significant procedure related acute side effects. None of the patients developed acute radiation induced liver disease or renal toxicity. Only 14 patients developed grade 1 to 2 hematological toxicity. Only 10 patients developed transient increase of hepatic enzymes, which normalized subsequently with no decrease in the total bilirubin levels. 50% patients showed partial response to therapy according to RECIST criteria and patients showed stable disease. All patients reported significant improvement in symptoms and sense of well-being after treatment initiation.*Conclusions Our initial experience of intra arterial administration of 177Lu-DOTATATE therapy in patients with liver dominant metastases from NET is promising, feasible, safe and tolerable. The preliminary therapeutic potential of this therapy is encouraging. However, further prospective studies are needed to show its impact in improving clinical outcomes, median survival and progression free survival.*Clinical Relevance/Application Intra-arterial 177Lu DOTATATE Therapy for hepatic metastases of neuroendocrine tumors is a well-tolerated treatment option in patients suffering from multiple, non-resectable hepatic metastases from NET. Since both loco-regional and systemic effects can be achieved by intra-arterial application of peptide-labeled radioactive isotopes, notably symptom control and treatment response seem to be superior to systemic intravenous protocols.

RESULTS

We found that 88% (CR+PR) of patients had a significant radiological tumour response and 12% showed a stabilization of the disease. No patients were found to have progressive disease. All patients tolerated the procedure well, with none experiencing any significant procedure related acute side effects. None of the patients developed acute radiation induced liver disease or renal toxicity. Only 14 patients developed grade 1 to 2 hematological toxicity. Only 10 patients developed transient increase of hepatic enzymes, which normalized subsequently with no decrease in the total bilirubin levels. 50% patients showed partial response to therapy according to RECIST criteria and patients showed stable disease. All patients reported significant improvement in symptoms and sense of well-being after treatment initiation.

CLINICAL RELEVANCE/APPLICATION

Intra-arterial 177Lu DOTATATE Therapy for hepatic metastases of neuroendocrine tumors is a well-tolerated treatment option in patients suffering from multiple, non-resectable hepatic metastases from NET. Since both loco-regional and systemic effects can be achieved by intra-arterial application of peptide-labeled radioactive isotopes, notably symptom control and treatment response seem to be superior to systemic intravenous protocols.

SDP-IR-23 Advanced Hepatocellular Carcinoma Treated By Transcatheter Arterial Chemoembolization With Drug-eluting Beads Plus Tyrosine Kinase Inhibitor: Lenvatinib Or Sorafenib?

Participants
Jiaping Li, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

This study aimed to investigate the safety and efficacy of DEB-TACE plus lenvatinib in comparison with that of DEB-TACE plus sorafenib for advanced HCC.*Methods and Materials The medical records of consecutive patients with advanced HCC who underwent DEB-TACE plus lenvatinib (DEB-TACE+LEN) or DEB-TACE plus sorafenib (DEB-TACE+SOR) between January 2017 and December 2020 were retrospectively reviewed. All patients were started on sorafenib (800mg/day) or lenvatinib (8mg/day (<60kg) or 12mg/day (=60kg)) 2-3 weeks prior to the first DEB-TACE session. Propensity score matching was performed to fit the baseline characteristics between the two groups. Adverse events (AEs), objective response rate (ORR), disease control rate (DCR), overall survival (OS) and time to progression (TTP) were compared between patients who underwent DEB-TACE+LEN and DEB-TACE+SOR.*Results A total of 150 patients were enrolled in this study. The patients in DEB-TACE+LEN group (n=50) showed significantly better ORR (64.0% vs. 33.3%; P=0.008), OS (hazard ratio [HR] =0.63, 95% confidence interval (CI): 0.41-0.98; P=0.043) and TTP (HR=0.65, 95%CI: 0.45-0.94; P=0.023) than that in DEB-TACE+SOR group (n=100). Subgroup analyses showed that in patients with portal vein tumor thrombus (PVTT), median OS and TTP were significantly longer in the DEB-TACE+LEN group than did the DEB-TACE+SOR group (HR=0.59, 95%CI: 0.36-0.98; P=0.043; HR=0.89, 95%CI: 0.35-2.29; P=0.035). The patients in DEB-TACE+LEN group had a significantly lower incidence of hand-foot skin reaction (32.0% vs. 49.0%; P=0.048), but a higher incidence of proteinuria (26.0% vs. 10.0%; P=0.010) than that in the DEB-TACE+SOR group. There was no significant difference in the rate of grade 3-4 AEs between the two groups.*Conclusions DEB-TACE combined with lenvatinib confers better ORR, OS and TTP than does DEB-TACE combined with sorafenib in patients with advanced HCC, especially patients with PVTT, with acceptable DEB-TACE-related and tyrosine kinase inhibitor (TKI)-related AEs, thus making it a superior treatment modality for these patients.*Clinical Relevance/Application Oral tyrosine kinase inhibitors (TKIs), including lenvatinib and sorafenib, are recommended as a standard therapy for advanced HCC. Recently, there were many results suggesting that DEB-TACE plus sorafenib is an effective and promising treatment for patients with advanced HCC. However, no studies on DEB-TACE plus lenvatinib for advanced HCC patients have been reported to date. The results of our study suggested that lenvatinib plus DEB-TACE is a potential therapeutic option for advanced HCC.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Oral tyrosine kinase inhibitors (TKIs), including lenvatinib and sorafenib, are recommended as a standard therapy for advanced HCC. Recently, there were many results suggesting that DEB-TACE plus sorafenib is an effective and promising treatment for patients

with advanced HCC. However, no studies on DEB-TACE plus lenvatinib for advanced HCC patients have been reported to date. The results of our study suggested that lenvatinib plus DEB-TACE is a potential therapeutic option for advanced HCC.

SDP-IR-24 Prognostic Tool For HCC Beyond Milan Criteria Undergoing Transarterial Chemoembolization After Transjugular Intrahepatic Portosystemic Shunt

Participants
Wenzhe Fan, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Currently, there is a need for a model that can predict the outcome of transarterial chemoembolization (TACE) in patients with hepatocellular carcinoma (HCC) beyond the Milan criteria after transjugular intrahepatic portosystemic shunt (TIPS). This study aimed to develop an easy-to-use tool specifically for such patients.*Methods and Materials From January 2013 to January 2019, 160 consecutive patients with HCC exceeding the Milan criteria underwent TIPS and TACE. Univariate and multivariate analyses were performed to explore the clinical factors independently correlated with overall survival (OS). A prognostic score was then developed to identify different prognoses in an initial cohort and validated in an external cohort (n = 72).*Results In the multivariate analysis, the presence of portal vein tumor thrombus (PVTT), alpha-fetoprotein (AFP), extrahepatic spread (EHS), alanine aminotransferase (ALT), and red blood cell (RBC) count were identified as predictors of OS. These factors were used to develop a prognostic score (TAMAR score, range: 0-6). The median survival was found to decrease with an increase in TAMAR score, and patients were stratified into favorable (0-2 points), intermediate (3-4 points), and dismal (>4 points) groups with the corresponding median survival values of 17.3, 8.7, and 4.3 months, respectively (P < 0.001). Additionally, the time to progression (TTP) (P < 0.001) and tumor response were also stratified into the same prognostic groups. An external validation cohort was used to confirm the prognostic scores.*Conclusions The proposed scoring system can accurately stratify the outcomes of patients with HCC beyond the Milan criteria who underwent TACE after TIPS; it helps identify the patients who may benefit from this treatment approach.*Clinical Relevance/Application The results of this study may be of great significance for guiding individual treatment of patients with HCC after TIPS in clinical practice. The proposed scoring system is able to stratify the outcomes of patients with HCC beyond the Milan criteria who underwent TACE after TIPS.

RESULTS

In the multivariate analysis, the presence of portal vein tumor thrombus (PVTT), alpha-fetoprotein (AFP), extrahepatic spread (EHS), alanine aminotransferase (ALT), and red blood cell (RBC) count were identified as predictors of OS. These factors were used to develop a prognostic score (TAMAR score, range: 0-6). The median survival was found to decrease with an increase in TAMAR score, and patients were stratified into favorable (0-2 points), intermediate (3-4 points), and dismal (>4 points) groups with the corresponding median survival values of 17.3, 8.7, and 4.3 months, respectively (P < 0.001). Additionally, the time to progression (TTP) (P < 0.001) and tumor response were also stratified into the same prognostic groups. An external validation cohort was used to confirm the prognostic scores.

CLINICAL RELEVANCE/APPLICATION

The results of this study may be of great significance for guiding individual treatment of patients with HCC after TIPS in clinical practice. The proposed scoring system is able to stratify the outcomes of patients with HCC beyond the Milan criteria who underwent TACE after TIPS.

SDP-IR-25 Lipiodol As An Intra-procedural Imaging Biomarker For Liver Tumor Response To Transarterial Chemoembolization: Post-hoc Analysis Of A Prospective Clinical Trial

Participants
Christopher Petty, BS, New Haven, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

To prospectively evaluate the role of a 3D quantitative assessment of intra-procedural Lipiodol deposition on cone-beam CT (CBCT) as a predictive biomarker of outcome in patients with primary or metastatic liver cancer undergoing cTACE.*Methods and Materials This was a post-hoc analysis of data from an IRB-approved prospective clinical trial. Thirty-two patients with hepatocellular carcinoma or liver metastases underwent contrast-enhanced CBCT obtained immediately after cTACE, unenhanced MDCT at 24 hours after cTACE, and follow-up imaging 30-, 90- and 180-days post-procedure. Lipiodol deposition was quantified on intra-procedural CBCT and was characterized by 4 ordinal levels: =25%, >25-50%, >50-75%, >75%. Tumor response was assessed on follow-up MRI (Figure 1). Lipiodol deposition on imaging, the correlation between Lipiodol deposition and tumor response criteria, and correlation between Lipiodol coverage and median overall survival (MOS) were evaluated.*Results A Bland-Altman plot of Lipiodol deposition on imaging demonstrated a bias of 2.75, with 95%-limits-of-agreement: - 16.6 to 22.1%. Correlation between relative Lipiodol deposition and change in enhancing tumor volume showed a negative association post-cTACE (30-day: p<0.001; rho=-0.63). Comparing Lipiodol mRECIST responders versus non-responders showed statistically significant higher volumetric deposition in responders for EASL-30d, EASL-90d, and quantitative EASL-180d. An inverse relationship between Lipiodol deposition in responders versus non-responders for two-dimensional EASL reached statistical significance at 30 days (p=0.02) and 90 days (p=0.05). Kaplan-Meier analysis for patients with high vs. low Lipiodol deposition showed a MOS of 46 vs. 33 months (p=0.05).*Conclusions 3D quantification of Lipiodol deposition on intra-procedural CBCT is a predictive biomarker of outcome in patients with primary or metastatic liver cancer undergoing cTACE. There are spatial and volumetric agreements between 3D quantification of Lipiodol deposition on intra-procedural CBCT and 24h post-cTACE MDCT. More Lipiodol tumor coverage is associated with improved and sustained tumor response post-cTACE.*Clinical Relevance/Application The spatial and volumetric agreement between Lipiodol deposition on intra-procedural CBCT and 24hr post-cTACE MDCT could suggest that acquiring MDCT 24 hours after cTACE is redundant. Importantly, the demonstrated relationship between levels of tumor coverage with Lipiodol and degree of tumor response after cTACE underline the role of Lipiodol as an intra-procedural surrogate for tumor response, with potential implications for the prediction of survival.

RESULTS

A Bland-Altman plot of Lipiodol deposition on imaging demonstrated a bias of 2.75, with 95%-limits-of-agreement: -16.6 to 22.1%. Correlation between relative Lipiodol deposition and change in enhancing tumor volume showed a negative association post-cTACE (30-day: p<0.001; rho=-0.63). Comparing Lipiodol mRECIST responders versus non-responders showed statistically significant higher volumetric deposition in responders for EASL-30d, EASL-90d, and quantitative EASL-180d. An inverse relationship between Lipiodol deposition in responders versus non-responders for two-dimensional EASL reached statistical significance at 30 days (p=0.02) and 90 days (p=0.05). Kaplan-Meier analysis for patients with high vs. low Lipiodol deposition showed a MOS of 46 vs. 33

months (p=0.05).

The spatial and volumetric agreement between Lipiodol deposition on intra-procedural CBCT and 24hr post-cTACE MDCT could suggest that acquiring MDCT 24 hours after cTACE is redundant. Importantly, the demonstrated relationship between levels of tumor coverage with Lipiodol and degree of tumor response after cTACE underline the role of Lipiodol as an intra-procedural surrogate for tumor response, with potential implications for the prediction of survival.

SDP-IR-3 Safety And Efficacy Of Chemosaturation With Percutaneoushepatic Perfusion Of Melphalan For Metastatic Uveal Melanoma: An 8-year Retrospective Study Of 250 Interventions In 81 Patients.

Participants
Tom Gibson, MBBCHIR, Romsey, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Uveal melanoma, the most common primary ocular malignancy in adults, carries a poor prognosis: 50% of patients develop metastatic disease with a 10-25% 1-year survival and no established standard of care treatment. Prior studies of melphalan percutaneous hepatic perfusion (M-PHP) have shown promise in metastatic UM (mUM) patients with liver predominant disease but are limited by small sample sizes. We contribute our single centre findings on the safety and efficacy of the procedure in the largest sample population to date.*Methods and Materials We performed a retrospective analysis of outcome and safety data for all mUM patients receiving M-PHP at our institutions. Tumour response and treatment toxicity were evaluated using RECIST 1.1 and Common Terminology Criteria for Adverse Events (CTCAE) v5.03, respectively.*Results A total of 250 M-PHP procedures were performed in 81 patients (median of 3 per patient). Analysis demonstrated a hepatic disease control rate of 88.9% (72/81), hepatic response rate of 66.7% (54/81), and overall response rate (ORR) of 60.5% (49/81). After median follow-up of 12.9 months, median overall progression-free (PFS) and median overall survival (OS) were 8.4 months and 14.9 months, respectively. There were no fatal treatment-related adverse events (TRAE). Forty-three grade 3 (29) or 4 (14) TRAE occurred in 23 (28.4%) patients with a significant reduction in such events between procedures performed in 2016-20 vs 2012-16 (0.17 per patient vs 0.90 per patient, p<0.001).*Conclusions M-PHP provides excellent response rates and PFS compared with other available treatments. With a decreasing side effect profile with experience, combination therapy with systemic agents may be viable to further advance OS.*Clinical Relevance/Application There is currently no standard of care for patients with mUM. Hepatic involvement is common and a key determinant of survival. M-PHP can treat the entire liver and has previously been shown to be effective and safe in the relatively small cohort studies to date. We provide, to our knowledge, the largest single centre experience to date that indicates excellent ORR, good PFS, reduced complications with experience, and raises the idea that combination therapy with systemic agents may be feasible and necessary to further OS in this disease.

RESULTS

A total of 250 M-PHP procedures were performed in 81 patients (median of 3 per patient). Analysis demonstrated a hepatic disease control rate of 88.9% (72/81), hepatic response rate of 66.7% (54/81), and overall response rate (ORR) of 60.5% (49/81). After median follow-up of 12.9 months, median overall progression-free (PFS) and median overall survival (OS) were 8.4 months and 14.9 months, respectively. There were no fatal treatment-related adverse events (TRAE). Forty-three grade 3 (29) or 4 (14) TRAE occurred in 23 (28.4%) patients with a significant reduction in such events between procedures performed in 2016-20 vs 2012-16 (0.17 per patient vs 0.90 per patient, p<0.001).

There is currently no standard of care for patients with mUM. Hepatic involvement is common and a key determinant of survival. M-PHP can treat the entire liver and has previously been shown to be effective and safe in the relatively small cohort studies to date. We provide, to our knowledge, the largest single centre experience to date that indicates excellent ORR, good PFS, reduced complications with experience, and raises the idea that combination therapy with systemic agents may be feasible and necessary to further OS in this disease.

SDP-IR-4 Effects Of Particle Density On Outcomes After Lobar Radioembolization

Participants
Franz E. Boas, MD,PhD, Duarte, California (*Presenter*) Co-founder, CLARIPACS, LLC;Investor, Labdoor;Investor, Qventus, Inc;Investor, CloudMedx;Investor, Notable Labs;Investor, XGenomes Corp;Research support, Bayer AG;Research support, General Electric Company;Speaker, Guerbet SA;Research Grant, Guerbet SA;Research support, Guerbet SA;Research support, STEBA Biotech NV;Research support, Terumo Corporation

PURPOSE

To determine if larger or more vascular tumors benefit from more particles during lobar radioembolization.*Methods and Materials Propensity score matching was used to select 57 pairs of patients that received lobar radioembolization. In each matched pair, one patient was treated using glass microspheres (120 Gy), and the other patient was treated using resin microspheres (BSA method). For each patient, tumor and liver volumes, tumor-to-normal ratio, number of particles delivered, dose (Gy), and particle density (particles/ml) were determined. Tumor-to-normal ratio was measured on both 99mTc-MAA SPECT/CT and post-90Y bremsstrahlung SPECT/CT. Response, local progression-free survival, and REILD were analyzed.*Results Overall, there was no difference between glass and resin microspheres, in terms of response, local progression-free survival, overall survival, or REILD. Glass microspheres had a stronger correlation between tumor-to-normal ratio on 99mTc-MAA versus 90Y SPECT/CT, compared to resin microspheres. For hypervascular tumors (tumor-to-normal ratio = 2.6), delivering fewer particles (< 6000 particles/ml treatment volume) was associated with better local progression-free survival (p=0.03). For less vascular tumors (tumor-to-normal ratio < 2.6), delivering more particles (= 6000 particles/ml) was associated with better local progression-free survival (p=0.02). In rare cases, with hypovascular tumors and low tumor volume, gaps larger than 0.39 cm were predicted between particles.*Conclusions The original hypothesis was not supported by the data. For hypervascular tumors, fewer particles was associated with improved tumor-to-normal ratio, and improved local progression-free survival. For less vascular tumors, more particles was associated with improved tumor-to-normal ratio, and improved local progression-free survival.*Clinical Relevance/Application Optimizing the number of particles delivered, based on tumor vascularity, can improve outcomes after radioembolization.

RESULTS

Overall, there was no difference between glass and resin microspheres, in terms of response, local progression-free survival, overall survival, or REILD. Glass microspheres had a stronger correlation between tumor-to-normal ratio on 99mTc-MAA versus 90Y

SPECT/CT, compared to resin microspheres. For hypervascular tumors (tumor-to-normal ratio = 2.6), delivering fewer particles (< 6000 particles/ml treatment volume) was associated with better local progression-free survival (p=0.03). For less vascular tumors (tumor-to-normal ratio < 2.6), delivering more particles (= 6000 particles/ml) was associated with better local progression-free survival (p=0.02). In rare cases, with hypovascular tumors and low tumor volume, gaps larger than 0.39 cm were predicted between particles.

CLINICAL RELEVANCE/APPLICATION

Optimizing the number of particles delivered, based on tumor vascularity, can improve outcomes after radioembolization.

SDP-IR-5   Clinical And Imaging Outcomes After Transjugular Intrahepatic Portosystemic Shunt Reduction For Over Shunting Complications

Participants
Raj Shah, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

To assess clinical and imaging outcomes after transjugular intrahepatic portosystemic shunt (TIPS) reduction for over shunting complications.*Methods and Materials This investigation was an IRB-approved multi-institution retrospective observational cohort study. Thirty-three patients (M:F 20:13, median age 61 years, median MELD score 13) underwent TIPS reduction between 2007-2020. Procedure indications included medically refractory hepatic encephalopathy (HE) (n=28, 85%), post-TIPS liver failure (PTLF) (n=4, 12%), and heart failure (n=1, 3%). Measured clinical outcomes included improvement in HE (persistent, improved, resolved; classified using the West-Haven system) and PTLF (persistent, improved, or resolved) after TIPS reduction, and transplant free survival (TFS). Measured imaging outcomes included patency of reduced TIPS, assessed by surveillance ultrasound.*Results TIPS reductions were successfully performed using the parallel stent (n=31, 94%) or hourglass (n=2, 6%) techniques at median 120 days after TIPS creation (median 164 days for HE, median 5 days for PTLF). Portosystemic pressure gradient (PSG) increased from median 9 to 15 mm Hg (P<0.001). Overall HE rate after TIPS reduction was 54% (15/28); HE was persistent, improved, and resolved in 6 (21%), 9 (32%), and 13 (46%) cases, respectively. In PTLF patients, MELD score significantly increased from median 23 pre-TIPS to median 35 post-TIPS (P=0.008), but there was no improvement (0/4, 0%) in PTLF after TIPS reduction (median MELD 31, P=0.414). Median TFS was not reached. 30-day, 6-month, 1-year, and 3-year survival rates were 97%, 90%, 81%, and 60%. Median shunt patency was 961 days (95% CI 476-1,447). 30-day, 6-month, 1-year, and 3-year shunt patency rates were 92%, 81%, 74%, and 37%.*Conclusions While TIPS reduction may be an effective and durable approach to treat post-TIPS medically refractory HE, shunt reduction may not achieve a meaningful therapeutic benefit for PTLF, although more research is needed.*Clinical Relevance/Application TIPS is often used in the management of portal hypertension complications. However, increased shunting can lead to adverse events, including HE and PTLF. TIPS reduction may be considered in cases refractory to medical management. While published literature has described the technical outcomes and short-term results of TIPS reduction, data regarding longer term clinical and imaging (patency) outcomes of reduced shunts is scarce. Better understanding of TIPS reduction outcomes could help in the management of TIPS-related adverse events.

RESULTS

TIPS reductions were successfully performed using the parallel stent (n=31, 94%) or hourglass (n=2, 6%) techniques at median 120 days after TIPS creation (median 164 days for HE, median 5 days for PTLF). Portosystemic pressure gradient (PSG) increased from median 9 to 15 mm Hg (P<0.001). Overall HE rate after TIPS reduction was 54% (15/28); HE was persistent, improved, and resolved in 6 (21%), 9 (32%), and 13 (46%) cases, respectively. In PTLF patients, MELD score significantly increased from median 23 pre-TIPS to median 35 post-TIPS (P=0.008), but there was no improvement (0/4, 0%) in PTLF after TIPS reduction (median MELD 31, P=0.414). Median TFS was not reached. 30-day, 6-month, 1-year, and 3-year survival rates were 97%, 90%, 81%, and 60%. Median shunt patency was 961 days (95% CI 476-1,447). 30-day, 6-month, 1-year, and 3-year shunt patency rates were 92%, 81%, 74%, and 37%.

CLINICAL RELEVANCE/APPLICATION

TIPS is often used in the management of portal hypertension complications. However, increased shunting can lead to adverse events, including HE and PTLF. TIPS reduction may be considered in cases refractory to medical management. While published literature has described the technical outcomes and short-term results of TIPS reduction, data regarding longer term clinical and imaging (patency) outcomes of reduced shunts is scarce. Better understanding of TIPS reduction outcomes could help in the management of TIPS-related adverse events.

SDP-IR-6   Utilization Of Cooled Radiofrequency Ablation For The Treatment Of Uncomplicated Total Knee Arthroplasty Chronic Pain And Stiffness: Initial Single Institution Pilot Study

Participants
Felix Gonzalez, MD, Roswell, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

To introduce percutaneous image-guided cooled radiofrequency ablation for the treatment of chronic pain and stiffness after total knee arthroplasty with no hardware complication and to establish the clinical efficacy, technical feasibility, and safety profile of this technique.*Methods and Materials This retrospective pilot study includes a total of 19 consecutive patients experiencing persistent chronic pain after total knee arthroplasty, without underlying hardware complications, that failed conservative care. Patients initially underwent anesthetic blocks of the genicular nerve branches to determine C-RFA candidacy. After adequate response to the anesthetic blocks consistent of >50% immediate pain relief, patients were subjected to cooled radiofrequency ablations 2-3 weeks later. Treatment response was evaluated utilizing clinically validated questionnaires (KOOS: Knee injury and Osteoarthritis Outcome Score) and Visual Analog Score (VAS) in order to assess pain severity, stiffness, functional activities of daily living and use of pain medication. Follow-up outcome scores were collected up to 1 year after C-RFA procedure.*Results A total of 19 knees were treated consecutively between 4/2019 and 1/2020 (mean patient age 70.5 years; 5M:14F). The mean total KOOS score improved significantly from baseline at 36.2 ±?14.1 to 61.9?±?26.5 at a mean of 10.2 months after treatment (p?<?0.0001), with significant improvement in mean pain score from 36.5?±?15.2 to 72.45?±?25.2 (p?<?0.0001) and mean stiffness score from 47?±?21.9 to 68.5?±?24.9 (p?<?0.0001). No major complications were encountered. No patients went on to re-treatment, surgical revision, or other intervention.*Conclusions Image-guided genicular nerve cooled radiofrequency ablation is a safe and effective treatment method for chronic pain/stiffness, which can be seen after TKA with an intact hardware.*Clinical Relevance/Application Currently, there is no effective way to treat symptoms such as pain and stiffness in patients status post TKA with an intact harward refractory to conservative interventions. Cooled radiofrequency ablation offers an alternative treatment methodology for

these symptoms without significant complications.

RESULTS

A total of 19 knees were treated consecutively between 4/2019 and 1/2020 (mean patient age 70.5 years; 5M:14F). The mean total KOOS score improved significantly from baseline at 36.2 ±?14.1 to 61.9?±?26.5 at a mean of 10.2 months after treatment (p? <?0.0001), with significant improvement in mean pain score from 36.5?±?15.2 to 72.45?±?25.2 (p?<?0.0001) and mean stiffness score from 47?±?21.9 to 68.5?±?24.9 (p?<?0.0001). No major complications were encountered. No patients went on to re-treatment, surgical revision, or other intervention.

CLINICAL RELEVANCE/APPLICATION

Currently, there is no effective way to treat symptoms such as pain and stiffness in patients status post TKA with an intact harward refractory to conservative interventions. Cooled radiofrequency ablation offers an alternative treatment methodology for these symptoms without significant complications.

SDP-IR-7   Shear Wave Elastography For Tennis Elbow: Quantitative Outcome Measure To Track Healing Changes Of The Common Extensor Tendon After PRP Treatment Compared To Corticosteroid At 1 Year.

Participants
Grant M. Quilling, BS, Madison, Wisconsin (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the efficacy of a single platelet-rich-plasma (PRP) injection to a single corticosteroid (CS) injection at 1 year for the treatment of lateral epicondylosis and correlate morphologic and quantitative ultrasound (US) changes to clinical outcomes.*Methods and Materials IRB approval and informed consent obtained. 47 subjects with a mean age of 48 years old (range, 31-63) who had common extensor tendon pain for at least 3 consecutive months with US or MRI confirmation of chronic lateral epicondylosis that had failed conservative therapy. Subjects were block randomized into either a PRP or CS treatment groups and completed clinical surveys at 0, 4, 8, 12, 16, 26 and 52 weeks. Patient surveys consisted of VAS pain scores, QuickDASH, PRTEE, SANE, SF-12 and satisfaction surveys. Grip strength tests performed at 0, 26 and 52 weeks and underwent conventional US and shear wave speed (SWS) assessment at 0, 26 and 52 weeks. Tendon morphology on US was characterized by thickness, hyperemia and echogenicity.*Results There was no statistically significant difference in the PRP and CS found at 52-weeks for VAS pain, QuickDASH total, PRTEE, SANE, SF-12 and satisfaction scores. PRP injections were found to be a significant improvement to CS injections for QuickDASH work module scores at 26 weeks (p=0.01) and 52 weeks (p=0.001). There was no statistically significant improvement at 26 weeks for the PRP injection group (p=0.158) but statistically significant improved grip strength was present at 52 weeks (p=0.027). No significant difference was found in conventional US thickness, echogenicity and hyperemia at 26-weeks and 52-weeks. The PRP injection group had a significantly improved SWS at 52 weeks (p=0.023).*Conclusions PRP injection led to improvements in QuickDASH work module at 26-week and 52-weeks, grip strength at 52-weeks and SWS at 52-weeks but no significant improvements in other clinical surveys or conventional US. Increase in SWS correlated with significant improvement in pain and function in the PRP group.*Clinical Relevance/Application PRP is an effective treatment alternative for refractory lateral epicondylosis with an increased grip strength and QuickDASH work module score and SWS may be an acceptable quantitative biomarker for tendon healing.

RESULTS

There was no statistically significant difference in the PRP and CS found at 52-weeks for VAS pain, QuickDASH total, PRTEE, SANE, SF-12 and satisfaction scores. PRP injections were found to be a significant improvement to CS injections for QuickDASH work module scores at 26 weeks (p=0.01) and 52 weeks (p=0.001). There was no statistically significant improvement at 26 weeks for the PRP injection group (p=0.158) but statistically significant improved grip strength was present at 52 weeks (p=0.027). No significant difference was found in conventional US thickness, echogenicity and hyperemia at 26-weeks and 52-weeks. The PRP injection group had a significantly improved SWS at 52 weeks (p=0.023).

CLINICAL RELEVANCE/APPLICATION

PRP is an effective treatment alternative for refractory lateral epicondylosis with an increased grip strength and QuickDASH work module score and SWS may be an acceptable quantitative biomarker for tendon healing.

SDP-IR-8   Potential Of Pre-interventional Magnetic Resonance Angiography For Optimization Of Workflow And Clinical Outcome Of Prostatic Arterial Embolization

Participants
Leona Alizadeh, MD, Frankfurt, Germany (*Presenter*) Nothing to Disclose

PURPOSE

We evaluated the impact of pre-interventional magnetic resonance angiography (MRA) on prostatic artery embolization (PAE) regarding workflow, radiation dose, and clinical outcome.*Methods and Materials 259 patients (mean age 68.28 ± 8.69, range 41-92) with benign prostatic hypertrophy (BPS) who had undergone PAE between January 2017 and December 2020 were retrospectively evaluated. Pre-interventional MRA was performed in 137 cases. In 122 patients, no pre-interventional MRA was performed. MR-images were evaluated regarding origin of the PA, volumetry of the prostatic gland and ADC values. Impact of MRA on PAE workflow and Radiation-dose was examined.International Prostate Symptom Score (IPSS), Quality of Life (QoL) and International Index of Erectile Function (IIEF) were evaluated before and after PAE to examine clinical improvement.*Results Significant differences regarding volume reduction (-20 ± 13 ml with MRA vs. -17 ± 9 ml without MRA) and ADC value reduction were found (-78 ± 111 10-6 mm2/s with MRA vs. -45 ± 99 10-6 mm2/s without MRA). Workflow during PAE was altered because of pathological findings in MRA in 16 patients. Radiation dose (5518.54 ± 6677.97 µGym2 with MRA vs. 23963.50 ± 19792.25 µGym2 without MRA) and fluoroscopy times (19.35 ± 9.01 min. with MRA vs. 27.45 ± 12.54 min. without MRA) were significantly lower with MRA. The MRA-group showed significantly higher improvement in IPSS reduction (-11 ± 8 points with MRA vs. -7 ± 9 points without MRA, p<0.001), while QOL and IEF showed no significant differences (p>0.05).*Conclusions Pre-interventional MRA significantly improves workflow and clinical outcome of PAE while significantly reducing radiation dose. Therefore, we recommend performance of MRA for pre-interventional planning in patients undergoing PAE.*Clinical Relevance/Application Improvement of patient safety and radiation dose reduction during PAE.

RESULTS

Significant differences regarding volume reduction (-20 ± 13 ml with MRA vs. -17 ± 9 ml without MRA) and ADC value reduction were found (-78 ± 111 10-6 mm2/s with MRA vs. -45 ± 99 10-6 mm2/s without MRA). Workflow during PAE was altered because of pathological findings in MRA in 16 patients. Radiation dose (5518.54 ± 6677.97 µGym2 with MRA vs. 23963.50 ± 19792.25 µGym2 without MRA) and fluoroscopy times (19.35 ± 9.01 min. with MRA vs. 27.45 ± 12.54 min. without MRA) were significantly lower with MRA. The MRA-group showed significantly higher improvement in IPSS reduction (-11 ± 8 points with MRA vs. -7 ± 9 points without MRA, p<0.001), while QOL and IEF showed no significant differences (p>0.05).

CLINICAL RELEVANCE/APPLICATION

Improvement of patient safety and radiation dose reduction during PAE.

SDP-IR-9   Experimental Study On Transarterial Administration Of Bevacizumab Combined With Transarterial Chemoembolization In Rats With Hepatocellular Carcinoma.

Participants
shen zhang, Wuhan, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the effects of transarterial administration of Bevacizumab (Avastin), an inhibitor of vascular endothelial growth factor (VEGF), combined with transarterial chemoembolization (TACE) in the treatment of hepatocellular carcinoma in rats. *Methods and Materials Subcapsular implantation of solid Morris hepatoma 3924A (2 mm3) was performed in the livers of 20 male ACI rats. Animal subjects were assigned to the group based on which treatment drugs were injected into the hepatic artery: Group A: TACE (mitomycin C + lipiodol + degradable starch microspheres) + bevacizumab; Group B: TACE alone. Post-treatment (V2) and pre-treatment (V1) tumor volumes were assessed by magnetic resonance imaging (MRI) and the mean proportion (V2/V1) was calculated. Immunohistochemical expression of MMP-9 and VEGF in tumors was semi-quantitative in all rats.*Results The ratios of the post-treatment to pretreatment tumor volumes (V2/V1) in groups A and B were 1.6649 ± 0.1255 and 3.0061 ± 0.1910 respectively. Significant difference was observed between group A and group B (P<0.0001). Higher expression of MMP-9 and VEGF in hepatocellular carcinoma was demonstrated in the control group (TACE alone) than group A (TACE + Bevacizumab) (both P<0.0020).*Conclusions Transarterial administration of bevacizumab combined with TACE noticeably inhibits the growth of hepatic carcinoma and intrahepatic metastases in rats.*Clinical Relevance/Application To explore the effect of transcatheter arterial chemoembolization (TACE) combined with bevacizumab in the treatment of liver cancer.

RESULTS

The ratios of the post-treatment to pretreatment tumor volumes (V2/V1) in groups A and B were 1.6649 ± 0.1255 and 3.0061 ± 0.1910 respectively. Significant difference was observed between group A and group B (P<0.0001). Higher expression of MMP-9 and VEGF in hepatocellular carcinoma was demonstrated in the control group (TACE alone) than group A (TACE + Bevacizumab) (both P<0.0020).

CLINICAL RELEVANCE/APPLICATION

To explore the effect of transcatheter arterial chemoembolization (TACE) combined with bevacizumab in the treatment of liver cancer.

Abstract Archives of the RSNA, 2021

Sub-Events

IR04-A2   **Safety And Efficacy Of CT-Guided Percutaneous Biopsy Of Suspicious Sub-Centimeter Retroperitoneal Lymph Nodes Detected By Metabolic Imaging For The Diagnosis Of Metastatic Prostate Cancer**

Participants
Jamie Kapplinger, MD,PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

Greater than 20% of patients with treated prostate cancer will have recurrent disease within 10 years of treatment. Early and accurate diagnosis is key to the management of recurrent prostate cancer. While elevated PSA remains the major clinical indicator, increasingly imaging plays an important role in the evaluation for metastatic prostate cancer. Advances in molecular imaging, such as 11C-choline PET/CT (Chol/PET), have led to earlier detection of smaller sites of recurrence. As tissue diagnosis remains the gold standard for confirmation of recurrent prostate cancer, the purpose of this study was to evaluate the efficacy and risk profile of CT-guided biopsies of small (=1cm) retroperitoneal lymph nodes (rLN) detected with metabolic imaging.*Methods and Materials Retrospective review was performed of prostate cancer patients who had undergone CT-guided core biopsy of suspicious or indeterminate rLN detected by Chol/PET between 6/1/2012 and 3/20/2020. Patient, rLN size and location, Chol/PET, procedural, complication and pathologic data was recorded. The biopsy length was measured as the rLN short axis length along the path of the biopsy device.*Results A total of 290 biopsies were performed in 269 patients. Of these, 152 (52.4%) were done on rLN =1 cm (4-10mm, mean 8±1 mm) and 138 were >1 cm (11-54mm, mean 16±6mm). There was no difference in the technical success rate between biopsies of rLN =1 cm and >1 cm with a diagnostic rate of 91.4% (139/152) and 95.7% (132/138), respectively (p=0.16). A diagnosis of malignancy was made in 50.0% (76/152) of the =1 cm biopsies and 54.3% (75/138) for biopsies >1 cm. Considering the smallest rLNs, diagnostic samples were obtained from nodes of 4, 5 and 6 mm diameter in 50% (1/2), 100% (5/5), and 86.7% (13/15), respectively. There was no significant difference in bleeding complications (major: 1.3 vs. 1.5%; minor: 13.8 vs. 6.5% (p=0.05), lesion location or prostate specific antigen values (4.4±6.5 vs.10.9±48.9, p=0.12) between patients with rLN =1 cm and >1 cm, respectively. Not unexpectedly, rLN =1 cm had lower lesion maximum standardized uptake value (p<0.001) on Chol/PET.*Conclusions New techniques in metabolic imaging can identify suspected metastatic disease in tiny (4-10mm) retroperitoneal lymph nodes that could be overlooked by conventional imaging. We show that CT-guided percutaneous biopsy of these tiny nodes is safe and effective for diagnosis of metastatic prostate cancer.*Clinical Relevance/Application New techniques in metabolic imaging can identify suspected metastatic disease in tiny (4-10mm) retroperitoneal lymph nodes that could be overlooked by conventional imaging; we show that CT-guided percutaneous biopsy of these tiny nodes is safe and effective for diagnosis of metastatic prostate cancer.

RESULTS

A total of 290 biopsies were performed in 269 patients. Of these, 152 (52.4%) were done on rLN =1 cm (4-10mm, mean 8±1 mm) and 138 were >1 cm (11-54mm, mean 16±6mm). There was no difference in the technical success rate between biopsies of rLN =1 cm and >1 cm with a diagnostic rate of 91.4% (139/152) and 95.7% (132/138), respectively (p=0.16). A diagnosis of malignancy was made in 50.0% (76/152) of the =1 cm biopsies and 54.3% (75/138) for biopsies >1 cm. Considering the smallest rLNs, diagnostic samples were obtained from nodes of 4, 5 and 6 mm diameter in 50% (1/2), 100% (5/5), and 86.7% (13/15), respectively. There was no significant difference in bleeding complications (major: 1.3 vs. 1.5%; minor: 13.8 vs. 6.5% (p=0.05), lesion location or prostate specific antigen values (4.4±6.5 vs.10.9±48.9, p=0.12) between patients with rLN =1 cm and >1 cm, respectively. Not unexpectedly, rLN =1 cm had lower lesion maximum standardized uptake value (p<0.001) on Chol/PET.

CLINICAL RELEVANCE/APPLICATION

New techniques in metabolic imaging can identify suspected metastatic disease in tiny (4-10mm) retroperitoneal lymph nodes that could be overlooked by conventional imaging; we show that CT-guided percutaneous biopsy of these tiny nodes is safe and effective for diagnosis of metastatic prostate cancer.

IR04-A3   **Ultrasound-triggered Release Of Vancomycin From Prophylactic Spinal Device**

Participants
Flemming Forsberg, PhD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Canon Medical Systems Corporation;Research support, Canon Medical Systems Corporation;Research support, General Electric Company;Speaker, General Electric Company;Research support, Siemens AG;Research Grant, Butterfly Network, Inc;Research support, Lantheus Medical Imaging, Inc;Research support, Bracco Group

PURPOSE

Bacterial infection following spinal fusion surgery is a major clinical concern, with up to 10% incidence despite aggressive peri-operative antibiotic treatments. We have designed an ultrasound-triggered drug release system to combat post-surgical bacterial survival. This study quantified the long-term stability and ultrasound-triggered vancomycin (VAN) release from this system.*Methods and Materials Polylactic acid (PLA) clips with a 0.79cm3 drug-loading reservoir were 3D printed and loaded with ~150-180µL of VAN solution (400mg/mL, ~60-80mg total, Athenex) and 50µL of Sonazoid microbubbles (GE Healthcare), then sealed with a PLA film (0.05±0.01mm thick). Clips were then submerged in 37°C water and insonated in Doppler mode at 1.8MHz for

10min using a Logiq E9 scanner (GE Healthcare) with a C6 probe (6.5kHz PRF, ISPTA 146.2±1.4mW/cm2) to rupture the PLA seal for VAN release. VAN release was quantified in triplicate using spectrophotometry (Tecan, 281nm absorbance) at t=0, 10, 20, ? 60min, then at 2, 4, 6, 12, 24, 36, 48, and 72h. Long-term stability of Sonazoid was determined over a 14-day incubation at 4°C. Reconstituted microbubbles (50μL) were added to 150μL of either distilled water or VAN solution (400mg/mL). Microbubble counts were obtained in triplicate after 0, 1, 3, 6, 8, 10, and 14 days using a BD LSR II flow cytometer (BD Biosciences), while enhancement of the Sonazoid solutions was visualized in contrast mode on days 0, 3, 8, and 14.*Results After the 14 day incubation, Sonazoid in water had reduced by ~90% (from 7.3±1.4x107 to 7.3±1.6x106), while those in VAN reduced by ~60% (from 8.9±6.7x106 to 3.3±9.3x106). VAN appears to have a slightly conservatory effect on Sonazoid (p=0.0073). Marked contrast enhancement was observed from both solutions at all 4 time points, indicating the remaining microbubbles were still acoustically active. Rupture of the PLA seal was observed in all 5 insonated clips with a cumulative VAN release of 81.4±2.8mg at 72h. The majority of the VAN was released within the first hour post-insonation, which is ideal for delivering a supratherapeutic bolus and preventing development of bacterial resistance. None of the 5 uninsonated controls showed any significant leakage or rupture, with only a nominal amount of VAN detectable in the media (0.3±0.1mg at 72h), indicating that the PLA seals sufficiently contain the payload within the device until ultrasound triggering.*Conclusions Overall, these results demonstrate the ability to produce ultrasound-triggered release of an encapsulated prophylactic solution.*Clinical Relevance/Application This system will aggressively combat post-surgical bacterial infection with great versatility in applications for wide clinical impact.

RESULTS

After the 14 day incubation, Sonazoid in water had reduced by ~90% (from 7.3±1.4x107 to 7.3±1.6x106), while those in VAN reduced by ~60% (from 8.9±6.7x106 to 3.3±9.3x106). VAN appears to have a slightly conservatory effect on Sonazoid (p=0.0073). Marked contrast enhancement was observed from both solutions at all 4 time points, indicating the remaining microbubbles were still acoustically active. Rupture of the PLA seal was observed in all 5 insonated clips with a cumulative VAN release of 81.4±2.8mg at 72h. The majority of the VAN was released within the first hour post-insonation, which is ideal for delivering a supratherapeutic bolus and preventing development of bacterial resistance. None of the 5 uninsonated controls showed any significant leakage or rupture, with only a nominal amount of VAN detectable in the media (0.3±0.1mg at 72h), indicating that the PLA seals sufficiently contain the payload within the device until ultrasound triggering.

CLINICAL RELEVANCE/APPLICATION

This system will aggressively combat post-surgical bacterial infection with great versatility in applications for wide clinical impact.

IR04-A4   Effect Of Aspirin Administration On Transplant-free Survival After Transjugular Intrahepatic Portosystemic Shunt (TIPS) Placement: A Retrospective Multicenter Analysis

Participants
Philipp Schindler, MD, Muenster, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the effect of aspirin (acetylsalicylic acid) administration on transplant-free survival in patients with transjugular intrahepatic portosystemic shunt (TIPS).*Methods and Materials Data from all patients receiving TIPS at three university liver centers between 2013 and 2018 (n=814) were retrospectively reviewed. N=587 patients were stratified depending on aspirin administration after TIPS (aspirin cohort, n=163; no-aspirin cohort, n=424) and subdivided into two matched cohorts after propensity score matching. Primary endpoint of the study was transplant-free survival at 12 months after TIPS. Secondary endpoints included occurrence of hepatic encephalopathy (HE), recurrence of primary TIPS indication and TIPS re-intervention rates in 12-months follow-up.*Results Aspirin administration improved transplant-free survival 12 months after TIPS (aspirin cohort, 90.8% vs. no-aspirin cohort, 76.6%; p<0.001). HE occurred more frequently in the aspirin cohort (p=0.014). Frequency of recurrence of primary TIPS-indication (p=0.612) and TIPS re-intervention rates (p=0.406) were not affected by aspirin administration.*Conclusions This retrospective multicenter study provides first data demonstrating a beneficial effect of aspirin administration on transplant-free survival in TIPS patients without impairment of TIPS function.*Clinical Relevance/Application Aspirin administration after TIPS placement has a substantial effect on the transplant-free survival. These findings support the necessity for prospective randomized clinical trials to investigate the effects of aspirin in TIPS patients.

RESULTS

Aspirin administration improved transplant-free survival 12 months after TIPS (aspirin cohort, 90.8% vs. no-aspirin cohort, 76.6%; p<0.001). HE occurred more frequently in the aspirin cohort (p=0.014). Frequency of recurrence of primary TIPS-indication (p=0.612) and TIPS re-intervention rates (p=0.406) were not affected by aspirin administration.

CLINICAL RELEVANCE/APPLICATION

Aspirin administration after TIPS placement has a substantial effect on the transplant-free survival. These findings support the necessity for prospective randomized clinical trials to investigate the effects of aspirin in TIPS patients.

Abstract Archives of the RSNA, 2021

Sub-Events

IR02-B2   **Splenic Artery Steal Syndrome In Patients With Orthotopic Liver Transplant: Where To Embolize The Splenic Artery?**

Participants
Florian Fleckenstein, MS, Berlin, Germany (*Presenter*) Nothing to Disclose

PURPOSE

This study compared proximal and distal splenic artery embolization (SAE) in patients with splenic artery steal syndrome (SASS) after orthotopic liver transplantation (OLT) regarding post interventional changes of liver function to identify an ideal location of embolization.*Methods and Materials 80 patients with SASS after OLT treated with SAE between 2007 and 2017 were retrospectively reviewed. Periinterventional DSA was used to assess treatment success and to stratify patients according to the site of embolization. Liver function was assessed using following laboratory values: bilirubin (TBIL), albumin, gamma-glutamyl transferase (GGT), glutamat-pyruvat-transaminase (GPT), glutamic-oxaloacetic transaminase (GOT), Aspartate-transaminase (AST), aPTT, INR and thrombocyte count. Descriptive statistics were used to summarize the data. Median laboratory values of pre, 1- and 3-days, as well as 1-week and 1-month post-embolization were compared using linear mixed model regression analysis.*Results All procedures were technically successful and showed an improved blood flow in the hepatic artery post-embolization. Five Patients were excluded. Pairwise comparison using linear mixed model regression analysis could showed a significant difference between proximal and distal embolization for GPT (57.0 (IQR 107.5) vs. 118.0 (IQR 254.0) U/l, p=0.002) and GOT (48.0 (IQR 48.0) vs. 81.0 (IQR 115.0) U/l, p=0.008) 3-days after embolization as well as median thrombocyte counts 7-days after embolization (122 (IQR 108) vs. 83 (IQR 74) in thousands, p=0.014). For all other laboratory values, no statistically significant difference could be shown between both groups stratified regarding the site of embolization.*Conclusions In conclusion no clinical relevant difference could be detected between a proximal and distal SAE. We conclude that a successful SAE is independent of the site of embolization.*Clinical Relevance/Application Choice of SAE technique in patients suffering from SASS after OLT might solely be based on interventionalists preferences and anatomical conditions.

RESULTS

All procedures were technically successful and showed an improved blood flow in the hepatic artery post-embolization. Five Patients were excluded. Pairwise comparison using linear mixed model regression analysis could showed a significant difference between proximal and distal embolization for GPT (57.0 (IQR 107.5) vs. 118.0 (IQR 254.0) U/l, p=0.002) and GOT (48.0 (IQR 48.0) vs. 81.0 (IQR 115.0) U/l, p=0.008) 3-days after embolization as well as median thrombocyte counts 7-days after embolization (122 (IQR 108) vs. 83 (IQR 74) in thousands, p=0.014). For all other laboratory values, no statistically significant difference could be shown between both groups stratified regarding the site of embolization.

CLINICAL RELEVANCE/APPLICATION

Choice of SAE technique in patients suffering from SASS after OLT might solely be based on interventionalists preferences and anatomical conditions.

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Abstract Archives of the RSNA, 2021

Sub-Events

PH03-B1   Deep Learning Based Semantic Segmentation Of Intracranial Aneurysm With 3d Patches For Overcoming Imbalance In Brain TOF-MRA

Participants
Sungwon Ham, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop a semantic segmentation on an intracranial aneurysm with 3D patches in brain time-of-flight (TOF)-MR angiography (MRA) with convolutional neural net (CNN).*Methods and Materials Total 154 3D TOF-MRA datasets with intracranial aneurysm were acquired from XX center and YY hospital, which was split into 124, 14 and 16 patients as a training, validation, and test sets, respectively. The gold standard of ????the intracranial aneurysm was manually drawn by an expert neuroradiologist with more than 10 years' experience. These MRAs were pre-processed by using the skull-stripping, the signal intensity normalization and N4 bias correction. In addition, they were resampled into a 0.3mm isotropic voxel size. The 3D patches with 64x64x64 size along the vessel skeleton from MRA were extracted. Various kinds of ratios between normal vs aneurysm patches including 1:1, 2:1, and 3:1 were evaluated. 3200 normal patches and 1100 aneurysm patches were used for training, tuning, and validation sets as 8:1:1. These patches were augmented by flip, zoom, gaussian noise and rotation, etc. The sematic segmentation on intracranial aneurysm was trained using 3D U-Net with auxiliary classifier to differentiate each patch as normal or aneurysm, which could be useful to overcome the extreme imbalance of normal or aneurysm patches. To evaluate segment performance, Dice similarity coefficient (DSC), sensitivity and false positives (FP) per patient were evaluated.*Results The overall mean DSC of our model was 0.705 ± 0.09, the sensitivity per lesion was 0.88, and the FP per patient was 0.31.*Conclusions This 3D patch-level method, showed performance of aneurysms segmentation sufficiently in viewpoint of good sensitivity and small FP, which can be helpful in actual clinical setting.*Clinical Relevance/Application Segmentation of intracranial aneurysms, especially in smaller cases, is very difficult and a misdiagnosis may result in poor clinical outcomes. Therefore, our deep learning model that automatic intracranial aneurysms segmentation will be of valuable aid to radiologists. This is especially important due to the increased workload and consequent fatigue of the radiologist.

RESULTS

The overall mean DSC of our model was 0.705 ± 0.09, the sensitivity per lesion was 0.88, and the FP per patient was 0.31.

CLINICAL RELEVANCE/APPLICATION

Segmentation of intracranial aneurysms, especially in smaller cases, is very difficult and a misdiagnosis may result in poor clinical outcomes. Therefore, our deep learning model that automatic intracranial aneurysms segmentation will be of valuable aid to radiologists. This is especially important due to the increased workload and consequent fatigue of the radiologist.

PH03-B10   In Silico Imaging Trials With Unknown Lesion Location: Initial Results For A Search Task On The Victre Pipeline

Participants
Miguel Angel Lago Angel, PhD, Silver Spring, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the effect of visual search (or location uncertainty) on the outcome of an in silico imaging trial and to compare it to the location-known exactly paradigm.*Methods and Materials We generated 1000 computational images using the VICTRE pipeline corresponding to a Siemens Mammomat Inspiration system. Half of the virtual patients had an inserted simulated spiculated mass in a random location within the breast volume. Breast models were projected using a GPU-accelerated Monte Carlo simulation to generate a Digital Mammography (DM). This process was repeated for 7 mass sizes from 250 mm3 to 85,000 mm3. We analyzed the detectability using a Channelized Hotelling Observer with convolutional channels and a search paradigm of scanning all pixels in the image. The model calculated the likelihood ratio of the presence of the signal at each pixel, taking the maximum value as the response for each case. An analysis was then performed for all trials and the Area Under the ROC (AUC) was calculated for each size. For the search model, we used a mass material with a higher x-ray attenuation to compensate for task difficulty.*Results The use of the VICTRE pipeline in a parallel cluster allowed us to generate 1000 digital mammograms per day, averaging one every 1.5 minutes. Detectability results show a steady increase in the AUC with size and a rapid increase on sizes less than 10,000 mm3 finally saturating at 1 at around 30,000 mm3. The AUC obtained with the search task will be compared with results obtained for a location-known exactly detection task using the same VICTRE methodology.*Conclusions We show the potential of in silico imaging trials to analyze large amounts of images to investigate the effect of unknown lesion location in search tasks. Model observer training strategies for search tasks need to differ from location-known-exactly tasks to allow for the detection of subtle lesions in the presence of anatomical background noise.*Clinical Relevance/Application We show that in silico imaging trials are feasible and could provide additional insight into the performance comparison considering search tasks between imaging technologies. This is of particular relevance for the understanding of the differences between DM and DBT in terms of 2d and 3d search strategies and efficiency in a screening setting.

RESULTS

The use of the VICTRE pipeline in a parallel cluster allowed us to generate 1000 digital mammograms per day, averaging one every 1.5 minutes. Detectability results show a steady increase in the AUC with size and a rapid increase on sizes less than 10,000 mm3 finally saturating at 1 at around 30,000 mm3. The AUC obtained with the search task will be compared with results obtained for a location-known exactly detection task using the same VICTRE methodology.

CLINICAL RELEVANCE/APPLICATION

We show that in silico imaging trials are feasible and could provide additional insight into the performance comparison considering search tasks between imaging technologies. This is of particular relevance for the understanding of the differences between DM and DBT in terms of 2d and 3d search strategies and efficiency in a screening setting.

PH03-B12   Survival Outcome Prediction Following Risk-adaptive Chemoradiation For Unresectable Non-small Cell Lung Cancer Using Machine Learning Of Single / Multimodality Radiomics

Participants
Parisa Forouzannezhad, PhD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

We evaluated whether single / multimodality radiomics can improve survival outcome prediction relative to published prognostic clinical factors and quantitative imaging biomarkers in patients with unresectable locally advanced non-small cell lung cancer (LA-NSCLC).*Methods and Materials Survival outcomes were modeled for 45 patients with LA-NSCLC enrolled on a trial of risk-adaptive chemoradiation and optional consolidation PD-L1 checkpoint blockade. Semi-automatic gradient-based tumor segmentations on pre-treatment CT, FDG-PET, and MAA-SPECT perfusion imaging were passed to IBSI-compliant Pyradiomics to extract 110 intensity, shape, and texture features. Fixed bin width discretization of 0.25 SUV, 25 HU, and 25 CNTS was consistently applied to ensure sufficient gray-level sampling of PET, CT, and SPECT radiomics, respectively. Least Absolute Shrinkage and Selection Operator (LASSO) dimensionality reduction of each radiomics modality was applied to 10-fold cross-validation training sets. Stratified resampling minimized imbalances in survival event proportion between training and testing sets. Ensemble component-wise gradient boosting survival trees with LASSO-selected features were grown using the same training folds and a nested grid search for hyperparameter tuning. Concordance index (c-index) and 95% confidence intervals of survival prediction models were computed on 10-fold cross-validation testing sets using single-modality and multimodality radiomics.*Results Median follow-up was 19 months [3-50 months] with 18 overall survival (OS) events. OS prediction models achieved stratified resampled 10-fold cross-validated c-index of 0.70 [0.63-0.76], 0.63 [0.57-0.68], and 0.62 [0.55-0.66] using PET, CT, and SPECT radiomics, respectively. Multimodality PET/CT/SPECT radiomics achieved c-index of 0.72 [0.66-0.76] for predicting OS, significantly outperforming (p<0.001) the benchmark clinical-imaging model c-index of 0.64 [0.58-0.69], which consisted of LASSO-selected CT planning target volume, PET SUVmax, PET metabolic tumor volume, and PET total lesion glycolysis.*Conclusions A multimodality framework of gradient boosting survival trees was successfully implemented with pre-treatment PET, CT, and SPECT radiomics to predict survival outcomes of patients with unresectable NSCLC. PET radiomics had the highest prognostic value for OS, with incremental gains using multimodality PET/CT/SPECT radiomics.*Clinical Relevance/Application Multimodality radiomics outcome modeling can provide decision support for precise therapy combinations and adaptive treatment intensification based on risk stratification.

RESULTS

Median follow-up was 19 months [3-50 months] with 18 overall survival (OS) events. OS prediction models achieved stratified resampled 10-fold cross-validated c-index of 0.70 [0.63-0.76], 0.63 [0.57-0.68], and 0.62 [0.55-0.66] using PET, CT, and SPECT radiomics, respectively. Multimodality PET/CT/SPECT radiomics achieved c-index of 0.72 [0.66-0.76] for predicting OS, significantly outperforming (p<0.001) the benchmark clinical-imaging model c-index of 0.64 [0.58-0.69], which consisted of LASSO-selected CT planning target volume, PET SUVmax, PET metabolic tumor volume, and PET total lesion glycolysis.

CLINICAL RELEVANCE/APPLICATION

Multimodality radiomics outcome modeling can provide decision support for precise therapy combinations and adaptive treatment intensification based on risk stratification.

PH03-B2   The Effect Of A Z-axis Dynamic Collimation System On Organ Equivalent Dose In Thorax CT

Participants
Antonios Papadakis, MSc, PhD, Heraklion, Greece (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to investigate the effect of a z-axis dynamic collimation (DC) system on organ equivalent dose in pediatric and adult thorax CT.*Methods and Materials Five physical anthropomorphic phantoms that simulate the average individual as a neonate, 1-, 5-, 10-years-old child and female adult were employed. Thorax acquisitions were performed on a Revolution HD GE CT scanner. Acquisitions were performed first with the DC system disabled and then with the DC system enabled. z-axis exposure profiles were recorded using a solid state point detector. Whole body axial image series of the phantoms were used to generate age-specific voxelized phantoms, which were input to a Monte Carlo based simulation tool to generate three-dimensional radiation dose image maps. DC disabled and DC enabled acquisitions were simulated by applying material segmentation and using the scanner geometry, filtration, photon energy spectrum and recorded z-axis exposure profiles. The dose image maps were used to estimate thyroid, breast, lung, and liver equivalent doses. Percent reduction in organ equivalent dose achieved with DC was determined. Image noise was measured as the standard deviation of the Hounsfield unit value at selected anatomical sites along the z-axis.*Results In DC disabled acquisitions, thyroid equivalent dose ranged from 0.5 mGy in neonate to 4.1 mGy in adult. The corresponding organ equivalent doses for breast, lung and liver ranged from 1.2 mGy to 5.5 mGy, 1.5 mGy to 6.5 mGy, and 4.1 mGy to 4.7 mGy, respectively. In DC enabled acquisitions, equivalent dose was reduced for organs located beyond or close to the boundaries of the planned imaged volume, i.e. up to 16% for thyroid and 8% for liver. DC did not modify equivalent dose for breast and lung. Image noise was not significantly affected in DC enabled acquisitions (P < 0.01).*Conclusions z-axis dynamic collimation reduces the equivalent dose to organs located beyond the boundaries of the planned imaged volume. CT operators should be aware that this reduction is moderate and that they should still be careful when setting the boundaries of the planned imaged volume to limit exposure of radiosensitive organs.This work has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 755523 (MEDIRAD).*Clinical Relevance/Application The results presented in this study demonstrate that although the reduction of equivalent dose in organs located beyond the boundaries of the planned image volume is moderate, the use of the z-axis collimation system is important to optimize radiation dose in thorax CT.

RESULTS

In DC disabled acquisitions, thyroid equivalent dose ranged from 0.5 mGy in neonate to 4.1 mGy in adult. The corresponding organ equivalent doses for breast, lung and liver ranged from 1.2 mGy to 5.5 mGy, 1.5 mGy to 6.5 mGy, and 4.1 mGy to 4.7 mGy, respectively. In DC enabled acquisitions, equivalent dose was reduced for organs located beyond or close to the boundaries of the planned imaged volume, i.e. up to 16% for thyroid and 8% for liver. DC did not modify equivalent dose for breast and lung. Image noise was not significantly affected in DC enabled acquisitions (P < 0.01).

CLINICAL RELEVANCE/APPLICATION

The results presented in this study demonstrate that although the reduction of equivalent dose in organs located beyond the boundaries of the planned image volume is moderate, the use of the z-axis collimation system is important to optimize radiation dose in thorax CT.

PH03-B8　Utility Of High-resolution CT For The Detection And Characterization Of Stenotic Lesions: A Phantom Study Using Model Observers

Participants
Andrew Hernandez, PHD, Sacramento, California (*Presenter*) Research funded, Canon Medical Systems Corporation

PURPOSE

The accurate detection and grading of atheromatous stenotic lesions within the cardiacand intracranial vasculature is imperative for early recognition of disease and guiding treatmentstrategies. In this work, a novel stenotic lesion phantom was used to evaluate a high-resolution CTscanner in terms of disk detection and size discrimination performance.*Methods and Materials The phantom is comprised of three acrylic cylinders (15 cm in diameter and 1.3 cm thick) with matching array of holes machined in each module (1.32-10.08 mm in physical diameter). The outer two modules contain holes that are slightly larger than the corresponding hole in the central module. The stack of three modules was submerged in iodine solution emulating contrast-enhanced stenotic lesions with a range of five nominal diameters (2.95-10.08 mm) and stenosis severity (0, 50%, 60%, 70%, and 80%). The phantom was imaged on the Canon Aquilion Precision high-resolution CT scanner in high-resolution "HR" mode (0.25x0.50 mm detector size) and normal-resolution "NR" (0.50x0.50 mm) with 30 repeat scans acquired for each mode using 120 kV and 14 mGy CTDIvol. Both FBP and an iterative algorithm (AIDR3D) were used for reconstruction with the smooth FC18 kernel. A non-prewhitening model observer with an eye filter was implemented for both a disk detection task and a size discrimination task.*Results HR mode resulted in higher detectability in comparison with NR for disk diameters up to 4.0 and 2.8 mm for FBP and AIDR, respectively. For the size discrimination task, the larger the difference in stenosis severity the higher the detectability. For FBP, differences in detectability were all within 10% except for the 2.95 mm nominal diameter lesion comparing 50%vs. 80% (termed 50v80) stenosis severity where HR was 13% higher than NR. Differences in detectability for AIDR were within 10% except for the 2.95 mm nominal diameter where HR resulted in 12%, 17%, and 22% higher detectability in comparison to NR for 50v60, 50v70, and50v80 stenosis, respectively, and the 4 mm nominal diameter where HR resulted in 11% higher detectability in comparison to NR for 50v80.*Conclusions A stenotic lesion phantom and model observer methodology demonstrated the value of high-resolution imaging for fine size discrimination tasks simulating stenotic severity. It is anticipated that this methodology will be used to optimize the acquisition and reconstruction parameters on this new CT scanner technology for quantifying stenotic lesion detection and severity.*Clinical Relevance/Application The advantage of HR mode in comparison to NR was demonstrated in the size discrimination task. The accurate quantification of stenosis in atheromatous disease is clinically important for optimal patient risk stratification and treatment.

RESULTS

HR mode resulted in higher detectability in comparison with NR for disk diameters up to 4.0 and 2.8 mm for FBP and AIDR, respectively. For the size discrimination task, the larger the difference in stenosis severity the higher the detectability. For FBP, differences in detectability were all within 10% except for the 2.95 mm nominal diameter lesion comparing 50%vs. 80% (termed 50v80) stenosis severity where HR was 13% higher than NR. Differences in detectability for AIDR were within 10% except for the 2.95 mm nominal diameter where HR resulted in 12%, 17%, and 22% higher detectability in comparison to NR for 50v60, 50v70, and50v80 stenosis, respectively, and the 4 mm nominal diameter where HR resulted in 11% higher detectability in comparison to NR for 50v80.

CLINICAL RELEVANCE/APPLICATION

The advantage of HR mode in comparison to NR was demonstrated in the size discrimination task. The accurate quantification of stenosis in atheromatous disease is clinically important for optimal patient risk stratification and treatment.

PH03-B9　Key-slice Parsing And Diagnostic Confidence Estimation For Localization And Differentiation Of Liver Lesions Using Multi-phasic MRI

Participants
Yuhsuan Wu, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

Multi-phasic MRI is a key modality to non-invasively discover and diagnose liver lesions. Yet, reported reader specificities remain low, e.g., over-interpreting washout as hepatocellular carcinoma (HCC). Computer-aided diagnosis (CAD) solutions may help boost diagnostic performance, but reported algorithms assume lesions are localized already. As well, they offer no assessment of their diagnostic certainty, i.e., how confident each prediction is. To address this gap, we develop a fully automatic CAD workflow that localizes liver lesions, differentiates them, and outputs the certainty of each prediction.*Methods and Materials We retrospectively enrolled 400 patients, each imaged with multi-phasic MRI. Diagnoses were all histopathologically confirmed: 207 HCC, 83 intrahepatic cholangiocarcinoma (ICC), and 110 secondary metastases. Each present lesion was annotated with RECIST marks on each slice. To robustly localize lesions, we use a physician inspired deep-learning (DL) workflow: (1) identify key slices; (2) rank slices using curve parsing; and (3) localize one key lesion per key slice. A DL classifier then classifies each found lesion as either HCC, ICC, or metastasis, where Monte Carlo dropout provides an assessment of predictive certainty. For comparative human reader performance, an abdominal radiologist with > 20 years of experience diagnosed each patient based on only the MRI studies.*Results Because localization and classification must both succeed, performance demands are high. Using five-fold cross validation and ROC analysis, our model's HCC vs. others area under the curve (AUC) is a high 91.3%. Our model's max Youden index of 0.674 compares well to the senior radiologist's Youden index of 0.731. For categorical predictions, our model reports a mean F1 of 61.3%, Importantly, our model accurately assesses certainty, e.g., only keeping the 75% most certain predictions boosts the AUC and mean F1 to 94.3%. and 70.7%, respectively.*Conclusions We proposed a multi-phasic MRI CAD solution to localize liver lesions,

differentiate their type, and assess predictive certainty. Experiments demonstrate high diagnostic performance and an effective assessment of which patients it is uncertain about.*Clinical Relevance/Application Our CAD solution can support physicians in making more confident radiological liver lesion diagnoses. By providing certainty measurements, it can also help assess when other tests are required.

RESULTS

Because localization and classification must both succeed, performance demands are high. Using five-fold cross validation and ROC analysis, our model's HCC vs. others area under the curve (AUC) is a high 91.3%. Our model's max Youden index of 0.674 compares well to the senior radiologist's Youden index of 0.731. For categorical predictions, our model reports a mean F1 of 61.3%, Importantly, our model accurately assesses certainty, e.g., only keeping the 75% most certain predictions boosts the AUC and mean F1 to 94.3%. and 70.7%, respectively.

CLINICAL RELEVANCE/APPLICATION

Our CAD solution can support physicians in making more confident radiological liver lesion diagnoses. By providing certainty measurements, it can also help assess when other tests are required.

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IR03-A

Interventional Radiology Tuesday Poster Discussions

Sub-Events

IR03-A2   **Healthcare Disparity: Lack of Access to Embolization Identified for Black Women Affected by Uterine Fibroids in Rural Alabama**

Participants
Cynthia De la Garza Ramos, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

PURPOSE

Uterine fibroids are the most common benign tumor in women impacting approximately 70% by the age of 50. Uterine fibroid embolization (UFE) is a viable treatment for symptomatic control for most of these patients; however, access to this procedure is not ubiquitous. An estimated 55,000 African American women living in Alabama between the ages of 35-50 have symptomatic uterine fibroids but live in a county that does not offer UFE. This disparity is even further divided in an area known as the blackbelt, which comprises about 20 counties across nearly 300 miles and is well known for its healthcare scarcity. The purpose of this study is to identify and develop methods to move the needle away from the status quo and improve access to UFE, especially in the black belt region.*Methods and Materials Uterine fibroid burden in Alabama was estimated by extracting county level data based on age, sex and race. Once an unmet need was established, medical centers performing embolization were identified in relationship to each county and population density. With support from Varian Medical Systems, CPT codes from these hospitals were used to determine the volume of embolization procedures performed. These results will guide appropriate intervention in order to increase access to UFE in all counties, but especially in the blackbelt region.*Results There is a strong correlation between population density and embolization procedures (r = 0.83 on Pearson correlation; p = 0.0001). Only 10 medical centers in Alabama offer embolization and 89% of these procedures are performed at only 3 of these 10. In the blackbelt region, there is just one hospital that performs embolization for over 20 counties, which accounts for 3% of all procedures in Alabama.*Conclusions Thousands of women living in Alabama suffer from symptomatic uterine fibroids but do not have access to UFE. This effect is even worse for African American women where an estimated 55,000 have symptomatic fibroids but live in a county that does not offer UFE. The next phase of this project is to implement an outreach program to address this overwhelming need. Telehealth partnerships between university-based health systems and rural hospitals are in development to assuage this disparity.*Clinical Relevance/Application Over 55,000 Black women 35-50 years old in Alabama suffer from uterine fibroids but do not have access to embolization. Implementing telehealth services would address this healthcare disparity.

RESULTS

There is a strong correlation between population density and embolization procedures (r = 0.83 on Pearson correlation; p = 0.0001). Only 10 medical centers in Alabama offer embolization and 89% of these procedures are performed at only 3 of these 10. In the blackbelt region, there is just one hospital that performs embolization for over 20 counties, which accounts for 3% of all procedures in Alabama.

CLINICAL RELEVANCE/APPLICATION

Over 55,000 Black women 35-50 years old in Alabama suffer from uterine fibroids but do not have access to embolization. Implementing telehealth services would address this healthcare disparity.

IR03-A3   **Refining Prognosis In Chemoembolization For Hepatocellular Carcinoma: Immunonutrition And Liver Function.**

Participants
Lukas Mueller, MD, Mainz, Germany (*Presenter*) Nothing to Disclose

PURPOSE

A combination of the Albumin-Bilirubin (ALBI) grading and the Prognostic Nutritional Index (PNI) has recently been identified as a highly predictive scoring system for patients with hepatocellular carcinoma (HCC) undergoing tumor ablation. This study aimed to evaluate this combination's promising results in treatment naïve patients undergoing TACE treatment.*Methods and Materials Between 2010 and 2020, 280 patients who met the inclusion criteria were retrospectively identified at our tertiary care liver center. Lymphocyte count, serum albumin, and bilirubin levels were recorded to calculate both scores; further established risk factors entered multivariate analysis. Influence of ALBI grade and PNI on the median overall survival (OS) was assessed using univariate and multivariate regression analyses. In the next step, ALBI and PNI were combined, and the prognostic ability of this combined approach was compared to existing scoring systems (BCLC, HAP, mHAP-II) regarding their Harrell´s Concordance Index.*Results Both ALBI grade 2-3 and a low PNI were highly predictive for median OS (ALBI grade 1-3: 39.0 vs 16.3 vs 5.4 months, p<0.001; high vs low PNI: 21.4 vs. 7.5, p<0.001). Combination of both and stratification into 4 groups resulted in an OS of 39.0, 20.1, 10.3, and 5.4 months (p<0.001). With a Harrell´s Concordance Index (C-Index) of 0.69, the ALBI-PNI outperformed each individual score (C-Index = 0.65 respectively 0.64) and was also better than BCLC, HAP and mHAP-II (C-Indices 0.66, 0.60 and 0.59).*Conclusions The combination of ALBI and PNI was superior to each score alone and also to other established scoring systems in prognosis prediction. Thus, the easy-to-calculate ALBI-PNI might be a promising stratification tool for patients with HCC undergoing TACE, reflecting both immunonutritive status and liver function.*Clinical Relevance/Application ALBI-PNI might be a promising stratification tool for patients with HCC undergoing TACE and especially, the combination with other established risk factors offers great

potential.

RESULTS

Both ALBI grade 2-3 and a low PNI were highly predictive for median OS (ALBI grade 1-3: 39.0 vs 16.3 vs 5.4 months, p<0.001; high vs low PNI: 21.4 vs. 7.5, p<0.001). Combination of both and stratification into 4 groups resulted in an OS of 39.0, 20.1, 10.3, and 5.4 months (p<0.001). With a Harrell´s Concordance Index (C-Index) of 0.69, the ALBI-PNI outperformed each individual score (C-Index = 0.65 respectively 0.64) and was also better than BCLC, HAP and mHAP-II (C-Indices 0.66, 0.60 and 0.59).

CLINICAL RELEVANCE/APPLICATION

ALBI-PNI might be a promising stratification tool for patients with HCC undergoing TACE and especially, the combination with other established risk factors offers great potential.

IR03-A4   Catheter-directed Thrombolysis Vs. Anticoagulation For The Prevention And Treatment Of Post-thrombotic Syndrome In Deep Vein Thrombosis: A Systematic Review And Meta-analysis

Participants
Ashkan Heshmatzadeh Behzadi, MD, Milford, Connecticut (*Presenter*) Nothing to Disclose

PURPOSE

We performed a meta-analysis to assess the benefit of additional ultrasound-accelerated catheter-directed thrombolysis (CDT) for the prevention of post-thrombotic syndrome compared with standard anticoagulation(AC) therapy in patients with iliofemoral deep-vein thrombosis.*Methods and Materials This meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A search of databases was conducted by 2 researchers independently for clinical trials Medline, Embase , Cochrane CENTRAL and google scholar were reviewed. Outcomes of interest included post-thrombotic syndrome, thromboembolic events, mortality, and bleeding risk. A random effects model meta-analysis was performed. Heterogeneity was reported with the I2 statistic, >50% of I2 was considered to be statistically significant.*Results Five randomized controlled trials (RCTs) including 1157 patients met the inclusion criteria. Our meta-analysis showed additional ultrasound-accelerated catheter-directed thrombolysis does not change the risk of post-thrombotic syndrome 1 year after acute iliofemoral deep-vein thrombosis compared with Standard anticoagulation therapy alone, (OR: 0.5; 95% CI: 0.12-1.1; I2 = 85.1%). Safety outcomes Rates for bleeding were reported in all 5 studies included in the meta-analysis. The overall bleeding rates after a follow-up of 24 months in the CDT Group was 14% (80 out of 568 patients) whereas in the AC only group was 7.0% (40 out of 589 patients). The two groups did not have a statistically significant rate of bleeding (OR: 4.0; 95% CI: 0.80-15.54; I2 = 69.7%). The overall death rate in the whole cohort was 1.5%; 8 patients in the CDT group compared to 11 patients in the AC group. No difference was found between the two groups (OR: 0.99; 95% CI: 0.37- 2.38), I2 (70.7%).*Conclusions Our meta-analysis showed that additional ultrasound-accelerated catheter-directed thrombolysis does not change the risk of post-thrombotic syndrome 1 year after acute iliofemoral deep-vein thrombosis compared with standard therapy alone.*Clinical Relevance/Application Our meta-analysis based on combining data from multiple well designed randomized clinical trials showed that additional ultrasound-accelerated catheter-directed thrombolysis does not change the risk of post-thrombotic syndrome 1 year after acute iliofemoral deep-vein thrombosis compared with standard therapy alone.

RESULTS

Five randomized controlled trials (RCTs) including 1157 patients met the inclusion criteria. Our meta-analysis showed additional ultrasound-accelerated catheter-directed thrombolysis does not change the risk of post-thrombotic syndrome 1 year after acute iliofemoral deep-vein thrombosis compared with Standard anticoagulation therapy alone, (OR: 0.5; 95% CI: 0.12-1.1; I2 = 85.1%). Safety outcomes Rates for bleeding were reported in all 5 studies included in the meta-analysis. The overall bleeding rates after a follow-up of 24 months in the CDT Group was 14% (80 out of 568 patients) whereas in the AC only group was 7.0% (40 out of 589 patients). The two groups did not have a statistically significant rate of bleeding (OR: 4.0; 95% CI: 0.80-15.54; I2 = 69.7%). The overall death rate in the whole cohort was 1.5%; 8 patients in the CDT group compared to 11 patients in the AC group. No difference was found between the two groups (OR: 0.99; 95% CI: 0.37- 2.38), I2 (70.7%).

CLINICAL RELEVANCE/APPLICATION

Our meta-analysis based on combining data from multiple well designed randomized clinical trials showed that additional ultrasound-accelerated catheter-directed thrombolysis does not change the risk of post-thrombotic syndrome 1 year after acute iliofemoral deep-vein thrombosis compared with standard therapy alone.

IR03-A6   Factors Associated With Persistence In Treated Pulmonary Arteriovenous Malformations: A Retrospective, Single-center, Observational Study

Participants
Muhammad Latif, MBBS, Dundalk, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Persistence rates of treated pulmonary AVMs are as high as 25%. Risk factors for persistence have been established based on single timepoint cross-sectional studies. However, no study has analyzed patient, pAVM, and technical risk factors associated with persistence using a survival analysis model.*Methods and Materials We retrospectively analyzed 118 patients with 405 pAVM who underwent embolization with coils or microvascular plugs (MVP™ system) or Amplatzer vascular plug (AVPTM) at an academic tertiary care hospital from 2003 to 2020. We included patients with follow-up chest computed tomography pulmonary angiograms (CTPAs). Patient mean age ± standard deviation was 44 ± 18 years (69% women); range, 3-87 years] with 405 treated pAVMs were included in the analysis. Median follow-up time was 1.6 years (interquartile range 0.3, 5.7). Three experienced radiologist confirmed persistence after reviewing the follow up CTPA images with a general consensus agreement. Persistence was defined as a <70% reduction in pAVM sac size or contrast enhancement of the sac on follow-up CTPA. Forty-one pAVMs (10%) had persistence. Univariable Cox proportional hazard regression was used to determine associations of potential risk factors and embolic agents with persistence, and a multivariable prediction model was developed. A p value of < 0.05 was considered statistically significant.*Results On multivariate analysis, feeding artery diameter (hazard ratio [HR], 1.1; 95% confidence interval [CI], 1.0-1.3; P = .02), number of feeding arteries (HR, 2.0; 95% CI, 1.1-3.65; P = .03), embolic nest to pAVM sac distance (HR, 4.8; 95%CI, 2.0-11; P < .01), and embolic device types were significantly associated with persistence. pAVMs embolized with coils alone had a higher incidence of persistence compared with pAVMs treated with an MVP™ system, AVPTM, or a combination of either plug type with a coil (P = .02) or MVPTM and AVPTM. The persistence rate was 16% (34/207), 8% (7/88) and 0% (0/98) for coil only, AVPTM only and MVPTM only pAVMs respectively.*Conclusions We identified and confirmed several variables associated with persistence,

including type and size of embolic device used, site of deployment, intrinsic morphologic features of pAVM, and BMI. Such findings could have implications for the treatment of patients with pAVMs.*Clinical Relevance/Application As such, pretreatment knowledge of these variables can be used for planning and optimization of successful pAVM embolization. For now, we believe that there is sufficient evidence to encourage the use of either the MVP™ system or a combination of AVPTM and coils as first line agents for the embolization of pAVM.

RESULTS

On multivariate analysis, feeding artery diameter (hazard ratio [HR], 1.1; 95% confidence interval [CI], 1.0-1.3; P = .02), number of feeding arteries (HR, 2.0; 95% CI, 1.1-3.65; P = .03), embolic nest to pAVM sac distance (HR, 4.8; 95%CI, 2.0-11; P < .01), and embolic device types were significantly associated with persistence. pAVMs embolized with coils alone had a higher incidence of persistence compared with pAVMs treated with an MVP™ system, AVPTM, or a combination of either plug type with a coil (P = .02) or MVPTM and AVPTM. The persistence rate was 16% (34/207), 8% (7/88) and 0% (0/98) for coil only, AVPTM only and MVPTM only pAVMs respectively.

CLINICAL RELEVANCE/APPLICATION

As such, pretreatment knowledge of these variables can be used for planning and optimization of successful pAVM embolization. For now, we believe that there is sufficient evidence to encourage the use of either the MVP™ system or a combination of AVPTM and coils as first line agents for the embolization of pAVM.

Abstract Archives of the RSNA, 2021

Sub-Events

NMMI03-A2 177Lu-DOTATATE In The Treatment Of Recurrent Meningioma

Participants
Jay Gajera, MD,BSC, Melbourne, Australia (*Presenter*) Nothing to Disclose

PURPOSE

Somatostatin receptor (SSTR)-targeted peptide receptor radionuclide therapy (PRRT) represents a promising approach for treatment-refractory meningiomas. The objective of this study was to perform quantitative analysis to determine the early radiobiological disease response of progressive radiation therapy refractory WHO grade I-III meningiomas following 2 cycles of ^{177}Lu-Dotatate based PRRT.*Methods and Materials We performed a retrospective review of 17 patients with recurrent WHO grade I-III meningiomas (median age 69 years, range 40-80 years). Patients had pre- and post-therapy ^{68}Ga-DOTATATE positron emission tomography (PET) as well as T1 contrast-enhanced MRI. Regions of Interest were drawn on PET images using MIM version 7 (MIM Software Inc.; Beachwood, OH). Post treatment PET indices and volumes were compared with baseline values. Tumor response was classified as progressed for &gt15% volume change, regressed for &lt15% change, and stable for ± 15% of baseline volume. Outcomes on MRI were determined using response assessment in neuro-oncology (RANO) criteria for meningioma.*Results 33 lesions in 17 patients were included in the quantitative analysis. The median follow-up was 5 months (range 3-10 months). 25/33 (75.7%) lesions showed regression or remained stable on serial imaging. 8/33 (24.2%) lesions demonstrate interval progression. These 8 lesions were in 2 patients. The baseline SUVmax had a mean of 11.7 (range 4.1-29.9) and post-treatment SUVmax had a mean of 10.6 (range 1.3-29). The baseline tumour volume had a mean of 8.0ml (range 0.1- 54.5) and post-treatment tumour volume had a mean of 8.8ml (range 0.2- 59.3). We found baseline Max SUV to be a moderate predictor of post treatment PET volumes (R value 0.055). The majority of lesions with early progression had SUVmax at baseline of &lt7. An initial analysis of the MRI response revealed 6/8 lesions were stable on follow up and 2/8 demonstrated progressive disease.*Conclusions Lesions with a higher SUVmax may be more responsive to therapy and baseline SUVmax is a potentially useful criterion when considering patients for PRRT regimens.*Clinical Relevance/Application [177Lu]-Dotatate is a potentially useful management strategy in treatment refractory meningiomas.

RESULTS

33 lesions in 17 patients were included in the quantitative analysis. The median follow-up was 5 months (range 3-10 months). 25/33 (75.7%) lesions showed regression or remained stable on serial imaging. 8/33 (24.2%) lesions demonstrate interval progression. These 8 lesions were in 2 patients. The baseline SUVmax had a mean of 11.7 (range 4.1-29.9) and post-treatment SUVmax had a mean of 10.6 (range 1.3-29). The baseline tumour volume had a mean of 8.0ml (range 0.1- 54.5) and post-treatment tumour volume had a mean of 8.8ml (range 0.2- 59.3). We found baseline Max SUV to be a moderate predictor of post treatment PET volumes (R value 0.055). The majority of lesions with early progression had SUVmax at baseline of &lt7. An initial analysis of the MRI response revealed 6/8 lesions were stable on follow up and 2/8 demonstrated progressive disease.

CLINICAL RELEVANCE/APPLICATION

[177Lu]-Dotatate is a potentially useful management strategy in treatment refractory meningiomas.

NMMI03-A3 A Conjugation Strategy To Modulate Antigen Binding As Well As Fcrn Interaction Lead To Improved Tumor Targeting And Radioimmunotherapy Efficacy With An Antibody Targeting Prostate Specific Antigen

Participants
Joanna Strand, Lund, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

The hu5A10 is a humanized monoclonal antibody (mAb) that specifically targets and internalizes prostate cancer cells by binding to prostate-specific antigen (PSA). Preclinical evaluations have shown that hu5A10 is an excellent vehicle for PCa radiotheranostics. We studied the impact of different chelates and conjugation ratios on hu5A10's target affinity, neonatal fc-receptor interaction on in vivo targeting efficacy and possible enhanced therapeutic efficacy.*Methods and Materials hu5A10 was conjugated with DOTA or DTPA at a molar ratio of 3:1, 6:1, and 12:1. Surface plasmon resonance (SPR) was used to study antigen and FcRn binding to the antibody conjugates. [111In]hu5A10 radio-immunoconjugates were administered intravenously into BALB/c mice carrying subcutaneous LNCaP xenografts. Serial SPECT images were obtained during the first week. Tumors were harvested and radionuclide distribution was analyzed by autoradiography along with microanatomy and immunohistochemistry.*Results As seen by SPR, the binding to PSA was clearly affected by the chelate-to-antibody ratio Similarly, FcRn interacted less with antibodies conjugated at high ratios of chelator which was more pronounced for DOTA conjugates. The autoradiography data indicated a higher distribution of radioactivity to the rim of the tumor which was more pronounced for DOTA conjugates. The autoradiography data indicated a higher distribution of radioactivity to the rim of the tumor for lower ratios and a more homogenous distribution at higher ratios. Mice injected with ratio 3:1 111In-DOTA-hu5A10 showed no significant difference in tumor volume when compared to mice given vehicle over a time period of 3 weeks. Mice given a similar activity of the ratio 6:1 111In-DOTA-hu5A10 or 6:1 111In-DTPA-hu5A10 or 12:1 111In-DTPA-hu5A10 showed significant tumor growth retardation.*Conclusions The present study demonstrates that the radiolabeling strategy can positively modify the hu5A10's capacity to bind PSA and complex with the FcRn-receptor, which results in more homogenous

activity distribution in tumors and enhanced therapy efficacy.*Clinical Relevance/Application The present study demonstrates that the radiolabeling strategy can positively modify the hu5A10's capacity to bind PSA and complex with the FcRn-receptor, which results in more homogenous activity distribution in tumors and enhanced therapy efficacy. These new innovative radiochemistry ideas could potentially decrease relapse of tumors in patients treated with internalizing antibodies.

RESULTS

As seen by SPR, the binding to PSA was clearly affected by the chelate-to-antibody ratio Similarly, FcRn interacted less with antibodies conjugated at high ratios of chelator which was more pronounced for DOTA conjugates. The autoradiography data indicated a higher distribution of radioactivity to the rim of the tumor for lower ratios and a more homogenous distribution at higher ratios. Mice injected with ratio 3:1 111In-DOTA-hu5A10 showed no significant difference in tumor volume when compared to mice given vehicle over a time period of 3 weeks. Mice given a similar activity of the ratio 6:1 111In-DOTA-hu5A10 or 6:1 111In-DTPA-hu5A10 or 12:1 111In-DTPA-hu5A10 showed significant tumor growth retardation.

CLINICAL RELEVANCE/APPLICATION

The present study demonstrates that the radiolabeling strategy can positively modify the hu5A10's capacity to bind PSA and complex with the FcRn-receptor, which results in more homogenous activity distribution in tumors and enhanced therapy efficacy. These new innovative radiochemistry ideas could potentially decrease relapse of tumors in patients treated with internalizing antibodies.

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MS03-B

Multisystem Tuesday Poster Discussions

Sub-Events

MS03-B1   Imaging Features Of Beirut Blast Injuries: Distribution Of Patterns And Radiological Imaging

Participants
Caline Azzi, MD, Beirut, Lebanon (*Presenter*) Nothing to Disclose

PURPOSE

To determine imaging utilization and describe the range of radiologic findings and outcomes of immediate (within 30 hours) injuries following the August 4 Beirut blast that is considered one of the largest non-nuclear blasts in history and comprised 2 successive explosions, approximately 35 seconds apart.*Methods and Materials An Institutional Review Board approved retrospective analysis of the radiographic findings and outcomes of all patients who underwent imaging at the American University of Beirut Medical Center because of trauma from the blast was performed. Images were identified by searching the radiology PACS system for studies performed within 30 hours from the blast. Imaging findings extracted from the radiology reports were documented and analyzed. Patients' demographics, types of interventions and outcomes were determined by reviewing the Electronic Medical Records.*Results Within 30 hours of the second explosion, a total of 213 patients underwent 512 imaging studies (radiographs n=302 (59%), CT n=204 (40%), ultrasounds n=5 (1%) and MRI n=1), in addition to bedside ultrasound examinations in the Emergency Department. The most commonly imaged body parts with plain radiographs were the extremities (upper (47%), lower (31%)), and with CT were the brain (44%), chest (18%), and abdomen/pelvis (18%). The most commonly injured organs were the head and neck (40%) and extremities (40%). The most common injury in the head was skull injury (44%), followed by intracranial bleeding (21%) (subarachnoid hemorrhage (35%), subdural hematoma and hemorrhagic contusions (24% each), and epidural hematomas (17%)). The most common injury in the extremities was blast-related shrapnel injuries, with a total 925 shrapnel in 57 patients, most in the upper extremities (45%).*Conclusions The most common body region injured by the Beirut blast was the head and neck (40%), likely due to mass collapse of buildings. Blast injuries induced by penetrating shrapnel most commonly affected the upper extremity. The primary reason is likely the shockwave from the first smaller explosion that gave patients time to instinctively shield their head with their arms.*Clinical Relevance/Application To familiarize the radiologist with the nature and patterns of blast injury. This should enable the radiologist to seek out injuries that may not be clinically apparent initially.

RESULTS

Within 30 hours of the second explosion, a total of 213 patients underwent 512 imaging studies (radiographs n=302 (59%), CT n=204 (40%), ultrasounds n=5 (1%) and MRI n=1), in addition to bedside ultrasound examinations in the Emergency Department. The most commonly imaged body parts with plain radiographs were the extremities (upper (47%), lower (31%)), and with CT were the brain (44%), chest (18%), and abdomen/pelvis (18%). The most commonly injured organs were the head and neck (40%) and extremities (40%). The most common injury in the head was skull injury (44%), followed by intracranial bleeding (21%) (subarachnoid hemorrhage (35%), subdural hematoma and hemorrhagic contusions (24% each), and epidural hematomas (17%)). The most common injury in the extremities was blast-related shrapnel injuries, with a total 925 shrapnel in 57 patients, most in the upper extremities (45%).

CLINICAL RELEVANCE/APPLICATION

To familiarize the radiologist with the nature and patterns of blast injury. This should enable the radiologist to seek out injuries that may not be clinically apparent initially.

Abstract Archives of the RSNA, 2021

GI03-C

Gastrointestinal Tuesday Poster Discussions

Sub-Events

GI03-C2   **Comparison Of Image Quality Of 3D Magnetic Resonance Cholangiopancreatography Performed With Respiratory Triggered (PACE) Versus Breath-Hold Compressed Sensing (BH-CS) Techniques At 1.5T**

Participants
Chenchan Huang, MD, Manhasset, New York (*Presenter*) Nothing to Disclose

PURPOSE

To perform a qualitative and quantitative comparison of image quality of 3D-MRCP imaging of the biliary system and pancreatic duct acquired using respiratory triggered prospective acquisition correction technique (PACE) and breath-hold compressed sensing technique (BH-CS).*Methods and Materials 120 3D-MRCP exams performed with both PACE and BH-CS techniques during a 9 month period at a 1.5T MRI scanner were included. One experienced and one less-experienced radiologists retrospectively assessed duct clarity of extrahepatic bile duct (CHD/CBD), right central intrahepatic duct (IHD), right peripheral IHD, left central IHD, left peripheral IHD, and main pancreatic duct (PD) using a 1-5 scale. Overall image quality (IQ) and motion artifact of the bile ducts and PD were recorded using a 1-5 scale. Quantitative analysis of relative duct-to-periductal contrast ratios (RCs) of the pancreaticobiliary ducts were calculated by a different radiologist. Mean acquisition time of two techniques were recorded. These qualitative and quantitative measurements were compared between the two techniques. A p<0.05 indicated statistical significance.*Results The acquisition time was markedly reduced in BH-CS MRCP compared with PACE-MRCP (mean 17.5 sec versus 6 min 36 sec). RCs of the CHD/CBD, left IHD, right IHD, and PD were significantly higher at BH-CS than PACE MPCP (all p<0.001). Clarity of right peripheral IHD, left peripheral IHD, PD were significantly higher at PACE MRCP for experienced reader (all p<0.05). Clarity of CHD/CBD was significantly higher at CS-BH MRCP for less-experienced reader (p=0.001). Motion artifact of bile ducts was significantly better at BH-CS MRCP for experienced reader (p=0.014). Overall IQ of PD was significantly better at PACE-MRCP for experienced reader (p=0.046). Overall IQ of bile ducts and motion artifact of PD were not significantly different for either reader.*Conclusions Clarity of peripheral IHD was significantly higher at PACE MRCP for experienced reader though overall IQ of biliary tree was not significantly different for either reader. Clarity and overall IQ of PD were significantly better at PACE-MRCP for experienced reader.*Clinical Relevance/Application There is significant time saving using a breath-hold compressed sensing 3D MRCP. Implementing BH-CS MRCP into MRCP protocols should be carefully selected based on the clinical indications.

RESULTS

The acquisition time was markedly reduced in BH-CS MRCP compared with PACE-MRCP (mean 17.5 sec versus 6 min 36 sec). RCs of the CHD/CBD, left IHD, right IHD, and PD were significantly higher at BH-CS than PACE MPCP (all p<0.001). Clarity of right peripheral IHD, left peripheral IHD, PD were significantly higher at PACE MRCP for experienced reader (all p<0.05). Clarity of CHD/CBD was significantly higher at CS-BH MRCP for less-experienced reader (p=0.001). Motion artifact of bile ducts was significantly better at BH-CS MRCP for experienced reader (p=0.014). Overall IQ of PD was significantly better at PACE-MRCP for experienced reader (p=0.046). Overall IQ of bile ducts and motion artifact of PD were not significantly different for either reader.

CLINICAL RELEVANCE/APPLICATION

There is significant time saving using a breath-hold compressed sensing 3D MRCP. Implementing BH-CS MRCP into MRCP protocols should be carefully selected based on the clinical indications.

GI03-C4   **Value Of Dual Energy CT For Assessment Of Fatty Liver Disease: Comparison With Quantitative MRI**

Participants
Pengcheng Zhang, MD, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

To determine if dual-energy virtual non-contrast CT predicts hepatic steatosis measured using MRI proton density fat fraction.*Methods and Materials 128 patients undergoing dual energy CT (DECT) of the abdomen and MRI with proton density fat fraction (PDFF) within 30 days of each other were selected at a single center from 2016-2020. For DECT, both split-beam and dual source scanners were used. MRI PDFF was performed at 3T using 6 echoes. For each patient, DECT VNC attenuation values and MRI-derived PDFF values were measured in similar locations within the right and left hepatic lobes. Pearson correlation coefficients between CT and MRI were computed separately using measurements from each lobe. Patients were separated into steatotic and non-steatotic groups, using FF=6% as a threshold for establishing liver steatosis. Comparison of VNC HU was made between steatotic and non-steatotic groups by chi-square test. Receiver operator characteristic (ROC) curve and area under ROC curve (AUC) were used to establish an optimal HU threshold of VNC CT to determine hepatic steatosis (>6% on PDFF). All tests were performed separately in the right and left lobes.*Results Median interval between CT and MRI was 2 days. VNC and MRI-derived FF were significantly correlated with R = -0.61 and -0.66 for the right and left lobes, respectively (P<0.05). Median VNC HU in the right and left lobes were significantly different in the steatotic and non-steatoic groups (median steatotic vs non-steatotic right: 54.7 vs 70.3 HU, left: 49 vs 63.7 HU, P<0.001). ROC curves established an optimal threshold cutoff for hepatic steatosis on VNC of 54.8 HU (sensitivity 53.3%, specificity 91.8%; AUC 0.799) for the right hepatic lobe and 50.6 HU (sensitivity 60.7%, specificity 94%; AUC 0.853).*Conclusions Attenuation measured using DECT VNC images of the liver is highly specific (>90%) for the diagnosis of hepatic steatosis.*Clinical Relevance/Application Early detection of fatty liver disease could direct patients to medical intervention and

reduced progression to cirrhosis and need for liver transplant.

RESULTS

Median interval between CT and MRI was 2 days. VNC and MRI-derived FF were significantly correlated with R = -0.61 and -0.66 for the right and left lobes, respectively (P<0.05). Median VNC HU in the right and left lobes were significantly different in the steatotic and non-steatoic groups (median steatotic vs non-steatotic right: 54.7 vs 70.3 HU, left: 49 vs 63.7 HU, P<0.001). ROC curves established an optimal threshold cutoff for hepatic steatosis on VNC of 54.8 HU (sensitivity 53.3%, specificity 91.8%; AUC 0.799) for the right hepatic lobe and 50.6 HU (sensitivity 60.7%, specificity 94%; AUC 0.853).

CLINICAL RELEVANCE/APPLICATION

Early detection of fatty liver disease could direct patients to medical intervention and reduced progression to cirrhosis and need for liver transplant.

GI03-C5 Response Assessment Following Yttrium-90 Transarterial Radioembolization For Advanced Hepatocellular Carcinoma: Comparison Of RECIST, MRECIST, And LI-RADS Treatment Response Algorithm

Participants
Madeleine Sertic, MBBCh, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To compare Response Evaluation Criteria in Solid Tumours (RECIST), modified RECIST (mRECIST), and LI-RADS Treatment Response Algorithm (LI-RADS TRA) in treatment evaluation following Yttrium-90 transarterial radioembolization (TARE) for advanced hepatocellular carcinoma (HCC).*Methods and Materials This retrospective single institution study included 80 patients who underwent TARE for management of advanced HCC. The patients undergoing TARE had diagnostic CT or MRI performed at baseline, and post-treatment scans at 1 and 3 months. Evaluation of treatment response was performed by an independent reader according to RECIST, mRECIST and LI-RADS TRA. The patients were categorized as "responders" and "non-responders" as determined by RECIST, mRECIST and LI-RADS TRA criteria on the second post-treatment scan, and the findings were compared.*Results A total of 105 TAREs were performed in 80 patients. At 1 month, a higher proportion of patients were categorized as responders based on mRECIST (29%, n=30) compared to RECIST (5%, n=5) and LI-RADS TRA (19%, n=20). Similarly, at 3 months 33% (n=35) were categorized as responders based on mRECIST, compared to 12% (n=13) on RECIST and 25% (n=26) on LI-RADS TRA. At 1 and 3 months, 100% of responders per RECIST were also classified as responders by mRECIST. 8/26 (31%) LI-RADS TRA responders were only classified as such on LI-RADS TRA; of these, 7/8 were patients with new metastases. The one-year overall survival rates were 75%, 70% and 82% for responders based on RECIST, mRECIST and LI-RADS TRA, respectively. The one-year overall survival rates were 78%, 81% and 76% for non-responders based on RECIST, mRECIST and LI-RADS TRA, respectively.*Conclusions In patients with advanced HCC undergoing TARE, mRECIST identifies more responders at 1-month and 3-months compared to RECIST and LI-RADS TRA. LI-RADS TRA does not assess non-target lesions and can identify patients as responders despite the presence of new metastatic disease.*Clinical Relevance/Application In patients with advanced HCC, mRECIST identifies more responders at 1- and 3-months post TARE than RECIST or LI-RADS TRA. Accurate identification of responders and non-responders can be used to guide treatment decisions and expedite additional or alternate therapy.

RESULTS

A total of 105 TAREs were performed in 80 patients. At 1 month, a higher proportion of patients were categorized as responders based on mRECIST (29%, n=30) compared to RECIST (5%, n=5) and LI-RADS TRA (19%, n=20). Similarly, at 3 months 33% (n=35) were categorized as responders based on mRECIST, compared to 12% (n=13) on RECIST and 25% (n=26) on LI-RADS TRA. At 1 and 3 months, 100% of responders per RECIST were also classified as responders by mRECIST. 8/26 (31%) LI-RADS TRA responders were only classified as such on LI-RADS TRA; of these, 7/8 were patients with new metastases. The one-year overall survival rates were 75%, 70% and 82% for responders based on RECIST, mRECIST and LI-RADS TRA, respectively. The one-year overall survival rates were 78%, 81% and 76% for non-responders based on RECIST, mRECIST and LI-RADS TRA, respectively.

CLINICAL RELEVANCE/APPLICATION

In patients with advanced HCC, mRECIST identifies more responders at 1- and 3-months post TARE than RECIST or LI-RADS TRA. Accurate identification of responders and non-responders can be used to guide treatment decisions and expedite additional or alternate therapy.

GI03-C7 First In Human Safety Trial Of A Novel Oral Dark Borosilicate Contrast Material In Healthy Volunteers

Participants
Yuxin Sun, BS,MSc, San Francisco, California (*Presenter*) Stockholder, Nextrast, Inc

PURPOSE

To assess the safety and efficacy of a novel oral nonabsorbable Dark Borosilicate Contrast Material (DBCM) for CT in healthy volunteers*Methods and Materials FDA IND and institutional review board approval was obtained. Five groups of 5 to 6 healthy adult volunteers were consented for an escalating dose trial of a new oral DBCM (CT attenuation below -100 HU). Physical exam, hematology, metabolic panel, urinalysis and ECG were done before and 1, 4, and 24 hours after drinking 3% sorbitol placebo (n=2/group) or DBCM (n=3, groups 1-4; n=4, group 5), with each group consuming a progressively larger volume (400, 800, 1200, 1600, or 2000mL). Side effects were recorded on day 1 and 1 week post dosing. For groups 1, 3, and 5, blood at pre, 1, 2, 4, 7, and 24 hours and urine at pre, 4, and 24 hours after dosing were measured for silicon by digestion ICP-MS. Pre and post dose fecal occult blood tests were obtained. Volunteers were scanned by CT before and within 35 to 75 minutes after oral dose completion. Two radiologists independently recorded bowel lumen CT attenuation and rated bowel delineation (5-point Likert)*Results All adverse events were mild and transient, and 1, 2, 2, 4, 3 adverse events were seen in placebo groups 1-5, and 0, 2, 6, 7, 7 in DBCM groups 1-5, respectively. Of these adverse events, 8 of 12 and 10 of 22 total were diarrhea or loose stools in the placebo and DBCM groups respectively. Other side effects included abdominal pain (n=1 placebo, 4 in DBCM), nausea or vomiting (n=1 and 3), or flatulence (n=1 and 4). One event of temporary left ear pain in the DBCM group was judged to be unrelated. No significant changes in hematology, metabolic panel, urinalysis, or ECG were seen. No uptake of DBCM into blood or urine was detected. No nonconfounded fecal occult blood was seen (positive in 1 placebo and 2 DBCM in groups 1 and 2 related to straining at stool or high dietary meat consumption). CT scans showed marking of bowel from the stomach to the terminal ileum in 14 of 16 subjects with DBCM. Superior delineation of bowel wall was seen with DBCM compared to placebo.*Conclusions Novel oral DBCM is tolerated well, shows rapid transit time, no uptake into blood or urine, and excellent marking and delineation of the small bowel at CT.*Clinical

Relevance/Application Novel oral DBCM is well tolerated and provides excellent bowel distension and superior bowel wall delineation compared to neutral contrast at unenhanced CT. Further clinical study is warranted

RESULTS

All adverse events were mild and transient, and 1, 2, 2, 4, 3 adverse events were seen in placebo groups 1-5, and 0, 2, 6, 7, 7 in DBCM groups 1-5, respectively. Of these adverse events, 8 of 12 and 10 of 22 total were diarrhea or loose stools in the placebo and DBCM groups respectively. Other side effects included abdominal pain (n=1 placebo, 4 in DBCM), nausea or vomiting (n=1 and 3), or flatulence (n=1 and 4). One event of temporary left ear pain in the DBCM group was judged to be unrelated. No significant changes in hematology, metabolic panel, urinalysis, or ECG were seen. No uptake of DBCM into blood or urine was detected. No nonconfounded fecal occult blood was seen (positive in 1 placebo and 2 DBCM in groups 1 and 2 related to straining at stool or high dietary meat consumption). CT scans showed marking of bowel from the stomach to the terminal ileum in 14 of 16 subjects with DBCM. Superior delineation of bowel wall was seen with DBCM compared to placebo.

CLINICAL RELEVANCE/APPLICATION

Novel oral DBCM is well tolerated and provides excellent bowel distension and superior bowel wall delineation compared to neutral contrast at unenhanced CT. Further clinical study is warranted

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Abstract Archives of the RSNA, 2021

Sub-Events

NR01-B10   A Deep Learning Model To Detect Intracranial Hemorrhage In Computed Tomography Scans Without Medical Annotation

Participants
Andre C. Castilla, MD,PhD, Sao Paulo, Brazil (*Presenter*) Stockholder, NeuralMed

PURPOSE

Intracranial hemorrhage, a life-threatening condition, includes several types of bleeding within the intracranial cavity, generally confirmed using Computed Tomography (CT) scans. Previous deep learning algorithms developed to aid the detection of this pathology requires a physician to annotate exams per slice. In this work, we annotated a dataset of head CT exams using Natural Language Processing (NLP) and applied an architecture using convolutional and recurrent neural networks to classify each exam. We also highlight slices where the hemorrhage appears to aid diagnosis.*Methods and Materials We assembled a dataset of head CT exams collected from a group of 6 hospitals and 5 specialized outpatient clinics. The labels were extracted from the written reports using an NLP model previously trained using BERT architecture. From each of the 8432 collected exams, we selected the axial volumetric unenhanced series. Almost 40% of exams had some kind of intracranial hemorrhage. We did not separate the bleeding subtypes. Each exam was processed using brain, blood, and bone windows, resliced to 25 images, cropped, and resized to 300x300. We used a MobileNet network pre-trained with ImageNet weights combined with a Long short-term memory (LSTM) with categorical cross-entropy as loss function. The output of the model was: hemorrhage, no finding, and other pathologies. To identify in which slice and area the hemorrhage was found, we applied the Gradient Class Activation Map (GradCAM) technique.*Results On the validation set, we achieved an AUC of 0.96, 0.87 for recall, and 0.97 for precision. On the external set, validated by a doctor, these were 0.91, 0.85, and 0.86 respectively. Through the GradCAM method, we selected the best slices of each exam, and doctors were able to evaluate the results and indicate with more precision where a hemorrhage was found.*Conclusions Select CT exams using NLP and training classification with a CNN+LSTM architecture improved the classification without the need for a per slice annotation. The identification of the most relevant slices, using the GradCAM technique, alongside clinical information, may help doctors better understand each patient case, accelerating and improving the diagnosis. This method is faster because it removes the need for medical annotation, which can be added later on image errors to improve the model.*Clinical Relevance/Application By detecting 96.6% of the normal exams, we can speed up doctor's work, providing more time for the analysis of the slices with bleeding, increasing the precision of the diagnosis.

RESULTS

On the validation set, we achieved an AUC of 0.96, 0.87 for recall, and 0.97 for precision. On the external set, validated by a doctor, these were 0.91, 0.85, and 0.86 respectively. Through the GradCAM method, we selected the best slices of each exam, and doctors were able to evaluate the results and indicate with more precision where a hemorrhage was found.

CLINICAL RELEVANCE/APPLICATION

By detecting 96.6% of the normal exams, we can speed up doctor's work, providing more time for the analysis of the slices with bleeding, increasing the precision of the diagnosis.

NR01-B3   Addressing Intra- And Inter-rater Variability Within Response Assessment Of Pediatric Medulloblastomas And Leptomeningeal Seeding Tumors Using A Deep-learning Based Automatic Tumor Segmentation And Response Assessment Model

Participants
Daniel Kim, Hudson, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Longitudinal measurement of tumor burden with MRI is an essential component of response assessment in pediatric brain tumors but is vulnerable to inter- and intra-rater variability in clinical practice. We developed a fully automated pipeline for (1) the segmentation of tumors in pediatric medulloblastomas and leptomeningeal seeding tumors and (2) automatic 2D and 3D measurements of tumors.*Methods and Materials A preoperative and postoperative cohort were randomly split into training and testing sets in a 4:1 ratio. A 3D U-Net neural network was trained to automatically segment the enhancing tumor and T2/FLAIR hyperintensity regions on T1 contrast-enhanced (T1ce) and T2/FLAIR images, respectively. The product of the maximum bidimensional diameters according to the RAPNO criteria (AutoRAPNO) was determined. Performance was compared to that of two expert human raters who performed assessments independently. Volumetric measurements of predicted and expert segmentations were computationally derived and compared.*Results Our preoperative cohort consisted of 794 T2 and 638 T1ce MRIs from 794 patients. Our postoperative cohort consisted of 492 FLAIR and 511 T1ce MRIs from 122 patients. There was excellent agreement of volumes between preoperative and postoperative predicted and manual segmentations, with ICCs of 0.912 and 0.960 for the two preoperative and 0.947 and 0.896 for the two postoperative models. While there was high agreement between AutoRAPNO scores on predicted segmentations and manually calculated scores (Rater 2 ICC=0.909; Rater 3 ICC=0.851), there was higher agreement between AutoRAPNO scores on predicted segmentations and AutoRAPNO scores on manual segmentations (ICC = 0.933). Lastly, the performance of AutoRAPNO was superior in repeatability to that of human raters for MRIs with multiple lesions.*Conclusions Our

automated deep learning pipeline demonstrated tumor segmentation and size calculation performance comparable to that of human experts. More importantly, higher agreement of AutoRAPNO scores on predicted segmentations with AutoRAPNO scores on manual segmentations vs. with manually calculated scores demonstrates that automatic pipelines can reduce inter- and intra-rater variability in response assessment for pediatric brain tumors.*Clinical Relevance/Application A deep learning segmentation pipeline is more cost-effective than increasing volume of highly specialized human labor, scalable to demand, and excels in its remarkably fast volumetric calculations and robustness to inter and intra-rater variability. Incorporating deep learning-based response assessment can improve patient care by allowing medical specialists currently performing response assessment to focus on next steps in treatment.

RESULTS

Our preoperative cohort consisted of 794 T2 and 638 T1ce MRIs from 794 patients. Our postoperative cohort consisted of 492 FLAIR and 511 T1ce MRIs from 122 patients. There was excellent agreement of volumes between preoperative and postoperative predicted and manual segmentations, with ICCs of 0.912 and 0.960 for the two preoperative and 0.947 and 0.896 for the two postoperative models. While there was high agreement between AutoRAPNO scores on predicted segmentations and manually calculated scores (Rater 2 ICC=0.909; Rater 3 ICC=0.851), there was higher agreement between AutoRAPNO scores on predicted segmentations and AutoRAPNO scores on manual segmentations (ICC = 0.933). Lastly, the performance of AutoRAPNO was superior in repeatability to that of human raters for MRIs with multiple lesions.

CLINICAL RELEVANCE/APPLICATION

A deep learning segmentation pipeline is more cost-effective than increasing volume of highly specialized human labor, scalable to demand, and excels in its remarkably fast volumetric calculations and robustness to inter and intra-rater variability. Incorporating deep learning-based response assessment can improve patient care by allowing medical specialists currently performing response assessment to focus on next steps in treatment.

NR01-B5 Amplitude Synchronization Of Spontaneous Brain Activity Of Medial And Lateral Temporal Gyri In Epilepsy Patients With Mesial Temporal Sclerosis

Participants
Mahdi Alizadeh, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

In this study, we examine whether amplitude synchronization of medial and lateral temporal gyri can detect unique alterations in left temporal lobe epilepsy (TLE) patients with mesial temporal sclerosis (MTS).*Methods and Materials This is a retrospective study of preoperative rsfMRI data from 26 MTS patients (age 23-69) and 16 controls (age 21-35). fMRI data were preprocessed and registered to a standard space. Using each subject's T1 scan, medial and lateral temporal regions were automatically segmented, manually revised and then fit to a standard space using a symmetric normalization (SyN) registration algorithm. For each subject, we used dual regression analysis to detect amplitude synchronization of medial and lateral temporal segments with the rest of the brain. We calculated the overlapped volume ratio of synchronized voxels within target regions including the thalamus (total and bilateral), insula (bilateral), cerebellum (bilateral), brainstem, total gray matter, medial and lateral gyri (bilateral) and supratentorial. Two-sample student's t-tests (DoF = 15) were used for statistical comparison of synchronization in MTS patients and controls.*Results In MTS patients, the ipsilateral lateral temporal lobe demonstrated hyperactive connections with the thalamus bilaterally (ipsilateral: $p = 0.02$, t-score = -2.67; contralateral $p = 0.02$, t = -2.69; total thalamus: $p = 0.01$, t = -3.12) and the brainstem ($p < 0.01$, t = -5.06). The contralateral lateral temporal lobe also showed hyperactivity with the contralateral thalamus ($p = 0.05$, t = -2.17) and the brainstem ($p < 0.01$, t = -4.68). The contralateral medial temporal lobe showed hypoactivity with the ipsilateral medial temporal lobe ($p = 0.02$, t = 2.59).*Conclusions We found increased synchronization between lateral temporal lobes and the thalamus and brainstem, suggesting that hyperactivity in ascending arousal systems involving these structures may constitute a component of abnormal functional networks in MTS. Furthermore, we saw reduced synchronization between the ipsilateral and contralateral medial temporal lobes, indicating less intra-temporal lobe connectivity in MTS. Our results demonstrate amplitude synchronization as an effective method to detect functional connectivity alterations in MTS.*Clinical Relevance/Application Elucidating regions with altered functional connectivity to temporal regions can improve understanding of TLE networks, pathology and treatment. Future studies can examine the effectiveness of using patient-specific abnormal patterns to tailor targeted therapies such as guided surgical resection.

RESULTS

In MTS patients, the ipsilateral lateral temporal lobe demonstrated hyperactive connections with the thalamus bilaterally (ipsilateral: $p = 0.02$, t-score = -2.67; contralateral $p = 0.02$, t = -2.69; total thalamus: $p = 0.01$, t = -3.12) and the brainstem ($p < 0.01$, t = -5.06). The contralateral lateral temporal lobe also showed hyperactivity with the contralateral thalamus ($p = 0.05$, t = -2.17) and the brainstem ($p < 0.01$, t = -4.68). The contralateral medial temporal lobe showed hypoactivity with the ipsilateral medial temporal lobe ($p = 0.02$, t = 2.59).

CLINICAL RELEVANCE/APPLICATION

Elucidating regions with altered functional connectivity to temporal regions can improve understanding of TLE networks, pathology and treatment. Future studies can examine the effectiveness of using patient-specific abnormal patterns to tailor targeted therapies such as guided surgical resection.

NR01-B7 A Meta-stacked Ensemble Model: Classification Of Cognitive Decline Using Structural MRI

Participants
Emily Yunha Shin, MS,BEng, Seoul, Korea, Republic Of (*Presenter*) Employee, NEUROPHET, Inc

PURPOSE

Dementia is a neurodegenerative disorder that causes a wide range of decline in brain function. Although many studies explored various MRI properties, most of them focused on Alzheimer's disease (AD), a particular type of dementia. In this study, we propose a meta-stacked ensemble model (meta-SEM) that performs two-class classification of a wide range of cognitive decline (CD), including mild cognitive impairment (MCI) and multiple dementia (D) subtypes, from healthy controls (HC).*Methods and Materials A total of 1344 participants (CD=736, HC=608) were included from the Catholic Aging Brain Imaging (CABI) database. T1-weighted brain MRIs were processed using a deep learning-based multi-label segmentation model developed by our research group. Demographic data (age, gender, year of education), regional brain volumes, and T1 brain images were used for our meta-SEM. Our model consisted of three distinct modules. (1) Three machine learning (ML) models (including logistic regression, ridge classifier, and

linear discriminant analysis) were trained on demographic data and volumes of regions of interest. Each ML model was trained to classify four multi targets, (i) HC/CD, (ii) HC/MCI/D, (iii) MCI/D, and (iv) 8-class auxiliary subtypes. (2) Single deep learning (DL) VGGNet was trained using 32 axial 2D slices selected through entropy method from each brain image. The DL model was trained to classify three multi-labels except for MCI/D. (3) The outcomes from (1) and (2) were provided to a meta learner, which produced the final results of classification. For comparison, we also trained a standard SEM with only HC/CD estimators.*Results Our meta-SEM resulted in the following metrics: accuracy=0.836; sensitivity=0.788; specificity=0.885; and AUC=0.893. The result of meta-SEM showed better performance than the standard SEM (accuracy=0.828). To evaluate generalizing ability, we divided the test results into auxiliary subtypes. Except for early MCI (sensitivity=0.660) and late MCI (sensitivity=0.900), all other dementia subtypes showed sensitivities of 1.0.*Conclusions As suggested by the generalizing ability of our meta-SEM, using various targets containing a wide range of information appears to help learn diverse patterns of different dementia subtypes.*Clinical Relevance/Application Our generalizable classification model for cognitive decline may help distinguish cases requiring detailed clinical examinations as an auxiliary diagnostic tool.

RESULTS

Our meta-SEM resulted in the following metrics: accuracy=0.836; sensitivity=0.788; specificity=0.885; and AUC=0.893. The result of meta-SEM showed better performance than the standard SEM (accuracy=0.828). To evaluate generalizing ability, we divided the test results into auxiliary subtypes. Except for early MCI (sensitivity=0.660) and late MCI (sensitivity=0.900), all other dementia subtypes showed sensitivities of 1.0.

CLINICAL RELEVANCE/APPLICATION

Our generalizable classification model for cognitive decline may help distinguish cases requiring detailed clinical examinations as an auxiliary diagnostic tool.

NR01-B9   Adapting The RSNA Challenge-winner's Deep Learning Model To A Korean Population Dataset: Intracranial Hemorrhage Detection On Low Dose Scans

Participants
Changwon Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To enable the RSNA 2019-challenge-winner deep learning model (RSNA DLM) for intracranial hemorrhage detection (ICH) to adapt to and ensure to yield its proven performance in a different scan setting especially on low dose scan condition.*Methods and Materials Our prior study found that the RSNA DLM for ICH detection produced much low performance for an independent Korean population (Korea University Medical Center, KUMC) dataset obtained with low dose scan settings. Under an assumption that the strong image noise on the KUMC dataset owing to reduced photon flux disturbed the behavior of DLM, we applied an AI-based CT denoising solution (ClariCT.AI, ClariPi, Seoul, Korea) to the KUMC dataset as an off-the-shelf tool to adapt the RSNA DLM to the unseen low dose scan setting. In order to confirm the noise reduction effect, the image noise was measured on an ROI on ventricle from the RSNA dataset, and the KUMC dataset without and with denoising. The RSNA DLM was trained only with the challenge training dataset and not retrained with any other dataset. Finally, sensitivity and specificity were compared to see the adaptation effect.*Results Our prior study found that the RSNA DLM for ICH detection produced much low performance for an independent Korean population (Korea University Medical Center, KUMC) dataset obtained with low dose scan settings. Under an assumption that the strong image noise on the KUMC dataset owing to reduced photon flux disturbed the behavior of DLM, we applied an AI-based CT denoising solution (ClariCT.AI, ClariPi, Seoul, Korea) to the KUMC dataset as an off-the-shelf tool to adapt the RSNA DLM to the unseen low dose scan setting. In order to confirm the noise reduction effect, the image noise was measured on an ROI on ventricle from the RSNA dataset, and the KUMC dataset without and with denoising. The RSNA DLM was trained only with the challenge training dataset and not retrained with any other dataset. Finally, sensitivity and specificity were compared to see the adaptation effect.*Conclusions We were able to adapt the RSNA DLM to an independent Korean population dataset obtained with a low dose scan setting by applying an AI-based CT denoising solution. ICH detection performance was shown to recover after denoising of the low dose scan dataset.*Clinical Relevance/Application This study can be applied to construct a pre-processing procedure in intracranial hemorrhage detection software using a non-contrast enhanced head CT image.

RESULTS

Our prior study found that the RSNA DLM for ICH detection produced much low performance for an independent Korean population (Korea University Medical Center, KUMC) dataset obtained with low dose scan settings. Under an assumption that the strong image noise on the KUMC dataset owing to reduced photon flux disturbed the behavior of DLM, we applied an AI-based CT denoising solution (ClariCT.AI, ClariPi, Seoul, Korea) to the KUMC dataset as an off-the-shelf tool to adapt the RSNA DLM to the unseen low dose scan setting. In order to confirm the noise reduction effect, the image noise was measured on an ROI on ventricle from the RSNA dataset, and the KUMC dataset without and with denoising. The RSNA DLM was trained only with the challenge training dataset and not retrained with any other dataset. Finally, sensitivity and specificity were compared to see the adaptation effect.

CLINICAL RELEVANCE/APPLICATION

This study can be applied to construct a pre-processing procedure in intracranial hemorrhage detection software using a non-contrast enhanced head CT image.

NPM03-D

Noninterpretative Tuesday Poster Discussions

Sub-Events

NPM03-D1 Wide State By State Variations Exist In The Number Of Imaging Services Performed Per Medicare Beneficiary

Participants
Aditya Khurana, BS, Scottsdale, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate geographic variations over time in the number of imaging services performed per Medicare beneficiary per year.*Methods and Materials CMS Physician and Other Supplier Public Use File Database of Medicare Part B claims submitted from 2012 to 2018 was utilized. The number of imaging services performed per radiologist and the number of unique beneficiaries served per radiologist were extracted for each radiologist and a corresponding ratio (the number of services performed per unique beneficiary) was calculated for each radiologist. Ratios were tabulated by state and year.*Results In 2012, 3,574.6 claims for imaging services were submitted per radiologist, which decreased to 3,393.4 in 2018 (-5.1%). By US state, the number of imaging services submitted per radiologist ranged from 3,426.8 in Hawaii to 13,483.6 in Maryland. In 2012, there were on average 2033.3 unique Medicare beneficiaries seen per radiologist, which increased to 2124.7 in 2018 (4.5%). By US state, the number of unique beneficiaries seen per radiologist in 2018 ranged from 1,378.1 in Minnesota to 3,716.9 in Mississippi.Annual imaging services performed per Medicare beneficiary was 3.1 in 2012, and increased to 3.4 in 2018 (+10.4%). By US state in 2018, the ratio ranged from 1.8 in Maine to 8.2 in Minnesota. From 2012 to 2018, the ratio demonstrated the largest decrease in Alabama (3.4, 2.4, -29.9%) and the largest increase in Maryland (3.8, 5.7, 49.8%).*Conclusions Annual imaging services performed per Medicare beneficiary increased over the study period, and varies more than four fold across states. These findings raise concern for variable quality and potential unwarranted variations, such as access limitations for Medicare patients in some states and over- or inappropriate utilization in others.*Clinical Relevance/Application Varied utilization patterns of imaging services per beneficiary across US states suggest Medicare resources could be better optimized to ensure high quality care for the Medicare population.

RESULTS

In 2012, 3,574.6 claims for imaging services were submitted per radiologist, which decreased to 3,393.4 in 2018 (-5.1%). By US state, the number of imaging services submitted per radiologist ranged from 3,426.8 in Hawaii to 13,483.6 in Maryland. In 2012, there were on average 2033.3 unique Medicare beneficiaries seen per radiologist, which increased to 2124.7 in 2018 (4.5%). By US state, the number of unique beneficiaries seen per radiologist in 2018 ranged from 1,378.1 in Minnesota to 3,716.9 in Mississippi.Annual imaging services performed per Medicare beneficiary was 3.1 in 2012, and increased to 3.4 in 2018 (+10.4%). By US state in 2018, the ratio ranged from 1.8 in Maine to 8.2 in Minnesota. From 2012 to 2018, the ratio demonstrated the largest decrease in Alabama (3.4, 2.4, -29.9%) and the largest increase in Maryland (3.8, 5.7, 49.8%).

CLINICAL RELEVANCE/APPLICATION

Varied utilization patterns of imaging services per beneficiary across US states suggest Medicare resources could be better optimized to ensure high quality care for the Medicare population.

NPM03-D2 The Applicant's Perspective On A Dedicated DEI Discussion On Radiology Interview Day

Participants
Abdullah Memon, Northbrook, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

In the US, diversity, equity and inclusion (DEI) is a growing priority for both residency programs and applicants alike. The racially disparate workforce in medicine can exacerbate health inequities by providing less culturally competent care to minorities. To highlight the importance of DEI, residency programs can discuss the topic on interview day within the program's general presentation. At our institution, we partitioned a session on each DR and IR residency interview day to emphasize our DEI mission and promote student dialogue around DEI topics, demonstrating to students that our department is committed to becoming a leader in this work. We assessed applicants' outlooks on the session and if it will attract those committed to this mission to join our program.*Methods and Materials A 25-minute interactive DEI session led by departmental DEI leadership was presented on each interview day, which included icebreakers by way of radiology DEI statistics, an overview of institutional patient demographics, description of DEI initiatives the program is pursuing, and an open dialogue with candidates. Applicants then completed a voluntary, anonymous, 10-question survey between the deadline for Rank Order List entry and Match Day. Questions included demographics, such as gender and URiM status, and specifics of the session on a five-point Likert scale. T-tests were used to compare the responses of male to females and URiM to non-URiM applicants. Cronbach's alpha was calculated to measure internal consistency.*Results In the 2020-2021 application cycle, 31% of applicants who interviewed at our program completed the survey. 35% of male interviewees and 26% of female interviewees completed the survey. Of those applicants within the interviewee cohort self-identifying as URiM, 63% completed the survey. On average, applicants had mostly neutral to positive experiences, with comments noting the open nature of the discussion and that DEI seems to be emphasized by the program. Non-URiM applicants agreed more than URiM applicants ($p = 0.047$) that the session demonstrated DEI is an active priority for the program. Cronbach's alpha for all applicants, males, females, URiM, and non-URiM was between 0.94-0.97, indicating excellent internal

consistency.*Conclusions Overall, this study demonstrated that an independent DEI session was well received by applicants, and a dedicated but brief discussion on the topic within the interview day can help highlight a program's commitment to DEI. Further assessment is required to identify areas where the session can be improved.*Clinical Relevance/Application With DEI becoming an essential topic in medicine, residency programs can incorporate a dedicated session on this subject to demonstrate to applicants their mission of DEI.

RESULTS

In the 2020-2021 application cycle, 31% of applicants who interviewed at our program completed the survey. 35% of male interviewees and 26% of female interviewees completed the survey. Of those applicants within the interviewee cohort self-identifying as URiM, 63% completed the survey. On average, applicants had mostly neutral to positive experiences, with comments noting the open nature of the discussion and that DEI seems to be emphasized by the program. Non-URiM applicants agreed more than URiM applicants (p = 0.047) that the session demonstrated DEI is an active priority for the program. Cronbach's alpha for all applicants, males, females, URiM, and non-URiM was between 0.94-0.97, indicating excellent internal consistency.

CLINICAL RELEVANCE/APPLICATION

With DEI becoming an essential topic in medicine, residency programs can incorporate a dedicated session on this subject to demonstrate to applicants their mission of DEI.

Printed on: 06/28/22

SDP-MK

Musculoskeletal Pre-recorded Scientific Posters

Sub-Events

SDP-MK-1   Prevalence And Risk Factors Of T-score Discordance Between Lumbar Spine And Hip Bone Mineral Density Using Dual-energy X-ray Absorptiometry In The Hong Kong Chinese Population: A Pilot Study

Participants
Kwan Wai Li, Hong Kong, Hong Kong (*Presenter*) Nothing to Disclose

PURPOSE

T-score discordance between lumbar spine and hip bone mineral density (BMD) using Dual-energy absorptiometry (DXA) could affect the therapeutic plan for patients. The aim of this study is to investigate the prevalence and risk factors of such discordance in the Hong Kong Chinese population.*Methods and Materials In this retrospective study, a total of 403 subjects (86.4% female) with a mean age of 67.7 ± 10.4 years, who underwent DXA using Hologic Horizon A in our center from January 2020 to February 2021 were reviewed. Patients with spinal and femoral fixation devices were excluded. BMD was measured to calculate the T-score at L1-L4 lumbar spine and left hip for all subjects. If degenerative changes were observed in any of the vertebrae, that specific vertebrae were excluded for lumbar spine analysis. Classification of T-scores (osteoporosis, osteopenia and normal) were identified at the two sites according to the World Health Organization classification. Statistical analysis was performed using IBM SPSS version 26.*Results Concordance, minor discordance and major discordance of T-scores were observed in 63.3%, 34.7% and 2% of the subjects, respectively. Since there was a significant difference between the null hypothesis and the general model (P = 0.042) in the test of parallelism, multinomial logistic regression was used instead of ordinal regression. Multicollinearity between independent variables (age, body mass index (BMI) and gender) was checked using tolerance and variance inflation factor. Box-Tidwell test was used to verify the linear relationship between continuous independent variables (age and BMI) and the logit transformation of the dependent variable (discordance). Concordance was chosen as the reference group for comparison. BMI (Adjusted odds ratio (AOR) = 1.061, 95% confidence interval (CI): 1.006 - 1.118, P = 0.028) and males (AOR = 3.086, 95% CI: 1.704 - 5.587, P < 0.001) were found to be the risk factor of minor T-score discordance, while age (AOR = 1.073, 95% CI: 1.002 - 1.149, P = 0.045) was found to be the risk factor of major T-score discordance.*Conclusions Although major discordance is uncommon, nearly 37% of the sample population shows diagnostic discordance. Yet, the subjects in this study were referred for osteoporosis assessment in a single center and hence the results might not be generalized to the whole Hong Kong Chinese population. Future studies with larger sample sizes including more independent variables such as fat and muscle mass, menopause, age at menopause and menarche, medical and drug history would be conducted.*Clinical Relevance/Application In case of T-score discordance, radiologists should consider including an additional site such as forearm for BMD measurement to improve the diagnosis of osteoporosis.

RESULTS

Concordance, minor discordance and major discordance of T-scores were observed in 63.3%, 34.7% and 2% of the subjects, respectively. Since there was a significant difference between the null hypothesis and the general model (P = 0.042) in the test of parallelism, multinomial logistic regression was used instead of ordinal regression. Multicollinearity between independent variables (age, body mass index (BMI) and gender) was checked using tolerance and variance inflation factor. Box-Tidwell test was used to verify the linear relationship between continuous independent variables (age and BMI) and the logit transformation of the dependent variable (discordance). Concordance was chosen as the reference group for comparison. BMI (Adjusted odds ratio (AOR) = 1.061, 95% confidence interval (CI): 1.006 - 1.118, P = 0.028) and males (AOR = 3.086, 95% CI: 1.704 - 5.587, P < 0.001) were found to be the risk factor of minor T-score discordance, while age (AOR = 1.073, 95% CI: 1.002 - 1.149, P = 0.045) was found to be the risk factor of major T-score discordance.

CLINICAL RELEVANCE/APPLICATION

In case of T-score discordance, radiologists should consider including an additional site such as forearm for BMD measurement to improve the diagnosis of osteoporosis.

SDP-MK-10   MRI Evaluation Of Soft Tissue Tumors: Is A Fast Isotropic T2-weighted 3D Sequence Suitable?

Participants
Laura M. Fayad, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

To test whether a 4-fold accelerated 3-dimensional (3D) T2-weighted (T2) CAIPIRINHA SPACE turbo spin-echo (TSE) sequence with isotropic voxel size offers at least equivalent performance to conventional 2DT2 TSE for the evaluation of intrinsic and perilesional soft tissue tumors (STT) characteristics.*Methods and Materials 108 patients with histologically proven STTs underwent MRI, including 3DT2 (CAIPIRINHA SPACE TSE) and 2DT2 (TSE) sequences at 3T. Two radiologists independently evaluated each technique for quality (diagnostic, non-diagnostic), tumor characteristics (heterogeneity, signal intensity, tumor margin), and the presence or absence of cortex involvement, bone marrow edema, joint extension, neurovascular encasement, and perilesional edema; tumor size and perilesional edema extent were measured. Signal-to-noise (SNR) and contrast-to-noise (CNR) ratios and acquisition times for 2DT2 in two planes and isotropic 3DT2 sequences were reported. Descriptive statistics, inter-

method agreement, and intraclass correlation (ICC) were applied.*Results The image quality was rated as diagnostic for all 2DT2 and 3DT2 sequences (100% [108/108]). No difference was observed between the 3DT2 and 2DT2 qualitative parameters evaluated by the two readers (p>0.05). There was no difference in tumor size (3DT2: mean largest size, 2.9±2.5cm (range, 0.3-19 cm), 2DT: 22.8±2.6cm (range, 0.3-18.2cm) p=0.4) or perilesional edema extent between the sequences (3DT2: mean extent 0.5±1.2 cm (range, 0.2-7cm), 2DT2: 0.5±1.0cm (range, 0.3-6.3cm), p=0.9). Interobserver reliability for measurements was high (ICC range 0.7-1) for both sequences. There was no difference in the SNR of tumors, bone marrow, and fat between the sequences, whereas the SNR of muscle was higher (p<0.05) on 3DT2 compared with 2DT2. CNR measures on 3DT2 were similar to 2DT2 (p>0.1). The average 3DT2 acquisition time was 5:43min±2:07min (range,3:04min-8:36min), whereas the 2DT2 acquisition in two planes was 7:55min±2:42min(range,5:32min-12:30min).*Conclusions Isotropic 3DT2 CAIPIRINHA SPACE MRI offers higher spatial resolution and faster acquisition times and comparable assessments of soft tissue tumor characteristics than conventional 2DT2 TSE MRI in two planes. 3DT2 CAIPIRINHA SPACE TSE can substitute 2DT2 TSE in tumor protocols.*Clinical Relevance/Application Isotropic 3DT2 CAIPIRINHA SPACE TSE has higher spatial resolution and is comparable for assessments of soft tissue tumor characteristics compared to conventional 2DT2 TSE.Multiplanar reformats of 3DT2 CAIPIRINHA SPACE TSE can substitute 2DT2 TSE acquired in multiple planes, thereby reducing the acquisition time of MRI tumor protocols.

RESULTS

The image quality was rated as diagnostic for all 2DT2 and 3DT2 sequences (100% [108/108]). No difference was observed between the 3DT2 and 2DT2 qualitative parameters evaluated by the two readers (p>0.05). There was no difference in tumor size (3DT2: mean largest size, 2.9±2.5cm (range, 0.3-19 cm), 2DT: 22.8±2.6cm (range, 0.3-18.2cm) p=0.4) or perilesional edema extent between the sequences (3DT2: mean extent 0.5±1.2 cm (range, 0.2-7cm), 2DT2: 0.5±1.0cm (range, 0.3-6.3cm), p=0.9). Interobserver reliability for measurements was high (ICC range 0.7-1) for both sequences. There was no difference in the SNR of tumors, bone marrow, and fat between the sequences, whereas the SNR of muscle was higher (p<0.05) on 3DT2 compared with 2DT2. CNR measures on 3DT2 were similar to 2DT2 (p>0.1). The average 3DT2 acquisition time was 5:43min±2:07min (range,3:04min-8:36min), whereas the 2DT2 acquisition in two planes was 7:55min±2:42min(range,5:32min-12:30min).

CLINICAL RELEVANCE/APPLICATION

Isotropic 3DT2 CAIPIRINHA SPACE TSE has higher spatial resolution and is comparable for assessments of soft tissue tumor characteristics compared to conventional 2DT2 TSE.Multiplanar reformats of 3DT2 CAIPIRINHA SPACE TSE can substitute 2DT2 TSE acquired in multiple planes, thereby reducing the acquisition time of MRI tumor protocols.

SDP-MK-11 Non-neoplastic Outcomes From The Oxford Sarcoma MDT

Participants
Faheem Malik, MA,MBBCHIR, Oxford, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Bone and soft tissue tumours (BST) can give similar clinical and radiological findings as non-neoplastic lesions. One of the objectives of the Oxford Sarcoma Multidisciplinary Team (OSMDT) meeting is to distinguish true BST from non-neoplastic tumour-mimicking pathologies. In this poster, we present cases referred to the OSMDT in the last year that received an outcome of non-neoplastic lesion. Our primary outcome measure is the incidence of non-neoplastic lesions presenting as suspected sarcoma to the OSMDT. Our secondary outcome measure is the spectrum of conditions comprising these non-neoplastic lesions. We will discuss some specific examples, and outline their radiological features. We hope this gives other clinicians an insight into the tumour-mimicking pathologies encountered by a tertiary centre.*Methods and Materials We conducted a retrospective observational study compiling the non-neoplastic outcomes from the OSMDT in the last year. We identified all referrals made to our service between 1st January 2020 and 31st December 2020, and matched patient details from these referrals to our Electronic Patient Record (EPR) and Picture Archiving and Communication System (PACS).*Results The total number of case discussion events in the Oxford Bone and Soft Tissue Service MDT was 2337. The total number of new cases discussed at least once between 1st January 2020 and 31st December 2020 was 976; 958 from the UK, 17 from Malta, and 1 from Jamaica. Of these new cases, 84/976 (8.61%) received an outcome of non-neoplastic lesion. This gives a primary outcome incidence of 8.61% for seriously-suspected sarcomas receiving an outcome of non-neoplastic lesion at our MDT. These non-neoplastic outcomes can be categorised into the following types of pathologies: 32.1% vascular, 31.0% inflammatory, 14.3% traumatic, 6.0% degenerative, 6% idiopathic, 3.8% infective, 3.6% metabolic, 1.2% autoimmune, and 1% genetic. The most common specific diagnosis was vascular malformation, comprising 31.0% of all non-neoplastic outcomes.*Conclusions The incidence of non-neoplastic lesions presenting to our tertiary sarcoma MDT as suspected sarcoma is 8.61%. These lesions are made up of a number of pathologies, with vascular and inflammatory conditions being the most common.*Clinical Relevance/Application We hope that this poster gives clinicians an insight into the incidence of non-neoplastic conditions presenting to a tertiary centre as seriously-suspected sarcoma. We also hope to demonstrate the spectrum of radiological presentations of these conditions.

RESULTS

The total number of case discussion events in the Oxford Bone and Soft Tissue Service MDT was 2337. The total number of new cases discussed at least once between 1st January 2020 and 31st December 2020 was 976; 958 from the UK, 17 from Malta, and 1 from Jamaica. Of these new cases, 84/976 (8.61%) received an outcome of non-neoplastic lesion. This gives a primary outcome incidence of 8.61% for seriously-suspected sarcomas receiving an outcome of non-neoplastic lesion at our MDT. These non-neoplastic outcomes can be categorised into the following types of pathologies: 32.1% vascular, 31.0% inflammatory, 14.3% traumatic, 6.0% degenerative, 6% idiopathic, 3.8% infective, 3.6% metabolic, 1.2% autoimmune, and 1% genetic. The most common specific diagnosis was vascular malformation, comprising 31.0% of all non-neoplastic outcomes.

CLINICAL RELEVANCE/APPLICATION

We hope that this poster gives clinicians an insight into the incidence of non-neoplastic conditions presenting to a tertiary centre as seriously-suspected sarcoma. We also hope to demonstrate the spectrum of radiological presentations of these conditions.

SDP-MK-12 The Configuration Of Soft Tissue Sarcoma As A Valuable Feature On Mri

Participants
Sam Sedaghat, MD, Kiel, Germany (*Presenter*) Nothing to Disclose

PURPOSE

A new morphological aspect is to characterize soft tissue sarcomas (STS) by their configurations on MRI. The purpose of this multicenter study was to determine the value of STS configurations on MRI for use in the routine radiological setting.*Methods and

Materials 345 patients with STS were identified. Patients with other examinations than MRI and patients with lipo-, angio- and retroperitoneal sarcomas were excluded. 131 primary STS were included. Histological STS grades were derived from all available pathological reports and primary STS were divided into three groups according to the FNCLCC grading system: G1 (low-grade), G2 (intermediate) and G3 (high-grade). According to recent studies, the tumor configuration was divided into polycyclic/multilobulated, fascicular, ovoid/nodular, streaky, and fusiform. For imaging, 1.5-Tesla MRI systems were used.*Results 55 high-grade, 41 intermediate-grade and 35 low-grade primary STS lesions were identified. Primary STS significantly most often occurred in the extremities (p<0.001). Polycyclic/multilobulated, ovoid/nodular and streaky were the most common configurations. Most of the high-grade (G3) and intermediate-grade (G2) primary STS showed a polycyclic/multilobulated configuration (p<0.001), while low-grade primary STS (G1) were mostly ovoid/nodular. G3 polycyclic/multilobulated STS were significantly more often infiltrative, compared to G2 polycyclic/multilobulated STS (p<0.05). Most ovoid/nodular primary STS were well-defined (p<0.001). Streaky G3 and G2 sarcoma were all infiltrative, while streaky G1 sarcoma mostly showed well-defined borders. Additionally, high-grade streaky and polycyclic/multilobulated STS were significantly larger in size, compared to intermediate- and low-grade STS.*Conclusions Configuration of STS on MRI can indicate the grade of malignancy, as higher-grade (G2/3) STS significantly most often show a polycyclic/multilobulated configuration, while low-grade STS (G1) are mainly ovoid/nodular. Furthermore, infiltrative behavior might suggest higher-grade STS in streaky and polycyclic/multilobulated configured STS. Therefore, the configuration of STS is a valuable feature on MRI.*Clinical Relevance/Application The configuration is a long overlooked feature of STS on MRI and there are only a few studies dealing with this feature. Our study showed that the configuration of STS has the potential to predict the grade of malignancy and consecutively evaluate the therapy. Therefore, the configuration of STS should be implemented in MRI reports on STS.

RESULTS

55 high-grade, 41 intermediate-grade and 35 low-grade primary STS lesions were identified. Primary STS significantly most often occurred in the extremities (p<0.001). Polycyclic/multilobulated, ovoid/nodular and streaky were the most common configurations. Most of the high-grade (G3) and intermediate-grade (G2) primary STS showed a polycyclic/multilobulated configuration (p<0.001), while low-grade primary STS (G1) were mostly ovoid/nodular. G3 polycyclic/multilobulated STS were significantly more often infiltrative, compared to G2 polycyclic/multilobulated STS (p<0.05). Most ovoid/nodular primary STS were well-defined (p<0.001). Streaky G3 and G2 sarcoma were all infiltrative, while streaky G1 sarcoma mostly showed well-defined borders. Additionally, high-grade streaky and polycyclic/multilobulated STS were significantly larger in size, compared to intermediate- and low-grade STS.

CLINICAL RELEVANCE/APPLICATION

The configuration is a long overlooked feature of STS on MRI and there are only a few studies dealing with this feature. Our study showed that the configuration of STS has the potential to predict the grade of malignancy and consecutively evaluate the therapy. Therefore, the configuration of STS should be implemented in MRI reports on STS.

SDP-MK-13 Whole-body MR Imaging In Limb Girdle Muscular Dystrophy Type R1/2A (LGMDR1/LGMD2A): A Multicenter Study

Participants
Lais Aivazoglou, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

To provide a detailed description and define a characteristic WBMRI pattern of involvement in LGMDR1 patients with correlation to clinical and functional data.*Methods and Materials Patients with a confirmed diagnosis of LGMDR1 under follow-up in three neuromuscular disorder centers were recruited. Institutional ethical committee authorization and written informed consent of all patients were obtained. The study group consisted of 18 patients. Clinical and epidemiological data were collected and a functional evaluation was performed, consisting of the&9; Gardner-Medwin and Walton (GMW) scale to evaluate lower limb functionality and the Brooke scale to evaluate upper limb functionality.All patients underwent a WBMRI protocol (1.5T) consisting of axial T1 and STIR images. Fifty one different muscles were assessed regarding fatty infiltration (5-point scale) and muscle edema (4-point scale). The results were evaluated with non-parametric statistical analysis using the software R.*Results All patients showed strikingly symmetrical T1 abnormalities. The highest fatty infiltration scores involved the serratus anterior and the long head of the biceps femoris, adductor magnus and lumbar erector spinae. The most spared muscle bellies overall were cervical paraspinal muscles, sternocleidomastoid, thoracic transversospinal and popliteus.There was a mediolateral gradient of involvement of the posterior paraspinal muscles, in which the erector spinae muscles (the more lateral muscles) were more affected than the transversospinalis muscles (the more medial muscles), with p 0.0026 in the thoracic segment and p 0.0090 in the lumbar segment.In the thighs, the posterior compartment was preferentially involved in comparison to the anterior compartment. A striped pattern of involvement of the vastus lateralis was present in 13 of the 18 patients (72%): the "pseudocollagen sign".There was a strong correlation between the lower limbs MR score to the functional GMW score (Spearman's correlation coefficient: 0.8285) and a moderate correlation between the upper limbs MR score with the Brooke score (Spearman's correlation coefficient: 0.5396).*Conclusions We present a detailed description of the characteristic WBMRI pattern of involvement in LGMDR1 patients with the highlights of the mediolateral gradient of involvement of the posterior paraspinal muscles, the "pseudocollagen sign" and the strong correlation between the lower limbs MR score to the functional GMW score.*Clinical Relevance/Application Knowledge of the whole-body MR pattern of involvement of LGMDR1 patients adds to the diagnostic workup of myopathies in clinical practice and broadens the possibilities of different muscles to be used in the future as an outcome measure in clinical trials.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

Knowledge of the whole-body MR pattern of involvement of LGMDR1 patients adds to the diagnostic workup of myopathies in clinical practice and broadens the possibilities of different muscles to be used in the future as an outcome measure in clinical trials.

SDP-MK-14 Compression Of Nerve Roots May Increase The Degree Of Fat Infiltration Of Multifidus Muscle

Participants
Hui Hao, Xi'an, China (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to find the relationship between the degree of nerve root compression and the degree of multifidus muscle lipidization using conventional MRI images.*Methods and Materials Images of all patients undergoing lumbar MRI in our center from January to April 2019 were retrospectively analyzed, and T2 Sag and T2 Ax images were selected.The level of intervertebral disc herniation was determined in sagittal position, and Priffman grading and Kader grading of intervertebral disc herniation in transverse position were conducted.(Table 1 and Fig 1)Basic information such as name, gender and age were collected.All statistical analysis were performed by using SPSS 20.0 (SPSS, Chicago, IL, USA); p<0.05 was considered as statistically significant difference.*Results A total of 244 (110 male and 134 female) patients with the age(51±16)were enrolled in this study. Lumbar magnetic resonance imaging was performed in all patients , some patients had herniated discs at more than one vertebral level. So we analyzed a total of 453 problematic vertebral levels. According to the situation of disc herniation can be divided into central type and lateral recess type.Priffman grading and Kader grading were related to the central type. The degree of compression was correlated with the degree of aliphatization, and both sides were correlated, indicating that the higher the degree of compression was, the higher the degree of aliphatization was (the correlation coefficient r=0.207 on the left , r=0.195 on the right). (Table 2)A herniated disc to the left had the same result (left correlation coefficient r=0.289,and the right r=0.200). (Table 3)Disc herniation to the right can also indicate the correlation between degree of compression and degree of steatosis (left correlation coefficient r=-.050;right Correlation coefficient r=.292)(Table 4).*Conclusions The nerve root compression quantified by Priffman grading is correlated the degree of lipidization, also the inconsistently distributed degree of lipidization is higher in compression side. Those observations strongly support the hypothesis that nerve root compression is the reason of multifidus muscle fat infiltration.*Clinical Relevance/Application The increase of multifidus muscle fat infiltration will affect the postoperative rehabilitation of patients with lumbar spine surgery. In this study, reasons for fat infiltration on both sides of multifidus muscles were analyzed retrospectively.In our study, nerve root compression was found to be correlated with degree of multifidus muscle fat infiltration. This correlation support the hyposis that nerve root compression would result in an increase in the adiposity of multifarious muscles.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

The increase of multifidus muscle fat infiltration will affect the postoperative rehabilitation of patients with lumbar spine surgery. In this study, reasons for fat infiltration on both sides of multifidus muscles were analyzed retrospectively.In our study, nerve root compression was found to be correlated with degree of multifidus muscle fat infiltration. This correlation support the hyposis that nerve root compression would result in an increase in the adiposity of multifarious muscles.

SDP-MK-15 Achilles Tendon Changes Detected With Magnetization Transfer Of Ultrashort Echo Time Magnetic Resonance Imaging After Long-distance Running

Participants
Yijie Fang, Zhuhai, China (*Presenter*) Nothing to Disclose

PURPOSE

To explore the value of magnetization transfer of ultrashort echo time magnetic resonance imaging (UTE-MT) in demonstrate feasibility of detection of subclinical sports-related achilles tendon changes in athletes after the marathon.*Methods and Materials The research was approved by the institutional ethics committee review board, and the volunteers provided written consent before the study. Twenty-nine amateur long-distance runners underwent an MR examination (UTE-MT, T1-weighted MR imaging, and T2-weighted MR imaging with fat suppression) of both achilles tendon 1 week before, 2 days after, and 4 weeks after they participated in a marathon. The four regions was divided into 4 subregions: insertion, middle, muscle-tendon junction and whole achilles tendon. The MTR were derived from the UTE-MT data by 2 radiologists independently. Data per achilles tendon from the three time-points were compared by using a two-way mixed-design analysis of variance with a Bonferroni posthoc test.*Results The 2 radiologists had good consistency in the measurement of MTR of achilles tendon with the ICC values of 0.892 to 0.934. This study also revealed injured in UTE-MT that over time were not revealed by qualitative T2WI imaging with fat suppression. The MTR were significantly decreased (P <0.05) in the middle, muscle-tendon junction and whole achilles tendon 2 days after running, and the MTR was recovered 4 weeks after running.*Conclusions After a single marathon, the changes of achilles tendon in amateur marathon runners are reversible. In the absence of positive findings in conventional MRI, UTE-MT can indirectly reflect changes in biochemical composition of the achilles tendon during exercise.*Clinical Relevance/Application UTE-MT reflects the content of macromolecules and may be used as a technique for detecting Achilles tendon injury.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

UTE-MT reflects the content of macromolecules and may be used as a technique for detecting Achilles tendon injury.

SDP-MK-16 Comprehensive Assessment Of Ultrasound's Role For Carpal Tunnel Syndrome In Reference To

Electromyography In A Tertiary Hospital.

Participants
Yaman M. Alahmad, Doha, Qatar (*Presenter*) Nothing to Disclose

PURPOSE

Carpal Tunnel Syndrome (CTS) is the most common peripheral mononeuropathy related to entrapment syndrome. Although it is a clinical diagnosis, a confirmatory test is usually needed for uncertain cases. An increase in the median nerve cross-sectional area (CSA) is seen using ultrasound (US) imaging for CTS patients. However, the optimal cutoffs for the diagnosis and classification of CTS using the US are controversial. Several studies used cutoffs of 8.5 to 10.0 mm2 for the diagnosis, with various ranges for the severity indices. We aimed to study the correlation between the findings of US imaging and electromyography (EMG) in patient with CTS for diagnostic and classification purposes.*Methods and Materials We conducted a retrospective cross-sectional study for the period between 2014 and 2020 to identify CTS patients who are above eighteen-year-old and had both US and EMG studies. We excluded patient who had median nerve trauma or neoplasm and those who had US without EMG. For patients with bilateral ultrasound wrist assessment, each hand was considered as a separate image to be compared with EMG. Data were analyzed using SPSS 64-bit version 25. Shapiro-Wilk test was used to assess for distribution normality. Levene's test was performed to assess for homogeneity of variance. EMG findings were classified into: normal, mild, moderate, severe CTS (independent variable). US CSA used as dependent variable. One-way Analysis of Variance (ANOVA) test and Post Hoc analysis were used to assess for difference. US's sensitivity and specificity were calculated for CTS, when compared to EMG (gold standard).*Results Our final sample was 99 subjects; 81 females and 18 males. Their age range was between 24 to 87 years; with mean of 49 ± 3 years. CTS classification using the median nerve CSA reported by US, when compared to EMG, was as following (95% confidence interval of the mean): normal: 8.7 - 10.8 mm2, mild CTS: 10.6 - 16.5 mm2, moderate CTS: 15.4 - 18.1 mm2, severe CTS: 19.1 - 23.1 mm2. There was a statistically significant difference between groups as determined by one-way ANOVA (p<0.001). A Scheffe Post Hoc test revealed no statistical difference between normal and mild CTS groups (p=0.08). There was statistical difference between mild and moderate groups (p=0.006) and moderate and severe groups (p<0.001). Our data showed US sensitivity for CTS of 73.8% and specificity of 76.3%.*Conclusions Sonography seems unable to differentiate some normal from mild CTS cases. However, median nerve CSA of =10 mm2 are suggestive of normal EMG. Nevertheless, sonography appears to be excellent in diagnosing and classifying moderate and severe CTS cases.*Clinical Relevance/Application US can be used as a screening tool in patients with suspected CTS. More studies are needed to assure external validity.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

US can be used as a screening tool in patients with suspected CTS. More studies are needed to assure external validity.

SDP-MK-17 Diagnostic Performance Of Mr Arthrogram In Abduction And External Rotation For Detection Of Glenoid Labral Lesions: A Systematic Review And Meta-analysis

Participants
Mehrzad Shafiei, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic performance of direct magnetic resonance (MR) arthrography for labral lesions during conventional positioning, abduction and external rotation (ABER), and abduction and external rotation (ABER) plus conventional positioning by using a systematic review and meta-analysis.*Methods and Materials A comprehensive literature search was performed on the two main concepts of magnetic resonance arthrography position (Abduction and External rotation) and labral lesions. Inclusion criteria consisted of original studies that assessed the diagnostic accuracy of MR arthrography in ABER and conventional position for the diagnosis of labral lesions, by using surgical findings as the reference standard. The Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS-2) tool was used to assess methodologic quality. Meta-analyses were performed that compared MR arthrography during conventional positioning, abduction and external rotation (ABER), and abduction and external rotation (ABER) plus conventional positioning.*Results Seven studies met inclusion and exclusion criteria. Total of 695, 504, and 195 lesions assessed by conventional MRA, ABER MRA, and ABER MRA plus conventional MRA, respectively, were included in our analysis. Pooled sensitivities of MRA in conventional, ABER, and ABER plus conventional position for diagnosis of labral tear were 80.5%, 81.61%, and 94.47%, respectively. Pooled specificities of MRA in conventional, ABER, and ABER plus conventional position for diagnosis of labral tear were 88.52%, 85.56%, and 90.1%, respectively. Summary receiver operator characteristic (ROC) curve demonstrated improved accuracy of ABER plus conventional MRA compared with conventional MRA and ABER MRA with area under the curve (AUC) of 0.99, 0.89, and 0.88, respectively.*Conclusions ABER plus conventional MRA showed substantial superiority compared to both ABER MRA and conventional MRA alone for diagnosis of labral lesions. ABER MRA alone has a diagnostic value comparable to conventional MRA for depicting glenoid labral lesions.*Clinical Relevance/Application The addition of ABER position to conventional MRA could improve diagnostic accuracy for depicting labral tears.

RESULTS

Seven studies met inclusion and exclusion criteria. Total of 695, 504, and 195 lesions assessed by conventional MRA, ABER MRA, and ABER MRA plus conventional MRA, respectively, were included in our analysis. Pooled sensitivities of MRA in conventional, ABER, and ABER plus conventional position for diagnosis of labral tear were 80.5%, 81.61%, and 94.47%, respectively. Pooled specificities of MRA in conventional, ABER, and ABER plus conventional position for diagnosis of labral tear were 88.52%, 85.56%, and 90.1%, respectively. Summary receiver operator characteristic (ROC) curve demonstrated improved accuracy of ABER plus conventional MRA compared with conventional MRA and ABER MRA with area under the curve (AUC) of 0.99, 0.89, and 0.88, respectively.

CLINICAL RELEVANCE/APPLICATION

The addition of ABER position to conventional MRA could improve diagnostic accuracy for depicting labral tears.

SDP-MK-18 Improved Delineation Of Bone Structures In The Wrist Using Photon-counting CT

Participants
Nina Kammerling, MD, Motala, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate diagnostic image quality of wrist images obtained using a prototype photon-counting detector (PCD) computed tomography (CT) and to compare it to a state-of-the-art conventional energy-integrating detector CT (EID-CT).*Methods and Materials Twelve human wrist specimens were scanned with EID-CT (SOMATOM Force; Siemens Healthineers, Forchheim, Germany) and PCD-CT (SOMATOM Count Plus; Siemens Healthineers, Forchheim, Germany) at comparable patient dose levels (CTDI 5.3 mGy) and similar technique parameters (120 kV, rotation time 1 s, pitch 0.85). Axial images were reconstructed using the thinnest possible slice thickness, i.e. 0.4 mm on EID-CT and 0.2 mm on PCD-CT (UHR-mode) at 50% overlap, with the largest image matrix size possible (512 x 512 on EID-CT and 2048 x 2048 on PCD-CT). Reconstruction kernels with different sharpness, optimized for imaging of skeletal structures, were used. Noise levels were assessed using the standard deviation of the CT number of the image pixels in fat tissue. Contrast-to-noise ratios (CNR) were calculated for bone structures. Spatial resolution was evaluated by quantifying the separation of trabecular bone and bone marrow using 3D histogram analysis.*Results Bone CNR was lower for PCD-CT using a relatively sharp bone kernel (Br89u), compared to EID-CT (PCD-CT: 11.5 ± 1.2; EID-CT: 18.8 ± 3.4). The 3D histogram analysis, however, showed a better delineation of trabecular bone structure for PCD-CT reconstructed with the sharper bone kernel. The relative number of unsharp voxels was significantly lower for PCD-CT for both the radius (27 ± 3 %) and the scaphoideum (26 ± 4 %) compared to EID-CT (radius: 48 ± 11%; scaphoideum: 45 ± 13 %; p < 0.001), despite a 63% decrease in CNR for the sharper bone kernel.*Conclusions Computed tomography of the wrist using a prototype photon-counting CT scanner provides superior delineation of trabecular bone compared to conventional CT at comparable patient doses and despite using a sharper reconstruction kernel with a higher level of image noise. This is due to better detector dose efficiency, smaller detector elements allowing for thinner slice thickness and a large image matrix of 2048 x 2048 pixels.*Clinical Relevance/Application This study shows an improved visibility of bone structures using PCD-CT, which may lead to a better diagnosis of fractures, as well as more individualized and targeted treatment measures.

RESULTS

Bone CNR was lower for PCD-CT using a relatively sharp bone kernel (Br89u), compared to EID-CT (PCD-CT: 11.5 ± 1.2; EID-CT: 18.8 ± 3.4). The 3D histogram analysis, however, showed a better delineation of trabecular bone structure for PCD-CT reconstructed with the sharper bone kernel. The relative number of unsharp voxels was significantly lower for PCD-CT for both the radius (27 ± 3 %) and the scaphoideum (26 ± 4 %) compared to EID-CT (radius: 48 ± 11%; scaphoideum: 45 ± 13 %; p < 0.001), despite a 63% decrease in CNR for the sharper bone kernel.

CLINICAL RELEVANCE/APPLICATION

This study shows an improved visibility of bone structures using PCD-CT, which may lead to a better diagnosis of fractures, as well as more individualized and targeted treatment measures.

SDP-MK-19 Quantitative MRI Depicts Abnormal EMG Motor Unit Recruitment And Spontaneous Activity In Muscle Denervation

Participants
Kenneth Serrano, BA, Port Jefferson, New York (*Presenter*) Nothing to Disclose

PURPOSE

While MRI qualitatively depicts muscle denervation, electromyography (EMG) is used to grade its severity. This study elevated the role of quantitative MRI (qMRI) techniques (T2-mapping and diffusion tensor imaging-based apparent fiber diameter (AFD)) in denervation assessment. We hypothesized that qMRI can discriminate between different grades in severity of muscle denervation.*Methods and Materials 31 subjects (age=38.6+/-19.1, 22M/9F) undergoing brachial plexus MRI and EMG (mean=9.0 days apart) for suspected plexopathy were prospectively recruited for qMRI. A 10-minute qMRI included T2-mapping and multi-b-valued DTI. A novel AFD metric, using cylinders to model muscle fiber cross-section, was derived from DTI data. Five muscles (supraspinatus, infraspinatus, and deltoid anterior/middle/posterior heads) were manually segmented on 3 representative axial slices (superior, middle, and inferior). EMG measures included motor unit recruitment (MUR), from greatest to least: 'full', 'decreased', 'discrete', and 'none', and abnormal spontaneous activity: fibrillations and positive sharp waves (PSWs) ('0', '1+', '2+', '3+'). Parametric t-tests (a=0.05) with Holm-Bonferroni correction of T2 and AFD were performed between EMG grades.*Results 129 muscles (88 denervated, confirmed by EMG) were analyzed. Mean T2 (ms) was significantly (p<0.01) higher in more severe MUR denervation grades ('decreased': 45.7, 'discrete': 52.3, 'none':56.6) than non-denervated (38.6). Mean AFD (um) was significantly (p<0.01) lower in denervated (63.6, 60.4, 59.3) than non-denervated muscles (77.8). Significant mean T2 increases (p<0.01) and AFD decreases (p<0.02) existed between fibrillation grades of '2+' and '0' (by +5.7ms and -10.3um) and between '3+' and '0' (by +13.2ms and -8.9um). For PSWs, significant mean T2 (ms) increases ('1+':+14.0, '2+': +6.0, '3+': +14.4, p<0.01) and AFD (um) decreases ('2+':-11.3, '3+': -10.7 only, p<0.01) were observed.*Conclusions qMRI can discriminate between EMG severity grades. Future work will involve longitudinal imaging, analyzing other anatomies and disease processes, and validating the AFD metric with human muscle biopsy.*Clinical Relevance/Application Quantitative MRI (T2-mapping and diffusion diameter) may provide non-invasive depiction of muscle denervation severity.

RESULTS

129 muscles (88 denervated, confirmed by EMG) were analyzed. Mean T2 (ms) was significantly (p<0.01) higher in more severe MUR denervation grades ('decreased': 45.7, 'discrete': 52.3, 'none':56.6) than non-denervated (38.6). Mean AFD (um) was significantly (p<0.01) lower in denervated (63.6, 60.4, 59.3) than non-denervated muscles (77.8). Significant mean T2 increases (p<0.01) and AFD decreases (p<0.02) existed between fibrillation grades of '2+' and '0' (by +5.7ms and -10.3um) and between '3+' and '0' (by +13.2ms and -8.9um). For PSWs, significant mean T2 (ms) increases ('1+':+14.0, '2+': +6.0, '3+': +14.4, p<0.01) and AFD (um) decreases ('2+':-11.3, '3+': -10.7 only, p<0.01) were observed.

CLINICAL RELEVANCE/APPLICATION

Quantitative MRI (T2-mapping and diffusion diameter) may provide non-invasive depiction of muscle denervation severity.

SDP-MK-2 Quantitative Shear Wave Elastography Evaluation Of Rectus Femoris Muscle In Healthy Adults

Participants

Jisook Yi, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study is (1) to investigate the reliability of shear wave ultrasonography of rectus femoris (RF) muscle according to locations and (2) to compare the measurements of rectus femoris muscle between SWE and CT in healthy adults.*Methods and Materials Seventy (30 men, 40 women; mean age, 45.7 years) with healthy body mass index (BMI < 25) were included between June 2019 and January 2020. SWE of right RF muscle of subjects was performed by one musculoskeletal radiologist. Qualitative muscle visual grade was performed using 4 grades. SWE findings (stiffness and shear wave velocity [SWV]) of RF muscle were measured on proximal, mid, and distal 1/3 portion of RF muscle. Measurements were repeated 10 minutes after the first measurement. CT without contrast enhancement of RF muscle was performed the same day of SWE and RF muscle density (MD) was measured on mid 1/3 portion. The reliability of SWE measurements was assessed by using intraclass correlation coefficient (ICC). The correlation between SWE measurements and MD on CT was analyzed using Pearson's correlation.*Results The interobserver agreements for SWE findings were almost perfect for mid-RF muscle (k=0.831 for stiffness, k=0.822 for SWV) and substantial for proximal (k=0.775 for stiffness, k=0.770 for SWV) and distal (k=0.771 for stiffness, k=0.795 for SWV) RF muscle. There were negative moderate correlations in visual grade/velocity (r=-0.478, p<0.001) and visual grade/stiffness (r=-0.489, p<0.001). There were very weak to weak correlations between CT MD and SWE findings (r=-0.265-0.392).*Conclusions SWE findings of RF muscle demonstrated the highest reliability in mid-portion of thigh. SWE findings showed moderate correlation with visual grade of USG and very weak to weak correlation to muscle density on CT.*Clinical Relevance/Application SWE of muscle might be detected the early change of muscle degeneration compared to CT. And it could be used as an objective method to evaluate the quality of muscle and might promote precision medicine.

RESULTS

The interobserver agreements for SWE findings were almost perfect for mid-RF muscle (k=0.831 for stiffness, k=0.822 for SWV) and substantial for proximal (k=0.775 for stiffness, k=0.770 for SWV) and distal (k=0.771 for stiffness, k=0.795 for SWV) RF muscle. There were negative moderate correlations in visual grade/velocity (r=-0.478, p<0.001) and visual grade/stiffness (r=-0.489, p<0.001). There were very weak to weak correlations between CT MD and SWE findings (r=-0.265-0.392).

CLINICAL RELEVANCE/APPLICATION

SWE of muscle might be detected the early change of muscle degeneration compared to CT. And it could be used as an objective method to evaluate the quality of muscle and might promote precision medicine.

SDP-MK-20 Combination Use Of Compressed Sensing And Deep Learning For Shoulder MRI: Stability In Various Sequences

Participants
Takeshi Nakaura, MD, Kumamoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Deep learning-based reconstruction (DLR) has been reported to be effective in improving the image quality of magnetic resonance imaging (MRI), but almost no previous reports evaluated its stability for various sequences. This study aimed to evaluate the usefulness of the combined use of compressed sensing and DLR for various sequences in shoulder MRI.*Methods and Materials This retrospective study included 37 consecutive patients who underwent under-sampled shoulder MRI, including coronal short T1 inversion recovery (STIR) sequences, T1-weighted images (T1WI), and T2-weighted images (T2WI). Images were reconstructed using the conventional Wavelet-based denoising method (Wavelet method) or the combination of Wavelet and DLR-based denoising method (hybrid-DLR method) for each sequence. The signal-to-noise ratio (SNR) and the contrast-to-noise ratio (CNR) of bone, muscle, and fat and half width at half maximum (FWHM) of the shoulder joint were compared between the two image reconstruction methods. Two board-certified radiologists scored for image noise, contrast, sharpness, artifacts, and overall image quality of the two image types using a 4-point scale.*Results The SNRs and CNRs of bone, muscle, and fat in STIR, T1WI, and T2WI from the hybrid-DLR method were significantly higher than those of Wavelet method (p < 0.001). No significant differences were found in the FWHM of the shoulder joint among all sequences (p > 0.05). The image noise, sharpness, artifacts, and overall image quality in all sequences reconstructed using the hybrid-DLR method were significantly higher than those of the Wavelet method (p < 0.001). No significant differences were observed in the contrast between the two methods (p > 0.05).*Conclusions The hybrid-DLR method can improve the image quality of compressed sensing in STIR, T1WI, and T2WI of the shoulder relative to the Wavelet method.*Clinical Relevance/Application The hybrid-DLR method with compressed sensing can offer high-quality and fast scanning protocols for various sequences in shoulder MRI.

RESULTS

The SNRs and CNRs of bone, muscle, and fat in STIR, T1WI, and T2WI from the hybrid-DLR method were significantly higher than those of Wavelet method (p < 0.001). No significant differences were found in the FWHM of the shoulder joint among all sequences (p > 0.05). The image noise, sharpness, artifacts, and overall image quality in all sequences reconstructed using the hybrid-DLR method were significantly higher than those of the Wavelet method (p < 0.001). No significant differences were observed in the contrast between the two methods (p > 0.05).

CLINICAL RELEVANCE/APPLICATION

The hybrid-DLR method with compressed sensing can offer high-quality and fast scanning protocols for various sequences in shoulder MRI.

SDP-MK-21 Histopathologic And Radiologic Assessment Of Chemotherapeutic Response In Osteosarcoma: Correlation Of Adc With Huvos Grading

Participants
Himansu S. Mohanty, MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

PURPOSE

Histological necrosis, the current standard for response evaluation in osteosarcoma, is attainable after chemotherapy. To establish therole of surrogate markers of response prediction and evaluation using MRI in the pre-surgical assessment.*Methods and Materials In a retrospective analysis MRI images of newly diagnosed osteosarcoma patients who received more than threecycles of neo-adjuvant chemotherapy or high dose methotrexate followed by surgery during 2012-2018 were analysed. All patients

hadundergone post-chemotherapy conventional, diffusion-weighted and contrast-enhanced MRI. Classifying histological response in post-surgicalspecimens according to Huvos grading of necrosis as the reference standard, ADC was measured in pre-surgical DW MRI study and comparedto it. ADC was measured separately in soft tissues and bony component of tumor or only in the bone/soft tissue whichever feasible in the sampleand it was compared with Huvos grading of necrosis.*Results Mean ADC for soft tissue component in 28 samples was 2068.3±382.5 and mean ADC for 55 samples of bony component was 1866.6± 357.6. The ADC measured in bony samples of osteosarcoma is significantly correlating with Huvos grading with P value <0.05. However theADC of soft tissue component is not correlating significantly with Huvos grading.*Conclusions In osteosarcoma, chemotherapy related grade of bony necrosis can be predicted with the help of DW MRI.*Clinical Relevance/Application DWI allows assessment of tumor necrosis after neoadjuvant chemotherapy by ADC measurement.It can give an information of tumor burden before limb salvage surgery. It also helps in response evaluation who are continued on chemotherapy

RESULTS

Mean ADC for soft tissue component in 28 samples was 2068.3±382.5 and mean ADC for 55 samples of bony component was 1866.6± 357.6. The ADC measured in bony samples of osteosarcoma is significantly correlating with Huvos grading with P value <0.05. However theADC of soft tissue component is not correlating significantly with Huvos grading.

CLINICAL RELEVANCE/APPLICATION

DWI allows assessment of tumor necrosis after neoadjuvant chemotherapy by ADC measurement.It can give an information of tumor burden before limb salvage surgery. It also helps in response evaluation who are continued on chemotherapy

SDP-MK-22 High-resolution Imaging Of Large Joints Using Photon-counting Detector (PCD) CT

Participants
Francis Baffour, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To demonstrate improved spatial resolution of shoulder and pelvis CT exams using a photon-counting detector (PCD) CT compared to conventional energy-integrating detector (EID) CT.*Methods and Materials Patients who underwent clinically-indicated shoulder or pelvis/hip EID-CT exams were recruited to undergo the same exam on an investigational research whole-body PCD-CT system (SOMATOM Count Plus, Siemens Healthineers) using its non-comb-based high resolution (HR) mode. EID-CT images were reconstructed following routine clinical protocol (Br62/Br64 kernel, 1mm thickness). PCD-CT images were reconstructed using a HR kernel (Br76) at 0.6 mm thickness. Two musculoskeletal radiologists blindly evaluated randomized EID-CT and PCD-CT images, rating critical joint structure visualization using a 5-point Likert scale. Readers compared images from the same patient in a side-by side fashion, assigning a score to images on the left monitor in comparison to the right (1- worse visualization and diagnostic confidence; 2 - worse visualization, no change in diagnostic confidence; 3 - comparable visualization and diagnostic confidence; 4 - improved visualization, no change in diagnostic confidence; 5 - improved confidence and visualization). A post-hoc assignment of reader scores was performed such that they reflected PCD-CT visualization relative to that of EID-CT. Wilcoxon signed-rank test was used for statistical analysis.*Results 17 patients underwent shoulder CT (EID-CT: mean CTDIvol = 33.8 mGy; PCD-CT mean CTDIvol = 18.0 mGy) and 15 patients underwent pelvis/hip CT (EID-CT: mean CTDIvol = 15.2 mGy; PCD-CT: mean CTDIvol = 11.5 mGy). Both readers rated PCD-CT images significantly better than EID-CT for critical joint structure visualization (mean scores; Reader 1: shoulder 3.6, hip 3.5; Reader 2: shoulder 4.1, hip 3.7. shoulders; p<0.001; hips, p<0.05).*Conclusions PCD-CT in HR mode has better visualization of critical structures in the shoulder and pelvis/hip compared to conventional EID-CT. PCD-CT doses were 25-47% lower than EID-CT doses.*Clinical Relevance/Application Unlike EID-CT, where comb-based HR scans are limited to extremities, PCD-CT allows reduced dose and higher resolution imaging of large joints for better visualization of critical joint structures.

RESULTS

17 patients underwent shoulder CT (EID-CT: mean CTDIvol = 33.8 mGy; PCD-CT mean CTDIvol = 18.0 mGy) and 15 patients underwent pelvis/hip CT (EID-CT: mean CTDIvol = 15.2 mGy; PCD-CT: mean CTDIvol = 11.5 mGy). Both readers rated PCD-CT images significantly better than EID-CT for critical joint structure visualization (mean scores; Reader 1: shoulder 3.6, hip 3.5; Reader 2: shoulder 4.1, hip 3.7. shoulders; p<0.001; hips, p<0.05).

CLINICAL RELEVANCE/APPLICATION

Unlike EID-CT, where comb-based HR scans are limited to extremities, PCD-CT allows reduced dose and higher resolution imaging of large joints for better visualization of critical joint structures.

SDP-MK-23 Development And Operationalization Of An Automated Workflow For Correlation Of Knee MRI And Arthroscopy Findings

Participants
Naveen Subhas, MD, Cleveland, Ohio (*Presenter*) Research support, Siemens AG;

PURPOSE

To evaluate and assess the accuracy of an automated workflow developed at our institution to prospectively capture and correlate knee MRI results with surgical findings.*Methods and Materials Discrete data were extracted using a text search algorithm from a structured dictation macro with picklists implemented for knee MRI. Patients who underwent arthroscopic knee surgery in 2019-2020 and had undergone knee MRI within the 6 months before surgery were identified with Teradata. Operative findings were recorded discretely by surgeons using a custom-built iPhone application. Findings were classified as positive, negative, or other for tear in the medial meniscus (MM), lateral meniscus (LM), and anterior cruciate ligament (ACL). An automated Tableau dashboard displaying concordance and individual and group accuracy (sensitivity [Sn]/specificity [Sp]/positive predictive value [PPV]/negative predictive value [NPV]) for each structure was enabled for each radiologist, with updates provided via automated monthly emails. Manual correlation was performed on a random sample of 10% of cases for comparison with automatically derived values.*Results Data from 3287 patients (1569 women, 1718 men; mean age, 44) with MRI results (3472 exams) were analyzed. Automatic correlation was available for more than half of MRI exams (MM, 2074 [59.7%]; LM, 2143 [61.7%]; ACL, 2171 [62.5%]), with most cases (MM, 1888 [54.4%]; LM, 1890 [54.4%]; ACL, 2129 [61.3%]) demonstrating concordant imaging and operative findings. For cases with automatic correlation, the automatically calculated metrics were similar to those reported in the literature (highest Sn, Sp, PPV, and NPV for the ACL, followed by the MM and LM). For cases without automatic correlation, nearly 40% were missing both MRI and surgical data; roughly equal numbers of cases were missing either MRI or surgical data or were excluded from correlation (eg, because of previous surgery). Among the manual correlation cases, we found only 5 discordances, all due to entry error. For all

3 structures, Sn and Sp values for the manually labelled dataset were identical or almost identical to those of the automatically labelled dataset. We calculated that manual concordance analysis would take 12 days of continuous work by an MSK fellow.*Conclusions We have created, implemented, and verified the accuracy of an automated system that provides surgical correlation for knee MRI exams to each radiologist and allows radiologists to quickly review the images and their metrics.*Clinical Relevance/Application This system allows us to identify misses and good calls, facilitate peer learning by identifying common misses, increase the accuracy of image interpretation, improve patient outcomes, and provide a dataset for research and education.

RESULTS

Data from 3287 patients (1569 women, 1718 men; mean age, 44) with MRI results (3472 exams) were analyzed. Automatic correlation was available for more than half of MRI exams (MM, 2074 [59.7%]; LM, 2143 [61.7%]; ACL, 2171 [62.5%]), with most cases (MM, 1888 [54.4%]; LM, 1890 [54.4%]; ACL, 2129 [61.3%]) demonstrating concordant imaging and operative findings. For cases with automatic correlation, the automatically calculated metrics were similar to those reported in the literature (highest Sn, Sp, PPV, and NPV for the ACL, followed by the MM and LM). For cases without automatic correlation, nearly 40% were missing both MRI and surgical data; roughly equal numbers of cases were missing either MRI or surgical data or were excluded from correlation (eg, because of previous surgery). Among the manual correlation cases, we found only 5 discordances, all due to entry error. For all 3 structures, Sn and Sp values for the manually labelled dataset were identical or almost identical to those of the automatically labelled dataset. We calculated that manual concordance analysis would take 12 days of continuous work by an MSK fellow.

CLINICAL RELEVANCE/APPLICATION

This system allows us to identify misses and good calls, facilitate peer learning by identifying common misses, increase the accuracy of image interpretation, improve patient outcomes, and provide a dataset for research and education.

SDP-MK-24 Mri Of The Popliteus Tendon: Age-related Changes In Size And Signal In Asymptomatic Patients And Association With Osteoarthrosis

Participants
Barry Hansford, MD, Lake Oswego, Oregon (*Presenter*) Nothing to Disclose

PURPOSE

The popliteus tendon (PT) is often intermediate to high signal intensity (SI) on PD MRI, mimicking tendinosis. Little has been written on isolated PT pathology or normal MRI PT appearance. Aims: 1) describe normal size, SI and age-related changes of PT in asymptomatic patients (pts); 2) correlate PT size and SI changes to osteoarthrosis (OA); 3) correlate MRI diagnosis of PT pathology with pt symptoms.*Methods and Materials IRB approved retrospective study of pts without trauma/surgery history who had knee MRI from 01-12/2018. Weight-bearing knee radiographs and clinic visits in 150 patients were performed within 2 weeks of MRI. Pts divided by age into 3 cohorts of 50 (1-17y, 18-64y, > 65y). Variables included: PT size on T2/PDWI coronal and axial images; PT SI on T2/PD/T1; PT striations on T2/PD; Kellgren-Lawrence (KL) grade of OA; pt demographics and symptoms. A 2nd sub-analysis was performed for the MRI diagnosis of PT pathology (PACS search 1/2013-12/2018 yielded 38 pts) with the same variables, and whether PT pathology was called as isolated clinical or MRI findings.*Results Analyses of 150 MRIs without PT symptoms showed significant differences in PT thickness in the 3 age cohorts (ANOVA p < 0.0001; post hoc pair-wise p < 0.0001). T1/T2 SI change and striation on T2/PDWI increased in older pts (p < 0.0001). Positive correlation between PT size and KL grade was found (p < 0.0001). Analysis of 38 PT pathology pts showed lower % of female patients (p = 0.03), trend of increasing age (p = 0.08), and higher KL grade (p=0.0004) compared to the 150 knee MRI cohort. Generalized linear regression model trained on the combined dataset with dummy variable denoting PT pathology on MRI showed non-significant coefficients associated with the dummy variable and its interaction terms with age, gender, and KL grade (p > 0.05). Adjusting for age, gender, and KL grade, there was no significant difference in PT thickness between the groups with and without MRI PT pathology. Statistical analyses done in R and Prism.*Conclusions PT increases in size and striations with aging, and enlarges with increasing OA severity. If PT pathology on MRI is suspected, clinical notes should be reviewed to avoid over-diagnosis.*Clinical Relevance/Application Awareness of the normal changes in PT size and SI with aging and OA is important in order to prevent the over-diagnosis of PT pathology on routine knee MRI.

RESULTS

Analyses of 150 MRIs without PT symptoms showed significant differences in PT thickness in the 3 age cohorts (ANOVA p < 0.0001; post hoc pair-wise p < 0.0001). T1/T2 SI change and striation on T2/PDWI increased in older pts (p < 0.0001). Positive correlation between PT size and KL grade was found (p < 0.0001). Analysis of 38 PT pathology pts showed lower % of female patients (p = 0.03), trend of increasing age (p = 0.08), and higher KL grade (p=0.0004) compared to the 150 knee MRI cohort. Generalized linear regression model trained on the combined dataset with dummy variable denoting PT pathology on MRI showed non-significant coefficients associated with the dummy variable and its interaction terms with age, gender, and KL grade (p > 0.05). Adjusting for age, gender, and KL grade, there was no significant difference in PT thickness between the groups with and without MRI PT pathology. Statistical analyses done in R and Prism.

CLINICAL RELEVANCE/APPLICATION

Awareness of the normal changes in PT size and SI with aging and OA is important in order to prevent the over-diagnosis of PT pathology on routine knee MRI.

SDP-MK-25 Quickly Scan In Foot Dixon Using AI Based CS Technology

Participants
Wen Zeng, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To study the ability of ACS - based Dixon sequence in shortening time in foot MR examination. At the same time, it is discussed whether the Dixon image can maintain good image quality after shortening time.*Methods and Materials A total of 20 patients underwent magnetic resonance foot examination in the Department of Radiology, West China Hospital, Sichuan University. Each patient underwent routine T2 scan, Dixon scan and Dixon-ACS scan. Record the scan time for each sequence. ROI was delineated in the bone, muscle, ligament and air areas on Dixon and Dixon-ACS water charts, signal values and noise values were recorded, and the SNR was calculated. The images were also subjectively evaluated by two experienced radiologists on four aspects, including overall quality, sharpness, detail display, and fake film review scores.*Results The average scanning time of Dixon was 2 minutes 17 seconds, and that of Dixon-ACS was 4 minutes 2 seconds. SNR of bone, muscle and ligament in Dixon and Dixon-ACS water maps were different (P =0.002; P < 0.001; P <0.001), there was no significant difference in SNR in air (P =0.233). In

subjective evaluation, the overall quality and artifacts of Dixon and Dixon-ACS water maps were different (P =0.026; P =0.024), there was no significant difference in image sharpness and detail display (P =0.059).*Conclusions Dixon-ACS can greatly reduce the scanning time, improve the image quality and reduce the image motion artifacts to some extent.*Clinical Relevance/Application Shortening scan events can improve patient cooperation, reduce motion artifacts and improve clinical work efficiency.

RESULTS

The average scanning time of Dixon was 2 minutes 17 seconds, and that of Dixon-ACS was 4 minutes 2 seconds. SNR of bone, muscle and ligament in Dixon and Dixon-ACS water maps were different (P =0.002; P < 0.001; P <0.001), there was no significant difference in SNR in air (P =0.233). In subjective evaluation, the overall quality and artifacts of Dixon and Dixon-ACS water maps were different (P =0.026; P =0.024), there was no significant difference in image sharpness and detail display (P =0.059).

CLINICAL RELEVANCE/APPLICATION

Shortening scan events can improve patient cooperation, reduce motion artifacts and improve clinical work efficiency.

SDP-MK-3   Posterior Capsule Edema: An Ancillary Finding Of Adhesive Capsulitis

Participants
Rajdeep Kapoor, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To determine the value of analyzing the posterior joint capsule of the shoulder on MRI in patients suspected of having adhesive capsulitis.*Methods and Materials The MRI of 57 patients with the presumed diagnosis of adhesive capsulitis were identified retrospectively and matched to control patients (n=57) from 2010-2018. The posterior joint capsule was evaluated in both groups of patients independently by two attending MSK radiologists to determine the clinical significance of this finding in the setting of adhesive capsulitis. Specifically, the posterior capsule was qualitatively evaluated on the sagittal, oblique, T2-weighted, fat suppression sequence for pericapsular edema. Several other variables including the axillary pouch, the coracohumeral ligament (CHL), the rotator interval (RI), the subcoracoid fat triangle, and the teres minor, which have all shown to aid in identification of individuals with adhesive capsulitis, were also evaluated on MRI.*Results Posterior capsule edema was statistically significant (p <0.001) between patients with capsulitis versus the control group with substantial interobserver variability (Kappa 0.66). Both axillary pouch edema and CHL edema were present to a greater degree in the patient group (p<0.001). Axillary pouch and CHL thickness were also increased in the patient group compared to the control group. RI thickness and edema were seen more frequently in patients suspected of having capsulitis. Lastly, teres minor edema and atrophy along with subcoracoid fat obliteration were not statistically different between the case subjects and the control group (p > 0.05).*Conclusions Abnormal signal intensity involving the posterior shoulder capsule can reliably be used for the diagnosis of adhesive capsulitis of the shoulder. Additional MRI findings which provide strong diagnostic value include axillary pouch thickness and increased signal intensity, fatty replacement and abnormal signal in the rotator interval, and thickening and abnormal signal of the CHL. Together, these findings can increase the confidence of diagnosing adhesive capsulitis through imaging.*Clinical Relevance/Application Posterior joint capsule evaluation is a useful adjunct to identify patients with capsulitis and should be routinely assessed on individuals presenting with unknown etiology of shoulder pain.

RESULTS

Posterior capsule edema was statistically significant (p <0.001) between patients with capsulitis versus the control group with substantial interobserver variability (Kappa 0.66). Both axillary pouch edema and CHL edema were present to a greater degree in the patient group (p<0.001). Axillary pouch and CHL thickness were also increased in the patient group compared to the control group. RI thickness and edema were seen more frequently in patients suspected of having capsulitis. Lastly, teres minor edema and atrophy along with subcoracoid fat obliteration were not statistically different between the case subjects and the control group (p > 0.05).

CLINICAL RELEVANCE/APPLICATION

Posterior joint capsule evaluation is a useful adjunct to identify patients with capsulitis and should be routinely assessed on individuals presenting with unknown etiology of shoulder pain.

SDP-MK-4   Deep Interface Changes In Osteonecrosis Of The Femoral Head: Association With ARCO Stage 2 And 3A

Participants
Seul Ki Lee, MD, Suwon, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to determine the association between deep interface changes and Association Research Circulation Osseous (ARCO) stage 2 and 3A in patients with osteonecrosis of the femoral head (ONFH).*Methods and Materials A retrospective analysis of the deep interface changes of ONFH was conducted 99 cases of ONFH in ARCO stage 2 and 3A according to the 2019 revised ARCO staging system. The imaging findings of the deep interface changes on CT and/or MRI included 1) cystic changes, 2) bone marrow edema (BME), and 3) joint effusion. The characteristics of the deep interface changes were compared between ARCO stage 2 and 3A. Sensitivity and specificity of deep interface changes were estimated with ARCO stages.*Results According to the 2019 revised ARCO staging system, 41 hips were stage 2 and 57 hips were stage 3A. Deep interface changes occurred more frequently in ARCO stage 3A than ARCO stage 2 in terms of cystic changes (68.4% vs. 7.3%, P < 0.001), BME (100.0% vs. 28.9%, P < 0.001), and joint effusion (89.5% vs. 26.8%, P < 0.001). The sensitivity and specificity for ARCO stage 3A were as follows: cystic changes - 68.4% and 92.6%, BME - 100.0% and 71.0%, and joint effusion - 89.4% and 73.1%. The BME and joint effusion were highly sensitive (89.4 - 100.0%) deep interface changes for ARCO stage 3A. For the cystic changes, the sensitivity was not good (14.0 - 68.4%) for ARCO 3A, but the specificity was excellent (92.6 - 100.0%).*Conclusions In the case of ARCO stage 2, cystic change was hardly found, but BME and joint effusion were often found. In the case of ARCO stage 3A, cystic changes were frequently found, and BME and joint effusion almost always occurred.*Clinical Relevance/Application The exact classification between ARCO stage 2 and 3A is important for treatment decisions. However, it is often difficult to distinguish between 2 and 3A only by collapse or crescent sign on imaging studies, especially MRI. Analysis of association between deep interface changes and ARCO stages makes it easier to distinguish between 2 and 3A.

RESULTS

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CLINICAL RELEVANCE/APPLICATION

The exact classification between ARCO stage 2 and 3A is important for treatment decisions. However, it is often difficult to distinguish between 2 and 3A only by collapse or crescent sign on imaging studies, especially MRI. Analysis of association between deep interface changes and ARCO stages makes it easier to distinguish between 2 and 3A.

SDP-MK-5   Intraneural Ganglion Cysts Around The Hip: Focus On MRI Findings And Clinical Manifestation

Participants
Na Ri Shin, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study was to describe the cases of intraneural ganglion cysts around the hip based on review of MRI findings and clinical record.*Methods and Materials 15 patients with intraneural ganglion cysts (10 male and 5 female; mean age: 48.4±13.0; age range 22-66 years) were identified from the retrospective search of MRIs obtained in hip and pelvis between January 2013-March 2021. Presence of intraneural ganglion cysts were determined by consensus review of MRIs by two musculoskeletal radiologists for the lesions that met following criteria: 1) tubular of multilobulated fluid signal lesion in continuity with a paralabral cyst that extend along the course of the nerve structure; 2) absence of imaging features suggesting other possible diagnosis, such as neurgenic tumor. Review of medical records and MRI analysis regarding muscle denervation, hip pathology, and contralateral paralabral lesion were done.*Results 11 patients had lesions involving the sciatic nerve with 4 showing extension along the lumbosacral plexus. 3 patients had lesions extending along the obturator nerve and one patient had a lesion involving the superior gluteal nerve. All but one patient (14/15, 93.3%) had clinical symptom related to the lesion including sensory and motor deficit. 7 patients underwent arthroscopic surgery and showed partial improvement of symptom and one of the patient received ultrasound-guided cyst aspiration and steroid injection thereafter, which resulted further improvement of the residual symptom. Sciatic nerve ganglion cysts seemed to arise from the paralabral cyst at the posteroinferior quadrant, while obturator nerve lesions and superior gluteal nerve lesions showed connection with anteroinferior and anterosuperior quadrant of the labrum, respectively, probably representing connection of the articular branch of each nerve with the joint at these locations. Denervation edema of the innervated muscles were found in 3 cases (3/15, 20%). Mean length and diameter of the lesions were 7.96±2.78 cm (range, 3.9-14.5) and 1.85±1.04 cm (range, 0.4-4.6), respectively. One patient had acetabular dysplasia in the affected joint and one had a paralabral cyst at the same labral quadrant in the contralateral hip joint. No patient showed evidence of femoroactabular impingement, full-thickness chondral defect or significant subchondral bone lesion.*Conclusions Our study demonstrates rare cases of intraneural ganglion cysts arising from the hip joint. The lesions share similar MRI findings with specific quadrant of the labrum involved for each nerve.*Clinical Relevance/Application Prior knowledge of these MRI findings may aid in radiologists to diagnose these lesions and lead to early intervention which can improve clinical outcome.

RESULTS

11 patients had lesions involving the sciatic nerve with 4 showing extension along the lumbosacral plexus. 3 patients had lesions extending along the obturator nerve and one patient had a lesion involving the superior gluteal nerve. All but one patient (14/15, 93.3%) had clinical symptom related to the lesion including sensory and motor deficit. 7 patients underwent arthroscopic surgery and showed partial improvement of symptom and one of the patient received ultrasound-guided cyst aspiration and steroid injection thereafter, which resulted further improvement of the residual symptom. Sciatic nerve ganglion cysts seemed to arise from the paralabral cyst at the posteroinferior quadrant, while obturator nerve lesions and superior gluteal nerve lesions showed connection with anteroinferior and anterosuperior quadrant of the labrum, respectively, probably representing connection of the articular branch of each nerve with the joint at these locations. Denervation edema of the innervated muscles were found in 3 cases (3/15, 20%). Mean length and diameter of the lesions were 7.96±2.78 cm (range, 3.9-14.5) and 1.85±1.04 cm (range, 0.4-4.6), respectively. One patient had acetabular dysplasia in the affected joint and one had a paralabral cyst at the same labral quadrant in the contralateral hip joint. No patient showed evidence of femoroactabular impingement, full-thickness chondral defect or significant subchondral bone lesion.

CLINICAL RELEVANCE/APPLICATION

Prior knowledge of these MRI findings may aid in radiologists to diagnose these lesions and lead to early intervention which can improve clinical outcome.

SDP-MK-6   Communication Between The Trochanteric Bursa And Joint Capsule After Total Hip Arthoplasty

Participants
Christopher Watura, FRCR,MBChB, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Peritrochanteric bursal distension on MRI is uncommon (8%) in native hips with greater trochanteric pain syndrome (GTPS) but is often associated with gluteal tendon abnormalities. Furthermore, histological studies find no evidence of primary bursal inflammatory aetiology in GTPS. After total hip arthroplasty (THA), distended peritrochanteric bursae or 'pseudobursae' are common in both asymptomatic (32%) and GTPS patients (62%), suggesting that these are not the symptom generators. Nevertheless, corticosteroid injections into these are common for treating GTPS.Our aim was to investigate (i) the incidence of distended peritrochanteric bursae or pseudobursae after total hip replacement and (ii) the proportion which communicate directly with the hip joint capsule.*Methods and Materials All (1335) MRI hips from between 01/01/2017 to 31/12/2020 were retrieved from the picture archiving system. Only those with a THA were included. Duplicates and repeat studies of the same hip (e.g. performed for follow-up purposes) were excluded.Included cases were retrospectively reviewed by two musculoskeletal radiologists for bursal or pseudobursal distension and the presence of communication with the hip joint capsule, categorised as: "direct communication", "potential communication " or "no communication".*Results A total of 128 MRI hip scans were included.A peritrochanteric fluid-filled space was demonstrated in 23% (30/128) of cases.Direct communication between this and the hip joint capsule was clearly shown in 60% (18/30), potential communication demonstrated in 17% (5/30) and no communication evident in 23% (7/30).In almost all cases, the fluid-filled space demonstrated a thickened low signal wall, more suggestive of post-surgical changes in the soft tissue planes and hence representing a 'pseudobursa' appearance rather than a native bursa.*Conclusions A high proportion of post-THA

peritrocahteric fluid-filled spaces resulted from a direct communication with the hip joint capsule and demonstrated a thicker wall than a typical bursa. As such, these may be better described as pseudobursae relating to post-surgical changes in the soft tissues, rather than being called true native bursae or secondary to a primary bursitis.*Clinical Relevance/Application It is important to recognise pseudobursae on imaging and accurately differentiate them from true bursae in reports. The communication with the hip joint capsule may have implications for corticosteroid steroid injections performed for GTPS post-THA.

RESULTS

A total of 128 MRI hip scans were included.A peritrochanteric fluid-filled space was demonstrated in 23% (30/128) of cases.Direct communication between this and the hip joint capsule was clearly shown in 60% (18/30), potential communication demonstrated in 17% (5/30) and no communication evident in 23% (7/30).In almost all cases, the fluid-filled space demonstrated a thickened low signal wall, more suggestive of post-surgical changes in the soft tissue planes and hence representing a 'pseudobursa' appearance rather than a native bursa.

CLINICAL RELEVANCE/APPLICATION

It is important to recognise pseudobursae on imaging and accurately differentiate them from true bursae in reports. The communication with the hip joint capsule may have implications for corticosteroid steroid injections performed for GTPS post-THA.

SDP-MK-7 A New MRI Technique For The Detailed Inspection Of Compact Bone: Phantom And Preliminary Clinical Study

Participants
Takahiro Sueoka, MD, Hiroshima, Japan (*Presenter*) Nothing to Disclose

PURPOSE

On MRI scans the bone structure is a low-intensity area. Our MRI sequence is based on a T2*-weighted sequence; it delineates compact bones. We used a phantom to compare our MRI technique with conventional computed tomography (CT) for their spatial resolution and assessed their diagnostic ability in patients with osteoarthritis.*Methods and Materials We used a 3T MRI scanner (TRILLIUM OVAL, FUJIFILM Healthcare Corp.). The scan parameters were TR 12 ms, TE opposed-phase imaging 6.1 ms, in-phase imaging 7.3 ms, flip angle 40°, band width 150 kHz, FOV 20 cm, acquisition matrix 360, slice thickness and interval 1.5 mm; number of excitations 1. The CT scans were obtained on a 320-detector scanner (Aquilion Precision, Canon Medical Systems) at tube voltage 120 kV, automatic tube current modulation, noise index 7, rotation time 0.75 s, pitch factor 0.569, detector configuration 160 x 0.25 mm, display matrix 512, FOV 30 cm, reconstructed slice thickness and interval 1.5 mm. Using a phantom we measured the modulation transfer function (MTF); cattle bone and lard imitated the human bone and subcutaneous fat contrast. Scans were acquired in 7 patients with osteoarthritis (5 feet, 2 knees). Two board-certified radiologists scored the visibility of the bone cortex, cystic lesions, and osteophytes. They used a 5-point score where 5 = MRI and CT scans are similar, and 1 = MRI and CT scans are dissimilar. Inter-observer agreement was calculated with the kappa-coefficient.*Results In the phantom study the MTF of MRI exceeded that of CT in all spatial frequency ranges. In the clinical study we evaluated 5 distal tibiae, 5 taluses, 2 distal femoral bones, 2 proximal tibiae, 11 cystic lesions, and 12 osteophytes. The mean visual scores assigned by viewer 1 were 4.9 (SD 0.4) for the bone cortex, 4.0 (1.2) for cystic lesions, and 4.8 (0.4) for osteophytes. For viewer 2 they were 4.9 (0.4), 4.1 (1.2), and 4.7 (0.8), respectively. Inter-observer agreement was 0.63.*Conclusions The spatial resolution of phantom scans was higher with MRI than CT. In the clinical study, the diagnostic ability of MRI for the delineation of the bone structure was comparable to CT.*Clinical Relevance/Application The new MRI technique is useful for the morphological evaluation of bone lesions; it may reduce both imaging costs and radiation exposure.

RESULTS

In the phantom study the MTF of MRI exceeded that of CT in all spatial frequency ranges. In the clinical study we evaluated 5 distal tibiae, 5 taluses, 2 distal femoral bones, 2 proximal tibiae, 11 cystic lesions, and 12 osteophytes. The mean visual scores assigned by viewer 1 were 4.9 (SD 0.4) for the bone cortex, 4.0 (1.2) for cystic lesions, and 4.8 (0.4) for osteophytes. For viewer 2 they were 4.9 (0.4), 4.1 (1.2), and 4.7 (0.8), respectively. Inter-observer agreement was 0.63.

CLINICAL RELEVANCE/APPLICATION

The new MRI technique is useful for the morphological evaluation of bone lesions; it may reduce both imaging costs and radiation exposure.

SDP-MK-8 To Evaluate the Diagnostic Value Of18 F FDG PET-CT in Trauma Patients With Suspected Chronic Osteomyelitis

Participants
Sikandar Shaikh, DMRD, Hyderabad, India (*Presenter*) Nothing to Disclose

PURPOSE

To retrospectively evaluate the diagnostic value of 18F-FDG PET/CT in trauma patients with suspected chronic osteomyelitis.*Methods and Materials This was the retrospective study of 66 Limited 18F-FDG PET/CT scans were performed in 66 patients with trauma suspected of having chronic osteomyelitis. In 20 and 46 patients, infection was suspected in the axial and appendicular skeleton, respectively. In 36 patients, PET/CT was performed in the presence of metallic implants. Histopathology or bacteriological culture was used as the standard of reference. For statistical analysis, sensitivity, specificity and accuracy were calculated in relation to findings of the reference standard.*Results Of 66 PET/CT scans, 34 were true positive, 26 true negative, four false positive and one false negative. Eighteen patients had chronic osteomyelitis and 30 had no osseous infection according to the reference standard. Sensitivity, specificity and accuracy for 18F-FDG PET/CT was 94%, 87% and 91% for the whole group, 88%, 100% and 90% for the axial skeleton and 100%, 85% and 91% for the appendicular skeleton, respectively.*Conclusions 18F-FDG PET/CT is a highly sensitive and specific method for the evaluation of chronic infection in the axial and appendicular skeleton in patients with trauma. PET/CT allows precise anatomical localisation and characterisation of the infectious focus and demonstrates the extent of chronic osteomyelitis with a high degree of accuracy*Clinical Relevance/Application 18 FDG PET-CT plays an important role in the evaluation of the Infections like Osteomyelitis

RESULTS

Of 66 PET/CT scans, 34 were true positive, 26 true negative, four false positive and one false negative. Eighteen patients had chronic osteomyelitis and 30 had no osseous infection according to the reference standard. Sensitivity, specificity and accuracy for

18F-FDG PET/CT was 94%, 87% and 91% for the whole group, 88%, 100% and 90% for the axial skeleton and 100%, 85% and 91% for the appendicular skeleton, respectively.

CLINICAL RELEVANCE/APPLICATION

18 FDG PET-CT plays an important role in the evaluation of the Infections like Osteomyelitis

Abstract Archives of the RSNA, 2021

Sub-Events

CA05-B1   Comparison Of Agatston Score Derived From An Energy-integrating Detector CT And A Photon-counting Detector CT: An Ex Vivo Study Of Cadaveric Hearts

Participants

Lilian Henriksson, Linkoping, Sweden (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to analyze the correlation and agreement of the Agatston score (AS) between an energy-integrating detector CT (EID-CT) and a photon-counting detector CT (PCD-CT).*Methods and Materials Five cadaveric hearts were positioned in a chest phantom (N1 Lungman; Kyoto Kagaku Co. Ltd, Japan). Each heart was scanned in an EID-CT (SOMATOM Force; Siemens Healthineers, Forchheim, Germany) and a PCD-CT (SOMATOM CounT Plus; Siemens Healthineers, Forchheim, Germany) Examinations were performed according to a clinical calcium score protocol with a standardized slice thickness 3 mm and an increment 1.5 mm. The scans were performed using a spiral protocol at a tube potential of 120 kV. The EID-CT and PCD-CT radiation dose was matched as close as possible (CTDIvol varying between 0.85 and 1.14 mGy). In the PCD-CT reconstructions, a vendor-recommended reconstruction kernel (Qr36) was used, and different monoenergetic energy levels (50-150 keV) were compared to optimize a close match with the prevailing, clinical EID-CT kernel (Sa36). The semi-automatic evaluation of calcium score was performed on a post-processing multimodality workplace (Leonardo MMWP, Siemens, Germany). In total 26 calcified coronary lesions were identified for subsequent inclusion. To analyze the correlation and agreement between AS derived from the EID-CT and PCD-CT, the Pearson correlation (r) and Bland-Altman-plots were applied.*Results The best possible kernel match for Sa36 was Qr36, with a monoenergetic level of 72 keV. The correlation between the PCD-CT and EID-CT with regards to the AS was (r) =0,98 (p<0.001)). Also, a Bland Altman analysis showed mean difference and 1.96 standard deviations upper and lower limits of agreement -7.5 (-31.0 to 16.1), thus with a slight overestimation tendency for the PCD-CT. Fig1.*Conclusions There was an excellent correlation and good agreement between the AS derived from an EID-CT and a PCD-CT. The augmented PCD-CT detector technology, counting every incoming photon, resulted in a slight AS overestimation tendency.*Clinical Relevance/Application The clinically established AS method has excellent possibilities for a conversion to the forthcoming PCD-CT technology. Method dependent PCD-CT overestimation may be compensated for in further mono-energetic development.

RESULTS

The best possible kernel match for Sa36 was Qr36, with a monoenergetic level of 72 keV. The correlation between the PCD-CT and EID-CT with regards to the AS was (r) =0,98 (p<0.001)). Also, a Bland Altman analysis showed mean difference and 1.96 standard deviations upper and lower limits of agreement -7.5 (-31.0 to 16.1), thus with a slight overestimation tendency for the PCD-CT. Fig1.

CLINICAL RELEVANCE/APPLICATION

The clinically established AS method has excellent possibilities for a conversion to the forthcoming PCD-CT technology. Method dependent PCD-CT overestimation may be compensated for in further mono-energetic development.

Abstract Archives of the RSNA, 2021

SDP-IN

Informatics Pre-recorded Scientific Posters

Sub-Events

SDP-IN-1 **Leveraging Predictive "Uncertainty": Assessing Bayesian Convolutional Neural Networks In A Pneumonia-screening Task**

Participants
Tyler Lian, BS, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

Bayesian convolutional neural networks (BCNNs) have emerged in a recent effort to quantify "uncertainty" in machine learning prediction by equipping standard convolutional neural networks with Bayesian posterior inference. In BCNNs, model parameters are represented by updateable probabilistic distributions rather than single point estimates, enabling an incorporation and quantification of uncertainty as probabilistic variance in model prediction. By applying BCNNs to a pneumonia-screening task, this study assessed the behavior and potential clinical utility of model-quantified uncertainty for out-of-sample prediction and within a hypothetical AI-assisted clinical workflow.*Methods and Materials BCNN models (M1, M2) implemented Monte Carlo Dropout in a VGG-19 base and were trained on chest X-rays from one of the NIH CXR14 or CheXpert datasets, respectively. Models were designed as multiclass classifiers to address class imbalance, but only performance on the binary pneumonia-screening task was considered. Both models were evaluated on both validation sets, and model uncertainty was computed as predictive variance over 50 Monte Carlo iterations and plotted. Then, models were evaluated in a mock referral scheme, where 20 percent of the most uncertain of the same-site validation set images were "referred" to a hypothetical clinician and the remaining assessed for model accuracy, compared to a scheme where a random twenty percent were referred out.*Results AUC decreased from 0.606 and 0.697 for same-site sets to 0.533 and 0.641 for opposite-site sets, for M1 and M2 respectively. For both models, distributions of model-quantified uncertainty were more right-skewed (less uncertain) for same-site sets. In the uncertainty-informed referral scheme, model accuracy was 0.185 and 0.143 for M1 and M2 respectively, compared to 0.155 and 0.126 in the random referral scheme.*Conclusions In an applied pneumonia-screening task, higher model-quantified uncertainty was associated with both out-of-distribution prediction and model misclassification error, suggesting the potential of this measure to anticipate these issues in real-world application and promote transparency between clinicians and algorithms in clinical practice.*Clinical Relevance/Application BCNNs supplement model prediction with a quantified measure of prediction uncertainty, which may offer actionable information about model decision-making for clinicians, given more robust development.

RESULTS

AUC decreased from 0.606 and 0.697 for same-site sets to 0.533 and 0.641 for opposite-site sets, for M1 and M2 respectively. For both models, distributions of model-quantified uncertainty were more right-skewed (less uncertain) for same-site sets. In the uncertainty-informed referral scheme, model accuracy was 0.185 and 0.143 for M1 and M2 respectively, compared to 0.155 and 0.126 in the random referral scheme.

CLINICAL RELEVANCE/APPLICATION

BCNNs supplement model prediction with a quantified measure of prediction uncertainty, which may offer actionable information about model decision-making for clinicians, given more robust development.

SDP-IN-10 **Deep Learning For Segmentation Of Veins And Detection Of Deep Vein Thrombosis On Computed Tomography Imaging**

Participants
Anoop Manjunath, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

60,000 - 100,000 Americans die annually from complications arising from deep vein thrombosis (DVT), blood clots that form in the veins of the lower extremities and pelvis. Given this condition's nonspecific symptoms and diagnostic difficulty, it remains underdiagnosed, especially in the trauma setting where DVT remains the leading cause of preventable hospital death. An automated warning system for DVTs on Computed Tomography (CT) imaging has the potential to improve the incidental diagnosis of DVTs, especially in the context of trauma, while adding little to no excess burden on the healthcare system.*Methods and Materials 107 CT studies of the lower extremities and pelvis of 86 patients from the Stanford Interventional Radiology Venous InTerventionAL database were used for this study. The dataset consists of 51,451 images, each with hand annotation of veins and DVTs by a trained radiologist. Images were preprocessed and the dataset was split into training, validation, and test sets according to a 70%/10%/20% split on a patient basis. An encoder-decoder convolutional neural network (CNN) model was utilized for vein segmentation. Several CNN architectures for vein segmentation were trained and evaluated using intersection over union (IoU) and Sørensen-Dice coefficient. The predicted vein segmentations in addition to the original images were then used as input to a CNN tasked with determining whether a given CT image contained a DVT. Multiple architectures for DVT classification were evaluated for accuracy, precision, recall, and area under receiver operator curve (AUROC).*Results The best segmentation model, based on the UNet++ architecture, achieved a test set IoU of 0.83 and test set Dice score of 0.79. The best classification model, based on the InceptionNet architecture, achieved a test set AUROC of 0.86, recall of 0.84, precision of 0.86, and accuracy of 0.87. The inclusion of vein segmentation information significantly improved performance for all classification models. The InceptionNet without vein

segmentation had an AUROC of 0.61.*Conclusions We developed a deep neural network system that leverages individual slice-level data for segmentation of deep veins and identification of DVT from CT imaging. Executing this task through an innovative strategy utilizing vein segmentation followed by DVT identification, our system achieves strong performance on both tasks.*Clinical Relevance/Application This automated detection system for DVT will allow for drastically improved incidental diagnosis of DVT, and its interpretable output will minimize clinical burden. In addition to decreasing the incidence and mortality of DVT complications, this algorithm could serve as the foundation for novel systems identifying venous pathology on CT imaging.

RESULTS

The best segmentation model, based on the UNet++ architecture, achieved a test set IoU of 0.83 and test set Dice score of 0.79. The best classification model, based on the InceptionNet architecture, achieved a test set AUROC of 0.86, recall of 0.84, precision of 0.86, and accuracy of 0.87. The inclusion of vein segmentation information significantly improved performance for all classification models. The InceptionNet without vein segmentation had an AUROC of 0.61.

CLINICAL RELEVANCE/APPLICATION

This automated detection system for DVT will allow for drastically improved incidental diagnosis of DVT, and its interpretable output will minimize clinical burden. In addition to decreasing the incidence and mortality of DVT complications, this algorithm could serve as the foundation for novel systems identifying venous pathology on CT imaging.

SDP-IN-11   AI Monitoring In Practice For Bone Age Assessment

Participants
Osvaldo Landi Junior, MD, Sao Paulo, Brazil (*Presenter*) Consultant, Diagnósticos da América SA

PURPOSE

With the increasing number of FDA clearances for artificial intelligence (Ai) models in radiology, we are observing a transition from the field of science to real world applications. These algorithms, now deployed to clinical practice, are exposed to variables that did not exist in the laboratory that could affect its performance in unpredictable ways. The only way to ensure that a model is working as intended in a clinical environment is through ongoing monitoring. The purpose of this study is to describe our results from the prospective surveillance of an Ai model for bone age assessment on hand radiographs on a multi-site healthcare network.*Methods and Materials This model is a convolutional neural network trained on 12611 studies from the RSNA 2017 Pediatric Bone Age Machine Learning Challenge. For the ongoing monitoring, studies were prospectively obtained from the PACs from october 2020 to february 2021, and the ground truth skeletal age was obtained from semi-structured clinical radiology reports using a python script. We also track if radiologists are accessing the Ai results tab by an integration to the radiology information system.*Results In our initial pre-deployment clinical validation using 2835 studies the model achieved a mean average error (MAE) of 11.7 months for females, and 9.36 months for male patients. It was then deployed to the central PACs, reaching 8 different clinical sites and processing 11.900 studies from october 2020 to february 2021, from which 7140 studies were from female patients (60%) and 4760 from male patients (40%). Radiologists accessed the Ai results for 90% of the studies, and the observed MAE was 10.4 for females and 10.2 for males (10.3 months overall) during this timeframe. 10 outlier results were selected for a clinical review which showed that most disagreements between the radiologist and the model were due to asymmetric skeletal maturation of the hand and wrist. Also, while the model training data included only unilateral hand radiographs, one of the clinical sites included both hands in the acquisition protocol. MAE was 10.6 when considering only these studies.*Conclusions This study describes our results from the prospective surveillance of an Ai model for bone age assessment in clinical practice, which has shown acceptable generalization and robustness capabilities, despite variations in input data, such as different acquisition techniques.*Clinical Relevance/Application This research showcases the ongoing monitoring of an Ai model in radiology, which is essencial for its adoption in clinical practice.

RESULTS

In our initial pre-deployment clinical validation using 2835 studies the model achieved a mean average error (MAE) of 11.7 months for females, and 9.36 months for male patients. It was then deployed to the central PACs, reaching 8 different clinical sites and processing 11.900 studies from october 2020 to february 2021, from which 7140 studies were from female patients (60%) and 4760 from male patients (40%). Radiologists accessed the Ai results for 90% of the studies, and the observed MAE was 10.4 for females and 10.2 for males (10.3 months overall) during this timeframe. 10 outlier results were selected for a clinical review which showed that most disagreements between the radiologist and the model were due to asymmetric skeletal maturation of the hand and wrist. Also, while the model training data included only unilateral hand radiographs, one of the clinical sites included both hands in the acquisition protocol. MAE was 10.6 when considering only these studies.

CLINICAL RELEVANCE/APPLICATION

This research showcases the ongoing monitoring of an Ai model in radiology, which is essencial for its adoption in clinical practice.

SDP-IN-12   A Novel Deep Learning-based Iodine Contrast Boosting Algorithm For Reduced-iodine-dose CT Imaging

Participants
Chul Kyun Ahn, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop a novel deep learning (DL)-based iodine contrast boosting algorithm for reduced-iodine-dose CT imaging*Methods and Materials Virtual non-contrast (VNC) and iodine map images were derived from dual-energy liver CT (Somatom Force, Siemens Healthineers AG) of 70 patients (80 kV & 150 kV). In order to generate a training dataset, a paired dataset of 50% iodine map and 50% iodine dose images were generated by multiplying the iodine map image by 0.5 and by summing the VNC with the 50% iodine map images, respectively. A modified U-net was trained by feeding 50% iodine dose images to the input and to predict the corresponding 50% iodine map images. After training, the DL algorithm predicted iodine map image from a new reduced-iodine-dose image. Finally, the predicted iodine map was added to the input image, to produce the contrast-boosted image. Among the 70 patient cases, 50 cases were used for training and the rest 20 cases (10 HCC & 10 non-HCC patients) were used to evaluate the performance of the trained DL algorithm. Intraclass correlation coefficient (ICC3, Two-way mixed effects) was calculated between the predicted iodine map images and the ground-truth iodine map images. Contrast-to-noise ratio (CNR) were measured on HCC lesions and liver vessels in 50% iodine dose, 50% iodine dose after contrast boosting, and 100% iodine dose images.*Results ICCs between the predicted and ground-truth iodine map images of HCC and non-HCC patients were 0.88 and 0.89, respectively. CNR on HCC lesions was 1.6, 4.6, and 4.2 in 50% iodine dose, 50% iodine dose after contrast boosting, and 100% iodine dose images, respectively. CNR on liver vessels was 1.6, 3.6, and 3.3 in 50% iodine dose, 50% iodine dose after contrast boosting, and 100%

iodine dose images, respectively.*Conclusions Our trained DL algorithm has a potential to boost iodine contrast of reduced iodine-dose images to a comparable level of regular iodine-dose images in both HCC and non-HCC patients.*Clinical Relevance/Application Iodine contrast boosting for reduced-iodine-dose CT imaging is feasible with deep learning-based iodine contrast boosting algorithm, which potentially allow reducing iodine dose in clinical practice.

RESULTS

ICCs between the predicted and ground-truth iodine map images of HCC and non-HCC patients were 0.88 and 0.89, respectively. CNR on HCC lesions was 1.6, 4.6, and 4.2 in 50% iodine dose, 50% iodine dose after contrast boosting, and 100% iodine dose images, respectively. CNR on liver vessels was 1.6, 3.6, and 3.3 in 50% iodine dose, 50% iodine dose after contrast boosting, and 100% iodine dose images, respectively.

CLINICAL RELEVANCE/APPLICATION

Iodine contrast boosting for reduced-iodine-dose CT imaging is feasible with deep learning-based iodine contrast boosting algorithm, which potentially allow reducing iodine dose in clinical practice.

SDP-IN-13   Development Of Weakness Compensated-AI Model Of The Maxillary Sinusitis Using Curriculum Learning Algorithm

Participants
Hyug-Gi Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

The objective of this study was to develop the minimized over-fitting model using weakness compensated- curriculum learning algorithm and to implement the generalization deep learning model for maxillary sinusitis.*Methods and Materials A total of 3,596 subjects, which included three medical centers, underwent PNS X-ray scan. All subjects were independently labeled as 'normal' and 'sinusitis' by two radiologists. The datasets were split into training (n=2,225), validation (tuning) (588), internal test (n=300), external test #1(n=300), and external test #2 (n=183). Input data was performed three pre-processing steps; extracted maxillary sinus patch, z-score normalization, and data augmentation. We implemented with the ResNet-101 convolutional neural network (CNN) model for classification. First, to minimize the over-fitting between internal and external datasets, the distribution and recognized pattern of predicted results was examined from the learned model - total opacification, air-fluid level, mucosal thickening, and retention cyst. Second, curriculum learning was conducted to compensate weakness data from examined results.*Results Predicted results from learned model was shown over-fitting patterns- external test sets were relative lower performance compared with internal test set (internal test: 80.5 %; external test #1: 69.2%; external test: 63.0%). Especially, air-fluid level, mucosal thickening, and retention cyst data were shown lower performance in external test sets (< 50 %). The external test sets were shown improved performance using weakness compensating curriculum learning (external test #1: 75.1 %; external test #2: 73.2 %). It was significantly different between without and with purposed model (p-value < .05).*Conclusions The proposed weakness compensated curriculum learning algorithm was shown efficient approach to reduce over-fitting between internal and external sets for diagnosis of maxillary sinusitis. Our proposed deep learning method showed potential of the AI system in predicting sinusitis in screening of PNS X-ray.*Clinical Relevance/Application Our method can be explainable the characteristics learned model and it enables generalization. Furthermore, it can be used in other medical imaging diagnostic applications.

RESULTS

Predicted results from learned model was shown over-fitting patterns- external test sets were relative lower performance compared with internal test set (internal test: 80.5 %; external test #1: 69.2%; external test: 63.0%). Especially, air-fluid level, mucosal thickening, and retention cyst data were shown lower performance in external test sets (< 50 %). The external test sets were shown improved performance using weakness compensating curriculum learning (external test #1: 75.1 %; external test #2: 73.2 %). It was significantly different between without and with purposed model (p-value < .05).

CLINICAL RELEVANCE/APPLICATION

Our method can be explainable the characteristics learned model and it enables generalization. Furthermore, it can be used in other medical imaging diagnostic applications.

SDP-IN-14   Automatically, Precisely, And Comprehensively Measuring Tumor Sizes With Minimal Human Effort

Participants
Youbao Tang, PhD, Bethesda, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Precisely measuring the tumor sizes from computed tomography (CT) scans is an indispensable step in oncology image analysis for monitoring disease progression and therapy response. RECIST (Response Evaluation Criteria in Solid Tumors) diameters are adopted widely in clinical practice but imperfect. Although 2D and 3D segmentations prove clinically more valuable, it is not practical to annotate them manually due to time constraints. To address them, we propose a new deep learning system called Prior-guided Dual-path connection Network (PDNet) to measure the tumor sizes automatically, precisely, and comprehensively.*Methods and Materials PDNet consists of an image encoder (IE), a prior encoder (PE), and a decoder (DE). IE extracts highly discriminative multi-scale features from CT images. PE further enhances the features by learning lesion-specific attention matrices in parallel from the click prior information. DE can aggregate the enhanced multi-scale features comprehensively to predict the RECIST diameters and lesion segmentations precisely by introducing top-down and bottom-up connections. Radiologists only need to give a simple click guidance inside the lesion region on any slice. The system is able to segment the lesion slice-by-slice to get its 3D segmentation result and demonstrate the key slice where the lesion has the largest spatial extent. PDNet was trained and tested on the large-scale DeepLesion dataset consisting of 32,735 lesions labeled with RECIST diameters from 10,594 studies of 4,459 patients. 1,000/200 lesions were randomly selected from 500/140 patients and manually annotated their 2D/3D masks as the validation/test set. The remaining patient data served as the training set.*Results For RECIST diameter annotation, compared to the manual reference standard, the diameter differences of long and short axis produced by PDNet were 1.7±1.5 mm and 1.5±1.4 mm, respectively. For lesion segmentation, PDNet achieved a 2D Dice score of 0.924±0.045 on the key slices where lesions have the largest spatial extents and a 3D Dice score of 0.853±0.073.*Conclusions We proposed a deep learning system to automatically annotate tumor sizes with RECIST diameters and segmentations that demonstrate comparable accuracy to experts. It greatly improves the clinical workflow efficiency by using only a click.*Clinical Relevance/Application Our system offers a useful tool for radiologists to get reliable and comprehensive tumor size measurements with minimal effort and may provide high positive clinical values on oncologic imaging analysis workflows and deriving quantitative precision biomarkers.

RESULTS

For RECIST diameter annotation, compared to the manual reference standard, the diameter differences of long and short axis produced by PDNet were 1.7±1.5 mm and 1.5±1.4 mm, respectively. For lesion segmentation, PDNet achieved a 2D Dice score of 0.924±0.045 on the key slices where lesions have the largest spatial extents and a 3D Dice score of 0.853±0.073.

CLINICAL RELEVANCE/APPLICATION

Our system offers a useful tool for radiologists to get reliable and comprehensive tumor size measurements with minimal effort and may provide high positive clinical values on oncologic imaging analysis workflows and deriving quantitative precision biomarkers.

SDP-IN-15 Ct-based Radiomics For The Preoperative Prediction Of The Muscle-invasive Status Of Bladder Cancer And Comparison To Radiologists' Assessment

Participants
Yingpu Cui, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop a radiomics model to predict the muscle-invasive status of bladder cancer (BC) in contrast-enhanced computed tomography (CECT) images, compared with radiologists' interpretations.*Methods and Materials 188 CECT images with pathological confirmed BC were retrospectively archived from November 2018 to December 2019 and were randomly divided into the training (n = 120) and test dataset (n = 68). The BC were manually labeled and validated on the venous phase by a general radiologist and an experienced radiologist, respectively. The radiomics analysis including radiomics feature extraction and model development was completed by the Feature Explorer (FAE) software. The same images were also evaluated by two radiologists. The diagnostic performance of radiomics was evaluated with receiver operating characteristic (ROC). The area under the curve (AUC), sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. The predictive performance of radiomics was then compared with visual assessments of the two radiologists.*Results The radiomics model reached an AUC of 0.979 and 0.894 in the training and test dataset, respectively. The radiomics model outperformed the visual assessment (AUC: 0.691-0.775) both in the training and test dataset. Pairwise comparisons showed that the specificities of the radiomics model were higher than the radiologists (85.3-96.7% vs. 47.1-58.3%, all p < 0.05), but the sensitivities were comparable between the radiomics and the radiologists (79.4-90.0% vs. 91.2-96.7%; p range from 0.125-1.000).*Conclusions A radiomics model was developed that outperformed the radiologists' visual assessment in predicting the muscle-invasive status of BC.*Clinical Relevance/Application Distinguishing non-muscle-invasive bladder cancer (non-MIBC) and muscle-invasive bladder cancer (MIBC) is crucial for clinical decision making. Non-MIBC can be managed with less aggressive treatment than MIBC. A preoperative noninvasive tool for detection and staging of BC with high accuracy would be of immense value.

RESULTS

The radiomics model reached an AUC of 0.979 and 0.894 in the training and test dataset, respectively. The radiomics model outperformed the visual assessment (AUC: 0.691-0.775) both in the training and test dataset. Pairwise comparisons showed that the specificities of the radiomics model were higher than the radiologists (85.3-96.7% vs. 47.1-58.3%, all p < 0.05), but the sensitivities were comparable between the radiomics and the radiologists (79.4-90.0% vs. 91.2-96.7%; p range from 0.125-1.000).

CLINICAL RELEVANCE/APPLICATION

Distinguishing non-muscle-invasive bladder cancer (non-MIBC) and muscle-invasive bladder cancer (MIBC) is crucial for clinical decision making. Non-MIBC can be managed with less aggressive treatment than MIBC. A preoperative noninvasive tool for detection and staging of BC with high accuracy would be of immense value.

SDP-IN-16 Construction And Application Of A Patient Derived Hybrid 3d Printing Phantom For Quantitative COVID-19 Imaging

Participants
AHYEONG LEE, SEOUL, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To develop and construct a patient-derived hybrid 3D anthropomorphic thorax phantom for use in quantitative imaging of COVID-19. We intended to develop a phantom mimicking lung anatomy, HU values, and various lung lesions similar to those of real patients with COVID-19.*Methods and Materials The normal anatomy of the phantom was derived from the chest CT of a 58-year-old woman. The thorax including heart, lungs, and airway were segmented and modeled using a commercial 3D modeling software (AVIEW, CORELINE, Seoul, Korea), and then 3D printed. The lung parenchyma was mimicked by using bead foam with an intent to allow insertion/exchange of fabricated volumetric lesions in the lung parenchyma. COVID-19 lesions in both lungs were also derived from a CT scan of separate patient by using same procedure. Other lung lesions such as emphysema and GGO were spherically fabricated with different sizes by using a casting technique. Polyurethane and PLA were used to reproduce GGO and COVID-19, respectively. After finishing the phantom fabrication, MDCT scanning was made to evaluate its CT imaging appearance. Also we used three COVID-19 quantification software products (LungQuant, VUNO Med, Seoul, Korea; MEDIP COVID19, Medical IP, Seoul, Korea; CAD4COVID-CT, Thirona, Nijmegen, Netherlands) to compare their quantification performance.*Results The HU values of normal anatomy and lung lesions from the phantom were in the similar range of patient CT scans except narrow distribution of HU values owing to the homogenous material. The quantified COVID-19 lesion volume showed significant discrepancy among the three COVID-19 quantification software products ranging from 34.9 ml to 140.28ml and 160ml, with underestimation from the ground truth segmentation of 247.1ml in all three products.*Conclusions Our hybrid anthropomorphic thorax phantom produced the CT image appearance resembling that of patient anatomy and lung lesions including COVID-19 pneumonia. Our phantom has a potential to be used as a platform for simulating lung lesions with known values and performance evaluation of AI-based quantitative imaging software tools.*Clinical Relevance/Application Using a hybrid phantom that reproduces anatomy and lung lesions such as COVID-19, it is possible to generate CT images similar to real patients and evaluate the performance of quantification software tools.

RESULTS

The HU values of normal anatomy and lung lesions from the phantom were in the similar range of patient CT scans except narrow distribution of HU values owing to the homogenous material. The quantified COVID-19 lesion volume showed significant discrepancy among the three COVID-19 quantification software products ranging from 34.9 ml to 140.28ml and 160ml, with underestimation from the ground truth segmentation of 247.1ml in all three products.

SDP-IN-17 Automatic Lung Tumor Segmentation Using Capsule Network Considering The Relationship Between Tumor And Surrounding Structures In Chest Ct Images

Participants
Jumin Lee, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Volumetric lung tumor segmentation is essential for monitoring tumor response to treatment by tracking changes in lung tumor volume. However, it is difficult to segment a lung tumor that is attached to nearby structures that have a shape or intensity similar to that of the lung tumor. Moreover, large tumors have a wide attachment to surrounding structures, making it more difficult to distinguish between the tumor and surrounding structures. The purpose of this study is to accurately segment the lung tumors using Capsule Network, which learns the relative spatial relationship between lung tumor and surrounding structures.*Methods and Materials The dataset used in this study included chest CT images of 256 non-small cell lung cancer (NSCLC) patients consisting of 147 lung squamous cell carcinomas and 109 lung adenocarcinomas. To reduce the occurrence of inter-image differences due to different acquisition protocols among datasets, intensity and pixel spacing normalizations are performed on the input images. To segment lung tumors, a 2D Capsule Network is trained, in which a dynamic routing algorithm enhances specific feature maps with high similarity between lower and upper features to preserve spatial information during convolution.*Results For holdout validation, 256 datasets were randomly divided into 187 training sets, 21 validation sets, and 48 test sets. To evaluate the segmentation accuracy according to the tumor size, the test set was divided into three groups: Group 1 with a size of less than 3cm, Group 2 with a size of 3cm or more and less than 5cm, and Group 3 with a size of more than 5cm. The F1 scores for Group 1, 2, and 3 were 68.52%, 74.89%, and 74.96%, respectively. Although the tumors of Groups 2 and 3 were extensively attached to the surrounding structures, they were found to be accurately segmented in consideration of the relative spatial relationship with the surrounding structures. In whole test set, the F1 score, recall and precision were 71.45%, 76.59% and 73.08%.*Conclusions The lung tumors which are widely attached to surrounding structures were accurately segmented using Capsule Network. (This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (No. 2020R1A2C1102140) and the Korea Medical Device Development Fund grant funded by the Korea government(the Ministry of Science and ICT, the Ministry of Trade, Industry and Energy, the Ministry of Health and Welfare, the Ministry of Food and Drug Safety)(KMDF PR 20200901 0269).)*Clinical Relevance/Application It can be used to automatically segment lung tumors that are difficult to segment by considering the relationship between lung tumor and surrounding structures and can be utilized for volume measurement for monitoring treatment effects.

RESULTS

For holdout validation, 256 datasets were randomly divided into 187 training sets, 21 validation sets, and 48 test sets. To evaluate the segmentation accuracy according to the tumor size, the test set was divided into three groups: Group 1 with a size of less than 3cm, Group 2 with a size of 3cm or more and less than 5cm, and Group 3 with a size of more than 5cm. The F1 scores for Group 1, 2, and 3 were 68.52%, 74.89%, and 74.96%, respectively. Although the tumors of Groups 2 and 3 were extensively attached to the surrounding structures, they were found to be accurately segmented in consideration of the relative spatial relationship with the surrounding structures. In whole test set, the F1 score, recall and precision were 71.45%, 76.59% and 73.08%.

CLINICAL RELEVANCE/APPLICATION

It can be used to automatically segment lung tumors that are difficult to segment by considering the relationship between lung tumor and surrounding structures and can be utilized for volume measurement for monitoring treatment effects.

SDP-IN-18 All True Positives Are Not Truly Positive - Utility Of Explainability Failure Ratio In A High Sensitivity Screening Setting To Compare Incorrect Localizations Among Algorithms

Participants
Marcela Rosa, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the localization failures of deep learning based Chest Xray classification algorithms on a for detection of consolidationTo compare the localization accuracies of two algorithms in a high sensitivity screening setting by comparing the explainability failure ratios (EFR)*Methods and Materials 632 chest x-rays were randomly collected from an academic centre hospital, read by a chest radiologist, and ground truth for consolidation was established on CARING analytics platform (CARPL), both at study level and at image level by marking bounding box around the lesion. These X-rays were then analysed by tow algorithms , an open-sourced re-implementation of Stanford's baseline X-Ray classification model, CheXpert which uses DenseNet121 as its backbone architecture and by CareXnet, network is trained using the Multi-Task Learning paradigm and uses a Densenet121 backbone. Both provide heat maps corresponding to each class to indicate the confidence of the detected disease using guided GRAD-CAM. The number of true positive cases were estimated at an operating threshold that provides 95% sensitivity. The matching of heat maps and the GT bounding box was done by creating a greedy matching algorithm. EFR is then estimated as the ratio of true positive cases that failed the matching process to the total true positive cases.*Results There were a total of 169 cases of consolidation. The number of true positive cases were 145 and 143 for cheXpert and CareXnet respectively. Upon matching of the localization outputs with GT bounding box, the number of unmatched cases for CheXpert and CareXnet were 41 and 39 respectively, giving an EFR of 28 % and 27 % respectively.*Conclusions In this study, we found that even at high sensitivity operating point with maximum true positive cases, the deep learning algorithms can have a high degree of explainability failures.*Clinical Relevance/Application We present a new clinically acceptable way to compare the localization accuracies of multiple algorithms at high sensitivity operating points using explainability failure ratios.

RESULTS

There were a total of 169 cases of consolidation. The number of true positive cases were 145 and 143 for cheXpert and CareXnet respectively. Upon matching of the localization outputs with GT bounding box, the number of unmatched cases for CheXpert and CareXnet were 41 and 39 respectively, giving an EFR of 28 % and 27 % respectively.

CLINICAL RELEVANCE/APPLICATION

We present a new clinically acceptable way to compare the localization accuracies of multiple algorithms at high sensitivity operating points using explainability failure ratios.

SDP-IN-19   Fully Automatic Detection And Measurement Of Abdominal Aortic Aneurysm Using Artificial Intelligence

Participants
Makoto Orii, Yahaba, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Abdominal aortic aneurysm (AAA) is a life-threatening disease, and the decision to treat relies on the exact detection and size of AAA, which is time-consuming and prone to high inter-reader variability. Artificial intelligence (AI) has revealed new insights into the management of AAA, but it needs large amounts of contrast-enhanced CT data. Moreover, there has been few studies about the fully automatic detection and measurement of AAA. The aim of this study is to evaluate the accuracy of AI for the detection and measurement of AAA using small amounts of non-contrast CT.*Methods and Materials We retrospectively collected 145 non-contrast CT scans of suspected AAA. The first step was to manually segment the 30 non-contrast CT scans to create training data for the AI, and the second step was to improve accuracy using 9 of non-contrast CT scans. The model is then further tested for generalizability on a separate set of 106 examinations with differing patient. Image processing is used to identify the AAA area and automatically measure the size. The AAA region was identified from the amount of change in the minor-axis, and the maximum minor-axis diameter was calculated using elliptical fitting. To evaluate the diagnostic utility of AI for the detection of AAA, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated referred for the diagnostic report. The reproducibility in the size of AAA was assessed using intraclass correlation coefficients (ICCs) between the diagnostic report and AI.*Results AI achieves high performance for the detection of AAA (sensitivity / specificity / PPV / NPV: 94.6% / 98.7% / 53.8% / 99.9%). The size of AAA calculated by the AI (42.5 ± 8.8 mm) showed a strong correlation with the those of diagnostic reports (44.6 ± 8.4 mm; ICCs = 0.97).*Conclusions AI represents a useful tool in the fully automatic detection and measurement of AAA using small amounts of non-contrast CT.*Clinical Relevance/Application AI will help to accurately detect and measure the size of AAA.

RESULTS

AI achieves high performance for the detection of AAA (sensitivity / specificity / PPV / NPV: 94.6% / 98.7% / 53.8% / 99.9%). The size of AAA calculated by the AI (42.5 ± 8.8 mm) showed a strong correlation with the those of diagnostic reports (44.6 ± 8.4 mm; ICCs = 0.97).

CLINICAL RELEVANCE/APPLICATION

AI will help to accurately detect and measure the size of AAA.

SDP-IN-2   Deep Learning-based Algorithm For Bone Metastasis Detection On Whole-body CT: Evaluation On An Observer Study

Participants
Shunjiro Noguchi, Kyoto, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To develop and evaluate a deep learning-based algorithm (DLA) for automatic detection of bone metastasis on whole-body CT.*Methods and Materials This retrospective study included CT scans acquired at a single institution between 2009 and 2019. Positive scans with bone metastasis and negative control scans without bone metastasis were collected to train the DLA. Another 50 positive and 50 negative scans were collected separately from the training dataset and were divided into validation and test datasets with a 2:3 split. The DLA was constructed on the training and validation datasets and assessed on the test dataset. The clinical efficacy of the DLA was further evaluated by an observer study with board-certified radiologists. Jackknife alternative free-response receiver operating characteristic analysis was used to evaluate observer performance.*Results A total of 269 positive scans including 1375 bone metastasis lesions and 463 negative scans were collected for the training dataset. The number of lesions identified in the validation and test datasets was 49 and 75, respectively. For the test dataset, the DLA achieved a sensitivity of 89.3% (67 of 75) with 1.5 false positives per case and 82.7% (62 of 75) with 0.617 false positives per case. With the DLA, the overall performance of nine radiologists with reference to the weighted alternative free-response receiver operating characteristic figure of merit improved from 0.746 (95% CI: 0.690, 0.802) to 0.899 (95% CI: 0.865, 0.932) (P < .001). Furthermore, the mean interpretation time per case reduced from 168 to 85 s (P = .004).*Conclusions With the aid of the algorithm, radiologists detected bone metastases on CT with high accuracy and short interpretation time.*Clinical Relevance/Application Bone metastasis detection on CT is a common but challenging task for radiologists. Our algorithm enables radiologists to detect bone metastases with high accuracy and short interpretation time.

RESULTS

A total of 269 positive scans including 1375 bone metastasis lesions and 463 negative scans were collected for the training dataset. The number of lesions identified in the validation and test datasets was 49 and 75, respectively. For the test dataset, the DLA achieved a sensitivity of 89.3% (67 of 75) with 1.5 false positives per case and 82.7% (62 of 75) with 0.617 false positives per case. With the DLA, the overall performance of nine radiologists with reference to the weighted alternative free-response receiver operating characteristic figure of merit improved from 0.746 (95% CI: 0.690, 0.802) to 0.899 (95% CI: 0.865, 0.932) (P < .001). Furthermore, the mean interpretation time per case reduced from 168 to 85 s (P = .004).

CLINICAL RELEVANCE/APPLICATION

Bone metastasis detection on CT is a common but challenging task for radiologists. Our algorithm enables radiologists to detect bone metastases with high accuracy and short interpretation time.

SDP-IN-20   A Machine Learning Model For Automated Selection Of Abdominal MRI Series

Participants
Chad M. Miller, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

PURPOSE

To develop an automated machine learning (ML) model for accurately identifying abdominal MRI sequence types.*Methods and

To develop an automated machine learning (ML) model for accurately identifying abdominal MRI sequence types. Methods and Materials This retrospective study used a dataset including 2,215 MRI series from 105 examinations. The method described in Gauriau et al. (Journal of Digital Imaging (2020) 33:747-762) for distinguishing brain MRI sequences with a random forest classifier was adapted for abdominal MRI examinations. A subset of DICOM metadata including image acquisition parameters and scanner options were used to train a random forest classifier to predict the sequence type for each series. Ground truth labels were established via review of images by three radiologists with 2-15 years' experience in abdominal imaging. Data were split at the subject level into development and test datasets, and the development set between training and validation datasets. Hyperparameters were optimized using a grid search on the training set.*Results The model performed with high accuracy (98%) in predicting the correct abdominal MRI series on the validation data set (354 series from 17 examinations). A confusion matrix is provided as a Figure, which shows high accuracy for most of the MRI sequences.*Conclusions Our algorithm using DICOM metadata can correctly identify the abdominal MRI series with high accuracy.*Clinical Relevance/Application This random forest classifier could be incorporated into a larger automated pipeline incorporating conditional logic, heuristics, and an image-based deep learning classifier that we have previously developed in order to robustly identify abdominal MRI series for input into pipelines for ML or other post-processing methods, or for development of smart hanging protocols.

RESULTS

The model performed with high accuracy (98%) in predicting the correct abdominal MRI series on the validation data set (354 series from 17 examinations). A confusion matrix is provided as a Figure, which shows high accuracy for most of the MRI sequences.

CLINICAL RELEVANCE/APPLICATION

This random forest classifier could be incorporated into a larger automated pipeline incorporating conditional logic, heuristics, and an image-based deep learning classifier that we have previously developed in order to robustly identify abdominal MRI series for input into pipelines for ML or other post-processing methods, or for development of smart hanging protocols.

SDP-IN-3   Intermediate Slices Generation For Improving Orbital Thin Bone Segmentation Performance In Head CT Images

Participants
Min Jin Lee, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

To make customized bone plate model for the reconstruction of fractured orbital bone in craniomaxillofacial surgery, it is necessary to accurately segment the orbital thin bone on head CT images. However, because slice thickness is two to three times larger than pixel spacing, segmentation accuracy is degraded, and reconstructed orbital thin bones show an aliasing effect. The purpose of this study is to improve the inter-slice resolution of head CT images and to validate the effect of improving the inter-slice resolution on the performance of orbital thin bone segmentation.*Methods and Materials We used 355 head CT images with resolution of 512x512, pixel spacing of 0.4~0.619mm, and slice thickness of 1mm. First, to improve the inter-slice resolution using 2D CNN-based OB-SRNET that considers context and area information of labeled orbital bones in multiple view, intermediate slices are generated using images that are down-sampled twice from original CT images. Second, orbital bones with improved inter-slice resolution are segmented using ensemble of two 3D U-Nets. Finally, to validate the effect of the improvement of inter-slice resolution on segmentation, the dataset was randomly divided into 228 training sets, 71 test sets, and 56 validation sets, and original CT image, down-sampled images, and images generated with OB-SRNET are used to compare and analyze segmentation results.*Results Images generated with OB-SRNET over the whole orbital bone area showed 51%, 56%, and 25%, 44% improvement in PSNR, VIF scores, respectively, compared to images generated with bilinear interpolation and 3D SRGAN. Images generated with OB-SRNET have reduced aliasing effects and clear boundaries of thin bones, while images generated with 3D SRGAN have blurry boundaries of thin bones. The orbital bone reconstructed in 3D from images generated by OB-SRNET was similar to the original CT image, and aliasing effect was reduced compared to orbital bone reconstructed in 3D from thick-slice CT. The segmentation performance in F1 score and recall of images generated by OB-SRNET was improved by 10% and 22% in orbital medial wall area, and 25% and 42% in orbital floor area compared to the images with slice thickness of 2mm.*Conclusions Our method improved the inter-slice resolution and validated effect of improving inter-slice resolution on segmentation performance. (Technology Innovation Program (20001811) funded by the Ministry of Trade, Industry & Energy (MOTIE, Korea) and the Korea Medical Device Development Fund grant funded by the Korea government (Ministry of Health & Welfare) (NTIS Number: 9991007552))*Clinical Relevance/Application Our method can be used to provide a customized bone plate for the reconstruction of fractured orbital thin bones in craniomaxillofacial surgery.

RESULTS

Images generated with OB-SRNET over the whole orbital bone area showed 51%, 56%, and 25%, 44% improvement in PSNR, VIF scores, respectively, compared to images generated with bilinear interpolation and 3D SRGAN. Images generated with OB-SRNET have reduced aliasing effects and clear boundaries of thin bones, while images generated with 3D SRGAN have blurry boundaries of thin bones. The orbital bone reconstructed in 3D from images generated by OB-SRNET was similar to the original CT image, and aliasing effect was reduced compared to orbital bone reconstructed in 3D from thick-slice CT. The segmentation performance in F1 score and recall of images generated by OB-SRNET was improved by 10% and 22% in orbital medial wall area, and 25% and 42% in orbital floor area compared to the images with slice thickness of 2mm.

CLINICAL RELEVANCE/APPLICATION

Our method can be used to provide a customized bone plate for the reconstruction of fractured orbital thin bones in craniomaxillofacial surgery.

SDP-IN-4   Cascaded Localization And Segmentation Networks For Renal Parenchymal Segmentation With Self-shape Information For Evaluation Of Contralateral Renal Hypertrophy After Renal Partial Nephrectomy In Abdominal MR Images

Participants
Hyeonjin Kim, MS, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Contralateral kidney volume change as a consequence of ipsilateral parenchymal atrophy promotes overall renal function recovery after renal partial nephrectomy (RPN). Segmentation of the renal parenchyma responsible for renal function on abdominal MR images is required to assess contralateral renal hypertrophy and predict renal function after RPN without radiation exposure instead of abdominal CT imaging. The purpose of this study is to segment the renal parenchyma into cascaded localization and segmentation

networks (CLSN) that are less sensitive to outliers by considering its self-shape information.*Methods and Materials The patient's left kidneys were evaluated with 51 abdominal T1-weighted MR images acquired from GE Medical Systems. To localize the kidneys in the abdomen, an ensemble of three 2D U-Nets using attention module is performed individually in the axial, coronal, and sagittal planes with average voting to infer the spatial shape of the kidneys. To segment the renal parenchyma in the localized volume, two 3D U-Nets are individually trained into an image patch and a shape patch and then ensemble, which reduces outliers of the renal parenchyma-like shapes. The image patch is generated by using signal intensity correction to reduce the irregular signal intensity in the localized volume, and the shape patch is generated through convolution of the image patch and the ensemble of three 2D segmentation results.*Results For evaluation, all datasets were trained and tested with 5-fold cross-validation. 2D segmentation results of the axial, coronal and sagittal planes showed under-segmentation and outliers to other organs. The ensemble of three 2D segmentation results avoided outliers and gave the best results in precision, but under-segmentation still occurred. CLSN with image patch avoided under-segmentation and gave the best results in recall, but outliers occurred to nearby organs. CLSN with image and shape patches avoided outliers and showed the best results of 86.75% on an F1-score that combines precision and recall.*Conclusions Our method can be used to predict kidney function after RPN by measuring the volume change in the contralateral renal parenchyma. (This work was supported Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Science and ICT (NRF-2019R1A2C2004746).*Clinical Relevance/Application The renal parenchymal segmentation results on MR can be used to measure the volume of the contralateral kidney and to analyze the relationship between renal parenchymal volume and renal function.

RESULTS

For evaluation, all datasets were trained and tested with 5-fold cross-validation. 2D segmentation results of the axial, coronal and sagittal planes showed under-segmentation and outliers to other organs. The ensemble of three 2D segmentation results avoided outliers and gave the best results in precision, but under-segmentation still occurred. CLSN with image patch avoided under-segmentation and gave the best results in recall, but outliers occurred to nearby organs. CLSN with image and shape patches avoided outliers and showed the best results of 86.75% on an F1-score that combines precision and recall.

CLINICAL RELEVANCE/APPLICATION

The renal parenchymal segmentation results on MR can be used to measure the volume of the contralateral kidney and to analyze the relationship between renal parenchymal volume and renal function.

SDP-IN-5 Deep Neural Network Augments Performance Of Junior Residents In Diagnosing COVID-19 Pneumonia On Chest Radiographs

Participants
Jordan Sim Zheng Ting, MBBS, Singapore, Singapore (*Presenter*) Nothing to Disclose

PURPOSE

To assess the performance of a deep neural network at differentiating COVID-19 and other pneumonia and evaluate its value in augmenting junior residents' performance.*Methods and Materials A total of 5,125 CXRs were used to develop and evaluate a deep neural network model that was able to perform 3-class classification (Normal, Non-COVID-19 pneumonia and COVID-19 pneumonia). Inputs from two senior radiologists were used as the reference standard. Another independent set of 500 CXRs was used as the external test dataset, which were blindly reviewed by three junior residents with various levels of training without and then with AI assistance.*Results The model achieved an average area under the receiver operating characteristic curve (AUC) of 0.95 with sensitivity of 93% and specificity of 84% on the test set. On the external test dataset, the model achieved AUC of 0.84 with sensitivity of 87% and specificity of 69%. Assisted by the probabilities of the AI model, the performance of the junior residents improved at a degree that is inversely proportionate to their level of training. The junior resident with the least training achieved a 5% improvement in both sensitivity and specificity.*Conclusions Deep neural network model assistance augmented junior residents' performance in diagnosing COVID-19 pneumonia and non-COVID-19 pneumonia on CXRs.*Clinical Relevance/Application Chest X-rays (CXRs) are often the initial radiological investigation in the management of Coronavirus disease-19 (COVID-19). Junior residents may be the first point-of-contact and are thus expected to interpret these CXRs accurately. Artificial intelligence (AI) can potentially improve the performance of junior residents.

RESULTS

The model achieved an average area under the receiver operating characteristic curve (AUC) of 0.95 with sensitivity of 93% and specificity of 84% on the test set. On the external test dataset, the model achieved AUC of 0.84 with sensitivity of 87% and specificity of 69%. Assisted by the probabilities of the AI model, the performance of the junior residents improved at a degree that is inversely proportionate to their level of training. The junior resident with the least training achieved a 5% improvement in both sensitivity and specificity.

CLINICAL RELEVANCE/APPLICATION

Chest X-rays (CXRs) are often the initial radiological investigation in the management of Coronavirus disease-19 (COVID-19). Junior residents may be the first point-of-contact and are thus expected to interpret these CXRs accurately. Artificial intelligence (AI) can potentially improve the performance of junior residents.

SDP-IN-6 Curation Of The CANDID-PTX Dataset With Free-text Reports

Participants
Sijing Feng, MBChB, Mosgiel, New Zealand (*Presenter*) Nothing to Disclose

PURPOSE

Artificial Intelligence (AI) has many potential uses in radiology, but curating the large datasets required to train AI algorithms demands significant time and expertise. This project aims to produce a large chest X-ray (CXR) dataset with segmented annotations of pneumothoraces, acute rib fractures and intercostal chest tubes for use in training and testing AI algorithms.*Methods and Materials 295,613 CXRs were obtained from [Hospital] PACS with radiology reports, with all image and reports data being anonymized algorithmically with manual checking and imported onto the MD.ai image annotation platform. Inclusion criteria was a frontal CXR from a patient over 16 years old. Based on preliminary classifications from a report-based algorithm, all preliminary pneumothorax positive images were reviewed by annotators, along with a selection of approximately five time the number of negative cases.35 doctors were divided into three tiers as per their experience level, with each image being reviewed by multiple doctors including one Tier 3 annotator (a radiology trainee for simple images, or consultant radiologist for difficult images). Cases of significant difficulty were assessed by consultant consensus with the involvement of a thoracic

radiologist. Images were given segmented annotations of any pneumothoraces, acute rib fractures and intercostal chest tubes. After a validation process, a ground truth was established.*Results 26,798 images were reviewed by an appropriate Tier 3 annotator with 7,561 being excluded, leaving 19,237 frontal CXRs in the final dataset. There were 3,196 images with pneumothorax region segmented labels, 1,423 images with intercostal chest tube freeform line labels, and 355 images with acute rib fracture bounding box labels.*Conclusions This study describes the curation of the 19,237-image CANDID-PTX dataset, with segmented annotations of pneumothoraces, acute rib fractures and intercostal chest tubes. This dataset is prepared for the training and testing of AI algorithms in the detection of these features on CXR. Instructions for accessing the CANDID-PTX dataset can be found at DOI: 10.17608/k6.auckland.14173982.*Clinical Relevance/Application This chest X-ray dataset has been curated with segmented pneumothorax, chest tube and rib fracture labels. It can help train artificial intelligence algorithms that can be used in clinical medicine.

RESULTS

26,798 images were reviewed by an appropriate Tier 3 annotator with 7,561 being excluded, leaving 19,237 frontal CXRs in the final dataset. There were 3,196 images with pneumothorax region segmented labels, 1,423 images with intercostal chest tube freeform line labels, and 355 images with acute rib fracture bounding box labels.

CLINICAL RELEVANCE/APPLICATION

This chest X-ray dataset has been curated with segmented pneumothorax, chest tube and rib fracture labels. It can help train artificial intelligence algorithms that can be used in clinical medicine.

SDP-IN-7   Deep Learning Beats Radiologists In Clinical Routine Assessment Of Intensive Care Unit X-rays

Participants
Firas Khader, Aachen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Intensive Care Unit chest radiographs typically serve as the initial imaging step that allow physicians to find pathologic abnormalities. Accurate and timely reading of chest radiographs is of paramount importance. In this study we aim to employ state-of-the-art deep learning methods to detect abnormalities in chest radiographs and compare the results to human raters in a clinical setting.*Methods and Materials Using our in-house dataset comprised of 193,556 chest radiographs that were taken from 2009 until 2020 at a maximum care hospital we trained a ResNet-34 to predict the state of pulmonary infection, effusion, atelectasis (each separately for the left and right lung) as well as the state of congestion and cardiomegaly. For all data the labels were set by experienced radiologists in a structured manner using a dedicated annotation mask. We also calculated Spearman's correlation coefficient between laboratory values of BNP and the predictions of the neural network as well as the archived clinical reports.*Results We compared the results of our neural network (NN) with the archived clinical reports (CR) used to train the neural network, the rating of 6 radiologists (R1-R6) and the rating of an intensive care unit physician (ICU). Cohen's kappa was used to assess the agreement between the raters, using the majority voting of the 6 radiologists as the ground truth. Evaluation was performed on 100 samples. Agreement between the ground truth and the neural network (0.69, 95% interval: [0.63, 0.73]) is significantly higher than that of each single radiologist and the archived clinical reports. Additionally, the ICU has a lower agreement with the ground truth than all the other raters. However, when provided with a prefilled annotation mask with labels predicted by the neural network (ICU+AI), the ICU achieves an agreement that is better than that of the radiologists. We found that in the case of heart size and congestion, the predicted values of the neural network correlated significantly better with the BNP values than those of the CR.*Conclusions In our study we found that neural networks can surpass the performance of experts in the assessment of chest radiographs. Additionally, these predictions also show a better correlation with relevant laboratory values than clinical reports generated by trained radiologists.*Clinical Relevance/Application We demonstrate the superiority of neural networks in a realistic scenario and show that trained physicians can benefit from the preliminary assessment of thoracic radiographs by neural networks. This could help physicians in their initial diagnostic workflow and improve patient care.

RESULTS

We compared the results of our neural network (NN) with the archived clinical reports (CR) used to train the neural network, the rating of 6 radiologists (R1-R6) and the rating of an intensive care unit physician (ICU). Cohen's kappa was used to assess the agreement between the raters, using the majority voting of the 6 radiologists as the ground truth. Evaluation was performed on 100 samples. Agreement between the ground truth and the neural network (0.69, 95% interval: [0.63, 0.73]) is significantly higher than that of each single radiologist and the archived clinical reports. Additionally, the ICU has a lower agreement with the ground truth than all the other raters. However, when provided with a prefilled annotation mask with labels predicted by the neural network (ICU+AI), the ICU achieves an agreement that is better than that of the radiologists. We found that in the case of heart size and congestion, the predicted values of the neural network correlated significantly better with the BNP values than those of the CR.

CLINICAL RELEVANCE/APPLICATION

We demonstrate the superiority of neural networks in a realistic scenario and show that trained physicians can benefit from the preliminary assessment of thoracic radiographs by neural networks. This could help physicians in their initial diagnostic workflow and improve patient care.

SDP-IN-8   Early Detection Of COVID-19 Using Convolutional Neural Networks

Participants
Juana Plasencia-Martinez, MD,PhD, Murcia, Spain (*Presenter*) Nothing to Disclose

PURPOSE

The sensitivity of a chest radiograph for diagnosing COVID-19 is modest at the onset of the disease, even in expert radiological hands. Being able to detect the disease earlier than the radiologist using artificial intelligence tools would allow us to anticipate care and isolation. Our purpose is to evaluate the performance of a deep learning artificial intelligence (AI) algorithm on the first clinical encounter and compare it with several radiologists with different years of experience in chest imaging.*Methods and Materials An ensemble of four deep convolutional networks, Ensemble4Covid, was trained to detect COVID-19 on frontal chest radiographs. The algorithm was tested using images from the first clinical encounter of positive and negative patients over a period of three months. The reference standard for test-positive patients was a positive real-time polymerase chain reaction test, taken within one day of the chest radiograph. The performance of the algorithm was compared with that of 5 radiologists with different years of experience on a smaller test subset of patients. The performance of the deep model training was also validated using the large public dataset COVIDx.*Results A total of 311 positive and 513 negative chest radiographs were used to evaluate the model.

The Ensemble4Covid model achieved an AUC of 85% whereas the radiologists achieved an AUC of 71%. Compared with other models, the performance of a single model of our ensemble achieved non-significant differences on the large public dataset COVIDx.*Conclusions The performance of our Ensemble4Covid on these challenging conditions is significantly higher compared to the assessment of five radiologists. AI can be used for a fast COVID-19 diagnosis.*Clinical Relevance/Application This AI tool can be used for early detection of COVID-19 from conventional chest radiograph taken at the onset of disease before the corresponding density difference is visible to the radiologist.

RESULTS

A total of 311 positive and 513 negative chest radiographs were used to evaluate the model. The Ensemble4Covid model achieved an AUC of 85% whereas the radiologists achieved an AUC of 71%. Compared with other models, the performance of a single model of our ensemble achieved non-significant differences on the large public dataset COVIDx.

CLINICAL RELEVANCE/APPLICATION

This AI tool can be used for early detection of COVID-19 from conventional chest radiograph taken at the onset of disease before the corresponding density difference is visible to the radiologist.

SDP-IN-9   Quantifying Uncertainty In Machine Learning Classifiers For Medical Imaging

Participants
Pascal Tyrrell, PhD, Toronto, Ontario (*Presenter*) Officer, AceAge Inc;Stockholder, AceAge Inc;Investigator, Novo Nordisk AS;Consultant, Novo Nordisk AS;CEO and Co-founder, SofTx Innovations Inc

PURPOSE

Machine learning (ML) models in medical imaging (MI) can be of great value in computer aided diagnostic systems, but little attention is given to the confidence (alternatively, uncertainty) of such models, which may have significant clinical implications. This paper applied, validated, and explored a technique for assessing uncertainty in convolutional neural networks (CNNs) in the context of MI.*Methods and Materials We used a publicly accessible pneumonia chest x-ray dataset with two classes to explore the proposed measure of uncertainty (based on 1. experiments with different class imbalance-sample sizes, 2. experiments with images close to the classification boundary, and 3. the relationship with other performance metrics). A collection of the five most confidently and the five least confidently classified images of the CNN were cross-examined by a radiologist. Additionally, bounds were derived on the uncertainty metric, and recommendations for interpretability were made.*Results With respect to training set class imbalance, the uncertainty metric was minimized when both classes were nearly equal in size (regardless of training set size) and was approximately 17% smaller than the maximum uncertainty resulting from greater imbalance. We found that less-obvious test images (those closer to the classification boundary) produced higher classification uncertainty, about 10-15 times greater than images further from the boundary. Relevant MI performance metrics like accuracy, sensitivity, and sensibility showed seemingly negative correlations, though none were statistically significant (p= 0.05). An expert radiologist and our CNN demonstrated good agreement on a collection of chest exams with respect to confidence in classification.*Conclusions This paper demonstrated the importance of uncertainty reporting alongside predictions in medical imaging. Results demonstrate considerable potential from automatically assessing classifier reliability on each prediction with the proposed uncertainty metric. Going forward, radiologists using ML technologies can more closely examine the prediction quality of these methods, automating workflow and providing richer context with model outputs.*Clinical Relevance/Application The ability for informed decision making based on AI technology is not fully developed without any meaningful measure of uncertainty. In much the same way that a human radiologist may assign a subjective confidence score to their diagnoses, the machine too, should be able to mimic this process. In doing so, radiologists will be able to identify machine classifications that are more uncertain and provide a human interpretation.

RESULTS

With respect to training set class imbalance, the uncertainty metric was minimized when both classes were nearly equal in size (regardless of training set size) and was approximately 17% smaller than the maximum uncertainty resulting from greater imbalance. We found that less-obvious test images (those closer to the classification boundary) produced higher classification uncertainty, about 10-15 times greater than images further from the boundary. Relevant MI performance metrics like accuracy, sensitivity, and sensibility showed seemingly negative correlations, though none were statistically significant (p= 0.05). An expert radiologist and our CNN demonstrated good agreement on a collection of chest exams with respect to confidence in classification.

CLINICAL RELEVANCE/APPLICATION

The ability for informed decision making based on AI technology is not fully developed without any meaningful measure of uncertainty. In much the same way that a human radiologist may assign a subjective confidence score to their diagnoses, the machine too, should be able to mimic this process. In doing so, radiologists will be able to identify machine classifications that are more uncertain and provide a human interpretation.

Printed on: 06/28/22

CA01-B

Cardiac Sunday Poster Discussions

Sub-Events

CA01-B2 Reproducibility Of Quantitative Thoracic 4D Flow MRI: Physiological Variability Of Hemodynamics Due To Circadian Rhythm And Food Intake

Participants
Thekla Helene Oechtering, MD, Madison, Wisconsin (*Presenter*) Research Grant, German Research Foundation (OE 746/1-1)

PURPOSE

To characterize the physiological variability of hemodynamics measured with 4D flow MRI in the thoracic aorta of young, healthy volunteers depending on time of day and food intake.*Methods and Materials 4D flow MRI of the thoracic aorta in 37 healthy volunteers (25±3years, 19 females; no shift work, fasting =5hrs prior to MRI) was acquired at 3T at 7AM and 7PM to evaluate possible circadian changes. 19 subjects were examined a third time after a standardized meal challenge. Typical acquisition parameters included Cartesian sampling, acquired voxel size 2.5x2.5x2.0-2.5mm reconstructed to 2.0x2.0x2.0mm, FOV 28x28x6.4 cm, venc 180 cm/s, 24±3 acquired cardiac phases, and acquisition time 11±3min. Stroke volume (SV), peak flow (Q) and peak velocity (V) were analyzed with GTFlow (Gyrotools, CH) at 8 standardized aortic planes. Statistics included t-test, calculation of relative difference, and Pearson correlation.*Results Peak flow differed significantly in every analysis plane and peak velocity in most planes with higher values in the evening and after a meal compared to the morning and fasting exams (Figure). Circadian differences were less pronounced for stroke volume. Combining the results for ascending aorta, descending aorta, and total thoracic aorta, respectively, all differences proved significant with higher values in the evening and after a meal. AM- and PM-results as well as pre- and postprandial findings showed strong to very strong correlation (SV: r=0.76-0.91; Q: r=0.85-0.94; V: r=0.63-0.95, for all p<0.001). Blood pressure and cardiac frequency were normal and did not differ significantly between exams (p<0.05).*Conclusions For the first time, this study demonstrated that 4D flow MRI can detect circadian hemodynamic changes in the thoracic aorta of young, healthy volunteers. We found significantly higher peak flow, peak velocity, and stroke volume in PM measurements compared to AM acquisitions. Circadian rhythm can be deranged in cardiovascular disease, potentially making 4D flow MRI a non-invasive cardiovascular risk-stratification tool. Our results in the thoracic aorta agree with findings of increased flow in the abdominal aorta in response to a meal challenge described in the literature.*Clinical Relevance/Application 4D flow MRI can detect the variability of thoracic aortic hemodynamics due to circadian rhythm and food intake. If confirmed, this might necessitate consistent timing of 4D flow MRI follow up studies.

RESULTS

Peak flow differed significantly in every analysis plane and peak velocity in most planes with higher values in the evening and after a meal compared to the morning and fasting exams (Figure). Circadian differences were less pronounced for stroke volume. Combining the results for ascending aorta, descending aorta, and total thoracic aorta, respectively, all differences proved significant with higher values in the evening and after a meal. AM- and PM-results as well as pre- and postprandial findings showed strong to very strong correlation (SV: r=0.76-0.91; Q: r=0.85-0.94; V: r=0.63-0.95, for all p<0.001). Blood pressure and cardiac frequency were normal and did not differ significantly between exams (p<0.05).

CLINICAL RELEVANCE/APPLICATION

4D flow MRI can detect the variability of thoracic aortic hemodynamics due to circadian rhythm and food intake. If confirmed, this might necessitate consistent timing of 4D flow MRI follow up studies.

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Abstract Archives of the RSNA, 2021

IR03-D

Interventional Radiology Tuesday Poster Discussions

Sub-Events

IR03-D2   Preliminary Assessment Of Intraoperative Neuromonitoring Equipment For MRI-guided Ablations: RF-heating And Image Quality

Participants
Christopher Favazza, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate RF heating risks and image degradation associated with use of intraoperative neuromonitoring equipment during interventional MRI.*Methods and Materials Monopolar and bipolar electrodes each connected to separate stimulator systems and two receiver electrode pairs were inserted into opposite ends of a ~50 cm long porcine tissue phantom. Six fiberoptic thermometers were placed at electrode tips. Saline bags were positioned next to the phantom for coil loading and SNR measurements. Bipolar stimulator and receiver electrode wires were routed directly out of the scanner along the shortest pathlength. Monopolar stimulator electrode wires were routed through the length of the bore to reach the stimulator on the opposite side of the scanner. The neuromonitoring computer system was located outside of the scanner room and connected through a waveguide. Two pulse sequences used to monitor ablations, T2-TSE (B1+rms= 3.52μT) for iceball monitoring and T1 SPGR (B1+rms=0.32μT) for thermometry, were executed with different electrode connection configurations: (1) all connected, (2) bipolar + receivers only (3) monopolar + receivers only,(4) receivers only, and none connected with monopolar wires exiting (5) opposite and (6) proximal bore opening. For each of these connection configurations, temperatures were continually measured during MRI. SNR measurements were obtained from saline images.*Results Temperature data showed no heating during the T1 SPGR sequence for all configurations. During T2 imaging, the monopolar electrode's temperature rose ~9°C; all other electrodes showed =2°C temperature rise—for configurations (1)-(5). For configuration (6), a maximum temperature rise of ~3.5°C was measured. Notably, there was visual evidence of a burn at one of the monopolar electrodes with a large wire section coiled within the bore. However, temperature was not monitored out of concern for potential damage to the thermometer. Image quality was severely corrupted with all electrodes connected but increasingly improved with disconnecting stimulator electrodes. SNR values increased maximally by factors of ~50 and 300 for T1 SPGR and T2 TSE sequences, respectively.*Conclusions Neuromonitoring electrodes can substantially heat during MRI, dependent on exact wire placement. However, data suggest heating can be reduced through minimizing wire pathlength in the bore. With a single set of stimulators connected, image quality was sufficient for procedural monitoring, thereby permitting imaging with intermittent neurostimulation and monitoring.*Clinical Relevance/Application Facilitating intraoperative neuromonitoring during MRI-guided ablations could improve patient safety and permit more aggressive treatments.

RESULTS

Temperature data showed no heating during the T1 SPGR sequence for all configurations. During T2 imaging, the monopolar electrode's temperature rose ~9°C; all other electrodes showed =2°C temperature rise—for configurations (1)-(5). For configuration (6), a maximum temperature rise of ~3.5°C was measured. Notably, there was visual evidence of a burn at one of the monopolar electrodes with a large wire section coiled within the bore. However, temperature was not monitored out of concern for potential damage to the thermometer. Image quality was severely corrupted with all electrodes connected but increasingly improved with disconnecting stimulator electrodes. SNR values increased maximally by factors of ~50 and 300 for T1 SPGR and T2 TSE sequences, respectively.

CLINICAL RELEVANCE/APPLICATION

Facilitating intraoperative neuromonitoring during MRI-guided ablations could improve patient safety and permit more aggressive treatments.

IR03-D4   Long-term Follow-up After Image-guided Percutaneous Pancreatic Duct Drainage

Participants
Malkhaz Mizandari, PhD, Tbilisi, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

To introduce a new technical development - steering using a coaxial large gauge needle to avoid critical structures in a percutaneous image-guided pancreatic duct (PD) access. Also, we prospectively review of efficacy and long-term outcomes of percutaneous image-guided PD drainage for treating benign or malignant pathologies with PD obstruction.*Methods and Materials Out of 85 patients with PD duct obstruction, percutaneous drainages were performed in 73 cases under CT, combined ultrasound and fluoroscopy or CT and fluoroscopy guidance in our center during the last 10-years. The technical and clinical success rate, adverse events based on the SIR scale, and survival rate were evaluated.*Results Final cases included acute and chronic pancreatitis (25) or postoperative stricture (1), pancreatic head tumors (42), and papilla of Vater tumors (5). We revealed that image-guided PD drainage was considered a highly feasible therapeutic intervention with an overall success rate of 98.6%. More than 15% of the patients remained alive after 4 years of follow-up. One patient had pancreatic cutaneous fistula, the PD was not dilated and was accessed under CT guidance using a 22 ga needle. Finally, The patient died 5 months later because of tumor progression, with no cutaneous fistula. No major complications occurred in all included cases.*Conclusions Image-guided PD drainage had significant additional benefits in managing cases of PD obstruction due to both benign or malignant

pathologies.*Clinical Relevance/Application The direct PD decompression provided by the image-guided PD drainage procedure may be more effective than commonly used pancreatic fluid collection drainage procedures in terms of lower complication rates and acceptable outcomes.

RESULTS

Final cases included acute and chronic pancreatitis (25) or postoperative stricture (1), pancreatic head tumors (42), and papilla of Vater tumors (5). We revealed that image-guided PD drainage was considered a highly feasible therapeutic intervention with an overall success rate of 98.6%. More than 15% of the patients remained alive after 4 years of follow-up. One patient had pancreatic cutaneous fistula, the PD was not dilated and was accessed under CT guidance using a 22 ga needle. Finally, The patient died 5 months later because of tumor progression, with no cutaneous fistula. No major complications occurred in all included cases.

CLINICAL RELEVANCE/APPLICATION

The direct PD decompression provided by the image-guided PD drainage procedure may be more effective than commonly used pancreatic fluid collection drainage procedures in terms of lower complication rates and acceptable outcomes.

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Abstract Archives of the RSNA, 2021

GI02-B

Gastrointestinal Monday Poster Discussions

Sub-Events

GI02-B1   **Analysis Of CT Findings In Patients With Different Serum Pancreatic Amylase Trends After Major Pancreatic Resections**

Participants
Francesca Mambrin, MD, Verona, Italy (*Presenter*) Nothing to Disclose

PURPOSE

A recent study has demonstrated that a dynamic evaluation of serum pancreatic amylase (spAMY) trends is a more proper predictor of severe early morbidity after partial pancreatectomy than a single postoperative evaluation. We, therefore, sought to analyze the CT features that correlate with early spAMY trends after partial pancreatic resections.*Methods and Materials This is a retrospective study from an IRB-approved prospectively collected register. We included patients who underwent major pancreatic resections between 2016 and 2019 and had a contrast-enhanced postoperative MDCT between postoperative day (POD) 3 and POD 15. Patients were divided into 3 groups based on their patterns of spAMY: (1) spAMY values always< the lower limit of normal/within the reference range /a single increase in spAMY >upper limit of normal at any POD; (2) Sustained increase in spAMY activity on POD 0+1; (3) Sustained increase in spAMY activity including POD 1+2. Two readers in consensus, blinded to spAMY trend, analyzed the exams and logged arterial enhancement homogeneity, MPD diameter, peripancreatic edema, fluid collections, non-enhanced densities of liver, paraspinal and ileo-psoas muscles, and retrorenal fat thickness.*Results 383 patients were included in the study (230 males, 153 females, mean age 62,51 years). A inhomogeneous pancreatic enhancement was more commonly observed in spAMY-3 patients (47%) than in spAMY-2 or spAMY-1 patients (38% and 30%, respectively; p=0.0081). The main pancreatic duct (MPD) was larger in spAMY-1 (mean caliber 2.31±1.66 mm) than in the other groups (p=0.0011). Peripancreatic fat stranding was significantly more common in spAMY-3 than in spAMY-1 and -2 (p=0.0047). Fluid collections were more common in spAMY-3 (p<0.0001).No statistically significant correlations were found between spAMY trends and non-enhanced density of liver (p=0.4043), paraspinal (p=0.3989) and ileo-psoas (p=0.4092) muscles, or between spAMY trends and retrorenal fat thickness (p=0.6281).*Conclusions A correlation was observed between the spAMY-3 trend and the presence of inhomogeneous pancreatic enhancement, MPD dilation, presence of peripancreatic fat stranding, and fluid collections.*Clinical Relevance/Application A clear definition of the CT features of postoperative acute pancreatitis is the base for the radiological description of this entity, which will lead to its accurate and early diagnosis and thus to a proper treatment.

RESULTS

383 patients were included in the study (230 males, 153 females, mean age 62,51 years). A inhomogeneous pancreatic enhancement was more commonly observed in spAMY-3 patients (47%) than in spAMY-2 or spAMY-1 patients (38% and 30%, respectively; p=0.0081). The main pancreatic duct (MPD) was larger in spAMY-1 (mean caliber 2.31±1.66 mm) than in the other groups (p=0.0011). Peripancreatic fat stranding was significantly more common in spAMY-3 than in spAMY-1 and -2 (p=0.0047). Fluid collections were more common in spAMY-3 (p<0.0001).No statistically significant correlations were found between spAMY trends and non-enhanced density of liver (p=0.4043), paraspinal (p=0.3989) and ileo-psoas (p=0.4092) muscles, or between spAMY trends and retrorenal fat thickness (p=0.6281).

CLINICAL RELEVANCE/APPLICATION

A clear definition of the CT features of postoperative acute pancreatitis is the base for the radiological description of this entity, which will lead to its accurate and early diagnosis and thus to a proper treatment.

GI02-B2   **Whole-abdomen Metabolic Imaging In Healthy Volunteers Using Hyperpolarized 13C-Pyruvate MRI**

Participants
Philip Lee, BS, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

Hyperpolarized (HP) 13C MRI is a novel metabolic imaging technique enabling real-time characterization of LDH-catalyzed pyruvate metabolism. It is a promising biomarker of early-stage diffuse liver diseases and therapeutic response in abdominal malignancies. Human clinical studies are now underway at several sites around the world. However, whole-abdomen coverage remains a challenge and little is known about normal HP 13C metabolite levels in humans. To investigate baseline energetics and demonstrate feasibility of whole-abdomen coverage, we investigated HP 13C-pyruvate metabolism in multiple organs of healthy volunteers.*Methods and Materials After IRB approval, 5 healthy subjects underwent HP 13C MRI on a clinical 3 T scanner with volumetric transmitter and an 8-channel receiver array. T1- and T2-weighted images were acquired for anatomic reference. After injection of 0.43 mL/kg of 250 mM HP [1-13C]pyruvate, signals from [1-13C]pyruvate and its downstream metabolites, [1-13C]lactate and [1-13C]alanine, were acquired using a multi-slice echo planar imaging acquisition with flip angles of 30° for pyruvate, 60° for lactate and alanine. Temporal resolution was 3 s, with total scan time 1 minute. Voxel size was 2×2×2 cm3. Data were phase corrected, Fourier transformed, pre-whitened and coil-combined using pyruvate to estimate the coil weights. Metabolite signals were summed throughout the entire time course and ROIs selected within each organ.*Results Metabolite signals (pyruvate, lactate) from kidney and spleen were 3-6 times higher than those from liver and pancreas, reflecting differences in overall perfusion. Although absolute metabolite signals were lower in the liver, lactate:pyruvate and alanine:pyruvate ratios were both higher (L/P: 0.38 vs 0.17-0.21,

A/P: 0.25 vs 0.02-0.10), indicating higher production of these metabolites. Right and left kidney metabolism were symmetric as expected. The pancreas showed higher levels of alanine production relative to other organs, possibly due to high levels of protein synthesis. *Conclusions We successfully acquired HP 13C metabolic images in multiple organs throughout the abdomen with excellent spatial and temporal resolution. This broad spatial coverage will be valuable in developing novel applications of HP 13C MRI. Establishing normal values for metabolite levels will serve as an important baseline for imaging cancer as well as metabolic liver diseases.*Clinical Relevance/Application Whole abdomen HP 13C MRI is technically feasible with metabolite-specific images of pyruvate and downstream metabolites lactate and alanine. Understanding the metabolism in the whole abdomen will be crucial for the characterization of disease states in the liver, spleen, pancreas, and kidneys.

RESULTS

Metabolite signals (pyruvate, lactate) from kidney and spleen were 3-6 times higher than those from liver and pancreas, reflecting differences in overall perfusion. Although absolute metabolite signals were lower in the liver, lactate:pyruvate and alanine:pyruvate ratios were both higher (L/P: 0.38 vs 0.17-0.21, A/P: 0.25 vs 0.02-0.10), indicating higher production of these metabolites. Right and left kidney metabolism were symmetric as expected. The pancreas showed higher levels of alanine production relative to other organs, possibly due to high levels of protein synthesis.

CLINICAL RELEVANCE/APPLICATION

Whole abdomen HP 13C MRI is technically feasible with metabolite-specific images of pyruvate and downstream metabolites lactate and alanine. Understanding the metabolism in the whole abdomen will be crucial for the characterization of disease states in the liver, spleen, pancreas, and kidneys.

GI02-B4   Nodules Identified On Surveillance Ultrasound: CEUS Or MRI As The Initial Test

Participants
Stephanie Wilson, MD, Calgary, Alberta (*Presenter*) Equipment support, Koninklijke Philips NV;Equipment support, Siemens AG;Equipment support, Samsung Electronics Co, Ltd;Research support, Samsung Electronics Co, Ltd;

PURPOSE

Patients at-risk for HCC undergo surveillance ultrasound (US) every 6 months. MRI is the modality of choice to characterize positive ultrasound findings. In our institution, CEUS is well integrated into the surveillance diagnostic pathway. We aim to show equivalence of CEUS as the first step in evaluating lesions from surveillance US.*Methods and Materials This prospective IRB approved study recruited 250 high risk patients for HCC from those referred with a positive surveillance US. We report the first 105 patients, recruited between July 2019 and March 2020. All patients were referred for CEUS and MRI. Biopsy (n=26) and follow-up (n=50) were used as gold standard. MRI and CEUS lesions are classified according to enhancement features and their Liver Imaging and Reporting Data System (LI-RADS) category. A non-blinded research student reviewed all results to show concordance and discordance between CEUS and CEMRI, LI-RADS categorization and resolution of clinical problems posed by surveillance US.*Results The first 105 surveillance US include 37 confirmed HCC. 19/37 were concordant LR-5 on CEUS and MRI, 11/37 cases were concordant LR-4, and 3/37 were concordant LR-M. Additionally, two LR-4 on MRI were upgraded to LR-5 on CEUS, and 2 cases without an MR correlate for the surveillance US observation were LR-4 and LR-5 on CEUS (both biopsy-confirmed HCC). We document 7 concordant LR-M: including the three aforementioned HCC, two intrahepatic cholangiocarcinoma (ICC), one melanoma metastasis, and one benign inflammatory tumor. One patient with tumor-in-vein (LR-TIV) showed concordant CEUS and MRI. All malignancies (n=38) were categorized appropriately on CEUS, and had high agreement with MR exams (36/38 cases = 95%). Additionally, we document 13 benign hepatocellular lesions (LR-3 / LR-4) showing concordance between CEUS and MR exams, 22 cases with concordant benign LR-1. Lastly, 9/105 cases (8.5%) are concordant negative scans, and 20/105 (19%) in which CEUS identifies the surveillance US correlate and MRI does not. Of these 20 patients, two were biopsy-confirmed HCC, correctly categorized on CEUS, and 18 patients had focal fatty sparing/pseudolesion on CEUS.*Conclusions For diagnosis of benign and malignant pathology, CEUS performs equivalent and sometimes superior to MRI in resolving of nodules from surveillance US. Pseudolesions are more easily explained with selection of the same modality and misregistration between modalities doesn't occur with CEUS.*Clinical Relevance/Application US with CEUS is a readily available, less expensive choice for first examination resolution of positive surveillance US scans, accurately diagnosing benign and malignant pathology, and accurately excluding pseudolesions from further evaluation.

RESULTS

The first 105 surveillance US include 37 confirmed HCC. 19/37 were concordant LR-5 on CEUS and MRI, 11/37 cases were concordant LR-4, and 3/37 were concordant LR-M. Additionally, two LR-4 on MRI were upgraded to LR-5 on CEUS, and 2 cases without an MR correlate for the surveillance US observation were LR-4 and LR-5 on CEUS (both biopsy-confirmed HCC). We document 7 concordant LR-M: including the three aforementioned HCC, two intrahepatic cholangiocarcinoma (ICC), one melanoma metastasis, and one benign inflammatory tumor. One patient with tumor-in-vein (LR-TIV) showed concordant CEUS and MRI. All malignancies (n=38) were categorized appropriately on CEUS, and had high agreement with MR exams (36/38 cases = 95%). Additionally, we document 13 benign hepatocellular lesions (LR-3 / LR-4) showing concordance between CEUS and MR exams, 22 cases with concordant benign LR-1. Lastly, 9/105 cases (8.5%) are concordant negative scans, and 20/105 (19%) in which CEUS identifies the surveillance US correlate and MRI does not. Of these 20 patients, two were biopsy-confirmed HCC, correctly categorized on CEUS, and 18 patients had focal fatty sparing/pseudolesion on CEUS.

CLINICAL RELEVANCE/APPLICATION

US with CEUS is a readily available, less expensive choice for first examination resolution of positive surveillance US scans, accurately diagnosing benign and malignant pathology, and accurately excluding pseudolesions from further evaluation.

GI02-B7   Mri Features Of Primary Liver Cancer With Biliary Invasion: The Biliary Involvement Pattern Is A Possible Differential Clue And Prognosis Prediction

Participants
Kenichiro Okumura, Kanazawa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To reveal MR Imaging features of hepatocellular carcinoma with imaged bile duct dilation (HCC w/ imgBD) compared to other liver malignancies with imaged bile duct dilatation and HCC without imaged bile duct dilatation (HCC w/o imgBD).*Methods and Materials This retrospective single-institutional study included consecutive 482 patients (337men, mean age 66 +/- 9.8 years) of hepatectomy due to primary liver tumor between January 1, 2008, and December 31, 2018, who received dynamic CT. Among the

tumors with imaged bile duct dilatation (n = 77), the cases that had apparent mass were extracted (n = 53), which included (HCC (n = 21), intrahepatic cholangiocarcinoma (IMCC) (n = 29), combined or mixed hepatocellular cholangiocarcinoma (cHCC-CC) (n = 3). We compared MR imaging findings including non-rim arterial phase hyperenhancement (APHE) and washout, any targetoid appearance (DWI, rim APHE, and central hyperenhancement), pattern of bile duct involvement (compressive or convergent), pathological and imaged bile duct tumor thrombi (BDTT) between HCC w/ imgBD and other malignancies w/ imgBD, or size-matched HCC subcohort w/o BD (n = 42) using chi2-test. The decision tree induction model was built using selected important variables for differential diagnosis of the tumors w/ imgBD. The Kaplan-Meier method was used to estimate overall survival (OS) between HCC patients with and without BDTT.*Results There was no significant difference between size-matched HCC w/ and w/o imgBD in all MRI findings. Among the tumors with imaged bile duct dilatation, a total of 9 cases showed imaged BDTT and 7 of them (78%) were HCC. The Wilcoxon test showed that the overall survival rates were significantly worse for HCC patients with imaged BDTT than for HCC patients without (P = 0.02). The pattern of bile duct involvement (compressive or convergent) was a significant finding for the differentiation of HCC from other malignancies (P < .0001). Decision-tree analysis was built using non-rim APHE with washout and pattern of biliary involvement, and it showed 87% accuracy for diagnosis of the intrahepatic mass with bile duct dilatation.*Conclusions Among MR imaging features of HCC w/ imgBD, a pattern of bile duct involvement (compressive or convergent) and the imaged BDTT, which involved overall survival, could be helpful in differential diagnosis from other primary liver malignancies with bile duct dilatation.*Clinical Relevance/Application Hepatocellular carcinoma sometimes presents with bile duct dilatation in imaging. In this study, we revealed two findings i.e., i) bile duct tumor thrombi in the dilated bile duct and ii) the pattern of bile duct involvement (compressive or convergent) are helpful for differentially diagnosing HCC from other tumors.

RESULTS

There was no significant difference between size-matched HCC w/ and w/o imgBD in all MRI findings. Among the tumors with imaged bile duct dilatation, a total of 9 cases showed imaged BDTT and 7 of them (78%) were HCC. The Wilcoxon test showed that the overall survival rates were significantly worse for HCC patients with imaged BDTT than for HCC patients without (P = 0.02). The pattern of bile duct involvement (compressive or convergent) was a significant finding for the differentiation of HCC from other malignancies (P < .0001). Decision-tree analysis was built using non-rim APHE with washout and pattern of biliary involvement, and it showed 87% accuracy for diagnosis of the intrahepatic mass with bile duct dilatation.

CLINICAL RELEVANCE/APPLICATION

Hepatocellular carcinoma sometimes presents with bile duct dilatation in imaging. In this study, we revealed two findings i.e., i) bile duct tumor thrombi in the dilated bile duct and ii) the pattern of bile duct involvement (compressive or convergent) are helpful for differentially diagnosing HCC from other tumors.

Abstract Archives of the RSNA, 2021

RI03-D

Reproductive Imaging Tuesday Poster Discussions

Abstract Archives of the RSNA, 2021

Sub-Events

MK05-A1 The Role Of A Virtual Noncalcium Dual-energy CT Application In Osteomyelitis

Participants
Mayuran Saththianathan, MBChB,MS, Westmead, Australia (*Presenter*) Nothing to Disclose

PURPOSE

To determine the sensitivity and specificity of dual-energy CT (DECT) virtual noncalcium images with bone and soft tissue reconstructions in the diagnosis of osteomyelitis.*Methods and Materials Between 1 December 2014 to 1 December 2020, 91 patients who had 99 DECT performed for a clinical indication of osteomyelitis with corresponding MRI, triphasic bone scan and/or white blood cell scintigraphy with CT/SPECT performed either 2 weeks before or 1 month after the DECT were retrospectively identified. Two radiologists interpreted DECT virtual noncalcium images alone for bone marrow edema and with bone and soft tissue reconstructions for osteomyelitis. Fleiss k statistics was used to assess inter-level agreement.*Results Osteomyelitis was present in 25 cases (25%), of which 4 cases (4%) had co-existing septic arthritis, and absent in 74 cases (75%). DECT was performed at the following sites: ankle/foot (n=59), calf (n=12), knee (n=3), thigh (n=7), hip (n=9), pelvis (n=6), wrist/hand (n=1) and shoulder (n=2). Sensitivity with virtual non-calcium images alone was 64% and 76% and specificity was 85.1 and 71.6%. Sensitivity with virtual non-calcium images and bone and soft tissue reconstructions was 72% and 84% and specificity was 81.1% and 73.0%. Interobserver agreement was 76.7% (76 of 99 cases), for virtual noncalcium images alone (k = 0.487), 84.8% (84 of 99 patients) for bone and soft tissue reconstructions with virtual noncalcium images together (k = 0.677).*Conclusions When DECT virtual noncalcium images were combined with standard bone and soft tissue reconstructions, there is improved sensitivity in the diagnosis of osteomyelitis.*Clinical Relevance/Application There is little knowledge on the utility of DECT virtual noncalcium application in the diagnosis of osteomyelitis. To the authors' knowledge, this will be the first study assessing the sensitivity and specificity of DECT in the diagnosis of osteomyelitis.

RESULTS

Osteomyelitis was present in 25 cases (25%), of which 4 cases (4%) had co-existing septic arthritis, and absent in 74 cases (75%). DECT was performed at the following sites: ankle/foot (n=59), calf (n=12), knee (n=3), thigh (n=7), hip (n=9), pelvis (n=6), wrist/hand (n=1) and shoulder (n=2). Sensitivity with virtual non-calcium images alone was 64% and 76% and specificity was 85.1 and 71.6%. Sensitivity with virtual non-calcium images and bone and soft tissue reconstructions was 72% and 84% and specificity was 81.1% and 73.0%. Interobserver agreement was 76.7% (76 of 99 cases), for virtual noncalcium images alone (k = 0.487), 84.8% (84 of 99 patients) for bone and soft tissue reconstructions with virtual noncalcium images together (k = 0.677).

CLINICAL RELEVANCE/APPLICATION

There is little knowledge on the utility of DECT virtual noncalcium application in the diagnosis of osteomyelitis. To the authors' knowledge, this will be the first study assessing the sensitivity and specificity of DECT in the diagnosis of osteomyelitis.

MK05-A3 Artificial Intelligence In Orthopaedic Implant Model Classification: A Systematic Review

Participants
Paul Yi, MD, Baltimore, Maryland (*Presenter*) Consultant, FH Orthopedics SAS;Consultant, BunkerHill Health

PURPOSE

Artificial intelligence (AI) algorithms have demonstrated the ability to accurately and rapidly identify orthopedic implant models on radiographs, which could facilitate preoperative planning and development of large-scale joint replacement registries. However, the scope and performance of AI algorithms in classifying orthopedic implant models has not been systematically evaluated.We performed a systematic review of research studies developing AI algorithms to identify orthopedic implant models on medical images to determine: (1) How well does AI perform in identifying the model of a given orthopedic implant, and (2) What is the performance of deep learning algorithms compared with clinicians?*Methods and Materials We performed a systematic literature search according to PRISMA guidelines in PubMed, EMBASE, and the Cochrane Library for studies published up to March 10, 2021 using search terms related to "artificial intelligence", "orthopaedic", "implant", and "arthroplasty." Inclusion criteria were an original scientific study describing performance of at least one AI algorithm for identification of a specific orthopedic implant on any imaging modality. We summarized performance of AI models for implant identification and comparisons to clinicians.*Results From 2,689 potential publications, 11 were included in the final review (Figure 1). The majority (10, 90.1%) of studies used deep learning models for identification of implants, with one exception using support vector machine. Most studies identified arthroplasty implants for hips, knees, and shoulders (9, 81.8%) with the remaining two identifying spine implants. The number of implant models evaluated/identified ranged from 2 to 27. All studies used radiographs of the extremities or spine with datasets ranging from 170 to 2894 images.Five studies reported overall AUC across all included models ranging from 0.94 - 1.0. Overall accuracy values reported across all studies ranged from 0.804 - 1.0. Only one study compared an AI with clinicians, reporting no statistically significant difference in its performance for identification of THA model compared to three orthopedic surgeons.*Conclusions AI algorithms have demonstrated strong performance in classifying orthopedic implant models from radiographs, particularly for arthroplasty of the hip and knee. Comparison to human experts has been seldom performed, however, highlighting the need for further research to evaluate potential benefit of AI algorithms to human observers.*Clinical Relevance/Application AI algorithms show high performance

to identify specific orthopedic implant models, which could facilitate preoperative planning and curation of large-scale joint replacement registries.

RESULTS

From 2,689 potential publications, 11 were included in the final review (Figure 1). The majority (10, 90.1%) of studies used deep learning models for identification of implants, with one exception using support vector machine. Most studies identified arthroplasty implants for hips, knees, and shoulders (9, 81.8%) with the remaining two identifying spine implants. The number of implant models evaluated/identified ranged from 2 to 27. All studies used radiographs of the extremities or spine with datasets ranging from 170 to 2894 images.Five studies reported overall AUC across all included models ranging from 0.94 - 1.0. Overall accuracy values reported across all studies ranged from 0.804 - 1.0. Only one study compared an AI with clinicians, reporting no statistically significant difference in its performance for identification of THA model compared to three orthopedic surgeons.

CLINICAL RELEVANCE/APPLICATION

AI algorithms show high performance to identify specific orthopedic implant models, which could facilitate preoperative planning and curation of large-scale joint replacement registries.

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Abstract Archives of the RSNA, 2021

PHEE

Physics Education Exhibits

Sub-Events

PHEE-1 The Physics Of Yttrium-90 Radiopharmaceuticals: History ; Review Of Current Industrial Production Methods

Participants
Daniel Braga, MD, Miami Beach, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Provide a brief history of Yttrium and its uses2. Outline Yttrium's geology and main sources worldwide3. Summarize the medical physics of Yttrium-90 (Y-90)4. Analyze the different modes of producing the Y-90 isotope5. Review company-specific manufacturing methods6. Examine the physics regarding the logistics of distribution

TABLE OF CONTENTS/OUTLINE

Yttrium is transitional rare earth metal, first discovered in mineral form in 1787 by the Swedish chemist Carl Arrhenius, with a breadth of industrial applications from lasers to thermal barrier coatings on jet engines. The vast majority of Yttrium is currently sourced from ion-adsorption ore deposits located in several southern Chinese provinces. Early research regarding the vascularity of hepatic neoplasms led to initial reports of a radioactive isotope of Yttrium, called Yttrium-90, being used as a radiopharmaceutical. Y-90 primarily undergoes ß- decay to stable Zirconium-90 with a half-life of 64 hours, and average energy of 0.9367MeV. The dominant manufacturing modes of Y-90 will be reviewed and include (1) Theraspheres produced by melting Y-89 together with filtered aluminum and silicate oxide into glass beads followed by neutron activation of Y-89 to Y-90 in a nuclear reactor, and (2) Sir-Spheres produced by coating Y-90 onto the surface of a microsphere via a cation exchange polystyrene resin. Both require appropriate handling and preparation at the hospital level to ensure consistent delivery of a planned specified dose that is then ultimately administered to the patient.

PHEE-10 Various Applications Of Deep Learning-based Reconstruction At CT: Denoise, Dual-energy CT, And Super-resolution

Participants
Toru Higaki, PhD, Minami-ku, Hiroshima, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Deep learning-based reconstruction (DLR) is becoming popular as a new CT image reconstruction method after hybrid iterative reconstruction (hybrid IR) and model-based IR (MBIR). Since DLR can significantly reduce image noise while preserving image texture, it is expected to reduce radiation exposure in CT scans. Also, DLRs trained with images reconstructed with advanced reconstruction methods can reduce artifacts such as blur. The DLR, which can reduce such noise/artifact, has recently been applied to dual-energy CT (DECT). In addition, super-resolution deep learning reconstruction (SR-DLR) is being developed as a new application of DLR. The SR-DLR increases the matrix of conventional CT images and enhances their spatial resolution. In this presentation, we will first explain the basics of DLR and then introduce various DLR applications and future prospects.

TABLE OF CONTENTS/OUTLINE

1. Basics of deep neural networks2. Denoising deep learning reconstruction: DN-DLR3. DLR for dual-energy CT3.1 Image-based approach3.2 Sinogram-based approach4. Super-resolution deep learning reconstruction: SR-DLR

PHEE-11 Easy Introduction Of The Photon Counting Detector CT (PCD-CT) For Radiologists

Participants
Shota Kondo, Hiroshima, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Unlike conventional (energy-integrated detector [EID]) CT, photon counting detector CT (PCD-CT) measures the photon energy as height of the pulse wave for each x-ray photon. Therefore, PCD-CT can collect X-ray data at multiple energies, and it can achieve CT images with lower noise and higher spatial resolution than conventional CT. On the other hand, there are some phenomena inducing inaccurate pulse counting and energy measurement such as charge sharing, K-escape, Compton scattering at PCD-CT and it is necessary to implement solutions of these issues like simultaneity (coincidence) check to realize a clinically practical PCD-CT scanner. In this educational exhibit, we will easily describe the principle, scan modes, technical issues, physical properties, and potential clinical applications of PCD-CT for radiologists.

TABLE OF CONTENTS/OUTLINE

1. Structure of detector of the PCD-CT 2. Data collection at the PCD-CT 3. Scan mode of the PCD-CT 1) Multiple energy discrimination mode (utilizing energy information) 2) Ultra high resolution mode (higher spatial resolution than conventional CT) 4. Technical issues to be solved to achieve clinically practical PCD-CT scanners 5. Comparison of physical characteristics between the

PCD-CT and conventional CT 1) Noise characteristics 2) Contrast characteristics 3) Spatial resolution 6. Potential clinical applications of PCD-CT 1) Improvement of low contrast detectability 2) High resolution images for lung 3) Accurate measurement of CT number 4) Accurate material decomposition

PHEE-13 "To Scan Or Not To Scan" MRI Safety Questions And Answers To The Various Implanted Electronic Devices.

Participants
Sangam G. Kanekar, MD, Hershey, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

To discuss the safety challenges of MR and scanning active implanted electronic devices.Discuss the important points to remember while screening the patient safety with the various common and less common AIMDs, before the patient is subjected to MRI examination. Discuss the ACR safety guidelines and approach to the various AIMDs

TABLE OF CONTENTS/OUTLINE

The MR environment is associated with multiple challenges to safe scanning in patients with active implanted medical devices (AIMDs). A variety of AIMDs is implanted for the treatment of multiple conditions. These patients are likely to require advanced imaging, including MR imaging to follow up on their disease conditions. These devices under exposure to the MR environment may cause heating of leads and burns to the surrounding vital tissues, device malfunction (eg, infusion pump failure to restart; damaged circuitry in a cardiac pacemaker). In this exhibit, we discuss the approach to investigate the safety of the various Implanted electronic devices include cardiac devices (pacemakers and defibrillators) and neurostimulators (deep brain, auditory brainstem implant, spinal cord, vagal nerve, sacral nerve, hypoglossal nerve, phrenic nerve, peripheral nerve, and auditory nerve/cochlear implants), as well as implantable medication pumps.

PHEE-14 Main Magnetic Field Homogeneity Measurement For MRI Quality Control

Participants
Teresa M. Peterson, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

Understand the importance of main magnetic field homogeneity measurement on diagnostic and interventional MRI quality control.Learn the basic principles of measuring main magnetic field homogeneity and the potential practical challenges of measuring it.Learn the workflow, imaging protocols and technical measures used at our practice to ensure consistent measurement of the main magnetic field homogeneity across multiple MRI vendors.

TABLE OF CONTENTS/OUTLINE

1. Impact of main magnetic field homogeneity measurement on MR image qualitySources of main magnetic field inhomogeneityEffects of main magnetic field inhomogeneity on image quality2. Main magnetic field homogeneity measurement approaches and the practical challengesMagnetic field homogeneity specifications and ACR requirementsField homogeneity measurement by service engineersACR recommended measurement methods Practical challenges3. Automated tool for magnetic field homogeneity measurement used in our institutionImaging protocols based on basic sequences widely available on scannersPhantom and shimming option considerations during imaging for homogeneity measurementsAutomatic conversion of images into proper format and unit for B0 mappingAutomatic phase unwrappingAutomatic detection of phantom center and reporting homogeneity measurements

PHEE-15 Simple Approach To MR Parameters Adjustments For Radiologists

Participants
Matthew Holbrook, MD, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

The aim of this workshop is to introduce a simplified, radiologist-relevant approach to learning the effects of different MR parameters on the signal to noise ratio, to briefly review the relevant background MR physics, and to provide case examples of tuning MR sequences to obtain better quality images. The audience member should leave the workshop feeling confident that they can quickly recognize the effects of different MR parameters and adjust the sequences in a decisive manner.

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Increasing the signal to noise ratio (SNR) is better for image interpretation. The SNR is affected by the following parameters: 1. Magnetic field strength 2. Number of acquisitions 3. TR, TE, and flip angle 4. Slice thickness and receiver bandwidth 5. Field of view 6. Size of matrix 7. RF coil selection. These parameters can be hard to remember in terms of their effect on SNR and we will present a novel way to tackle the memorization of this learning. Finally, we will present common examples to demonstrate the effects and trade-offs of adjusting these parameters, which will solidify the newly learned material.

PHEE-16 Decoding The Labyrinth Of ASL: A Primer For Radiology Residents

Awards
Certificate of Merit

Participants
Sabha Ahmed, MBBS, Jodhpur, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

To address the complexity of ASL physics with illustrations.To prime the residents with the basics of functional imaging applications of ASL.To elaborate on the applications with emphasis on oncology and neurodegeneration.To illustrate with examples the applications in neuroradiology.

TABLE OF CONTENTS/OUTLINE

Introduction Illustration of the basic technique of ASL Illustrate the various labeling techniques of ASL Limitations and pit falls of

introduction.Illustration of the basic technique of ASL.Illustrate the various labeling techniques of ASL.Limitations and pit falls of each labeling technique .Discussion the applications of ASL in neuroimaging.Case illustrations.

PHEE-17   Impact Of Deep Learning-based Adaptive Noise Reduction For MR Imaging.

Awards
Identified for RadioGraphics

Participants
Shigeru Kiryu, MD, Tokyo, Japan (*Presenter*) Research collaboration, Canon Medical Systems Corporation

TEACHING POINTS

Denoising approach that incorporates deep learning-based reconstruction (dDLR) has improved MR image quality compared with previous reported filtering methods and is the earliest application using deep learning technique brought in clinical practice. In this educational exhibit, we show the concept of dDLR and our experience in this field. While dDLR enables efficient noise reduction, noise issue in MR images has become more prominent. We will present our approaches to deal with this issue.To know the basic concept of dDLR for denoising of MR images. To know current dDLR applications in clinical MRI. To know the noise issue of MR images in the application of dDLR and its solutions.

TABLE OF CONTENTS/OUTLINE

Basic concepts of dDLR for denoising of MR images Our experience in applying dDLR in clinical MRI -Brain MR imaging -MR angiography -MRCP -Musculoskeletal imaging Noise issues and solutions.

PHEE-18   Clinical Implementation Of A First-generation Dual Source Photon Counting Detector CT: First Experience And Perspective For Clinical Use

Participants
Marcel L. Dijkshoorn, Rotterdam, Netherlands (*Presenter*) Consultant, Siemens AG;Research collaboration, Siemens AG;

TEACHING POINTS

To understand the technical differences between a conventional energy integrating detector (EID) CT versus a novel photon counting detector (PCD) CT.To explain the benefits of dual source PCD CT for radiation dose, contrast media usage, image quality and spectral information optimization.To provide an overview and explanation of clinical exam types where photon counting technology changes the scan protocol, image interpretation and reporting approach.To demonstrate how PCD technology affects clinical workflow, education & training and IT infrastructure requirements.

TABLE OF CONTENTS/OUTLINE

Technical backgroundDetector characteristics and data acquisition comparison between PCD CT and EID CT.General spatial resolution improvementSpectral data acquisition and processingDual source specific characteristicsClinical potentialRadiation dose reductionIncreased iodine enhancementImproved spatial resolutionBroader spectral data availabilitySpecific impact on dual source applicationsPitfalls and potential barriersData size handlingServer-thin client software vs PACS readingTraining of your staffClinical examplesNeuroChestAbdomenCardiovascularCT-AngiographyMusculoskeletal

PHEE-19   Direct MR-guidance Of Brachytherapy In Gynecologic Cancers: Workflow Considerations, Technical Development, And Clinical Benefits

Participants
Megan Jacobsen, PhD, Houston, Texas (*Presenter*) Research Grant, Siemens AG

TEACHING POINTS

1. Explain the benefits of direct magnetic resonance (MR) guidance for gynecologic brachytherapy 2. Discuss steps required for imaging physics evaluation of the program, including development of MR safety procedures and pulse sequence optimization. 3. Describe procedural workflow for direct MR guidance of brachytherapy applicator and interstitial needle placement.

TABLE OF CONTENTS/OUTLINE

1. Benefits of MR-guided gynecologic brachytherapy over CT. a. Tumor differentiation from background. b. Segmentation of organs at risk (OAR). c. Clinical benefits and role for direct MR guidance. 2. Introduction to direct MR guidance of gynecologic brachytherapy. a. In-suite applicator placement. b. Specialized equipment. c. Workflow in the MR suite. 3. Imaging physics requirements. a. MR safety evaluation of all equipment. b. MR safety training and verification of personnel. c. Hardware evaluation with transfer table. i. Magnetic field homogeneity. ii. Geometric accuracy. d. Protocol optimization. i. Pulse sequences. ii. Phantom image quality. iii. Volunteer scanning. 4. Case studies demonstrating benefits of direct MR-guidance. a. Reduction in returns to operating room for repositioning. b. Dosimetric benefits. 5. Conclusions.

PHEE-2   Characteristics Of Deep Learning Reconstruction: Application In Clinical Practice

Participants
Akio Tamura, MD, Shiwa, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

In recent years, deep learning has received a lot of attention, and multiple applications have been developed in various fields. One of the most advanced applications of deep learning is in the improvement of image quality by denoising. A new deep learning reconstruction (DLR) algorithm has recently been introduced in CT image reconstruction. This educational exhibit will present the differences between DLR and traditional reconstruction methods, their physical properties and visual evaluation, and how DLR should be used in clinical practice based on these properties.

TABLE OF CONTENTS/OUTLINE

1. The effects of object size and radiation dose on resolution characteristics are compared among DLR, model-based iterative reconstruction (MBIR), hybrid iterative reconstruction (HIR), and filtered back-projection (FBP) methods.2. Application of DLR for CT imaging with both image quality and radiation dose reduction in children.3. Innovations in CT imaging with DLR in adults. Aiming for

dose reduction, especially in patients with a high body mass index.4. Application of DLR to dual energy CT, low tube voltage imaging and ultra-high-resolution CT.

PHEE-20   How CT Happened: Getting To The First CT Image 50 Years Ago

Participants
Raymond A. Schulz, MS, Palo Alto, California (*Presenter*) Employee, Varian Medical Systems, Inc

TEACHING POINTS

Hounsfield & EMI's invention of CT benefitted from no preconceptions. Hounsfield's intuitive inventive genius overcame the lack of a college degree.

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50 years ago, October 1, 1971, Hounsfield's non-invasive procedure, of a live patient's brain, was performed. Two-days later, a remarkable image appeared on the screen of a monitor - after having been processed offline on a remote mainframe computer and archived on Polaroid film. This presentation by EMI alum professionals explores new material regarding what led to CT. Interviews of former EMI employees who worked with or met Hounsfield provided a wealth of data. Unpublished archives from EMI, etc. have added new insights on the birth of CT. Keys to the success of Hounsfield & EMI included:- no preconceptions of imaging; expertise in radar electronics and managing the development of early mainframe computers. Finally, the advent of the first minicomputers allowed for onsite, in hospital computation & installation. Hounsfield showed his intuitive genius in his 16-page proposal "An Improved Form of X-Radiography". It demonstrated a clear mental model of CT including volumetric sectioning, beam filtering, image reconstruction, windowing and display. All are still in use today. He even demonstrated the basics of cone-beam CT with a drawing. Hounsfield struggled to get the project approved but benefitted from not having preconceived notions of better medical image quality requirements. Low-contrast detail was key. All of which led to a Nobel Prize a mere 8 years later

PHEE-3   Dual-source Whole-body Photon Counting CT: Physics And Images From A New Investigational System

Awards
Certificate of Merit

Participants
Elisabeth Shanblatt, PhD, Rochester, Minnesota (*Presenter*) Employee, Siemens AG

TEACHING POINTS

1 Explain the fundamentals of photon counting detectors (PCDs) and how they differ from energy integrating detectors (EIDs)2 Describe a new investigational dual-source whole-body PCD-CT scanner (NAEOTOM Alpha, Siemens Healthineers)3 Explain how these new detectors lead to improved spatial and spectral image characteristics4 Illustrate image quality in phantom and patient examples

TABLE OF CONTENTS/OUTLINE

1 What is the difference between EIDs and PCDs? EIDs require scintillation to convert x-rays to visible light readable by photodiodes. This requires reflective inter-pixel septa to decrease optical crosstalk. PCDs directly convert x-rays into electronic signal, eliminating the need for inter-pixel septa.2 Technical specifications of the novel prototype whole-body PCD-CT scanner. Description of the x-ray tubes and PCD arrays. Acquisition parameters and imaging modes are discussed.3 Spatial resolution and noise: 0.4 mm slice width in routine mode, 0.2 mm in high resolution (HR) mode. Energy thresholding allows elimination of electronic noise, resulting in improved image quality and/or reduced radiation dose4 Spectral imaging: Energy thresholding allows capabilities such as virtual monoenergetic, virtual non-contrast, and iodine map images. Uniform photon weighting improves iodine contrast. Accurate iodine quantification is shown.5 Clinical image examples demonstrating excellent image quality in an HR CTA runoff exam and a virtual monoenergetic image from a spectral coronary CTA exam with 66 ms temporal resolution.

PHEE-4   Simulation In Medical Education: Parallax In Interventional Radiology

Participants
Rachel Brader, MD, Chapel Hill, North Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Parallax is the apparent difference in the position of an object when viewed from different angles. • Parallax contributes to image artifacts, but understanding of parallax can be utilized to localize internal structures, especially in interventional radiology.• In interventional radiology standard convention to describe positioning refers to the location of the image intensifier (II) or flat panel detector (FPD) relative to the patient, ie. In Left Anterior Oblique (LAO) position the II/FPD is anterior and to the left of the patient (typically lying supine on the table). • An object further from the image detector will have apparent motion in the same direction as the image detector. For example, when evaluating the thoracic aorta and moving from Anterior to LAO position, the descending aorta will appear to move to the left (right side of the screen) relative to the ascending aorta. This is because the descending aorta is posterior to and further from the image detector than the ascending aorta in a supine patient. • Utilization of parallax can help an interventional radiologist efficiently and accurately locate structures, thereby improving the safety of the procedure.

TABLE OF CONTENTS/OUTLINE

1. Pre-content knowledge check 2. Introduction regarding parallax concepts using illustrations and phantom model 3. A series of images from IR cases demonstrating concept 4. A video of concept simulation in the IR suite 5. Post-content knowledge check 6. Summary of key teaching points

PHEE-5   What You Should Know About Plane Wave Ultrasound Imaging

Awards
Certificate of Merit

Participants
Zaiyang Long, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

1. What is plane wave ultrasound imaging; 2. Why would we like to have plane wave imaging; 3. Clinical applications of plane wave imaging;

1. Background a. Conventional ultrasound imaging is typically performed by insonification of tissue line by line using narrow, focused ultrasound beams, and echo processing with a hardware beamformer. b. It suffers from limited frame rate, which depends on the field of view (FOV), line density and the number of focus, and is insufficient for many clinical tasks, such as freezing cardiac motion, 3D/4D imaging, and monitoring shear wave propagation. 2. Plane wave (PW) ultrasound imaging a. PW ultrasound imaging transmits a wide, unfocused PW and is capable of computing a wide FOV image per excitation via software beamforming. Its frame rate could reach the order of 10 kHz, but image quality is compromised. b. Coherent spatial compounding with multiple tilted PW frames was developed to improve image quality, which can be superior or comparable to conventional imaging yet with faster frame rate. 3. Clinical applications of PW imaging a. Improved B-mode imaging b. Microflow color Doppler, power Doppler, and retrospective spectral Doppler c. Shear wave elastography d. Ultrafast contrast imaging and super-resolution localization microscopy e. Functional ultrasound imaging 4. Safety consideration (Thermal Index and Mechanical Index) 5. Conclusion a. Due to major technological breakthroughs, PW imaging brings revolutionary changes and benefits to clinical ultrasound imaging.

PHEE-6 What You Should Know In Ultra High Resolution CT?

Participants
Fuyuki Washizuka, Tokyo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

To learn about mechanism of the latest ultra-high resolution CT: UHRCT for acquiring ultra-fine structure.To learn about the use of UHRCT in applications other than ultra-fine structures.To learn the effects of partial volume suppression in UHRCT. To learn the limitation of UHRCT and the way to overwhelm them.

TABLE OF CONTENTS/OUTLINE

A. The impact of UHRCT on the depiction of ultra-fine structure.B. The usefulness of UHRCT considering exposure in pediatric CT with small structures.C. Advantage of UHRCT in peripheral abdominal vessels.D. The superiority of UHRCT in low contrast region represented by the liver. E. Consider the effect of UHRCT on the partial volume effect.

PHEE-7 Seeing More With Less: Clinical Benefit Of Photon-counting Detector CT (PCD-CT)

Awards
Cum Laude
Identified for RadioGraphics

Participants
Avinash Nehra, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

? To understand fundamental differences in acquisition and reconstruction between PCD-CT and conventional energy-integrating detector CT. ? To illustrate benefits of improved spatial resolution, multi-energy imaging, and decreased electronic noise across multiple clinical applications using an investigational PCD-CT system.

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PCD-CT systems quantify the number and energy of incoming photons, directly converting this information into electrical signal. Absence of inter-pixel septa increases geometric dose efficiency and improves spatial resolution. Uniform weighting of photons results in higher iodine contrast and optimized spectral imaging, including reduced artifacts and lack of electronic noise. • Spatial resolution to 150 µm improves visualization of small objects, e.g., imaging findings of bronchiectasis and interstitial lung disease, small vessels at CTA, small aneurysms in the brain, and improved visualization of small bony structures. • Spectral acquisition enables multi-energy applications, such as virtual monoenergetic imaging, virtual non-calcium, metal artifact reduction, and material quantification. • The use of a tin (Sn) filter facilitates radiation dose reduction while maintaining spatial resolution and reduces metal artifacts. • The absence of electronic noise results in improved image quality perception across dose-reduced exams and large patients.

PHEE-8 Understanding Doppler Ultrasound: Technique, Artifacts And Interpretation

Participants
Cristina Gomez Varela, MD, Pontevedra, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the basic principles of Doppler Ultrasound. Incorrect adjustment of the doppler parameters can lead to misleading imaging interpretation. To recognize the most frequent pitfalls and artifacts and highlight the nomenclature and interpretation of Doppler waveforms.

TABLE OF CONTENTS/OUTLINE

Background: Doppler physics. Doppler settings: doppler angle, sample volume, wall filters, gain, velocity scale. Doppler artifacts: aliasing, blooming, directional ambiguity, partial volume artifact, pseudoflow, flash artifact, mirror image artifact, edge artifact, twinkling artifact. Doppler waveforms interpretation.

PHEE-9 When Numbers Lie: Pearls And Pitfalls To Avoid In Hounsfield Unit Interpretation

Participants
Aaron Brumbaugh, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Hounsfield units are calculated values of an attenuated photon beam, dependent on the linear attenuation coefficient. 2) The linear attenuation coefficient is proportional to the atomic number of the attenuating material, and inversely proportional to the photon energy. 3) Accurate Hounsfield unit measurement is important in varied, multisystem clinical contexts. 4) Describe the phenomenon of pseudoenhancement as a possible cause of spurious Hounsfield unit measurements, as well as potential causes of pseudoenhancement. 5) Hounsfield units serve as a semi-quantitative metric, with inter-scanner variability demonstrated across multiple generations of CT scanners. This variability cautions against quantitative applications of Hounsfield units as absolute values.

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Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Sub-Events

INEE-1   Volume Sweep Imaging: A New Horizon In Teleradiology

Participants
Thomas Marini, MD, Rochester, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Although essential to provide high-quality care, the majority of the world population lacks access to diagnostic medical imaging. 2) Teleultrasound is a low-cost means to deliver vital diagnostic medical imaging, but its deployment is limited by availability experienced sonographers. 3) Volume sweep imaging (VSI) teleultrasound circumvents this issue by the use of standardized scan protocols based off easily recognized external body landmarks that can be performed by individuals without prior ultrasound experience. 4) Images obtained from VSI allow asynchronous teleultrasound acquisitions which can be sent over low internet bandwidths for many clinical applications including lung, obstetric, breast, thyroid, and abdominal right upper quadrant (RUQ) scanning indications.

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1) Explanation of VSI teleultrasound in the context of modern telemedicine systems. This includes a discussion of asynchronous versus synchronous teleultrasound and engineering specifications of VSI teleultrasound. 2) Discussion of VSI teleultrasound training techniques and practical issues surrounding deployment. How to perform VSI examinations of the lung, pregnant abdomen, breast, thyroid, and RUQ will be shown with original posters. 3) Discussion of VSI lung, obstetric, breast, thyroid, and RUQ VSI protocols and their applications in low-resource settings. 4) Public health perspective on the use of VSI teleultrasound. 5) Medical-legal considerations of the use of teleultrasound.

INEE-10   Real World Evidence: What Do Radiologist Need To Know?

Participants
Daniel Poon, MBBS,FRCR, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Real-world evidence (RWE) methodologies are a powerful tool for assessing the effectiveness, safety, and economic benefits of pharmaceuticals in clinical practice. Indeed, RWE is increasingly being used by the FDA (Food and Drug Administration) and EMA (European Medicines Agency) for regulatory decisions, including in the arena of medical devices and novel digital health tools.The use of RWE is likely to grow within radiology; for example, it is anticipated that the RWE approach to evidence generation will be an invaluable method to ascertain the real-world utility of AI within radiology. Furthermore, contemporary radiology provides ample potential sources of real-world data (RWD), with PACS being a primary example.We present a primer of the basic principles of RWE for the practising radiologist, to enable an understanding into the potential use cases of RWE in radiology. We also hope that a basic understanding of RWE will encourage our profession to be stalwarts of appropriate use of radiological data in all its forms.

TABLE OF CONTENTS/OUTLINE

What is RWE?Current uses of RWEWhat are the sources of real world data in radiology?What are the potential uses of RWE in radiology?What do I need to know as a radiologist?

INEE-11   Overcoming Data Shift: The Challenge To Translating AI To Clinical Practice

Awards
Identified for RadioGraphics

Participants
Youngwon Choi, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) We will describe data shift and its negative impact on generalizability and clinical translation of ML models. 2) We will introduce mitigation strategies to detect and account for data shift, in particular explainability and domain knowledge.

TABLE OF CONTENTS/OUTLINE

1) Data shift description and example of its negative impact on clinical translation; 2) Mitigation strategies overview with example; 3) Importance of explainability in various AI models; 3-1) CNN for idiopathic pulmonary fibrosis (IPF) diagnosis within an interstitial lung disease (ILD) population; 3-2) CNN for prostate organ/tumor segmentation; 4) Converting domain knowledge to CNN feedable form; 4-1) ML-feature-based population maps from quantitative CT biomarkers among patients with ILD; 4-2) Radiology-based population maps of tumor occurrence in the prostate; 4-3) Pathology- and radiology-based population maps for non-visualized prostate cancer lesions; 5) Improved CNN training with domain knowledge; 5-1) Attention-gated CNNs guided with population maps;

5-2) Robust CNN for IPF diagnosis within an ILD population; 5-3) Robust CNN for prostate tumor segmentation; 6) Post-training interpretation; 6-1) Robustness of CNN for IPF diagnosis example with different image protocols; 6-2) Robustness of CNN for prostate tumor segmentation with different staging scores

INEE-12 Outsmarting AI: What Role Can The Radiologist Play In The Making And Deployment Of Artificial Intelligence Applications

Awards
Certificate of Merit

Participants
Tianyuan Fu, MD, Cleveland, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Provide radiologists an overview of the process of developing an AI based tool and deploying it in a clinical setting. This includes identifying a problem which the AI tool is designed to solve, obtaining a representative and unbiased dataset, preprocessing and labeling of data, designing and training the algorithm, and validating the AI tool in a specific clinical setting. 2) Identify points in this process in which radiologists, in particular those without a technical background, can get involved. 3) Discuss resources for radiologists to learn about the development of AI tools.

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1) Overview of the steps to develop and deploy an AI based image analysis tool in the clinical setting. For each of the following steps, emphasize the role the radiologist could play. 2) Step 1: Defining the problem that we are trying to solve. 3) Step 2: Obtaining a sufficiently large, representative, and unbiased dataset. 4) Step 3: Data labeling and defining an appropriate ground truth. 5) Step 4: Design and train a deep learning algorithm. 6) Step 5: Validation and deployment of the AI tool in a clinical setting. 7) Summary of the role of radiologists in the aforementioned process. 8) Resources on the process of AI development for the curious radiologist.

INEE-13 Structured Reporting And Natural Language Processing: A Successful Marriage

Participants
Salvatore Fanni, MD, Pisa, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

Structured reporting has showed to be an added value in radiologists work, standardising language and relevant findings specifically for different clinical scenarios. Structured reporting provides completeness, comparability and lead to analysis of a large amount of data so far underutilized. However, most radiologists still prefer free-form text reports, due to the lack of time and integration of structured reports in Radiology Information System.Natural language Processing (NLP) is an area of research that explores how to understand and analyse free-form text or speech to complete specific tasks. Artificial Intelligence has been implemented to process NLP features extracted from the text, outperforming traditional NLP methods. Convolutional or Recurrent Neural Network (CNN - RNN) are the most used models to process NLP features.Natural Language Processing and Artificial Intelligence showed us that "Reports are more than words, they are data". NLP could be a brilliant solution to achieve structured reporting in clinical daily practice, producing automatically structured reports from free-form text reports.

TABLE OF CONTENTS/OUTLINE

1. Structured reporting in radiology, relevance in clinical practice and current application 2. Basic concepts of Natural language Processing: features extraction and processing 3. Applications of NLP in Radiology, up to date overview 4. NLP and structured reporting: a successful marriage 5. Future perspectives

INEE-14 Establishing A Hospital-based Quality Control System For 3D Printed Anatomic Models

Participants
Nicole Wake, PhD, Bronx, New York (*Presenter*) Employee, General Electric Company

TEACHING POINTS

1. The workflow to create 3D printed anatomic models is complex and errors can occur at any step during the process.2. The accuracy of 3D anatomic mesh geometries may be ensured by overlaying contours of the regions of interest onto the volumetric medical images.3. Coupons/phantoms with specific geometries may be created and printed to ensure the printing process is accurate.4. Quality Assurance of 3D printed anatomic models can be performed by incorporating visual inspection, caliper measurements, surface scanning, or CT scanning after printing.5. Sterilization of anatomic models is necessary for models that come in contact with patients during operating procedures; and sterilization may affect the material properties of a final 3D printed model.

TABLE OF CONTENTS/OUTLINE

1. Summary of the typical workflow utilized to create 3D printed patient-specific anatomic models.2. Overview of verification and validation steps required to ensure the required accuracy of 3D printed medical models is achieved.3. Revision of methods used to assess geometrical and dimensional accuracy of 3D printed anatomic models.4. Synopsis of biocompatible materials and sterilization techniques commonly used in hospitals.5. Assessment of possible effects of the sterilization on the accuracy and mechanical properties of the 3D printed medical models.

INEE-15 Onboarding To The RSNA-ACR 3D Printing Registry

Participants
Nicole Wake, PhD, Bronx, New York (*Presenter*) Employee, General Electric Company

TEACHING POINTS

1. The joint RSNA-ACR 3D Printing Registry addresses the need for coordinated tracking of medical 3D printing.2. The registry collects anonymized case information on 3D printing efforts for clinical applications.3. Data entry for the registry includes information about case types, image acquisition, image segmentation, and printing.4. The registry will facilitate institutional quality

improvement efforts.5. Information collected from this registry will be used to show that there is widespread use of 3D printing in medicine and to support an application for Category I CPT Codes for 3D printed anatomic models and guides.

TABLE OF CONTENTS/OUTLINE

1. Overview of medical 3D Printing.2. Introduction to the RSNA-ACR 3D Printing Registry.3. Explanation of application process.4. Description of data dictionary and case submission.5. Benefits of registry participation.

INEE-16   Establishing A 3D Imaging Laboratory Within A Publicly-funded Academic Clinical Center In A Low-resource Country

Awards
Certificate of Merit

Participants
Silvina Zabala Travers, MD, Montevideo, Uruguay (*Presenter*) Nothing to Disclose

TEACHING POINTS

It is commonly believed that implementation of 3D technologies such as 3D biomodel navigation, virtual surgical planning and simulation with 3D printing models in the surgical planning workflow is expensive in terms of software, hardware and human resources. The purpose of this exhibit is to demonstrate step by step how we established a 3D laboratory in a publicly-funded academic clinical center in a low-resource country. Our aim is to encourage and provide tools to radiologist in a similar situation to establish their own laboratory. We review available education and leverage tools for radiologists, free software tools and possible workarounds for financial limitations. We present example 3D cases.

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1)Our research survey results about considered causes for lack of 3D widespread use in Iberoamerica. 2)Review our experience setting up a 3D lab in a radiology department from a low-resource Latin-American publicly-funded academic clinical center. 3)Review available education and leverage tools for radiologists. 4)Review free open source software options for segmentation and 3D navigation. 5)Discuss possible workarounds to overcome financial limitations for hardware acquisition or hiring human resources. 6)Tips for your first steps. 7)3D biomodeling example cases from our 3D lab

INEE-18   RadLex For Semantics And Interoperability In Imaging Workflows

Awards
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Participants
Leonid Chepelev, MD,PhD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

a. Radiologists benefit from the interoperability enabled by standard terminology.b. RadLex comprises standard imaging terminology and conceptual relationships between these terms, including anatomy, pathology, imaging techniques, contrast agents, imaging findings, interventions, imaging assessment categories, and many others.c. RadLex supports numerous applications, including text search, natural language processing, procedure coding, structured reporting, patient follow-up, big data integration, software interoperability, and teaching.d. RadLex provides standard terminology in image and text annotation for machine learning.e. Formalizing knowledge in an ontology facilitates the practice of Radiology

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1. The role of RadLex as a key RSNA initiative.2. What is Radlex and what is an ontology?3. Benefits of representing practical clinical knowledge as an ontology a. Clinical Decision Support b. BI-RADS c. Diagnoses with actionable consequences4. How do ontologies allow us to discover deeper meaning in medical data?5. Practical Applications of RadLex a. Structured Reporting b. Report Search c. Education d. ACR Dose Index Registry e. RSNA-ACR Common Data Elements f. Cancer Care Ontario g. LOINC6. Tools in Ontology Development7. RadLex in the future of Radiology a. Personalized Medicine b. Big Data Integration c. Artificial Intelligence Integration

INEE-19   Basic Python For Advanced Radiologists

Participants
Eduardo Chiovatto, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

At the end of this presentation, you will be able to:-Learning about basics of Python and start to practice, with simple lessons and review with concepts of Python-To discuss how Python could help to create an algorithm to use for artificial intelligence models.-To develop, step by step, a Dicom viewer by Python.

TABLE OF CONTENTS/OUTLINE

-Introduction.-ObjectiveLearn basics about python.-How to start python.-Relationship with Artificial intelligence.- Development of a Dicom viewer with python.- Learn about the main difficulties and solutions.

INEE-2   Applications Of Artificial Intelligence In Cardiac MRI

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

The role of Artificial Intelligence (AI) in cardiac imaging continues to expand. It is now used in almost all aspects of cardiac MRI.1. To provide an overview of the basic principles and algorithms of AI.2. To discuss the role of AI in cardiac MRI3. To review and

illustrate the applications of AI in cardiac MRI

TABLE OF CONTENTS/OUTLINE

IntroductionDefinitions- AI, Machine learning, deep learningNetworks used in AI- Convolutional neuronal network (CNN), general adversarial network (GAN)Clinical applications of AI in cardiac MRI- Illustration with case examples.A. Image acquisition- MRI plane prescriptionB. Image reconstruction- Decreased artifacts- Decreased noise- Improved resolution- Super resolution- Decreased acquisition timeC. Segmentation of structures- Ventricular volumes, MRAD. Automated quantification- Volumes, function, scar, parametric mapping, flow, strain, aortic diameterE. Post-processing- 4D flowF. Classification (Diagnosis) of disease- Cardiomyopathy, Myocardial infarction, coronary artery disease, atherosclerosis, valvular disease, heart failureG. Prognostic factors- Risk stratificationH. RadiomicsI. Automated reportingChallenges & pitfallsFuture directionsConclusion

INEE-20   **Radiomic For Dummies : Image Texture Analysis And Much More**

Awards
Certificate of Merit

Participants
Charly Girot, DIPLENG,MS, Villejuif, France (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiomic is an image analysis process to develop quantitative imaging biomarkers. It relies, among others, on texture analysis. In the multi-step process of radiomic, 5 families of features can be identified: shape, intensity histograms, texture, filters, and fractals. Among these families, texture aims to analyze image heterogeneity patterns by analyzing pixels gray level spatial distribution in an image. Texture features are extracted from 4 matrix describing respectively recurrence of pairs of pixels (GLCM), pixel sequences (GLRLM), zones of same pixel intensity (GLZLM) and differences between a pixel and its neighbors (NGLDM). One of the main radiomic features extraction software, that we use as an example, is LIFEx (www.lifexsoft.org). Generally, recommendations for the validation of radiomic-based imaging biomarkers are now well described in the literature. It must rely on a technical validation in multi-centric studies (robustness), a clinical and biological validation (comparison to gold-standard) and a final validation in a prospective clinical study. With the fast-evolving field of deep-learning, radiomic can now make use of model-defined features instead of user pre-defined features.

TABLE OF CONTENTS/OUTLINE

After a review of what is radiomic, each family of available features will be described. LIFEx will be used as an example to illustrate the process of features extraction in a radiomic pipeline. Finally, recommendations on how to develop an imaging biomarker and associated guidelines will be reviewed.

INEE-21   **3D Printing And Augmented Reality (mixed Reality): A Combination Of Two Promises Technologies For Image-guided Neurosurgery.**

Participants
Vitor M. Sardenberg, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) 3D printing in neurosurgery has the potential to be applied to accurate replicate anatomic detail of native cranial vessels and vascular lesions, such as aneurysms, arteriovenous malformations and dissection. 2) The integration of images information into the real surgical environment, through augmented reality, can be very useful for surgeons, providing simple and easy solutions for neurosurgical procedures and supporting the transfer of preoperative plans to the surgical field. 3) Brain tumors visualization by AR can be well succeeded independently of tumor sizes and localizations. 4) Mixed reality in neurosurgical procedures can help to determine the relation between mass lesions and important brain vessels, such as the internal carotid arteries, cerebral arteries and superior sagital sinus.

TABLE OF CONTENTS/OUTLINE

- Review 3D printing techniques. - Review the most common congenital and acquired vascular anomalies of the brain, in which 3D Printing and AR could have a potential to influence the surgical planning. - Review the 3D printing applications in neurosurgery, especially in vascular lesions and in the study of the relation between brain tumors and vascular structures. - Review the potential role of AR in neurosurgical planning, and discuss the use of Apps such as M3DMIX. - Review the main advantages of mixed reality in neurosurgery.

INEE-22   **Applications Of Domain-Inspired Radiomics And Deep Learning In Neuroradiology**

Participants
Tejasvi Kainth, MD, Stony Brook, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Develop an understanding of domain-inspired radiomics pipelines and its key components.- Appreciate the role of deep learning models in providing early diagnostic and prognostic information to tailor patient-specific treatment plans.- Discuss the role of Radiomics and Deep Learning algorithms in providing predictive information about treatment outcomes in glioblastoma multiforme and medulloblastoma.- Outline current limitations and explore future directions of using Radiomics in oncology.

TABLE OF CONTENTS/OUTLINE

- Introduction to Radiomics Workflow- Introduction to Deep Learning algorithms- Role of Radiomics and Deep Learning in cancer diagnosis and staging- Role of Radiomics and Deep Learning in predicting treatment response- Limitations of Radiomics and Deep Learning- Future directions- Conclusion

INEE-23   **3d Printing In Gynecological Microanatomy And Pathology Using Microtomography**

Participants
Pedro Castro, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

1) MicroCT: non-destructive imaging tool for the production of high-resolution 3D images composed of 2D axial projections of a target specimen2) Micro-CT has grown as a technique with potential for clinical purposes in many areas of human health 3) It can provide highly accurate 3D rendering of human gynecological organs and its complex 3D anatomy

TABLE OF CONTENTS/OUTLINE

1)Review the use of microtomography in human specimens 2) Review the use of microtomography in clinical practice and medical education 4) Demonstrate the images generated by the technique in gynecological specimens 5) Demonstrate the potential of 3D printing of microscopic specimens in medical education

INEE-24 Clinical Implementation Of Deep Learning Models In A Large Multicenter Mammography Practice: A Practical Guide To Establish Robust Infrastructure For Continuous Learning

Participants
Constance Lehman, MD,PhD, Boston, Massachusetts (*Presenter*) Institutional Grant, General Electric Company;Institutional Grant, Hologic, Inc;Co-founder, Clairity, Inc.

TEACHING POINTS

With rapid expansion of artificial intelligence (AI) in the imaging sciences, deep learning (DL) models have been developed to support improved workflow, image acquisition, triage and interpretation. In this relatively early phase of AI in healthcare, emphasis has been on model training; fewer than 10% of models have undergone rigorous external validation and even fewer have been deployed in routine clinical practice.?The resources needed for clinical implementation are significantly different than those required for model development. Clinical IT support and clinical radiologists' engagement are critical for successful implementation and continuous improvement. There are limited examples of potentially transformative techniques being successfully deployed at full scale in clinical practice. This exhibit explores a real-world example of how we translated our breast imaging DL models into routine clinical practice, across multiple screening sites of a large academic medical center.

TABLE OF CONTENTS/OUTLINE

• Infrastructure to support model development to assess breast cancer risk from a screening mammogram alone • Key elements of robust infrastructure for clinical implementation of DL models to support "real time" immediate score availability to clinical radiologist • Pearls and Pitfalls of "Go Live" clinical implementation

INEE-25 Extended Reality And Arterial Intelligence For Precision Telemedicine And Spatial Education

Participants
Maki Sugimoto, MD, PhD, Tokyo, Japan (*Presenter*) Officer, Holoeyes Inc

TEACHING POINTS

) To learn the utilization of XR (virtual-augmented-mixed reality) in medical imaging. 2) To learn how to segment and export polygons of targeting organs from DICOM data from CT or MRI. 3) To learn how to select and use XR devices and applications. 4) To show illustrative examples of XR, such as in medical education, surgical planning, surgical simulation, and intraoperative navigation. 5) To learn how to use XR and A.I. to improve visual-spatial ability to mentally manipulate medical anatomy in three dimensions associated with performance on practical examinations. 6) To learn Precision Medicine by selecting radiological analysis of patient's individual medical imaging data.

TABLE OF CONTENTS/OUTLINE

1. Terminology: The representative forms such as XR (VR/AR/MR) are referring to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables. 2. Beneficial applications of the XR devices. 3. How to integrate the spatial imaging system by interactive superimposing 3D holograms. 4. Effectiveness: Enhancing scene visualization is a feasible strategy for augmenting spatial awareness in complex anatomy education. For surgery, this reduces the length of the operation and discussion time.

INEE-26 A New Jungle Is Sprouting. It'S Not Entirely Radiologist Friendly. How AI Algorithms Mark-up Findings On Chest Radiographs?

Participants
Parisa Kaviani, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. One to 124 and counting - number of detectable findings with artificial intelligence (CXR-AI) algorithms for assessing chest radiographs is expanding. 2. Heatmaps, boxes, free-hand, arrows - many ways CXR-AI algorithms mark-up findings. 3. Not all markup options are good options - What can and can't work for CXR-AI mark-up. 4. Color, percentage, Likert scale of confidence - how CXR-AI algorithms display or not (for some algorithms) their confidence for presence of findings

TABLE OF CONTENTS/OUTLINE

1. Landscape of FDA-cleared and EU-cleared CXR-AI algorithms: Triage, detection, characterization and quantification of findings 2. What are the assessable findings with different CXR-AI algorithms? 3. Multi-vendor CXR-AI examples of how positive and negative findings are displayed and/or documented. 4. Examples of how CXR-AI algorithms quantify some findings 5. Display of AI confidence on presence of findings 6. If and how CXR-AI should communicate with radiology reports interface 7. Survey and ideas of "what radiologists want" from display format

INEE-27 Quality Management Considerations For Hospital-based Anatomical 3D Printing

Participants
Rami Shorti, PhD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching Points • Understand the forces driving the need for the quality assurance program in a hospital-based 3D printing program

Teaching Points - Understand the forces driving the need for the quality assurance program in a hospital-based 3D printing program • Describe the basics of a Quality Management System (QMS) and practices implementation • Discuss the key quality control checks considerations within stem of the 3D printing process • Dive deeper into the quality control implications at each key step • Layout a simplified quality control considerations and checklist • Identify opportunities for early success in quality control implementation 3D printing at point-of-care • Identify quality control resources for continued QMS improvement

TABLE OF CONTENTS/OUTLINE

• Background: Quick history and forces driving the Quality Management System (QMS) programs for hospital-based 3D printing programs • QMS Basics • Key 3d printing QA check points: The QMS program is based on evaluating accuracy and recognizing and mitigating errors at each major step of the 3D printing process. Standard Operating Procedures (SOP) can be developed for each of these steps. These steps include: o image acquisition o image segmentation o cad processing o 3d printing o cleaning & post-processing • Implications of 3d printing QA check points • Simplified quality assurance considerations and checklist • Opportunities for early success • Quality assurance continuous improvement

INEE-28   Strengths, Weaknesses, Opportunities, And Threats (swot) Analysis Of Ai Algorithms In Abdominal Radiology

Participants
Asser Abou Elkassem, MD, Birmingham, Alabama (*Presenter*) Nothing to Disclose

TEACHING POINTS

- AI algorithms can be categorized into three main categories (black box, explainable, and transparent) based on the abdominal radiologist's ability to interpret the output - The strengths of AI include: detection of image findings, image segmentation and measurement, classification of image findings and exams, image reconstruction, and analysis of big data and radiomics- The weaknesses of AI include: difficulty in annotating data sets, difficulty in integrating AI into clinical workflows, inability to understand the mechanism of action of blackbox AI algorithms, narrowness of AI, brittleness of AI, and limited ability to detect failures for blackbox AI algorithms.- The opportunities of AI include: improvements in key domains (accuracy, efficiency and standardization), reduction in errors, and the potential for big data analysis.- The threats of AI from the abdominal radiologist's perspective include: negative perception (by trainees, clinicians and patients) and the disruption of the abdominal radiologist's job with the potential to replace certain aspects

TABLE OF CONTENTS/OUTLINE

- Introduction to artificial intelligence terminology and algorithm categorization from the abdominal radiologist's perspective - Review and categorization of current and future AI algorithms in abdominal radiology - Review the strengths, weaknesses, opportunities and threats of AI algorithms in abdominal radiology

INEE-29   3D Slicer: An Open Source Software Platform For Medical Image Analysis, 3D Visualization, And Image-Guided Therapy

Participants
Sonia M. Pujol, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

3D Slicer is an open-source software platform used in clinical research worldwide. The platform provides over 300 modules and extensions for multi-modal data analysis, 3D visualization, and image-guided therapy. The goal of the exhibit is: 1. To learn how to import and export DICOM data; 2. To visualize GPU-based volume rendering; 3. To learn how to perform interactive segmentation of 2D/3D/4D data; 4. To generate ground truth training datasets for Deep Learning applications; 5. To discover Slicer AI-assisted automatic segmentation; 6. To learn Radiomics feature extraction; 7. To run Slicer in a web browser, Docker container, or Jupyter notebook kernel; 8. To use Slicer server modes for cloud-based quantification; 9. To explore interactive 3D views in virtual and augmented reality; 10. To create 3D solid objects for 3D printing; 11. To gain knowledge on real-time data fusion for surgical navigation and image-guided therapy; 12. To understand how to use 3D Slicer in clinical research applications.

TABLE OF CONTENTS/OUTLINE

Overview of the 3D Slicer platform; DICOM standard interoperability; Advanced GPU-based volume rendering; Interactive 2D/3D/4D image segmentation; 3D Markups and automated measurements; Artificial Intelligence; Radiomics; Quantitative Imaging; Cloud Computing; Virtual and Augmented reality; 3D Printing; Clinical applications in Radiology and Image-Guided Therapy; Community Resources: Slicer Forum, Slicer Documentation, and Slicer Training Compendium.

INEE-29-HC   Use Of 3D Printed Patient Specific Vascular Phantoms To Optimize The Neuro-interventionalist Mechanical Thrombectomy Approaches

Participants
Kelsey Sommer, Buffalo, New York (*Presenter*) Stockholder, QAS.AI

TEACHING POINTS

1. Learn how to use patient specific 3D neurovascular anatomical models with ex-vivo clots to simulate large vessel occlusions.2. How to use a benchtop flow study for mechanical thrombectomy simulation using 3D printed models.3. Understand the challenges related to patient anatomy, clot properties and occlusion location to optimize the interventional approach using 3D printed patient specific models. 3D-printed vascular models allow replication of complex neurovascular structures with high accuracy for neuro-interventional simulations. In this project we present a novel approach that combines 3D printing with patient specific anatomical variants for accurate simulation of acute ischemic stroke (AIS) from large vessel occlusion (LVO) treated with mechanical thrombectomy (MT).

TABLE OF CONTENTS/OUTLINE

• 3D-printing of neurovascular models for image guided neuro-interventions simulations • Large vessel occlusion simulations using clots with different mechanical properties • Middle cerebral artery (MCA) region large vessel occlusion • Neuro-intervention simulations within MCA • Understand the interventional challenges related to the patient anatomy, clot location, clot mechanical properties and geometry on the clot • Use neuro-intervention simulations to optimize the mechanical thrombectomy approach

INEE-3   Undergraduate Medical Student Radiology Teaching During Covid-19: What Has Changed And What Will Continue Post-pandemic?

Participants
Nikhil Patil, Waterloo, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review evidence-based strategies for delivering effective and well-received virtual radiology lectures in pre-clerkship and clerkship.2. Review changes that have been made to radiology clerkship rotations and electives in the pandemic setting.3. Discuss the advantages and disadvantages of changes made to the delivery of undergraduate radiology curricula during the COVID-19 pandemic by medical educators, and suggest which strategies may persist post-pandemic.

TABLE OF CONTENTS/OUTLINE

1. Virtual delivery of core curriculuma. Remote synchronous and asynchronous lectures- Tips for designing PowerPoint slides- Audience polling- Gamificationb. Flipped classroom model- Interactive small group workshops- Incorporation of online resourcesc. Testing and invigilation strategies2. Modified radiology rotations and electivesa. Virtual electives- Virtual case-based interactive sessions and lecturesb. Pre-recorded self-directed lecture seriesc. Simulation technologies3. Benefits and drawbacks of virtual teaching in radiologya. Increased attendance at teaching sessionsb. Heightened interest in radiology as a specialtyc. Emphasis on self-directed learningd. Suitability for distance learninge. Networking and professional development4. What educational strategies will survive post-pandemic?

INEE-30-HC Move Away HIPAA And GDPR, Here Comes CrypTFlow - Secure AI Inferencing Without Data Sharing

Participants
Vidur Mahajan, MBBS, New Delhi, India (*Presenter*) Researcher, CARING;Research collaboration, General Electric Company ;Research collaboration, Koninklijke Philips NV;Research collaboration, Qure.ai;Research collaboration, Predible Health;Research collaboration, Oxipit;Research collaboration, Synapsica Healthcare Inc;Research collaboration, Quibim

TEACHING POINTS

• Currently, running Artificial Intelligence (AI) algorithms on medical images requires either the sharing of medical images with developers of the algorithms, or sharing of the algorithms with the hospitals. Both these options are sub-optimal since there is always a real risk of patient privacy breach or of intellectual property theft. • Encryption is the process of converting data into a "secret code" using a "key" making the data meaningless for anyone without the key. The challenge is that, with current technology, the key needs to be shared with the AI developer, so that the data can be converted to its meaningful form, thereby compromising the security and privacy of the data. • We propose using CrypTFlow, which uses Multi-Party Computation and encryption to run AI algorithms on medical images without sharing the encryption key described above. This means that the images remain in the hospital network, the AI algorithm remains in the AI developer's network, but the AI is still able to run on the images. • We will present the results of our experiments of running CheXpert, an AI algorithm, on Chest X-Rays.

TABLE OF CONTENTS/OUTLINE

• Current privacy and intellectual property concerns with deploying AI algorithms in clinical practice • What is encryption? • What is multi-party computation (MPC)? • What is CrypTFlow and how can it help run AI algorithms without requiring data to be shared with AI developers? • Results of running CheXpert AI algorithm using CrypTFlow - accuracy, time and computation - The Future of secure AI deployment

INEE-31   Continual Learning For Diagnostic Radiology

Participants
Camila Gonzalez, MS, Darmstadt, Germany (*Presenter*) Nothing to Disclose

TEACHING POINTS

The abstract will provide an overview of continual learning, the practice of training deep learning models with a sequence of distinct tasks, for diagnostic radiology. Continual learning is a major paradigm shift which the FDA is actively trying to regulate. In diagnostic radiology, where a variety of scanners and acquisition protocols are used, training continuously allows to leverage heterogeneous data sources while adhering to privacy constraints.We will start by describing why it is often necessary to train models continuously in the clinical practice and how continual learning differs from the static learning setup used in most deep learning evaluations. To illustrate the challenges and opportunities that continual learning poses, we will clarify the concepts of catastrophic forgetting and transferability, as well as summarize current regulatory efforts.A taxonomy of continual learning scenarios and a summary of common continual learning strategies and model architectures will also be introduced. Finally, we will outline how to carry out a thorough continual learning evaluation.

TABLE OF CONTENTS/OUTLINE

1. Motivation of continual learning in diagnostic radiology2. Continual vs. static learning3. Current regulatory guidelines for continual learning4. Understanding continual learning opportunities and challenges: catastrophic forgetting and transferability5. Continual learning scenarios6. Common continual learning strategies and model architectures7. Properly evaluating a continual learning approach

INEE-32-HC Collaborative Learning Approaches For Privacy Preserving Deep Learning Using Multi-institutional Data

Awards
Identified for RadioGraphics

Participants
Jayashree Kalpathy-Cramer, MS, PhD, Charlestown, Massachusetts (*Presenter*) Institutional Research Grant, General Electric Company;Institutional Research Grant, F. Hoffmann-La Roche Ltd

TEACHING POINTS

Deep learning methods have been shown to be brittle. In this educational exhibit, we will provide a motivation for the need of

institutional datasets to train robust and generalizable models using breast density estimation from mammograms and analysis of chest X-rays for COVID-19 as use cases.We will review multiple technical approaches for collaborative learning including the popular federated learning, cyclical weight transfer and split learning. We will discuss the advantages and limitations of these methods and recommend best practices for different scenarios.We will then discuss open-source options to ease setting up collaborative learning across institutions. We will review lessons learning from multiple large-scale national and international projects.Finally, we will discuss considerations for setting up consortia of collaborative learning sites including agreements on clinical questions, data annotation and interoperability, machine learning architecture, as well as issues around authorship and IP.

TABLE OF CONTENTS/OUTLINE

Motivation: brittleness of deep learning methods and need for multi-institutional training.Methods: discussion of the different technical approaches for collaborative learning including federated learning, distributed learning and split learning.Infrastructure and frameworks: discussion of the logistics for collaborative learning including open-source toolkits.Lessons learned: discussion of lessons learned from real-life multi-institutional federated learning projects

INEE-33-HC Image Quality And Higher Resolution Of Latest Monitor/TV Screens. Essential Toolkit For Radiologist In Image Preparation For Scientific Presentations.

Awards
Certificate of Merit

Participants
Antonio Nunziata, MD, Naples, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

The technological evolution of screens, monitors, TVs and digital projectors has allowed an increasingly high resolution (HD, FullHD, 4K, 8K). The images prepared at 72/96 dpi for the old screens are no longer sufficient to guarantee acceptable quality. We give the radiologist an essential guide on image preparation for scientific presentations on the latest screens with higher resolution.

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The screen resolution is measured in reference to the number of horizontal and vertical lines. A 4K screen with 16/9 aspect ratio has 3840 vertical lines (from which the 4K parameter, approximately 4000, mostly used in TVs) and 2160 horizontal lines (from which the parameter 2160p used mostly in computer screens). The number of lines is independent from the geometric size of the screen. A 20" and a 65" screen have the same number of lines, and therefore the same resolution. The intersections of the vertical and horizontal lines can be compared to the pixels of digital images. So a digital image, to be faithfully represented on a 4K screen, must have at least 3840 x 2160 = 8.3 Mpx. The various resolutions and aspect ratio of the screens, the various digital images, the various color modes, the effects of compression on the image quality and a final toolkit for the optimal preparation of the images are illustrated in uploaded pdf.

INEE-34-CS Chest Cinematic Rendering: An Interactive Universal Application Approach To Anatomy Education

Participants
Sara Raminpour, BS, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

After reviewing this exhibit, users will:1. Understand how photorealistic 3-D CT images created by CRT (cinematic rendering technique) can be used in novel ways in medical trainees' education.2. Improve their knowledge of chest normal anatomy using 360 interactive tutorial displays of anatomic structure.3. Enhance their learning experience with a self-assessment section.

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1. Home: presents a brief overview of CRT (cinematic rendering technique) and the entire app.2. Normal Anatomy Tutorial: demonstrates a pattern-based approach to chest anatomy, using an organ system-based approach; each section provides illustrations, an interactive 360 visualization, and a discussion. A. Muscle - lower neck, chest wallB. Bone - vertebrae, ribs, sternumC. Lungs- airways, lung parenchymaD. Vascular - arterial, venousE. Cardiac - pericardium, valves, chambers, coronary arteries3. Quiz: provides a self-assessment of 41 various questions in 5 main organ systems of the chest. Users will be able to get their scores by submitting their answer to each question.

INEE-36-CS Using The Open Health Imaging Foundation (OHIF) Framework To Build Web-based Imaging Applications

Participants
Erik Ziegler, MSc,PhD, Boston, Massachusetts (*Presenter*) Consultant, Radical Imaging LLC;Consultant, Novometrics LLC

TEACHING POINTS

The purpose of this exhibit is to:1. Explain how radiologists can build their own imaging tools and applications using the open source Open Health Imaging Foundation (OHIF) framework to address their custom use cases.2. Discuss the components of a full fledged zero-footprint web-based imaging application and how they interact using various APIs (e.g. DICOMweb).3. Explain how advanced functionality, such as 3D visualization, image fusion, and segmentation, can be incorporated in these applications.4. Demonstrate how to organize specific function sets into custom workflow modes for optimizing efficiency5. Demonstrate how this type of system can be deployed both securely and cost effectively.

TABLE OF CONTENTS/OUTLINE

- Open source resources for radiology and AI applications- Relationships between components in web imaging applications- Building custom measurement toolsIncorporating advanced visualization and segmentation tools- Building custom workflow modes for the OHIF Viewer (e.g. configuring the application to provide functionality for use cases like ProstateCancer.ai, NCI Imaging Data Commons, XNAT)- Deploying scalable secure web imaging applications locally or using cloud resources- Future directions

INEE-37-CS NCI Imaging Data Commons: Status Update

Participants

Andriy Fedorov, PhD, Arlington, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

The National Cancer Institute's (NCI) Cancer Research Data Commons (CRDC) aims to establish a cloud-based data science infrastructure. The Imaging Data Commons (IDC) is a component of CRDC to enable access and exploration of de-identified imaging data, and to support integrated analyses with non-imaging data available in other components of CRDC, such as genomics and proteomics repositories. IDC uses a combination of commercially available Google Cloud Platform and open source components. IDC relies on the DICOM standard to harmonize both imaging and image-derived data. As CDRC grows, imaging datasets will be cross-linked to genomic, proteomic, and clinical data about the subjects. The IDC portal is available at https://imaging.datacommons.cancer.gov, and integrates a customized web viewer for visualization of images and image annotations. Production release of IDC is planned for Fall 2021, and will include all of the public TCIA collections. In this exhibit the attendees will learn about the scope and status of IDC, its role within CRDC, and the plans for future development, including support of digital pathology, annotations and derived data.

TABLE OF CONTENTS/OUTLINE

Overview of CRDC and IDC; Data curation and the role of The Cancer Imaging Archive; Portal; Viewer; Organization of data; Data versioning; Integration of tools; Use case development; Documentation and user support resources; IDC cloud credit program; Status update and plans for future development.

INEE-38-CS Training Visuospatial And Visuomotor Skills For Ultrasound Imaging With A Game

Participants
Lukas Mayer, MSc, Flensburg, Germany (*Presenter*) Nothing to Disclose

TEACHING POINTS

This hands-on exhibit will allow attendees toa) experience a simulation-based ultrasound training tool that focuses on simple non-anatomical objects that can be examined with a virtual ultrasound probeb) improve their visuospatial understanding of cross-sectional ultrasound image creationc) improve their visuomotor skills with regard to ultrasound probe handlingd) assess the benefits of using gamification elements in a training toole) learn how educational games can be developed for medical imaging with a game engine

TABLE OF CONTENTS/OUTLINE

A simulation based learning game for ultrasound imaging will be presented with the following content:1. Introduction: Using a virtual ultrasound probe to examine non-anatomical objects2. Minigames to train visuospatial and visuomotor skills (e.g., "Identify Object", "Recreate Slice")3. Game design elements (e.g., scoring system, campaign mode)4. Implementation of the game with the help a game engine

INEE-39-CS : The Federated Tumor Segmentation Initiative: The First Real-world Large-scale Federation Focusing On Neurooncology

Participants
Spyridon Bakas, PhD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

There is a growing body of literature offering evidence of the potential impact that artificial intelligence (AI) methods can have towards healthcare. To ensure robustness and generalizability of AI methods, ample and diverse multi-site patient datasets are desired. However, there are various factors that hinder access to such data in the current paradigm of multi-site collaborations, which include the tedious bureaucratic processes, data ownership concerns, and legal considerations reflected in patient privacy regulations. To tackle these issues, we introduce the Federated Tumor Segmentation (FeTS) Initiative, which includes an open-source software toolkit for data-private collaborative learning of AI methods across multiple international institutions using federated learning (FL). The goals of the exhibit are to: (i) broaden the understanding of the general community regarding FL, (ii) showcase how a user can leverage FL to train a model across various sites, (iii) present results of the first real-world federation across 50 collaborating sites, focusing on brain tumors, (iv) discuss privacy and data protection concerns and how FeTS hopes to solve it.

TABLE OF CONTENTS/OUTLINE

This exhibit will present a toolkit to define a FL-based model training problem and deploy it across multiple partnering sites, ensuring a data-private AI training paradigm. Specific principles to protect data privacy will be described, along with common pitfalls to avoid when performing an FL-based study.

INEE-4 Radiomics Analysis Using The Image Biomarker Standardization Initiative (IBSI): Benchmarks And Guidelines

Awards
Cum Laude

Participants
Martin Vallieres, PHD, Sherbrooke, Quebec (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiomic studies still suffer from severe reproducibility problems that prevent the routine use of these methods in clinical practice. For example, it was previously shown that differences in feature definitions and implementation workflows (e.g., interpolation) can lead to coefficients of variation as high as 150% for some texture features. To overcome these challenges, about 75 researchers from 25 institutions in 8 countries have now participated in the Image Biomarker Standardization Initiative (IBSI). For better reproducibility of high-throughput medical image analysis, the IBSI seeks to provide a standardized computation workflow for radiomics, as well as benchmark datasets and values. To achieve compliance with the IBSI standards, research teams have the possibility to calibrate their computation pipeline by performing benchmark tests designed by the IBSI team and described in comprehensive reference manuals. This presentation aims to facilitate this calibration process by explaining in detail the radiomics

computation workflow of the IBSI.

TABLE OF CONTENTS/OUTLINE

(1) IBSI tools: documentation, datasets and website; (2) Radiomics computation workflow of the IBSI; (3) IBSI benchmark tests explained; (3a) IBSI 1 - Phase 1: computing radiomics features without image processing; (3b) IBSI 1 - Phase 2: computing radiomics features with image processing; (3c) IBSI 2 - Phase 1: computing imaging filters; (3d) IBSI 2 - Phase 2: computing radiomics features from filtered response maps.

INEE-40-CS MIDRC: Medical Imaging and Data Resource Center

Participants
Maryellen Giger, PhD, Chicago, Illinois (*Presenter*) Advisor, Emalex Biosciences, Inc;Stockholder, Hologic, Inc;Royalties, Hologic, Inc;Shareholder, Quantitative Insights, Inc;Co-founder, Quantitative Insights, Inc;Shareholder, QView Medical, Inc;Royalties, General Electric Company;Royalties, MEDIAN Technologies;Royalties, Riverain Technologies, LLC;Royalties, Canon Medical Systems Corporation

TEACHING POINTS

Medical imagesplay an essential clinical role in the diagnosis, treatment and monitoring ofCOVID-19, because they provide quantitative information about the lungs andother organs that are targets of the virus. In response to the need for collection, artificial intelligence analysis, anddissemination of imaging and associated data, the American College ofRadiology (ACR), the Radiological Society of North America (RSNA), and theAmerican Association of Physicists in Medicine (AAPM) have jointly developedthe Medical Imaging and Data Resource Center, hosted at theUniversity of Chicago.

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This multi-institutional initiative represents a model partnership spearheaded by the medical imaging community aimed at accelerating the transfer of knowledge and innovation, including clinical problem identification, discovery, development, evaluation, translation, implementation, and dissemination. This education exhibit explains the MIDRC model for data collection, organization and dissemination in support of AI-focused research on the imaging of Covid-19.

INEE-5 Users' Feedback Vs. Apple Analytics Statistics: A Challenge Ahead For Medical And Educational Ios Developers

Participants
Sara Raminpour, BS, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. An overview of App Store Connect and review of each data item that App Analytics and Sales and Trends provide for a single app.2. To present the frustration that developers encounter after publishing an app in terms of user feedback and analyzing statistics from different analytics.3. To compare App Analytics to Google Firebase Analytics in keeping track of user engagement with our app.4. To discuss statistical comparisons of free and paid apps and challenges ahead for each free app developer.

TABLE OF CONTENTS/OUTLINE

1. A brief overview of App Store Connect:A. Overview of App Analytics and its metrics.B. Overview of Sales & Trends and its metrics.2. Description of different ways the developers are able to get users' feedback and challenges they encounter to achieve reasonable data:A. Apple Rating and Review.B. Social Media Poll.3. A brief review of Google Firebase Analytics and how we can retrieve more helpful statistics from it in comparison to App Analytics regarding user engagements with an app.4. The challenges that free iOS app developers may encounter in getting a reasonable number of downloads.

INEE-6 Voice-triggered Macros - A Radiologist-friendly Method Of Increasing Productivity And Reducing Burnout

Awards
Certificate of Merit

Participants
Shawn Lyo, MD, Brooklyn, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Macros are saved sequences of commands which are triggered by user defined inputs. Macros can reduce the biomechanical and attentional demands associated with performing multi-step tasks, and may potentially reduce repetitive stress injury and burnout . Tools such as AutoHotkey mostly utilize mechanical input for triggering macros; however, macros can also be triggered using speech recognition and user defined phrases. Voice-triggered macros are easy to remember and intuitive for radiologists who are more accustomed to dictation. We review the benefits and drawbacks of voice-triggered macros using the free software VoiceMacro, through demonstrations of multiple scenarios ranging from simple commands to advanced usage including integration with AutoHotkey.

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I. What are macros and how can they make radiologists' lives easier a. Comparison of mechanical and voice triggered macros II. Macro demonstrations: a. Simple inputs i. EMR orders ii. PACS commands 1. Examples: Axial MIP iii. EMR Navigation 1. Examples: Switch directly to protocoling menu, surgical pathology b. Intermediate i. Communication 1. Telephone calls 2. Beeper paging 3. E-mail 4. Directory look up ii. Frequent reference lookup 1. Examples: TI-RADS calculator, Head and Neck anatomy atlas, etc. iii. Education 1. Study resources tied to dictation macros c. Advanced i. Advanced text manipulation 1. Calculate lesion volume from reported dimensions ii. Integration with AutoHotKey II. Potential for future integration with AI III. Conclusion

INEE-7 Deep Learning Reconstructions: Diagnostic Impact

Participants
Serageldin Kamel, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) DLR markedly reduces image noise and preserves image texture 2) Early evidence suggests significant capacity for rad dose reduction of 46-61% compared to hybrid IR, including for low contrast liver lesion detection task (albeit with lower reader confidence) 3) No free lunch; next gen DLR algorithms will need to address mild loss of high spatial frequency information in clinical images

TABLE OF CONTENTS/OUTLINE

1) Reconstruction Background - how did we get here? a) Reconstruction history b) Iterative recon (IR) limitations c) Unique QA issues for IR d) Case examples 2) What is DLR? 3) Phantom Evidence 4) Clinical Evidence 5) DLR Implementation a) Assessing your practice baseline b) Determining intended clinical tasks 6) DLR pitfalls 7) Conclusion

INEE-8   How Should Radiologists Use AI To Fight COVID-19 Pneumonia?

Awards
Cum Laude

Participants
Rintaro Ito, MD,PhD, Nagoya, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation

TEACHING POINTS

Pneumonia reported for the first time at the end of 2019 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This is one of the diseases that radiologists are currently most interested in as COVID-19 pneumonia. The development of artificial intelligence (AI) in medical imaging is accelerating, and it is now applied to clinical practice. AI studies for COVID-19 pneumonia are being actively conducted. It would be the first time in history that AI research has been conducted worldwide for a single disease. In those studies, there are similarities, differences, good performance, and some problems. The next generation of radiologists will need to use AI properly. Knowing about the current AI research trends, development speed, and problems will help them become more familiar with AI.

TABLE OF CONTENTS/OUTLINE

There are three sections in the educational exhibit. The first section presents an overall analysis of AI studies of medical imaging performed on COVID-19 pneumonia. This section analyzes the study objectives, number of study data, number of COVID-19 cases, sensitivity, specificity, and Area under the curve (AUC). In the second section, we present an extract of AI studies with popular objectives and analyze each AI study. In the third section, we discuss the problems with AI studies on medical images with COVID-19 pneumonia.

INEE-9   Validation System For Mammography Using Deep Learning: Guarantee Of Appropriate Technique

Participants
Haruyuki Watanabe, PhD, Maebashi, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Breast cancer is the commonest cause of cancer death in women worldwide. Mammography (MMG) plays an important role in the early detection and assessment of patients. Guaranteeing the image quality of the MMG is necessary to maintain the accuracy of the diagnosis. However, diagnosis depends on the imaging techniques of operators, it shows the variability of diagnostic accuracy. Thus, we propose a deep convolutional neural network (DCNN) classification regarding the validation of mammogram imaging techniques. It can guarantee the quality of mammograms and give useful information for retaking MMG. Furthermore, the proposed method makes it possible to present MMG image quality improvements to the operator. The major teaching points of this exhibit are to: 1. automatically classify the quality in MMG. 2. understand how to classify schemes in the computer-aided detection system using DCNN. 3. be useful for the diagnosis in MMG.

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To provide DCNN classification regarding validation of mammograms and to discuss clinical usefulness toward an accurate diagnosis in MMG.

BREE

Breast Education Exhibits

Sub-Events

BREE-1   Contrast Enhanced Mammography. Advantages And Controversies.

Awards
Cum Laude

Participants
Rosa M. Lorente-Ramos, MD, PhD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To review contrast enhanced mammography (CEM) technique. -To understand usefulness and limitations of CEM in detection, diagnosis, local staging and follow-up of breast cancer. - To analyze controversial points in CEM: Indications, protocols, limitations and pitfalls. - To become familiar with normal and abnormal imaging findings providing correlation with imaging (mammogram, US, MR) and pathology, emphasizing pitfalls, diagnostic difficulties and differential diagnosis.

TABLE OF CONTENTS/OUTLINE

We review the basics and state-of-the-art of CEM highlighting subjects which may cause conflicts while the technique is implemented in a Breast Imaging Department. 1. Basics of CEM. 2. Technique: Before the exam. Image acquisition. After acquisition. 3. Controversies. - Use. Indications (symptomatic breast, screening, staging, neoadjuvant treatment); Adjunct tool to traditional methods; CEM vs MR; - Protocols. Optimization: pros and cons for different protocols. - Limitations. 4. Imaging. - we present a series of normal and abnormal cases, including frequent and uncommon lesions with mammography, US, MR and pathology correlation - Artifacts and potential pitfalls are analyzed.

BREE-10   Dedicated Breast CT: State Of The Art

Participants
Yueqiang Zhu, Tianjin, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

¦ Dedicated breast CT (BCT) is an emerging modality with enormous potential in the future of breast imaging by addressing numerous clinical needs from diagnosis to treatment. ¦ Current BCT systems differ in acquisition modes (cone-beam, fan-beam, parallel-beam), imaging techniques (absorption-contrast, phase-contrast), and detector types (flat-panel energy-integrating, photon-counting). ¦ Advantages of BCT include lack of breast compression, no tissue overlap, improved patient comfort compared with DM and DBT, and rapid acquisition, concurrent assessment of microcalcifications and contrast enhancement compared with MRI. ¦ BCT shows either noninferiority or superiority with DM and numerical comparability to MRI after contrast administration in diagnostic statistics, demonstrates excellent performance in lesion characterization, density assessment, implant evaluation, and intervention, and exhibits potential in future screening. ¦ There are still details to be decided regarding BCT techniques. Contrast media dosage and optimal delay time have to be determined. Mean glandular dose of CE-BCT is high due to multi-phase acquisition. Table design has limitation in imaging axilla. Discomfort remains in some patients during scanning. Several artifacts occur in scanning and post-processing. ¦ New imaging modalities such as phase-contrast BCT, spectral BCT, and hybrid imaging are in the progress of R & D.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. History 3. Technique 4. Clinical application 5. Future perspectives 6. Summary

BREE-11   Breast Cancer In Women Under Age 30: An Overview

Participants
Arielle Sasson, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Breast cancer is rare in adolescents and young women, but more aggressive with a worse prognosis compared to older women. (2) High risk women due to family history, certain germline mutations (i.e., TP53) or who have received mantle radiotherapy should undergo high risk screening.(3) Imaging protocols for palpable breast lesions in those under 30 years old will be reviewed.(4) Breast cancer treatment can result in fertility impairment and premature menopause and should be addressed.

TABLE OF CONTENTS/OUTLINE

(1) Background- Incidence of breast cancer in young women- Behavior, prognosis, imaging features, molecular subtype and risk of recurrence in those under 30- Risk Factors: a. Diseases/past medical history, b. Deleterious gene mutations, c. Familial risk(2) Surveillance and Risk Assessment- Who should undergo screening less than 30 and why(3) Young Women with Breast Cancer: Unique Challenges- Long-term complications, e.g., fertility loss and cardiotoxicity- Fertility preservation- Increased risk of

psychological issues(4) Imaging Evaluation- Standard protocols to evaluate palpable masses in women under 30 years old, i.e., ACR Appropriateness Criteria(5) Case Series- Present pathology and multi-modality imaging findings from patients with breast cancer under age 30 years(6) References

BREE-12   Revitalizing Breast Imaging Rotations: Suggestions To Increase Resident Interest

Participants
Darrell Morris, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Hands-on experience is essential to the apprenticeship-based education model, a structured framework to the breast imaging rotation will increase resident interest.(2) The foundations of breast imaging should be introduced in a plain, understandable manner, with readily available resources.(3) Early exposure to Breast ultrasound and MRI should be encouraged along with involvement in breast consults and patient-facing tasks.(4) Strategies to make the rotation more interactive such as question bank assignments, journal club presentations and participation in multidisciplinary conferences should be encouraged.

TABLE OF CONTENTS/OUTLINE

(1) Getting Started: The First Breast Rotation and Early Introduction to:- Breast imaging- Mammography- How to read a Mammogram- Breast imaging interpretation Lexicon/ BI-RADS- Positioning and Clockface localization of lesions- Observing technologist during mammograms and US- Views for diagnostic mammography(2) Beyond the Basics- Early exposure to procedures including MRI biopsy- Early exposure to patient-facing tasks and breast consults(3) Reading & Reinforcing information- Suggested reading- Question bank- Educational presentations(4) Breast Imaging Aunt Minnie's- Academic lecture Jeopardy

BREE-13   Peer Review Vs. Peer Learning: The How And Why Of The Paradigm Shift In Breast Imaging

Participants
Darrell Morris, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Outcome Assessment of breast imaging interpretations is necessary for improving quality assurance.(2) Peer-learning fosters a culture that encourages a nonpunitive process that encourages focused learning and reduces diagnostic errors.(3) Transitioning from a numerical score-based model to a qualifying assessment model, helps facilitate identification and discussion of learning and quality improvement opportunities.(4) An anonymous review process decreases the risk of reviewer bias and increases participation of radiologists who may be weary of privacy concerns.(5) Consensus Oriented Group Peer Review (COGR) peer learning, prioritizes group discussion of cases to improve outcomes, solidify and optimize group standards of practice and fosters peer feedback.(6) COGR strategies help to answer whether the report directly answers the clinical question, whether report wording was clear and whether the appropriate recommendation was justified.

TABLE OF CONTENTS/OUTLINE

(1) Quality Assurance in Radiology- Quality assurance in breast imaging- MQSA(2) History of Peer Review in Radiology- RADPEER- Limitations of peer review model(3) What is Peer Learning- Advantages- Limitations- Peer Feedback- Peer coaching(4) What is Consensus-Oriented Group Peer Review (COGR)- Advantages- Limitations(5) Implementing case based COGR strategies in breast imaging- Involvement of entire section by rotating presenters- Case Examples

BREE-14   Moving Beyond Gynecomastia- Pictorial Review Of Less Common Benign And Malignant Findings In The Male Breast

Participants
Haley Letter, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

Diagnostic mammography is the first-line imaging tool for the evaluation of the symptomatic adult male breast. The majority of male breast lumps are due to gynecomastia or benign lipomas, which can occur at any age and demonstrate classic findings on mammography. The purpose of this pictorial review is to describe key mammographic findings that suggest diagnoses other than gynecomastia, including characteristically benign lesions and suspicious lesions requiring additional diagnostic work-up and/or biopsy, in order to increase radiologists' confidence and accuracy in making these diagnosis.

TABLE OF CONTENTS/OUTLINE

Utilizing an interactive pictorial case based approach drawn from our case experience, we will review imaging findings of common and uncommon male breast pathology, highlighting at least one important distinguishing factor that makes its particular appearance inconsistent with gynecomastia. Cases included:1) Lipoma 2) Pseudogynecomastia 3) Simple cyst 4) Ductal carcinoma in situ presenting as calcifications 5) Invasive ductal carcinoma 6) Primary breast lymphoma 6) Benign spindle cell tumor 7) Metastasis to the breast 8) Kaposi sarcoma in a male to female transgender patient with HIV 9) Abscess. Many of the cases presented will also demonstrate concomitant gynecomastia, which will serve to highlight the important mammographic distinctions.

BREE-15   Imaging Atlas Of Axillary Lymphadenopathy After COVID-19 Vaccination

Participants
Beatriu Reig, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Vaccines administered in the deltoid muscle may cause ipsilateral axillary lymphadenopathy (LAD). Any vaccine type can cause axillary LAD, but this is more common with mRNA vaccines due to their immunogenicity. • Vaccine-related LAD is often in the apical portion of the axilla, near the axillary vein and artery, and may involve axillary levels I, II, III, as well as supraclavicular and cervical lymph nodes. • Duration of vaccine-related LAD is unknown and may be variable, with studies showing up to 10 weeks in some patients.

TABLE OF CONTENTS/OUTLINE

1) Brief introduction: LAD as a complication of all vaccines, including COVID-19 vaccines 2) Anatomy: a) Lymphatic drainage of the

1) Brief Introduction: LAD as a complication of all vaccines, including COVID-19 vaccines 2) Anatomy: a) Lymphatic drainage of the breast and upper extremity b) Lymph node (LN) stations: axillary levels I, II, III; supraclavicular 3) Morphology of normal and abnormal LNs on mammogram, ultrasound, MRI, PET a) smooth or focal cortical thickening, rounded morphology, loss of fatty hilum, non-hilar vascular flow, rim or heterogeneous enhancement on MRI b) No single size criterion defines an abnormal lymph node 4) Imaging atlas of vaccine LAD on mammography, ultrasound, MRI, and PET-CT a) Multimodality correlation b) Evolution of LAD over time 5) Management of LAD in setting of COVID-19 vaccination a) In asymptomatic patients b) In patients with recently diagnosed breast malignancy 6) Pitfalls/controversies a) Differential diagnosis: metastatic breast cancer, lymphoma b) Resolution over time of vaccine-related LAD has not been defined c) Endpoint of follow-up has not been defined

BREE-16   Pediatric Breast Masses

Participants
Kason Ashe, DO, Morgantown, West Virginia (*Presenter*) Nothing to Disclose

TEACHING POINTS

The majority of breast conditions occurring in pediatric patients are benign, including normal developmental changes and benign neoplastic lesions. Breast malignancy has an exceedingly low incidence.Ultrasound is the first-line imaging modality in pediatric patients. Mammography has a limited role, secondary to risks associated with exposure to ionizing radiation as well as the reduced sensitivity of mammography in extremely dense breast tissue encountered in adolescent patients.Clinical history and exam findings are important in guiding imaging and management decisions. Given the extremely low incidence of malignancy in pediatric patients in addition to the risk of damaging breast bud development with interventions such as core needle biopsy, a conservative approach of sonographic and clinical follow-up is generally warranted.

TABLE OF CONTENTS/OUTLINE

Review the most common symptoms prompting breast imaging in pediatric patients.Discuss the most appropriate imaging evaluation for pediatric patients with breast symptoms.Review the most frequently encountered pathologies, imaging characteristics, and discuss management.This content will be delivered by providing the clinical history and physical exam findings, imaging, pathology, treatment, and patient outcomes for cases including juvenile fibroadenoma, phyllodes tumor, gynecomastia, abscess/mastitis, breast bud formation, epidermal inclusion cyst, intramammary lymph node, reactive lymphadenopathy, infantile hemangioma and mammary duct ectasia.

BREE-17   Certifications, Audits, And National Benchmarks: Breaking Down The Basics For The New Mammography Attending

Participants
Ellen Clark, MD, Clinton, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

This poster prepares the upcoming graduate or new mammography attending to understand the MQSA requirements for certification and maintenance of certification, and introduces the yearly audit. We will delve into the details of the raw and derived data included in an audit, using a real example. By applying PPV1, PPV2, and PPV3 to real examples, we will provide the reader a more intuitive understanding of these challenging statistics. Finally we will discuss the significance of the Breast Cancer Surveillance Consortium and national benchmarks and guidelines that can be used for comparing one's own audit.

TABLE OF CONTENTS/OUTLINE

1. MQSA Initial Certification; 2. MQSA Continuing Certification; 3. The Yearly Audit; 4. Definitions of PPV1, PPV2, and PPV3; 5. Example Audit; 6. National Benchmarks from the Breast Cancer Surveillance Consortium (BCSC).

BREE-18   Lymphoma Of The Breast - A Multimodality Review Of Imaging Findings

Participants
Adam Brown, MBChB, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

After reading this educational exhibit, delegates will be able to:1) Recognise the imaging findings of lymphoma of the breast across multiple imaging modalities including mammography, ultrasound, MRI and FDG-PET/CT with histopathological correlation.2) Describe the key radiological findings that allow it to be distinguished from other malignant and non-malignant breast pathologies.

TABLE OF CONTENTS/OUTLINE

Introduction: Breast lymphoma is a rare hematological malignancy. Primary breast lymphoma originates in the lymphoid tissue of the breast in the absence of extramammary disease. Secondary breast lymphoma is the most common cause of metastasis to the breast. Breast lymphoma poses a diagnostic challenge to radiologists due to non-specific imaging findings.Imaging findings: Features of breast lymphoma on imaging, such as a mass, skin changes and lymphadenopathy, will be discussed and illustrated with case examples on mammography, ultrasound, MRI and PET/CT. Features which distinguish more common breast cancers from breast lymphoma, such as spiculation, distortion and calcification will also be discussed. Breast implant associated anaplastic large cell lymphoma, an important consideration in women with history of implants, will also be illustrated.Conclusion: Breast lymphoma can be indistinguishable from other breast malignancies on imaging alone. However, clinical history and certain imaging features can provide clues. Tissue sampling provides definitive diagnosis.

BREE-19   Breast Malignancies After Mastectomy With Autologous Or Implant Reconstruction

Participants
Amy Maduram, MD, San Diego, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) After mastectomy, patients face a plethora of options such as immediate vs delayed reconstruction and autologous flap vs implant placement. Since no standardized screening guidelines currently exist for imaging the reconstructed breast, it is vital for radiologists to be aware of the different presentations of malignancies after mastectomy. (2) Most recurrences present as palpable subcutaneous masses at the flap margin or edge of the implant and may be mammographically occult or incidentally identified on

surveillance imaging. Implant-associated lymphoma and new primary malignances in residual breast tissue are also possible after mastectomy. (3) Surgical and oncological treatment varies: local sites of malignancy can be treated with wide excision and chemoradiation. Multiple sites of recurrence or involvement of the flap pedicle may necessitate removal of the reconstruction.

TABLE OF CONTENTS/OUTLINE

(1) Overview of post-mastectomy reconstruction: (1a) Patient choice to reconstruct or not (1b) Current techniques and types of autologous and implant reconstruction (1c) Surgical complications after mastectomy such as residual breast tissue. (2) Challenges to screening and imaging the reconstructed breast. (3) Cases of recurrence after implant. (4) Cases of recurrence after autologous reconstruction. (5) Cases of additional malignancies in the post-mastectomy breast. (6) Self-assessment quiz.

BREE-2   Benign Mammography Findings: Tips And Tricks. Proceed? No Need!

Awards
Certificate of Merit

Participants
Marcela Lauar, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To demonstrate benign findings in mammography that do not require further investigation, and can be diagnosed in the mammography itself, sparing patients from unnecessary exams, procedures and psychological impairment. To didactically illustrate the most common benign features in mammography, and how to differ them from similar suspicious findings.

TABLE OF CONTENTS/OUTLINE

Evaluation of benign mammography findings from our service's personal archive, including calcifications, lesions containing fat, skin lesions, silicone-related findings, muscular anomalies, among others. Complementary ultrasound and magnetic resonance image are also included in this presentation on the purpose of correlating the image methods, although not necessary to diagnosis.Take home messages.References.

BREE-20   Breast Imaging Controversies In The Elderly: To Screen Or Not To Screen

Awards
Identified for RadioGraphics

Participants
Cindy Lee, MD, Woodbury, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Controversies of breast cancer screening in elderly: • Inconsistent recommendations: Women over age 74 excluded from all randomized control trials; best evidence from observational and modeling studies. • Overdiagnosis: Low with benefits outweighing risks until age 90. • False-positives: Screening mammography is more effective in older women with higher cancer detection rates and fewer false-positives. • Overtreatment: Cancers in older women have more favorable tumor biomarkers and histology subtypes, offering many treatment options. Many older women want to be treated and are more likely undertreated. • New technology: Digital breast tomosynthesis further improves screening accuracy in all ages. • Upper age limit for screening: Annual screening yields the greatest mortality reduction with most cancer deaths saved and life-years gained in women > age 70 years

TABLE OF CONTENTS/OUTLINE

1. Intro: Compare existing breast cancer screening guidelines for elderly from U.S. and international organizations; Consider trends in life expectancy. 2. Review outcomes of screening from clinical trials, observational studies and modeling predictions. 3. Analyze controversies of breast cancer screening in elderly. 4. Understand screening underutilization and breast cancer undertreatment in the elderly. 5. Decide when to stop screening in the elderly based on age, individual preferences, overall health and comorbidities

BREE-21   Health Disparity And Breast Cancer Outcomes In Asian Women: A Case-based Analysis

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Yiming Gao, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Breast cancer disparity in Asian women is not well understood due to a relative paucity of data and a perception of lower cancer incidence and higher survival as compared to other racial ethnic groups. However, Asian women are prone to early onset breast cancer and have a propensity for HER2 enriched tumors. According to CDC data published in 2021, among Asian/Pacific Islander women, 35% of all new cancers are breast cancers, and breast cancer incidence is rising. The Asian diasporas represent the fastest growing demographic in the United States, albeit heterogenous across a wide cultural and socioeconomic spectrum. Thus, race alone does not sufficiently account for the complex disparities that exist. We will discuss challenges and nuances in breast cancer diagnosis, management, and prevention in these patients via a case-based review.

TABLE OF CONTENTS/OUTLINE

1. Background a. Rising incidence b. Asian diversity 2. Immigrants vs US-born Asians a. Longer stay in US --> rising breast cancer risk b. Prior data: lower risk in immigrant than US-born c. New data: higher risk in immigrants than US-born 3. Breast density in Asians a. Higher density overall b. Risk distinct from whites c. Density vs BMI vs Risk d. Effectiveness of conventional screening 4. Tumor biology a. Early onset (<age 40) b. HER2+ prevalent 5. Poor screening attendance a. Regardless of status, wealth, access b. Cultural perceptions 6. Clinical implications

Demystifying The Diagnostic Display

Participants
Sherwin Chiu, MD,MPH, Augusta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Understand specifications used to describe mammography monitors.2) Recognize the impact of monitor specifications on image interpretation.3) Identify differences between 5-megapixel and 12-megapixel monitors.4) Learn to use calibration patterns for equipment auditing

TABLE OF CONTENTS/OUTLINE

1) Introduction to important monitor specifications.a) Resolution - the number of pixels the monitor can use to display images.b) Pixel pitch - distance between the center of two adjacent pixels which is the same as pixel width.c) Bit depth - the number of different shades of grey a single pixel can display.d) Viewing Angle - degree to which images can still be viewed with acceptable quality.2) Detector vs monitor resolution.a) 70 - 140 microns vs 165 - 168.6 microns.b) Binning is required due to larger pixel size on both 5MP and 12 MP monitors, but causes information loss.3) Comparing 5 MP and 12 MP monitors.a) Size - significant difference.b) Resolution - similar in dual vs single setup.c) Bit depth - functionally similar.d) Pixel width - similar.e) Color depth - major advantage for multi-modality use.f) Summary of differences found in study comparing 8 MP vs 5 MP monitors.4) Evaluation of monitor function and quality assurance.a) Understanding quality control patterns.b) Use of patterns to evaluate both spatial resolution and contrast.

BREE-24 **Calling The Shots: What Radiologists Need To Know About Axillary Lymphadenopathy In The COVID Era**

Awards
Cum Laude
Identified for RadioGraphics

Participants
Meng Zhang, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Axillary lymphadenopathy is a known side effect of mRNA-based COVID-19 vaccines, which may present a diagnostic dilemma on imaging for high risk and oncologic patients.2. Breast radiologists should be familiar with evolving data regarding vaccine-induced lymphadenopathy to minimize the confounding effect on breast cancer patients in different stages of treatment and surveillance.3. Careful review of patients' clinical and vaccination history, as well as ancillary imaging findings, help inform management of axillary lymphadenopathy with goals to reduce unnecessary biopsy in the general screening and breast cancer survivor populations, while avoiding potential delays in diagnosis of metastatic disease in oncologic patients.

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• Summarize the incidence and onset timing of axillary lymphadenopathy in the Pfizer-BioNTech SARS-CoV-2 and Moderna SARS-CoV-2 vaccine trials with a literature review of emerging publications.• Illustrate the imaging and histologic features of reactive lymphadenopathy and axillary nodal metastasis, with an emphasis on patterns and locations of abnormal findings.• Discuss outcomes of axillary lymphadenopathy observed on imaging studies during initial work up, response to treatment, and survivor surveillance exams in the recently vaccinated patient.• Review important clinical considerations and ancillary radiologic findings to inform management decision of short-term surveillance versus further work-up including biopsy during the different stages of oncologic care.

BREE-25 **Axillary Lymphadenopathy In COVID-19 Vaccine Recipients: What To Do?**

Participants
Consuelo Gatica, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.- Recognize the typical findings of a pathological lymphadenopathy on ultrasound. 2.-Identify in which cases we should consider vaccination adenopathy. 3.- Learn the recommendations for the mannagement of axillary adenopathy in patients with recent Covid-19 vaccination

TABLE OF CONTENTS/OUTLINE

1.-Definition and classification of axillary lymphadenopathy. 2.-Ultrasound Features: Parenchymal cortical thickness, loss of fatty hilum, irregular outer margins, abnormal vascularization in color Doppler mode. 3.-Usual management of patients with axillary lymphadenopathy. 4.-Previous studies of axillary lymphadenopathy as vaccination side effects: Pfizer BioNTech, Moderna, Coronavac, Aztrazeneca. 5.-Important previous history: Timing and side (right v.s left arm) of vaccination , which type of vaccine, personal history of previous cancer, family history of breast cancer. 6.-Management algorithm and BIRADS for patients with axillary lymphadenopathy in context of recent Covid-19 vaccination. 7.-Local cases and our management

BREE-26 **Preoperative MRI Evaluation Of Lymphedema: The Role Of The Breast Radiologist**

Participants
Haydee Ojeda-Fournier, MD, San Diego, California (*Presenter*) Research Consultant, View Point Medical;Stockholder, CureMetrix, Inc

TEACHING POINTS

SYNOPSIS: Upper extremity lymphedema is a debilitating progressive swelling often caused by breast surgery and lymph node dissection. Physical therapy and manual lymphatic drainage can temporize the progression of symptoms. Evolving microsurgical techniques, including lympho-venous anastomosis and lymph node transplant, can improve clinical symptoms. The plastic surgeon requires a presurgical assessment to plan the type and location of the surgery. MR Lymphography has been shown to identify lymphatic channels and their depth and allows the surgeon to plan for the type of surgery and location of the incision. TEACHING POINTS: By the end of this educational exhibit, the learner will:1. Review the clinical significance of lymphedema.2. Know the

protocols for MR Lymphography.3. Appreciate the need for clinical and nuclear medicine correlation.4. Describe the role of breast radiologist in the workup and preoperative assessment of lymphedema.

TABLE OF CONTENTS/OUTLINE

Introduction; Nuclear medicine lymphoscintigraphy; MR protocols; Number of lymph nodes; Dermal thickening; Honeycomb; Epifacial fluid collection; Evaluation of muscular compartment; Fluid infiltration; Lymphatic channels; Additional findings; Grading of lymphedema; Surgical options: lymphatic-venous anastomosis (LVA) v. lymph node transfer; Clinical management; Conclusion.

BREE-28   Idiopathic Granulomatous Mastitis Of The Breast. Tips And Tricks For Diagnosis.

Participants
Rosa M. Lorente-Ramos, MD, PhD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To review idiopathic granulomatous mastitis of the breast, highlighting clinical presentation, pathological and imaging findings as well as differences from inflammatory breast cancer -To illustrate common and uncommon imaging findings (mammogram, US, MR) of cases from our series with pathological correlation. -To analyze and discuss the specific management of those lesions, including diagnostic difficulties and imaging work-up. -To emphasize pitfalls and clues to differential diagnosis.

TABLE OF CONTENTS/OUTLINE

Idiopathic Granulomatous Mastitis is a rare benign inflammatory condition of the breast which may mimic advanced inflammatory breast cancer and infections both clinically and on imaging. At pathology it is characterized by non-caseating granulomas around the lobules and ducts in the breast without specific infectious agents, trauma, or foreign bodies. Keys for differential diagnosis should be recognized. We present: 1. Definition. Pathology. 2. Clinical presentation of idiopathic Granulomatous Mastitis. 3. Imaging findings. Mammograms, US, MR, interventional procedures. 4. Differential diagnosis: Infections: acute Mastitis (puerperal and non-puerperal), Granulomatous infections: Tuberculous mastitis; Sarcoidosis and autoimmune diseases (Granulomatosis with Polyangiitis and giant cell arteritis); Inflammatory breast cancer. 5. Management and outcome.

BREE-29   What's On The Menu: A Smorgasbord Of Cases From A Safety Net Hospital

Participants
Kevin Dao, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Safety net hospitals provide care to a diverse and vulnerable population. Hence, radiologists who serve this community encounter a wide variety of pathologies, often presenting at advanced stages. This exhibit will utilize a case-based approach to explore breast diseases that present to the largest safety net hospital in New England. Each case will help educate radiologists not only about the disease and its management but also about the social determinants that may have contributed to the condition.

TABLE OF CONTENTS/OUTLINE

1.Overview of a typical patient population that presents to safety net hospitals with focus on demographics, socioeconomic status, language barrier, and other contributory social determinants of health. 2.Case based presentations of advanced diagnoses of breast disease frequently encountered in patients presenting to a safety net hospital. These diseases may include but not limited to locally advanced breast cancer, inflammatory breast cancer, granulomatous mastitis, papillomatosis, and implant associated complications. Rarer diagnoses will include less common infectious processes (filariasis, sparganosis, tuberculosis), rare inflammatory conditions (lupus mastitis, IgG4 disease) and neoplasms (fibromatosis, metaplastic carcinoma). 3.For each case, discussion focused on imaging presentation and management with teaching points focused on strategies to streamline care, systems-based adaptations, and community outreach, with the ultimate goal of improving outcomes now and in the future.

BREE-3   The Riches In The Niches Of Breast Cancer Tumor Board: A Radiologist's Guide To Post Mastectomy Radiation Therapy

Awards
Identified for RadioGraphics

Participants
Laura Machado, MD, Darby, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching points: Well-established indications for post-mastectomy radiation therapy (PMRT) are few, and examples include inflammatory breast cancer and > 3 metastatic lymph nodes found at axillary lymph node dissection.Broader indications for the use of PMRT such as metastatic nodes found at sentinel node biopsy are still evolving and require a multidisciplinary discussion of management at breast tumor board.Although the exact timing of reconstruction with respect to radiotherapy is still uncertain, delayed autologous reconstruction is preferable in most patients. There are critical decision-points in the use of PMRT at which the radiologist and key imaging findings play a pivotal role.

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Table of Contents/Outline Review established and controversial indications for post-mastectomy radiation therapy. Present cases for which a discussion of PMRT may arise at multidisciplinary breast tumor board and apply guidelines to the clinical dialogue. Discuss types and timing of breast reconstruction when PMRT will be performed. Discuss common complications of PMRT and provide examples. Identify critical decision-points in tumor board at which the radiologist plays a pivotal role.

BREE-30   Navigating Implantable Devices Seen On Breast Imaging

Participants
Robert Pugh, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

· Identify the array of implantable devices encountered on breast imaging studies · Review breast imaging techniques and special

Identify the array of implantable devices encountered on breast imaging studies.· Review breast imaging techniques and special considerations for patients with implantable devices.· Discuss methods of differentiating similar appearing devices.· Summarize artifacts associated with these implanted devices and methods of remediation.· Recognize potential complications seen with implanted devices in the breast.

TABLE OF CONTENTS/OUTLINE

· Imaging techniques/considerations/physics:-- Mammogram-- Ultrasound-- MRI· Positioning/additional views· Artifacts related to devices:-- Causes-- Corrections· Complications seen with devices:-- Lead, electrode, or catheter breakage-- Device malfunction-- Migration-- Infection· Case Examples with Imaging Findings:-- VP shunt-- Loop recorder-- Sleep apnea device-- Vagal nerve stimulator-- Dual and single chamber implantable cardioverter defibrillator (ICD)-- Pacemaker-- Bioabsorbable marker-- Suture-- Retained object-- Tissue expander-- Nipple piercing-- Localization devices: magnetic seed, RFID, I-125 seed, SaviscoutConclusions:· Various implantable devices can be seen on routine breast imaging studies.· Appropriate identification and characterization of these devices are key for optimizing imaging technique and reducing associated artifacts.· Complications with implantable devices can be detected on breast imaging studies and should be properly managed.

BREE-31   Breast Manifestation Of Hematologic Malignant Diseases

Participants
Priscila Zanin Nano Tjong, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Breast manifestations of hematological diseases are rare, and may mimic other breast malignancies. Since these pathologies have different treatment management, it is important for the radiologist to known this entities, in order to suspect the diagnosis. Our intent is to review how hematologic diseases manifest in the breast, by demonstrating a series of cases of multiple myeloma (MM), myeloid sarcoma and lymphomas in a multimodality imaging approach. MM is a primary malignancy of bone marrow characterized by clonal proliferation of plasma cells and production of monoclonal immunoglobulin. Only few cases of multiple myeloma are reported in the literature. Myeloid sarcoma is a neoplasm composed of immature granulocytes or monocytes that usually occurs in patient with history of acute myeloid leukemia. The presentation as a breast mass is uncommon, with only 67 cases reported in the literature.The most common histological subtype of breast lymphoma is a diffuse large B cell. It can manifest as a single or multiple masses or as an inflammatory-like appearance. PET-CT/FDG is highly sensitive and specific in the evaluation of treatment response, tumor staging and/or restaging.

TABLE OF CONTENTS/OUTLINE

Evaluation of a series breast manifestations of hematologic diseases by demonstrating imaging features in multimodality methods, such as ultrasound, magnetic resonance image (MRI) and positron emission tomography (PET-CT), based on our service's personal archive.

BREE-32   Not Every Finding In The Axilla Is Malignant. What Should Residents Know?

Participants
Karina Pesce, MD, Capital Federal, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate imaging features of normal and benign etiologies with correlates of cases from our database To discuss the diagnostic challenges and differential diagnosis

TABLE OF CONTENTS/OUTLINE

1-Introduction 2-Anatomy of the axilla. 3- Review benign etiologies such as inflammatory causes, infectious diseases, collagen vascular diseases, and miscellaneous. 4-Pictorial imaging of normal findings and benign pathology A-Accessory breast tissue B-Lymph node lesions: Reactive lymphadenitis, Intranodal silicone, Tattoo Pigment C- Vascular lesions: Mondor's Disease D-Neurogenic lesions: neuroma E-Skin and subcutaneous lesions: Epidermal cysts, lipoma F-Post-surgical complications: Seroma, Hematoma, silicone G-Muscular pathology: Poland Syndrome, Aggressive fibromatosis 5-Conclusions

BREE-33   Liquid Biopsy In Breast Cancer . What Should Radiologists Know?

Participants
Karina Pesce, MD, Capital Federal, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review liquid biopsy in oncology with emphasis in breast cancer. To discuss the potential role of liquid biopsy compared with needle core biopsy in the diagnosis of breast cancer. To analyze the role of the liquid biopsy in the management of breast cancer.

TABLE OF CONTENTS/OUTLINE

A liquid biopsy consists of anybody fluid that contains tumor material suitable for molecular characterization. Therefore, this term includes blood, the most used human liquid sample, but also other fluids such as urine, ascitic fluid, pleural effusion, cerebrospinal fluid, and saliva. Both primary tumors and metastases can release tumor material into these body fluids, mainly consisting of circulating tumor cells (CTCs), nucleic acids (cNAs), and extracellular vesicles (cEVs). Although Thomas Ashworth described the presence of tumor cells in the blood of breast cancer patients for the first time in 1869, it was not until recent years that the scientific community focused their attention on the study of blood CTCs. 1-Introduction 2-History of liquid biopsy in breast cancer 3-Histological biopsies versus liquid biopsy 4-Advantages and disadvantages 5-Ongoing trials of liquid biopsy in breast cancer 6-Challenges and practical considerations

BREE-35   Safe Use Of Contrast Media In Breast Imaging; A Practical Guide

Participants
Faezeh Sodagari, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

Vascular-based breast imaging is becoming more popular due to its high sensitivity. Contrast-enhanced breast MR, the most widely

used vascular-based breast imaging technique, relies on Gadolinium-based MRI contrast agents. Other emerging imaging techniques include contrast-enhanced mammography. Molecular-based imaging and contrast-enhanced ultrasound. Optimal use of these agents requires familiarity with safety guidelines, indications, patient selection, and prevention and management of short-term or long-term adverse events. This exhibit aims to review different types of contrast agents used in breast imaging, indications, patient selection, management of potential adverse events, safe use during pregnancy and breastfeeding, as well as controversies surrounding long-term or repeated exposures to contrast media.

TABLE OF CONTENTS/OUTLINE

1) Contrast-enhanced breast imaging modalities: i) Contrast-enhanced MRI ii) Contrast-enhanced mammography (CEM) iii) Molecular breast imaging iv) Contrast-enhanced ultrasound (CEUS) 2) Practical aspects of contrast administration i) IV access ii) Injection methods iii) Contrast extravasation 3) Patient selection i) Contrast reactions (a) Definition and types (b) Risk factors (c) Classification (d) Premedication (e) Treatment ii) Impaired renal function (a) Screening (b) Minimizing risk (c) Treatment iii) Pregnancy and breast-feeding 4) Controversies: i) Gadolinium deposition ii) Steroid premedication cost-effectiveness] iii) Off label, non-FDA contrast agents

BREE-36   Delays In Diagnosis Of Breast Cancer: An Emerging Phenomenon That Can Have Long-term Consequences.

Participants
Flavia Sarquis, MD, Buenos Aires, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

Mammography screening was paused during COVID 19 pandemic. Women risk having breast cancer diagnosed at a more advanced stage, contributing to higher rates of breast cancer-related deaths that could potentially have been avoided with regular screening.We are still catching up.Experts predict thousands of undiagnosed cancers.After reading this education exhibit the radiologist will know:COVID-19 had an acute impact on breast imaging facilities.Declines in screening can lead to delays in diagnosis.The disruption in breast cancer screening services for months due to the pandemic may add thousands of deaths from breast cancer this decade.

TABLE OF CONTENTS/OUTLINE

Challenges of providing medical care during a global pandemic.Experience of a breast imaging facility in screening, diagnostic , follow-up and interventional procedures.Future best practices for delivering breast imaging care amid the ongoing and geographically shifting COVID-19 pandemic.Illustrative based cases showing delayed breast cancer diagnosis. Conclusions

BREE-37   How We Do It: Intralesional Therapy For Granulomatous Mastitis.

Participants
Haydee Ojeda-Fournier, MD, San Diego, California (*Presenter*) Research Consultant, View Point Medical;Stockholder, CureMetrix, Inc

TEACHING POINTS

SYNOPSIS: Granulomatous mastitis is idiopathic inflammation of the breast. Recurrent aseptic abscesses, fistulous drainage, and pain lead to decreased quality of life. The etiology and management of this unusual process are controversial. Management ranges from observation to mastectomy. Core biopsy for exclusion of breast cancer is essential. A sample of aspirated fluid or a core biopsy sample should be submitted to Microbiology for culture, including AFB and fungal on initial evaluation to exclude an infectious etiology. A high dose of oral steroid therapy can be used for medical management. However, this can lead to significant side effects, including glucose imbalances and severe insomnia. Recent attempts at an intralesional injection of steroids in conjunction with the breast surgeon and rheumatology consultation have been reported in the literature. This educational exhibit demonstrates how we set up a program for intralesional therapy of granulomatous mastitis. TEACHING POINTS: By the end of this educational exhibit, the learner will: Review the clinical presentation of granulomatous mastitis. Understand current medical and surgical therapies. Learn the protocol for intralesional therapy for granulomatous mastitis.

TABLE OF CONTENTS/OUTLINE

Introduction; Clinical presentation and appearance; Imaging features by Mammogram, Ultrasound, and MRI; Medical Therapy; Surgical options; Hydrocortisone intralesional injections; Differential considerations; Clinical management; Conclusion.

BREE-38   Important Imaging Characteristics Following Ultrasound Guided Cryoablation Of Breast Cancer: 5 Year Follow Up From The ICE3 Trial

Participants
Kenneth Tomkovich, MD, Freehold, New Jersey (*Presenter*) Speakers Bureau, IceCure Medical, Inc

TEACHING POINTS

The purpose of this exhibit is: 1. To demonstrate the optimal technique to perform successful ultrasound guided cryoablation of primary breast invasive ductal carcinoma. 2. To review inclusion criteria, methods, and interim results of the ICE3 trial for the primary treatment of low-grade breast cancers using ultrasound guided cryoablation without surgical excision. 3. To illustrate important "new normal" imaging findings seen post treatment following breast cancer cryoablation including 5 year follow up mammography from the ICE3 trial. 4. Illustrate cases of post cryoablation biopsies with benign pathology to recognize commonly expected imaging findings to potentially avoid these biopsies in future patients.

TABLE OF CONTENTS/OUTLINE

Techniques of ultrasound guided breast cancer ablation. Cryoablation as a primary treatment for low-risk invasive ductal carcinoma of the breast. Review of the ICE3 trial and associated imaging findings post breast cancer cryoablation: Mammography-Ultrasound-MRI-Image guided biopsy. Future implications.

BREE-39   Early Lessons Regarding Management Of COVID-19 Vaccine Related Adenopathy On Breast MRI

Participants
Samantha Zuckerman, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. COVID-19 vaccination-related adenopathy may include any of the following imaging features: a. Level I, II, III involvement b. Surrounding soft tissue inflammation and edema c. Diffuse nodal enlargement with cortical thickening and loss of fatty hila d. May spare adjacent lymph nodes2. Follow-up to resolution should be tailored to individual cancer risk, allowing adequate time for resolution without impacting or delaying diagnosesa. Women with prior or current history of malignancy should have shorter follow-up times than those undergoing high risk or supplemental screening3. Other vaccines, such as Shingles and Pneumovax, may also cause adenopathy. Follow-up may be based on COVID-19 vaccination-related adenopathy guidelines.

TABLE OF CONTENTS/OUTLINE

1. Overview of evolving literature on COVID-19 vaccination-related adenopathy and controversy regarding delays in breast cancer screening 2. Discussion of how management decisions should differ in high-risk MRI screening populations versus average risk screening population 3. Examples of MRI-detected COVID-19 vaccination-related adenopathy and follow-up outcomes 4. Reporting of early outcomes data - length of follow-up and biopsy outcomes

BREE-4   Piercing The Pectoralis: Procedure Cases And Considerations

Awards
Certificate of Merit

Participants
Nancy Emelife, MD, Stanford, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Upon completion of this educational exhibit, participants will be able to: 1) List differential diagnoses for pectoralis major muscle-associated lesions. 2) Demonstrate optimal patient positioning and procedure techniques when sampling masses within/adherent to the pectoralis major muscle or aspirating fluid collections deep to the pectoralis major muscle. 3) Describe sampling techniques to prevent pneumothorax. 4) Recognize surgical considerations for masses suspected to be non-mammary malignancies before biopsy. 5) Identify situations that may indicate CT-guided biopsy as an alternative to US-guided biopsy.

TABLE OF CONTENTS/OUTLINE

Background: 1) Pectoralis major muscle-associated primary/recurrent breast malignancies versus non-mammary origin masses. 2) Technical challenges and considerations for safe use of ultrasound or CT guided biopsy (i.e. patient positioning, needle orientation, biopsy trajectory, and sampling technique). 3) Indications for pre-biopsy planning with surgeon. Cases: Pictorial review of 5 US-guided and 1 CT-guided biopsy procedures of lesions associated with the pectoralis major muscle: 3 recurrent breast cancers within the pectoralis major muscle, 1 invasive breast cancer densely adherent to the pectoralis major muscle, 1 postoperative fluid collection deep to the pectoralis major muscle requiring aspiration for possible infection, and 1 mass within the pectoralis major muscle for which differential included sarcoma. Emphasis will be on technical/biopsy considerations and outcomes.

BREE-42   Catch Me If You Can- Paget's Disease Of The Breast

Participants
Alisha Rathi, MD, Manhasset, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. More common in 5th or 6th decades, Males > Females, and usually unilateral 2. Presents as an ulcerated, crusted, or scaling lesion on the nipple that can involve the areola 3. Diagnosis may be delayed given overlap of clinical findings with more common diseases (i.e, eczema, allergic contact dermatitis, and psoriasis). Punch biopsy is performed to diagnose PD 4. Dedicated mammogram and ultrasound is critical as 95-98% of patients will have concomitant malignancy in the breast 5. Prevalence of multifocality is 40% and multicentricity is 34% 6. In patients with symptoms suggesting PD, consider magnification mammographic views of the anterior breast to assess the nipple areolar complex for suspicious microcalcifications 7. Radiologists should be familiar with the normal appearance of the nipple on breast MR to differentiate it from PD or other pathologies including inflammatory breast cancer and nipple involvement by retroareolar breast malignancy.

TABLE OF CONTENTS/OUTLINE

1. Epidemiology of Paget's Disease (PD) ?2. Clinical and Pathologic features ?3. Imaging Findings ? a. Multimodality imaging findings ? b. Differentiating normal nipple from PD on breast MR ? c. Recognizing PD from involvement of the nipple by breast parenchymal disease. ?4. Benign and malignant mimics ?5. Diagnosis, treatment, staging/prognosis

BREE-43   Breast Cancer Recurrence: How To Predict The Predictable?

Participants
Priscila Zanin Nano Tjong, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

After treated, breast cancer may reappear even after some time in the absence of disease, usually in the first 5 years. The risk of recurrence depends on many factors, and special attention should be focused on patients considered high risk for breast recurrence. This presentation shows some examples of how predicting tools for recurrence of breast cancer were helpful in diagnosing the condition in early stages, during follow-up image exams, sparing the patient from treating a more evolved disease in the future. Our intent is to didactically show how recurrence breast cancer predictors, like PREDICT Score, can be an important tool for radiologists, and how to use this resource in our medical practice.

TABLE OF CONTENTS/OUTLINE

To illustrate cases in which breast cancer recurrence was spotted in image follow up exams, based on our service's personal achieve, including MMG, US, MRI, PET-CT, of the cases presented, as well as the correlation with their risk factors for recurrence, including average survival rate and risk category provide by predict tools.

BREE-45   Mammographic Appearance Of Iatrogenic And Non-iatrogenic Foreign Bodies In The Breast

Participants
Shama Jaswal, MBBS, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review common foreign bodies found at breast imaging and their mammographic appearance.2. Demonstrate mammographic findings of iatrogenic foreign bodies: Surgical and biopsy clips and lines/ tubes/ medical devices. 3. Demonstrate mammographic findings of non-iatrogenic and traumatic foreign bodies: Gunshot shrapnel and jewelry / adornments / tattoo ink. 4. Describe the strengths and weaknesses of mammography, ultrasound, and MRI in the evaluation of foreign material identified at breast imaging.

TABLE OF CONTENTS/OUTLINE

1. Common foreign bodies found at breast imaging and their mammographic appearance a. Iatrogenic foreign bodies i. Description of the unique appearance of a variety of iatrogenic foreign bodies ii. Example cases include surgical and biopsy clips, lines, tubes, and medical devices b. Non-iatrogenic foreign bodiesi. Description of the unique appearance of a variety of non-iatrogenic foreign bodies ii. Example cases of traumatic non-iatrogenic foreign bodies: gunshot shrapnel iii. Example cases of non-traumatic non-iatrogenic foreign bodies: tattoo ink2. Describe the strengths and weaknesses of mammography, ultrasound, and MRI in the evaluation of foreign material identified in breast imaginga. Mammography: i. Highly sensitive ii. Safe to detect metallic material and medical devicesb. Ultrasound: i. Cost-effective and safe; may detect an abscess ii. Limited deep tissue resolutionc. MRI: i. May help to detect complications ii. Unsafe for ferromagnetic foreign material

BREE-46   Clinical Application Of Contrast Enhanced Spectral Mammography In Predicting Response To Neo Adjuvant Chemotherapy

Participants
Juan Qiu, Guilin, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To understand the technical concept of contrast enhanced spectral mammography(CESM) and its implementation. 2. To understand which type of lesion can be evaluated under CESM. 3. To know why CESM could provide an accurate assessment of tumor response after neo-adjuvant chemotherapy(NAC), comparable to that provided by MR. 4. To introduce quantitative objective evaluation in predicting response to neo-adjuvant chemotherapy with RECIST 1.1 and combined evaluation methods.5. To recognize the limitations and benefits of CESM in treatment monitoring.

TABLE OF CONTENTS/OUTLINE

1.Background and physics of Contrast Enhanced Spectral Mammography. 2. Clinical application of CESM in acting as a promising modality of follow-up of cases after NAC. 3. Variables influence tumor shrinkage and its evaluation during NAC, including primary tumor size, edema or necrosis.4. Qualitative and quantitative evaluation of CESM in Predicting Response to NAC. 5. Benefits and limitation of CESM.

BREE-47   Implementation Of A Breast Biopsy Clinic: Engaging Medical Students

Participants
Eric Swy, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

Key considerations when implementing a breast biopsy clinic for maximum engagement of learnersDefine radiologist role in patient breast careCreation of realistic breast biopsy models and targetsHow to implement hands-on experience with ultrasound (US), multiple biopsy devices, and US/stereotactic biopsy techniquesUnique layout considerations for US and stereotactic/tomosynthesis clinicsHow to create an effective and safe environment for procedural skill developmentHow to provide constructive feedback while building confidence and procedural competenceConsiderations for longevity and sustained success of the breast biopsy clinic

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Introduction to the breast biopsy clinic at our institutionPotential breast biopsy modelsChicken BreastKnox Gelatin with Metamucil RecipeBolognaFuture: 3D printed breastPotential biopsy targetsOlives Blueberries Eggshells - calcifications Fluid-filled glove/balloon - cystsRoles, Mentoring, Graduated ResponsibilitiesSpecial considerationsContact vendor for expired devicesBlock set time when US/mammography unit is not in useLayout of US ClinicIntroduction to the US unitNumbing techniquesNeedles and biopsy devicesTechniques: Open-chamber vs closed-chamber Clip placementLayout of Stereotactic/Tomosynthesis ClinicIntroduction to Mammography UnitApproachPositioningTargetingSampling techniqueCheckoutSkill demonstrationWeekly clinicsProgression of skillsChallenging biopsy targetsFuture ImprovementsConclusion

BREE-48   Easy-Peasy! Simplifying Breast Cancer 8th American Joint Committee On Cancer (AJCC) Staging System

Participants
Ayla Yamamoto Mota, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Describe and illustrate the preoperative staging of breast cancer with the 8th American Joint Committee on Cancer's (AJCC) staging system.- Emphasize radiologist's role in recognizing and reporting breast cancer imaging findings that can change staging and clinical / surgical management.- Discuss the major changes in the 8th AJCC's staging system.

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- Introduction: description of the major changes in the 8th AJCC's staging system.- Anatomic staging system: discuss the categories of the anatomic staging and emphasize the key information that the radiologist must search and report.- Prognostic staging system: focus on important concepts for the radiologist.- Ultrasound, mammography and magnetic resonance images: illustrate and facilitate the understanding of the categories of the staging system.- Conclusion

BREE-49   Mammographic Asymmetries BI-RADS V5 Edition: Pearls And Pitfalls, Discussion N Multi-modality Imaging And Correlation With Pathology

Participants
Shima Roknsharifi, MD, Bronx, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

An asymmetry is defined as a unilateral mammographic density with concave margins, not meeting criteria for a mass. Depending on the type, asymmetries are present on 0.3-0.9% of screening mammograms and correlate with malignancy up to 15% of the time. Therefore, it is important to further evaluate and manage asymmetries based on the BI-RADS standardized approach. This presentation aims to discuss asymmetry classification based on the fifth edition of the BI-RADS lexicon, to define management protocols including appropriate BI-RADS category assignment, and to consider the differential diagnosis and pathologic correlation for asymmetries.

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Classification asymmetry, focal asymmetry, developing asymmetry, global asymmetry. Algorithmic approach to the finding. Assigning appropriate BI-RADS category and management plan. Differential diagnosis: Broad with main consideration of *benign lesions: Normal variation, post-traumatic/surgery including post reduction and fat necrosis, pseudoangiomatous stromal hyperplasia (PASH), diabetic mastopathy, infection/inflammation. *Malignancies: invasive ductal carcinoma (including different variants), invasive lobular carcinoma. Pathology related to each differential diagnosis.

BREE-5   Metastasis To The Breast.What Radiologist Should Know?

Participants
Karina Pesce, MD, Capital Federal, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

To discuss the major clinical, imaging and histological features that will be helpful in order to achieve a proper diagnosis and management. To illustrate imaging features and pathological correlates of cases from our database. To discuss the diagnostic difficulties and differential diagnosis of these cases.

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Metastasis is a term used to describe the spread of tumor cells from primary sites to surrounding structures and distant sites. It is considered a significant cause of morbidity and mortality. Distant metastasis is an indicative marker of the aggressive nature of the primary tumor. The clinically observed rate of breast metastases from extrammary malignancies is rare, ranging from 0,2 to 1,3%.Cancers that most frequently metastasize to breast parenchymal include Lymphoma, Melanoma and less frequently: Lung, Ovarian, Carcinoid tumors, Hypernephromas, Carcinomas of the liver, Tonsil, Pleura, Pancreas, Cervix, Perineum, Endometrium and Bladder. The recognition of metastases to the breast from extramammary tumor is clinically important. Most patients are treated with systemic therapy or palliative care, so accurate preoperative diagnosis guides appropriate management including the avoidance of unnecessary surgery.

BREE-50   Scoring A Triple Whammy: Understanding The Clinical, Pathologic, And Imaging Features Of Triple Negative Breast Cancer

Participants
Iris Chen, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Triple-negative breast cancer (TNBC) is a subgroup of breast cancer without estrogen, progesterone, or human epidermal growth factor receptors. TNBC represents 15-20% of all breast cancers and is associated with BRCA. Key imaging features of TNBC on mammography include irregular shape, ill-defined, and spiculated margins. On ultrasound, TNBC tends to appear as a hypoechoic or complex mass with an irregular shape and non-circumscribed margins. Magnetic resonance imaging (MRI) is the most accurate imaging modality to evaluate TNBC and demonstrates intra-tumoral T2 hyperintense signal and rim enhancement on post-contrast images. TNBC has a poor prognosis given its aggressive course, high rates of recurrence, and limited therapeutic options given its lack of target receptor expression. Prompt recognition and diagnosis by imaging is essential. Treatment often involves chemotherapy, and MRI can be used to predict chemotherapy efficacy and pathologic complete response.

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This exhibit will review the epidemiology, imaging features, pathology correlation, treatment/management, and prognosis of TNBC. We will discuss the key imaging findings of TNBC on multi-modality imaging and discuss the sensitivity and specificity of each feature. We will review how to distinguish TNBC from similar-appearing benign and malignant breast masses to avoid pitfalls in misdiagnosis. Lastly, these concepts will be reinforced through illustrative cases and interactive quiz questions.

BREE-51   Imaging Of The Pediatric Breast: Review Of Normal Development And Spectrum Of Pathology

Awards
Identified for RadioGraphics

Participants
Sonia Phadke, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Pediatricians may refer patients for breast imaging, typically ultrasound, for a number of reasons. Unlike the adult population, primary breast cancer is extremely rare in the pediatric population, which may signal that pediatric breast imaging is overutilized. Recognition of normal adolescent breast development and its variants is integral when interpreting pediatric breast imaging.? Most commonly, pediatric breast masses are benign entities including fibroadenoma, cyst, fibrocystic changes. Rarely do pediatric breast masses display malignant potential. Management of pediatric breast masses is more conservative than that of adult breast masses with history and clinical exam playing a crucial role in diagnosis and management.

BREE-52 Hiding In Plain Sight: Non-mass Lesions At Breast US

Participants
Julia Colombo, MD, Buenos Aires, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

• A non-mass finding is a focal area of alteration in the echo-structure different from that of the surrounding glandular tissue and from that at the same place in the contralateral breast. It is a subtle finding that does NOT conform to a mass shape. • It can be categorized by echogenicity (hypoechoic, hyperechoic, mixed) and distribution (isolated focus, multiple foci, speckled pattern, tubular-ductal, regional, lineal-segmentary). • Associated features such as posterior attenuation, calcifications, an echogenic halo and architectural distortion help to distinguish them. • Color Doppler is not always determinant. • Correlation of non-mass findings at US with mammogram and MRI findings is essential for a correct interpretation and categorization. • While at present it is not included as a BIRADS descriptor, its appearance is sometimes suspicious and biopsy is necessary. • The vast majority of this findings are benign, but when malignant, DCIS and ILC are the most frequent pathologies.

BREE-53 Hindsight Is 2020: Understanding The Impact Of The COVID-19 Pandemic On A Provincial Population-based Organized Breast Screening Program

Participants
Helena Bentley, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

The COVID-19 pandemic has widely disrupted modern healthcare systems. Access to timely, high-quality organized breast screening programs (OBSPs) remains essential to improved patient outcomes.Using data generated from our provincial cancer organization, which exclusively serves a provincial population of over 5 million residents, upon review of this educational exhibit the reader will be better able to: (1) recall the initial response of our provincial population-based OBSP to the COVID-19 pandemic; (2) describe the decrease in screening volumes in this program as a result of the COVID-19 pandemic and the disproportionate effects observed on certain segments of the population; (3) recognize the impacts of the subsequent decrease in downstream referrals of patients to provincial cancer centers for further evaluation; (4) estimate the decrease in early detection and diagnosis of breast cancer attributed to the aforementioned decrease in screening volumes; and (5) discuss recovery strategies employed.

BREE-54 Fast And Furious Breast Lesions: Not All Bad!

Participants
Chloe M. Chhor, MD, Brooklyn, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this educational exhibit is to:Review kinetic assessment in differentiating between benign and malignant breast lesions.Describe differences in kinetic assessment between abbreviated/ultrafast and standard dynamic contrast enhanced MRI.Illustrate with example cases of benign breast masses with early phase enhancement.Discuss the role of T2-weighted and T1 precontrast non-fat sat sequences in categorizing early enhancing breast lesions as benign or suspicious.

BREE-55 COVID-19 and Breast Cancer: To Screen or Not To Screen?

Participants
Julia Colombo, MD, Buenos Aires, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

• In a pre-COVID-19 era it was said that 1 in 8 women would have breast cancer before the age of 80. • Breast cancer screening in women is extremely important because it allows us to detect subclinical lesions that treated properly and in a timely fashion give our patients a better chance of survival. • During the COVID-19 pandemic thousands of women chose to postpone their breast cancer screening studies. • On the early stages of the pandemic scientific societies recommended to postpone breast cancer screening in women with previously normal studies (BIRADS 1 and BIRADS 2 categories). Afterwards scientific societies encouraged

women to return to routinely breast cancer screening, nonetheless lots of women where fearful of returning to health care facilities.
• While the COVID-19 pandemic should be taken very seriously and we should do our best to avoid non-essential clinical practices, breast cancer screening, given its high prevalence, is of the utmost importance and should be performed complying with all the current protocols available for the safekeeping of our patients.

TABLE OF CONTENTS/OUTLINE

• Short overview of breast cancer screening recommendations during COVID-19 • Main objective of breast cancer screening, its benefits. • Cases of our clinical practice • Conclusion

BREE-56   Fat Necrosis: A Consultant's Conundrum

Awards
Certificate of Merit

Participants
JINITA MAJITHIA, MUMBAI, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching Points:1. To familiarize the radiologist to a wide range of imaging appearances of fat necrosis: Ranging from benign to malignant appearing.2. Optimize the use of different imaging modalities, like Mammography, Sonography, Contrast Enhanced Mammography and MRI, in diagnosing fat necrosis so as to avoid unnecessary procedures / biopsies.3. To advocate the importance of follow up: At times fat necrosis can have sinister appearances on initial imaging which on follow up reveal benignity.

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This exhibit will be contain different etiologies of fat necrosis ranging from post-traumatic, post-operative to post radiation, and their multi-modality imaging approach.Post-operative imaging appearances of fat necrosis following different procedures like breast conservative surgery and reconstructive surgery will be demonstrated.Post radiation fat necrosis following EBRT (External Beam Radiotherapy), APBI (Accelerated Partial Breast Irradiation) will be discussed. It will be a pictoral walk-through, through different appearances on various imaging modalities.

BREE-57   Insiders' Tips For Breast Imaging Proceduralists From Pathologists, Surgeons And Oncologists

Participants
Jameson Cumsky, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiologists performing breast imaging interventions play a critical role in supporting downstream care provided by their multidisciplinary colleagues, including pathologists, surgeons and oncologists. Through informed collaboration with multidisciplinary stakeholders, radiologists can implement strategies to modify their techniques for breast interventions to support high quality longitudinal patient care. Participants will learn: New pathological/oncological stains and biomarkers used by multidisciplinary team to enable high quality personalized care How to evaluate appropriateness of quality/quantity of biopsy specimens in real time and selection criteria for appropriate biopsy devices. Multidisciplinary suggestions regarding image guided biopsies, optimization of pathological investigation and processing of specimens, and strategies to avoid unnecessary surgeries and/or biopsies.

TABLE OF CONTENTS/OUTLINE

Background: Opportunity to share lessons learned from on-going multidisciplinary discussions regarding breast interventions at our tertiary care referral center. Overview of changing landscape for breast cancer specimen testing, new biopsy devices, and biopsy capabilities of new advanced imaging modalities. Strategies for breast interventions to optimize patient outcomes: Instrument selection Tissue sampling Information exchange and accurate lesion management Pathological and oncological evaluation and therapy Surgical outcomes following image guided localization

BREE-58   Beyond Breast Cancer: Chest Wall Masses On Breast Imaging

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Heba Albasha, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review normal breast chest wall anatomy and lymph node stations.Understand imaging findings which suggest lesion origin and chest wall invasion.Discuss the background and multimodality breast imaging features of various benign and malignant chest wall masses, recognizing that not all breast masses found on breast imaging are breast cancer.

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Breast/chest wall anatomyMuscles/Soft tissuesBonesLymph node stationsOverview of imaging workup MammographyUltrasoundMRIPositioning techniques/Field-of-view limitationsBenign and malignant chest wall mass cases:Inflammatory/Infectious massesCutaneous tumorsAdipocytic tumorsMuscular tumorsFibrous tumorsPlasma cell tumorVascular tumorsPeripheral nerve sheath tumorsOsseous and skeletal tumorsMetastasis from distant cancerLocally invasive breast cancerMetastatic breast cancer

BREE-59   Implementation Of Targeted Automated Breast Ultrasound In A Diagnostic Breast Imaging Clinic: How We Do It

Participants
Gary Wang, MD,PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Use of targeted automated breast ultrasound (ABUS) for diagnostic indications can promote care equity by increasing access to high quality diagnostic breast ultrasound (US) in settings with limited handheld breast US expertise. Successful integration of ABUS into the diagnostic breast imaging (BI) setting requires optimization of clinical workflow, image acquisition, and communication protocols. Familiarity with pearls and pitfalls of ABUS image acquisition and interpretation is essential to support confident imaging interpretation in the diagnostic setting. ABUS technologists and interpreting radiologists should be comfortable with problem-solving techniques related to image artifacts, patient groups, and exam indications.

TABLE OF CONTENTS/OUTLINE

We review:1. Rationale for employing ABUS as a diagnostic breast US modality2. Considerations when planning to implement ABUS in the diagnostic setting3. ABUS-integrated clinical workflow used in our diagnostic BI clinic4. Diagnostic ABUS image acquisition protocol5. Diagnostic ABUS interpretation and reporting6. Pearls and pitfalls of ABUS in the diagnostic setting: (a) Artifacts, (b) Problem-solving techniques, and (c) Incidental findings7. Case examples of diagnostic ABUS exams illustrating pearls and pitfalls

BREE-6   Update On Lobular Neoplasia

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Participants
Samantha L. Heller, MD, PhD, New York, New York (*Presenter*) Research support, Koios Medical

TEACHING POINTS

Management of lobular neoplasia (LN) is often controversial with known variability in approaches to this high-risk lesion. Historical shifts in understanding of the disease have contributed to confusion regarding excision versus surveillance. However, evolving recognition of both distinct histopathologic variants of LN and the importance of stringent radiologic-pathologic correlation offer potential for more consistent management strategies. In this case-based review, we will examine the distinct pathologic variants of LN and discuss the current literature with respect to evidence-based management.

TABLE OF CONTENTS/OUTLINE

1) Intro/wide variability in management of LN2) Historical shifts in understanding a) 1941 (Foote and Stewart)-DCIS precursor; b) 1970's (Haagenson/Rosen)-risk marker; c) 1992 (Eusebi)-pleomorphic LCIS and variants 3) Non-obligate precursor 4) Risk marker 5) Upgrade rates a) Rad-path correlation b) Rad-path concordance i) Sampling (Cores/Needle gauge/modality) ii) Lesion size iii) Incidental vs. targeted c) Histopathologic variants appropriately classified? 6) Short-term management - Case based review with rad-path correlation: a) Atypical Lobular Hyperplasia b) Lobular carcinoma in situ (LCIS) classic type c) Pleomorphic LCIS d) Florid LCIS 7) Long-term management: a) Chemoprevention and MRI screening 8) Summary

BREE-60   Phantoms For Ultrasound Breast Interventionism: A Low-cost Experience.

Participants
Giannina Secco, MD, Buenos Aires, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review different types of phantoms. To illustrate a step by step way to build one. To discuss the benefits of using them.

TABLE OF CONTENTS/OUTLINE

Phantoms are widely used for practicing interventional techniques, and in this poster we highlight the benefits of the home-made ones, specially for skill developing in ultrasound guided procedures of the breast. US is an economic, mobile, widely available, minimal risk and efficient technique, that allows a controlled advance of the needle in real time. These advantages combined with low cost phantoms, can lead to well prepared and confident residents/fellows before experiencing with real patients.

BREE-61   Multimodality Imaging Review Of HER2-Positive Breast Cancers And Response To Neoadjuvant Chemotherapy.

Awards
Cum Laude
Identified for RadioGraphics

Participants
Leah Portnow, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. HER2+ breast cancer patients have improved outcomes with newer targeted chemotherapies including first-line agents trastuzumab and pertuzumab.2. Calcifications are more commonly associated with HER2+ cancers, and calcifications remaining on mammography after neoadjuvant chemotherapy may or may not correlate with malignancy and pathologic tumor size.3. Breast MRI has the highest sensitivity and specificity in assessing residual disease burden when compared to the pathologic gold standard.4. The standard of care for detecting residual disease and thus overall prognosis is based on pathologic confirmation.

TABLE OF CONTENTS/OUTLINE

1. Overview of HER2+ breast cancer pathology and patient demographics2. Current Perspectives on Surgical and Oncologic Treatment of HER2+ breast cancers3. Review of Multimodality Imaging Findings of HER2+ breast cancers: A pictorial display of pre- and post-neoadjuvant chemotherapy casesa. Pathologic concordantb. Pathologic discordant4. Future directions of HER2 positive breast cancer - Imaging, Surgical Treatment, and Clinical Trials

BREE-62   Cutaneous Lesions Encountered In Breast Imaging

Participants
Brianna Vey, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

Nonmalignant and malignant breast dermatologic conditions can be encountered in breast imaging setting and be challenging to differentiate.Recognizing clinical features, multimodality imaging findings, and histologic diagnosis when needed is important to establish the diagnosis of breast cutaneous disorders.Understanding of specific imaging work up is crucial in management of breast cutaneous disorders.

TABLE OF CONTENTS/OUTLINE

IntroductionExhibit ObjectivesDescribe normal skin anatomy and imaging.Review common benign and malignant breast dermatologic conditions.Differentiate non-malignant breast cutaneous disorders and malignant breast conditions by reviewing associated clinical presentations, imaging findings with pathologic correlations.Discuss management of lesions including imaging work up of benign and malignant cutaneous breast conditionsCutaneous Breast ConditionsInflammatory (Benign) Skin lesionsi. Epidermal Inclusion Cystii. Benign Skin Calcificationsiii. Radiation Dermatitis iv. Hidradenitis Supportiva v. Skin abscessMalignant skin lesions i. Inflammatory Breast Cancer ii. Advanced Breast Cancer with Skin Involvement iii. Radiation Induced Angiosarcoma iv. Paget's Disease v. Metastatic Melanoma vi. Mycosis Fungoides vii. Kaposi Sarcoma

BREE-63   Common And Uncommon Masses Of The Nipple-areolar Complex

Participants
Jose Lopez, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.Present a pictorial review of commonly known and uncommon nipple-areolar complex lesions.2.Build a differential for nipple-areolar complex lesions using history and mammographic/sonographic/MRI findings.

TABLE OF CONTENTS/OUTLINE

1. Review radiologic and clinical presentations of commonly known benign and malignant lesions.2. Review radiologic and clinical presentations of uncommon benign and malignant lesions.

BREE-64   Breast Imaging In Children And Adolescents: From Science To Practice - A Pictorial Essay.

Participants
Vanessa Merjane, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review the basic concepts of embryology, anatomy and physiology of normal breast development.2. To discuss multimodality imaging features of common developmental abnormalities, benign and malignant breast diseases in children and adolescents through a case-based review. 3. To suggest a management algorithm based on clinical and imaging findings to avoid unnecessary procedures as well as delays in the diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Embryology 2. Anatomy 3. Physiology / Normal breast development 4. Review of imaging modalities 5. Developmental abnormalities 6. Benign cystic masses 7. Benign solid masses 8. Malignant masses 9. Management algorithm

BREE-65   Fibrous Capsule Lesions: Far Beyond Lymphoma

Participants
Natalia Lima, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:1. To emphasize imaging aspects of the normal fibrous capsule;2. To present different lesions originating from fibrous capsule other than lymphoma;3. To discuss the most frequent changes and lesions related to fibrous capsule and the imaging aspects in different methods (mammography, ultrasound and magnetic resonance imaging).

TABLE OF CONTENTS/OUTLINE

1. Illustrate with cases from our database the usual aspects of the fibrous capsule;2. Correlation of imaging findings with clinical aspects and histopathological results;3. Present and analyze the various presentations imaging findings of the most common lesions of the fibrous capsule and correlate with histopathological results, such as- Contracture;- Calcifications;- Masses;- Lymphoma.

BREE-66   Invasive Lobular Carcinoma: Imaging Aspects In Different Methods (mammography, Tomosynthesis, Ultrasound And Magnetic Resonance Imaging) And Correlation With Tumor Molecular Profile

Participants
Natalia Lima, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:1. To present, based on confirmed cases by percutaneous biopsy and/or surgery from January 2015 to March 2021, the main characteristics of invasive lobular carcinoma (ILC) in different methods of breast imaging (mammography, tomosynthesis, ultrasound and magnetic resonance imaging);2. To correlate the imaging findings with the tumor molecular profile (immunohistochemistry analysis);3. To demonstrate the main characteristics, including clinical aspects and forms of presentation of invasive lobular carcinoma according to each histological and molecular subtype.

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1. Illustrate the ILC aspects with percutaneous biopsy/surgical proven cases from our Breast Imaging Center, using the four different imaging methods:- Mammography;- Tomosynthesis;- Ultrasound;- Magnetic resonance imaging.2. Teaching cases showing the challenging aspects based on imaging findings and correlate with clinical and pathological findings in different scenarios, such as:- ILC - Late enhancement;- ILC - Synchronous invasive breast cancer;- ILC - Multifocal with microcalcifications;- ILC - MMG ocult;- ILC related to hormonal replacement therapy.3. Correlate the imaging findings with the immunohistochemistry profile of ILC

in the different histological subtypes:- Classic;- Solid;- Alveolar;- Mixed;- Tubulo-lobular;- Pleomorphic.4. Exemplify the imaging aspects of the ILC and its different molecular profiles:- Luminal A;- Luminal B;- HER2+;- Triple negative.

BREE-67   Breast Cancer In Pregnant And Lactating Women. What Do Residents Need To Know?

Participants
Giannina Secco, MD, Buenos Aires, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

To discuss the key clinical, and imaging features helpful to properdiagnosis and management. To illustrate imaging features and pathological correlates of cases from ourdatabase. To discuss the diagnostic difficulties and differential diagnosis

TABLE OF CONTENTS/OUTLINE

Breast cancer is the second most common cause of oncological death around the world, only surpassed by lung cancer. In addition, breast cancer is one of the most commonly diagnosed malignancies during pregnancy, followed by blood and skin cancers.In the presence of a palpable or symptomatic mass in a pregnant or lactating patient, it is warranted to investigate the aetiology of the abnormality. The management of pregnant and lactating patients is safe and must be done in a multidisciplinary way.

BREE-68   What Lurks Beneath The Shadows: The Diagnostic Challenges Of Nipple And Retroareolar Breast Masses

Participants
Jason Chan, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

Approximately 8% of breast cancers are situated in the retroareolar region (within 2 cm of the nipple), and cancers in this area are considered more challenging to diagnose and biopsy than cancers elsewhere in the breast. The overall rate of missed breast cancers has been reported as high as 35%, and this may be higher in the retroareolar breast. Since missed cancers may have devastating consequences, it is imperative for radiologists to be aware of the challenges and commonly missed areas, or "blind spots", such as the retroareolar region. The purpose of this educational exhibit is to raise awareness of the diagnostic challenges in detecting retroareolar cancers and to provide tips on how radiologists can improve their detection of retroareolar cancers through a pictorial review of missed and interesting cases.

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The challenges of retroareolar masses and tips to avoid missed lesions: how to optimize visualization and assessment of the retroareolar "blind-spot", the increasing role of using MRI for problem solving and evaluation of nipple discharge, and the importance of correlating imaging findings with a physical exam.Tips on how to biopsy retroareolar and intraductal masses and review the common and more rare pathologies.

BREE-69   Breast Cancer Screening In Childhood Cancer Survivors: An Update In Evidence-based Risk Management

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Participants
Yiming Gao, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Breast cancer risk among childhood cancer survivors remains substantial despite advances in radiation therapy to curtail exposure. Cumulative risk among survivors of Hodgkin's lymphoma is up to 25% by age 45 vs. 1% in the general population and rises with time, and breast cancer survival is worse among these patients. Current screening guidelines focus on prior exposure to chest radiation, but the spectrum of at-risk survivors is wider. Compared to BRCA mutation carriers who have similar breast cancer risk, childhood cancer survivors have significantly poorer adherence to screening despite its mortality benefits. We will discuss new evidence in risk-based screening in the context of modern therapy, and consider challenges and mitigating strategies.

TABLE OF CONTENTS/OUTLINE

1. Childhood Cancer Survivors a. Exposure to developing breast tissue b. Average age breast cancer ~ 40 2. Breast cancer in young survivors a. High risk if XRT < age 30, dose = 10 Gy b. Prone to Triple Negative cancers 3. Risk considerations a. Low dose/large field --> ? risk b. High dose/small field --> ? risk c. XRT + Chemo (synergistic) --> ?? risk d. Chemo without XRT --> ? risk 4. Radiation therapy advancement a. Smaller field, Lower dose, Conformal techniques b. Mantle XRT dose (~40 Gy) >> Modern therapy 5. Screening guidelines a. Annual screening age = 25 or 8 years after XRT, whichever later b. Mammogram + MRI --> highest sensitivity/specificity 6. Poor screening adherence (12.6-57.1%) a. Transition from pediatric to adult care challenging 7. Case-based review

BREE-7   Breast Masses In Children And Adolescents

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Participants
Laura Harper, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Review breast embryology, early and pubescent breast development and recognize the spectrum of variations of normal development.-Compare various imaging modalities and best practice guidelines for evaluating breast masses in children and adolescents and understand why the diagnostic approach to the developing breast is different from that of the adult breast.-Learn a wide range of common and uncommon benign, borderline and malignant lesions of the pediatric breast and their diagnostic

management.

TABLE OF CONTENTS/OUTLINE

This will be a multimodality case-based review of the spectrum of breast masses in children and adolescents. The appropriateness of various imaging modalities, diagnostic imaging approach and next steps in management will be emphasized. Clinical images and pathologic slides will be included when available.Development: Breast embryology, pre-pubertal breast buds, five tanner stages of pubertal breast development.Normal variations of normal breast development: Asymmetric breast buds, accessory breast tissue, gynecomastia.Infection: Abscess/mastitis.Lymphatic/Vascular: Infantile hemangioma, lymphangioma.Benign masses: Cyst, fibroadenoma and juvenile fibroadenoma, intraductal papilloma and juvenile papillomatosis, pseudoangiomatous stromal hyperplasia.Borderline breast masses: fibroepithelial lesions, phyllodes tumor, neuroblastoma-like schwannoma.Malignant breast masses: invasive ductal carcinoma, lymphoma, rhabdomyosarcoma.

BREE-70   Tomosynthesis Guided Breast Procedures: Pearls And Pitfalls

Participants
Tali Amir, MD, Montvale, New Jersey (*Presenter*) Nothing to Disclose

TEACHING POINTS

Digital breast tomosynthesis (DBT) guided breast procedures have expanded to include both breast biopsy and preoperative localization. DBT procedures offer advantages of increased conspicuity of low contrast lesions, as well as time and dose reduction. Recognizing advantages, pitfalls and problem-solving techniques for DBT guided procedure can help ensure success.

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Through a case based series, we will discuss: 1. DBT guided biopsy a) Appropriate clinical setting b) Advantages over traditional DM stereotactic biopsy c) Potential pitfalls d) Problem solving techniques 2. DBT guided preoperative I-125 seed localization a) Appropriate clinical setting b) Advantages over traditional two-view preoperative localization c) Potential pitfalls d) Problem solving techniques

BREE-71   When A 5 Is Benign: Pictorial Review Of Breast Malignancy Mimics

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Participants
Bill Zhou, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

There are a multitude of benign, high-risk, inflammatory, post-surgical, and artifactual breast entities which can mimic features of malignancy. Frequently, these entities prompt tissue biopsy and not infrequently, they cause additional workup due to radiologic-pathologic discordance, causing both emotional stress and financial burden for patients. Based on our institution's own experience, the most over-called discordant findings resulting in additional excisional biopsy are stromal fibrosis, fat necrosis, and radial scar on final pathology. The objectives of this exhibit are to 1) recognize common and uncommon mimics of breast malignancy and 2) appreciate their mammographic, ultrasound, and MRI imaging characteristics with the hopes of reducing unnecessary surgical interventions.

TABLE OF CONTENTS/OUTLINE

Benign Entities: 1. Fat necrosis 2. Stromal fibrosis 3. Sclerosing adenosis 4. Fibroadenoma 5. Hemangioma 6. Pseudoangiomatous stromal hyperplasia 7. Intrammmary lymph node. 8. Granular cell tumor.High-risk Entities: 1. Atypical lobular hyperplasia 2. Atypical ductal hyperplasia 3. Usual ductal hyperplasia 4. Lobular carcinoma in situ 5. Papilloma 6. Radial scar/complex sclerosing lesion 7. Phyllodes tumor.Inflammatory Entities: 1. Mastitis 2. Diabetic mastopathy 3. Mondor disease.Post-surgical: 1. Post-surgical changes 2. Scar tissue 3. FloSeal 4. Bovie artifact.Artifacts: 1. Dead pixels 2. Dust on detector 3. Motion artifact.

BREE-72   Artificial Intelligence In Breast Imaging: What's Going On In Real World?

Participants
Fernamda Amorim, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Breast imaging has become the most clinical of radiology's specialties. A complex workflow including multimodality diagnostic evaluations, high patient volume, outcome audits is part of routine for breast imagers. Newer artificial intelligence (AI) methods, particularly deep learning (DL), are showing great promise improving diagnosis, clinical decision making, patient outcomes, and workflow areas in breast imaging. The advances in the computer power and mathematical algorithms has enabled the use of complex multilayered deep neural networks, resulting in improvement in performance of machine interpretation of highly standardized imaging tasks.

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Discuss AI current applications on Mammography, Digital breast tomosynthesis (DBT), handheld ultrasound (US), Automated breast US and magnetic ressonance imaging (MRI). Future directions on this imaging modalities and limitations. Potential uses of AI in breast imaging: diagnosis (detection and classification of lesions), clinical decision making (assesing breast cancer risk based on algorithms that mix patient data and image characteristics, such as breast density / mamographic parenchymal pattern), Outcomes analyses (breast cancer detection rates, recall rates and positive predictive values) and Workflow (improving reading time in diagnostic breast imaging, with no decrease in accuracy). Review the evidence supporting AI in practical and the challenges remaining.

BREE-73   On Target: A Step-by-step Guide For Residents To Learn Stereotactic Biopsy

Participants
Ayla Yamamoto Mota, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

- To familiarize resident physicians with the stereotaxis technique for diagnosing suspicious breast lesions seen on mammography;- Considerations about the equipment and needles used in the procedure;- Illustrate the stereotactic biopsy step by step, from planning to managing possible complications, with images documented in our radiology department.

TABLE OF CONTENTS/OUTLINE

-Learning the indications, contraindications, planning and technique os stereotactic breast biopsy; -Describe the post-biopsy care that should be directed to the patient; -Identify the main complications and learn how to manage them; -Image appearance in the step by step of stereotactic breast biopsy, facilitating the understanding of the resident who has not yet performed it.

BREE-74   Hey You, We Have Our Own Lesions! A Case;#8211;Based Quiz For An Update Of Breast Lesions In Children And Adolescents, Diagnostic Approach And Management

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Participants
Mariana de Oliveira Leite, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To explain in an illustrative, clear and interactive way, in the form of a quiz, normal breast development and its anomalies.To demonstrate the role of each imaging modality in the evaluation of pediatric breast findings.To emphasize the differential diagnosis and investigation algorithm in pediatric age group and practices to avoid.To clarify the management of imaging findings in children and adolescents, since most are benign and inappropriate invasive procedures can damage breast development.To clarify which cases require biopsy.

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To simplify understanding of normal breast development and the spectrum of pediatric breast lesions, that differ from those in adults and in the vast majority are benign. Ultrasound is the first imaging modality. Management is usually conservative.To show clinical cases that illustrate image manifestation of breast lesions in children and adolescents.To provide an educational basis for radiologists to reassure patients, families and healthcare professionals that the risk of malignancy of pediatric breast lesions is low.To reaffirm that physical examination and history are key to appropriate management in this population.To standardize an approach for management of pediatric breast masses, calling attention to the indications and particularities of each method.To elucidate alarming clinical history or radiographic findings of pediatric breast lesions that should lead to histopathological analysis and clarify those that can be followed-up with safety.

BREE-75   Breast Cancer Under The Age Of 30-An MRI Approach

Participants
Niels Vinicius Padua Carvalho, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The aim of this exhibition is to: Review the recommendations for screening in this age group. Understand how to access and interpret a breast MRI. Discuss the current concepts about breast cancer MRI findings in young women. Show the breast cancer data and rates from our institution in this age group. Highlight the importance of this method to guide the proper management of these patients.

TABLE OF CONTENTS/OUTLINE

INTRODUCTION: Epidemiological profile of breast lesions in this population. Recommendations for screening, control and surveillance in young women, and when to use MRI. IMAGING INTERPRETATION: Imaging techniques acquisition and protocols. ACR BI-RADS method for interpretation and reporting system of the findings. STATISTICAL DATA: Breast MRI and breast cancer in women under the age of 30 from our institution between 2016 and 2021.INTERACTIVE CASE-BASED DIDATICS: Sample cases to illustrate and solidify the concepts about the main findings of breast cancer in young women's MRI. CONCLUSION: Breast cancer under the age of 30 are rare but it is associated with poor survival. Early detection and proper management have the potential to improve survival, less invasive treatments and a better quality of life. Therefore, we need to know how to manage these patients, their screening and complaints.

BREE-76   Axillary Lymph Node Imaging In Breast Cancer

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Participants
Aishwarya Gulati, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

At the end of this presentation, the reader will be able to: 1. Understand the normal appearance of axillary lymph nodes and suspicious features on ultrasound. 2. Understand the technique of scanning the axilla as well as the available diagnostic modalities. 3. Understand the various options available to sample these lymph nodes, the indications to sample as well as the technique. 4. Understand the implication of preoperative diagnosis on clinical management.

TABLE OF CONTENTS/OUTLINE

1. Normal Anatomy a. Morphology and distribution 2. Importance of Lymph Nodes in Breast Cancer a. Staging, sentinel node biopsy, axillary dissection 3. Role of Imaging a. Ultrasound, MRI, PET scan 4. US Technique a. Patient positioning, ultrasound protocol 5. Normal and Abnormal Lymph Nodes on Ultrasound a. Comparison of imaging features and corresponding sensitivity/specificity for malignant involvement b. Collection of lymphadenopathy secondary to COVID vaccination 6. Image-guided Sampling a. Indications and technique b. Comparison of sensitivity and specify among sampling techniques 7. Impact on Management 8. Future Developments

BREE-77   Breast Incidental Findings: You Better Not Ignore Them!

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Participants
Rodrigo Carneiro, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To list the main benign and malignant breast incidental findings identified on different imaging modalities, including CT, PET-CT and MRI; 2. To demonstrate how to more accurately describe breast incidental lesions found in different imaging modalities; 3. To demonstrate the importance of a systematic exam analysis by the radiologist, avoiding missing the diagnosis of relevant incidental findings. 4. To warn clinicians and patients about the high rate of malignancy in breast incidental findings and assist in the management of these injuries. 5. Instructions for radiologists about the importance to communication and monitoring in relevant incidental findings.

TABLE OF CONTENTS/OUTLINE

1. Main benign and malignant incidental breast lesions; 2. Normal and abnormal breast appearance on CT; 3. Illustrated teaching cases from our department of breast incidental findings in different imaging modalities and their outcomes, including: CT angiography, Coronary CT angiography, CT of the ribs, Chest CT, Mediastinal MRI and PET-CT scan. 4. Systematic imaging analysis: tips from specialists to avoid missing lesions; 5. Show our department's strategy to report and follow up these findings, providing assistance to the patient to be able to proceed with further investigation when necessary.

BREE-78   Ultrasound Of Pediatric Breast Lesions - A Summary

Participants
Hiral Banker, MD, Memphis, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Breast masses in children are uncommon and mostly benign. Differential diagnostic considerations of a breast mass in children are different from adults. Ultrasound is the primary modality in pediatric breast mass evaluation and biopsy is rarely performed due to the potential of damage to the developing breast. Thorough knowledge of ultrasound appearance of different breast conditions is necessary, especially for the pediatric radiologists to differentiate lesions which may warrant extensive management from those in which aggressive/surgical diagnostic procedures and treatment is not necessary. This exhibit will review the common and uncommon conditions of the pediatric breast with image illustrations.

TABLE OF CONTENTS/OUTLINE

• Overview of ultrasound the appearance of the prepubertal and pubertal pediatric breast and normal variants. • Describe clinical presentation and imaging appearance of various breast lesions with case illustration. • Explain key radiological differentiating features of pediatric breast masses including congenital conditions, infection, neoplasm, trauma, and vascular lesions. • Review uncommon pediatric breast lesions with case illustration, e.g., breast metastasis from rhabdomyosarcoma, pediatric breast fibrous histiocytoma.

BREE-79   Application Of Deep Learning To Establish Diagnostic Model Of Breast Lesions Usingdynamic Videograyscaleultrasound Imaging

Participants
Nan Zhang, Beijing, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

This study aimed to establish artificial intelligence (AI) diagnostic models of breast lesions using dynamic video US imaging, , which will help radiologists detect lesions and classify lesions between benign and malignant.

TABLE OF CONTENTS/OUTLINE

Methods:Using pathology and follow-up results as a reference, the dynamic video US images of 2,091 breast lesions were evaluated and used to establish an AI model. The diagnostic performance of the AI diagnostic model and the radiologist was calculated and compared. Results: The accuracy of the AI model for the detection of lesions in the test set was 98.4%. The sensitivity, specificity, PPV, NPV and accuracy of radiologists were higher than those of the AI model, but the difference was not statistically significant, respectively (P&gt0.05). The AUC of radiologists was 0.930, and of the AI model was 0.894, the difference was not statistically significant (P&gt0.05). The AUC of the AI model that predicted the probability of malignancy was 0.945. And when the cut-off value was 0.0298, the Youden's index was the highest, which was 0.809. Conclusions: The diagnostic performance of the AI diagnostic model of dynamic video US images is comparable to that of radiologists. And with the development of AI technology, AI diagnostic model for real-time detection of lesions and classification of benign and malignant breast lesions will gradually achieve.KEY WORDS: Artificial intelligence, Breast ultrasound, Deep learning, Dynamic video

BREE-8   T2 Bright Lesions On Breast MRI: Benign And Malignant Causes

Participants
Averi Gibson, MD, Worcester, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Discuss the differential for T2 bright lesions seen on breast MRI. 2. Present examples of both benign and malignant T2 bright lesions. 3. Analyze the differences between the appearance of T2 bright benign and malignant etiologies. 4. Recognize that a complete understanding of the imaging features of T2 bright lesions will help to reduce false positives while still identifying the more rare T2 bright malignant lesions.

TABLE OF CONTENTS/OUTLINE

1. Introduction including MRI's role in breast cancer screening/workup and interpretation of T2 breast MRI sequences. 2. Case

presentations of specific T2 bright pathologies, including a discussion of the clinical history, imaging, diagnosis and management for each lesion. The following pathologies will be discussed: cyst, fibroadenoma, fat necrosis, apocrine metaplasia, tubular adenoma, benign lymph nodes, metastatic lymph nodes, mucinous breast cancer, and necrotic breast cancer. 3. Compare and contrast imaging features of benign and malignant etiologies. 4. Summary/Conclusion

BREE-80 What To Expect When You'Re Expecting: Unique Features Of Breast Lesions In Pregnant Women

Participants
Carolina Kiebert, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the epidemiology and clinical presentation of breast tumors in pregnant and lactating women.To review the best imaging methods for diagnostic investigation.To show the radiological and anatomopathological characteristics of the main breast cancer in pregnant and lactating women.To point out the clinical management and treatment of breast cancers in these patients.

TABLE OF CONTENTS/OUTLINE

To review breast imaging workup for pregnant and lactating patients.Briefly review benign entities that can simulate breast cancer in pregnant women.Focus on clinical and imaging forms of pregnancy-associated breast carcinoma in association with anatomopathological aspects.Highlight some of the recommendations for the treatment of these tumors by illustrating this exhibit with cases from our radiology department.

BREE-81 Keeping Up With Controversies: Everything You Need To Know About Breast Health In Elderly Patients

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Participants
Denny Lara Nunez, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Discuss key concepts about screening in elderly patients including benefits and risks 2. Review different guidelines, recommendations and evidence on screening mammography in older women 3. Assess normal aging imaging findings in mammography 4. Describe different benign and malignant breast pathologies frequently found in elderly patients 5. Discuss controversies regarding screening in elderly patients

TABLE OF CONTENTS/OUTLINE

1. Comparison between different screening guidelines including a discussion of controversies. 2. Review of general aspects and imaging findings of benign breast pathology in elderly women including the following: mastalgia, benign calcifications, fibroadenomas, ductal ectasia, cysts. 3. Description of each of the following categories for breast cancer in elderly women: A.Epidemiology B.Clinical presentation C.Imaging findings D.Treatment and management 4.Discussion of tumor biology and changes through age 5.Review of normal aging changes in breast imaging studies 6.Discussion of ethical aspects and assessment of older patients

BREE-82 Breast Imaging Controversies In The Elderly Population

Participants
Manisha Bahl, MD,MPH, Boston, Massachusetts (*Presenter*) Consultant, Lunit Inc;Advisory Board, Accolade Inc

TEACHING POINTS

Breast cancer is the second most common cause of death from cancer among women in the United States, with increasing incidence and mortality rates with age. The incidence of breast cancer peaks in women aged 70-79 years, and it is estimated that nearly half of breast cancer-related deaths occur in women aged 70 and older. Controversies exist with regard to screening guidelines for the elderly. For example, the American Cancer Society recommends that older women continue biennial screening mammography until their life expectancy is less than 10 years, while the United States Preventive Services Task Force recommends biennial screening mammography until the age of 74 years. Concerns also exist with regard to overdiagnosis and overtreatment of breast cancer in the elderly. However, older women are not as likely as younger women to undergo standard treatments for breast cancer, which may diminish the adverse effects of overtreatment, since older women are more likely to have competing comorbidities and/or favorable tumor biological profiles.

TABLE OF CONTENTS/OUTLINE

This educational exhibit will review: (1) breast cancer statistics in the elderly population (e.g., incidence, screening utilization), (2) the biological profile of breast cancers in the elderly, (3) the controversial guidelines for screening mammography, and (4) breast imaging and treatment considerations including concerns with regard to overtreatment.

BREE-83 AI For Breast Imagers: Past, Present, And Future

Participants
Alyssa Watanabe, MD, Manhattan Beach, California (*Presenter*) Officer, CureMetrix, Inc;Stockholder, CureMetrix, Inc

TEACHING POINTS

To provide an overview of nomenclature and used in artificial intelligence and new forms of CAD such as CADx and CADt. The challenges of AI including non-binary nature of breast disease, the lack of gold standard for breast tissue density, and promise of data driven reports will be discussed.

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The history of artificial intelligence (AI) and evolution toward use of deep learning and convolutional neural networks (CNN) will be covered. The basics of artificial neural networks and generational adversarial networks (GAN) will be explained along with how these techniques relate to new algorithms for breast imaging including lesion and case scoring, triage, tissue density classification, image

enhancement, and breast risk stratification. The current status and future of deep learning models in breast imaging will be presented as well as how AI may impact imaging workflow, physician performance, and patient management. The impact of AI in structured reports and interactive reporting and the potential of federated learning will be covered. The challenges of AI in breast imaging, such as shades of gray of breast pathology, how to train machines in subjective analysis such as tissue density, regulatory issues, QA, and generalizing to different equipment vendors and demographics are discussed. A brief review of how to analyze algorithms will also be covered.

BREE-84   Better Late Than Never - The State Of Locally Advanced Breast Cancer In 2021

Awards
Certificate of Merit

Participants
Victoria Wells, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Breast cancer is the most common cancer among women with the 2nd highest death rate after lung cancer and is the most common cancer globally as of 2021. Screening mammography helps to detect cancer early with improved outcome. In this exhibit we review the typical presentation of locally advanced breast cancer (LABC) and discuss the factors that may contribute to late presentations including health disparities, education, socioeconomic factors, and non-compliance with screening. We will review the imaging presentation and work-up and discuss the multidisciplinary approach which includes staging, neoadjuvant chemotherapy, decision points for surgery/XRT, and long-term outcomes. Lastly, we will present strategies to decrease the percentage of cases that present in the future including educational outreach regarding screening mammography and risk assessment in the breast imaging suite.

TABLE OF CONTENTS/OUTLINE

Review of LABC and clinical symptoms leading to patient presentations. Review factors that contribute to late presentation including social determinants of health, noncompliance with screening, and delays in care. Using cases, discuss diagnosis and staging including imaging (mammogram, US, PET/CT, bone scan, MRI), biopsy, and pathological evaluation. Discuss treatment options and outcomes for patients with LABC. Present strategies to decrease the incidence of late presentation in a breast imaging practice.

BREE-85   Through The Looking Glass: Demystifying Breast Pathological Markers

Awards
Identified for RadioGraphics

Participants
Victoria Wells, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Breast imagers regularly perform image-guided biopsies of breast lesions and provide management recommendations based on the radiologic-pathologic concordance. As diagnostic partners, pathologists perform immunohistochemical stains utilizing biomarkers to characterize the biopsied tissue and determine pathologic diagnoses including breast malignancy, lymphoma, and benign breast diseases. Utilizing a case-based approach, this exhibit will review biomarkers commonly used by pathologists to classify breast core tissue specimens into benign or malignant entities. Furthermore, we will discuss the role of immunophenotypes in breast cancer and their therapeutic implications.

TABLE OF CONTENTS/OUTLINE

Review role of biopsy indications in evaluation of patients presenting for diagnostic imaging evaluation Provide overview of pathological approach to classifying breast core biopsies including H&E staining, immunohistochemical markers, and FISH Present cases of benign and malignant biopsies with focus on how biomarkers, H&E and immunohistochemical markers are used to determine specific diagnoses including malignancy, lymphoma, and variety of benign diseases including fibroadenoma, phyllodes, complex sclerosing lesion, fibromatosis, granulomatous mastitis, and papilloma.

BREE-86   Extra-Mammary Vascular Findings Detectable On Breast Magnetic Resonance Imaging (MRI): A Pictorial Review.

Participants
Sonya Khan, MD, Fullerton, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Familiarity with the imaging characteristics and basic management of extra-mammary vascular findings detectable on contrast-enhanced breast magnetic resonance imaging (breast MRI) is crucial for the interpreting physician. Such findings may require additional imaging evaluation, treatment, or even urgent intervention, with missed/misinterpreted findings posing a dangerous risk to the patient.2. Establishing a knowledge base via review of key MRI sequence-specific imaging characteristics to aid accurate detection/differentiation of common and uncommon extra-mammary vascular pathologies.3. Review of multimodality imaging correlates for each pathology.4. Targeted discussion of key evidence-based clinically appropriate management pearls for each vascular finding, aimed at prompting recommendations that optimize patient care following accurate interpretation.

TABLE OF CONTENTS/OUTLINE

1. Multimodality (MRI, ultrasound, computed tomography [CT], angiography) imaging review of common, uncommon, incidental and critical extra-mammary vascular findings detected on breast MRI examinations performed at our institution, including:a. axillary hematoma versus pseudoaneurysm;b. pulmonary arteriovenous malformation;c. extra-mammary hemangioma;d. cardiac pathology;e. great arch vascular anomalies.2. Summary of key evidence-based clinically appropriate management guidelines for each reviewed pathology.

BREE-87 Is It Time To Consider Active Surveillance For Atypical Ductal Hyperplasia?

Participants
Cecilia L. Mercado, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

TEACHING POINTS• Atypical ductal hyperplasia is a nonobligate precursor to breast carcinoma and carries an associated elevated risk for the development of breast cancer.• Current management guidelines for atypical ductal hyperplasia dictate surgical excision for most cases.• Challenges with overtreatment of atypical ductal hyperplasia remain while clinical trials explore active surveillance for low grade DCIS.• Various patient and lesion criteria can be used to minimize overtreatment of ADH and allow for consideration for active surveillance

TABLE OF CONTENTS/OUTLINE

TABLE OF CONTENTS/OUTLINE1. Introduction2. Background• Definition of atypical ductal hyperplasia, nonobligate precursor and associated elevated risk• Imaging appearance (calcifications, mass, and nonmass enhancement in cases on MRI)• Pathology diagnosis and contrast with borderline ADH-DCIS lesions and DCIS3. The American Society of Breast Surgeons Consensus Guidelines for management of atypical ductal hyperplasia• Surgical excision for most cases• Active surveillanceo small-volume ADH and ADH completely excisedo imaging and pathology concordanceo consider breast cancer risk factors4. Overtreatment of ADH5. Additional patient and lesion criteria that can be used to support active surveillance of ADH• Criteria includeo Additional high-risk lesiono Mode of biopsyo Lesion typeo Lesion sizeo Genetics of atypical ductal hyperplasiao Use of DCE-MRI to triage patients to surgery vs. active surveillance

BREE-88 Male Breast MRI: Think Outside The Box And Put Them Inside The Tube

Participants
Tatiana Tucunduva, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To familiarize general radiologists, surgeons and clinicians with breast magnetic resonance imaging (MRI) in male patients. - To present clinical and imaging of some benign and malignant pathologies male breast in MR, and correlate it with other imaging modalities. - To demonstrate situations which MR had an important role in evaluating male breast imaging.

TABLE OF CONTENTS/OUTLINE

- Introduction: There are no clear indications or guidelines for performing MRI in male patients, even in the setting of a diagnosis of breast cancer. But there are few instances where MRI may help clinicians and surgeons. In this review of cases that were performed in our institution, we aimed to provide better understanding of when it may be helpful to perform breast MRI in male patients.- Mammography, ultrasound, chest computed tomography and MR images: clinical cases which breast MR had an important role.- Conclusion.

BREE-89 Mitigating The Impact Of Coronavirus Disease (COVID-19) Vaccinations On Patients Undergoing Breast Imaging Examinations: A Multimodality Case Based Breast Imaging Review

Awards
Certificate of Merit

Participants
Leslie Lamb, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Reports of patients with axillary lymphadenopathy identified on breast imaging after COVID-19 vaccination were described soon after vaccines were administered in December 2020. As these reports became more numerous in vaccinated patients, our division implemented a pragmatic management approach in consultation with our referring clinicians and breast specialists (medical oncology, surgery, and radiation oncology), based on clinical presentation (screening, diagnostic, pre/peri cancer treatment) and imaging findings. Our recommendations align with the ACR BI-RADS Atlas (5th Edition) and aim to: 1) reduce patient anxiety, provider burden and cost of unnecessary evaluation of enlarged nodes in the setting of recent vaccination and 2) avoid delays in vaccinations and breast cancer screening during the pandemic.

TABLE OF CONTENTS/OUTLINE

1. History of vaccine related adenopathy 2. CDC guidelines and recommendations for currently approved COVID-19 vaccines 3. Breast imaging COVID-19 vaccine position statements 4. Ipsilateral axillary lymphadenopathy in setting of COVID-19 vaccine: i. Multimodality case-based review in (a) screening, (b) diagnostic, and (c) pre/peri- cancer treatment settings ii. Incidence, outcomes and cost-savings analysis of diverse management protocols

BREE-9 Imaging Findings Of Acellular Dermal Matrix Used In Breast Reconstructive Surgery: What Do Radiologists Need To Know?

Participants
Manuela Durando, Turin, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

The major teaching points of this exhibit are:1. To review the current role of Acellular Dermal Matrix (ADM) in implant-based breast reconstruction2. To describe the normal ed abnormal imaging findings (including mammography, ultrasound and MRI features) related to the presence of ADM in Implant-Based Breast Reconstruction3. To gain awareness of the possible imaging changes, during time, of ADM

TABLE OF CONTENTS/OUTLINE

1)Different surgical techniques used in breast reconstruction; 2)Use of ADM in Implant-Based Breast Reconstruction: 2a) Indications, contraindications, disadvantages, and advantages; 2b) Human ADM versus animal ADM; 3) Mammography, ultrasound

and MRI findings of ADM (human and animal): 3a) Common appearance; 3b) Changing over time; 3d) Differential diagnosis from recurrence, postoperative seroma/hematoma, fat necrosis or extracapsular implant rupture; 3e) Sample cases; 3f) Tips & tricks; 4) Clinical implications and summary

BREE-90   Li-fraumeni Syndrome And Breast Cancer: What, Why, How And Who.

Participants
Yana C. Silva Neves, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To assess and give an update in detail the concepts of Li-Fraumeni Syndrome (LFS) with a focus on breast cancer. -To understanding the epidemiologic, genetic and pathophysiologic features associated with Li-Fraumeni Syndrome. -To empower and educate the radiologist to appropriately contribute to patient management, ensure accurate and timely diagnosis and make LFS-specific imaging recommendations.

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-Define what Li-Fraumeni Syndrome is, its current clinical diagnostic criteria and the importance of knowledge of it for radiologists.-Describe how the TP53 gene mutation contributes to oncogenesis in patients with LFS and show the factors associated with the highest prevalence of this syndrome in America. -Draw the profile of patients with LFS and despair the attention for this diagnosis in patients with early-onset BC (under 36 years) or very early-onset BC (under 31 years), as well as detailing the screening in this population.-Describe the main imaging findings and their histopathological correlation and review other types of breast cancer associated with this syndrome, such as breast implant-associated anaplastic large cell lymphoma and postoperative radiation-induced malignancies.

BREE-91   Bia-alcl: A Review Of The Recent National/ International Guidance And Best Practise Guide

Participants
Aia Mehdi, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Breast Implant Associated Anaplastic Large Cell Lymphoma is an emerging Non-Hodgkin Lymphoma associated with exposure to breast implants.- It presents as two clinical entities - 'effusion-only' and 'mass-forming' and has uniquely congruent radiologic-pathologic features and highly nuanced imaging findings- prompt diagnosis and subsequent treatment initiation can be achieved by utilization of appropriate imaging, and results in an excellent prognosis-Imaging diagnosis in BIA-ALCL has recently undergone review, with publication of international guidance: MHRA PRASEAG guidance (Feb 2020) and NCCN Guidance (October 2021).-In our tertiary specialist centre for BIA-ALCL, cases presented at the multidisciplinary team meeting frequently have had a) inappropriate imaging tests b)inappropriate results interpretation. Imaging features in the context of suspect BIA-ALCL can be particularly challenging and prone to misinterpretation.

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In this exhibit we will provide:- An introduction to evidence-based imaging features of BIA-ALCL- An outline of how the latest guidance have optimized the imaging pathway- A novel imaging pathway which simplifies and stratifies diagnosis based on: the disease subtype, management step, and disease stage- Demonstrative challenging clinical cases with learning points- Tips and tricks for reporting radiology residents and attendings on common imaging 'false-positives' and 'false-negatives'

BREE-92   Breast Infection With Corynebacterium Species, An Important Mimicker Of Breast Cancer Benefiting From A Directed Diagnostic And Therapeutic Approach

Participants
Fabio Accorsi, MD, London, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

Inflammatory breast disease is a known clinical and imaging mimicker of breast cancer. There is growing evidence for the pathologic role of corynebacteria in acute mastitis, granulomatous mastitis, and breast abscess, but these organisms present unique microbiological and histological challenges which contribute to their under-recognition as potential pathogens in breast infection. Corynebacteria are infrequently detected on gram stain and when seen are commonly dismissed as non-pathogenic contaminants. Additionally, culturing of some subspecies is difficult, requiring modified culture media and extended incubation. Lastly, corynebacteria have a broad and varied antibiotic resistance profile with special pharmacokinetic considerations. The astute radiologist may play a critical role by eliciting the possibility of corynebacterium infection when submitting fluid or tissue samples for gram-stain, culture, and sensitivity, facilitating rapid and accurate diagnosis, susceptibility testing and appropriate subspecialty care. They may also be the first to suggest repeat sampling in indeterminate cases falsely presumed to be contaminated with corynebacteria.

TABLE OF CONTENTS/OUTLINE

a) 1. Case 1: Corynebacterium infection mimicking inflammatory breast cancer - Imaging at Presentation. b) 2. Case 1: Diagnosis and Treatment c) 3. Case 1: Long-term Follow-up and Teaching Points d) 4. Case 2: Corynebacterium infection mimicking focal breast cancer 5. Case 3: Corynebacterium infection mimicking multifocal breast cancer

BREE-93   Sonography Findings Not Included In The Birads Lexicon: We Have To Weigh Non-mass Lesions

Participants
Helena de Souza, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:1- To review the available definitions and the main image features of non-mass lesions on ultrasound;2- To illustrate the differential diagnosis of non-mass lesions;3- To demonstrate the importance of recognizing non-mass lesions and how correlation with mammography and breast MRI can improve detection and accuracy of benign and malignant lesions.

-Illustrative teaching cases from our department of the categorization system focused on echogenicity and distribution of non-mass lesions;-Review of the most common breast lesions that may present as non-mass lesions;-Illustrative teaching cases from our department demonstrating lesions categorized as non-mass lesions on ultrasound, their correlation in different imaging modalities and with the respective pathologic examination.

BREE-94   A Guide To Preoperative Seed Bracketing Of Breast Lesions

Participants
Joao Horvat, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To discuss the impact of preoperative localization in breast cancer treatment. - To describe the advantages and disadvantages of preoperative seed localization in comparison with other approaches. - To demonstrate the imaging aspects of lesions that necessitate preoperative bracketing and what to discuss with the breast surgeon. - To show how to perform the procedure of seed bracketing through a step-by-step practical guide. - To teach the clinical difficulties of the procedure through challenging cases and how to overcome them.

TABLE OF CONTENTS/OUTLINE

- Introduction to preoperative localization of breast lesions. - Description of the use of radioactive seeds in clinical practice. - Comparison between preoperative seed localization and other modalities for the management of breast lesions. - The importance of seed bracketing in breast conservation surgery. - Systematic approach to identifying lesions that may require seed bracketing. - What to discuss with the breast surgeon - Practical guide on how to perform seed bracketing. - Template reporting system - Literature review focusing on bracketing of breast lesions. - Example cases with mammographic and pathologic correlation. - Clinical difficulties of seed bracketing and how to overcome them. - Teaching point summary and conclusion.

BREE-95   A Pictorial Review Of The Phylloides Tumor In The Breast Though Not That Innocent

Participants
Jenny Quevedo Parada, MD, ciudad de mexico, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

To Identify the morphological characteristics by mammography and ultrasound of the phylloides tumor. To correlate the imaging findings according to the histopathological grade of the phylloides tumor. To recognize the differences between benign, borderline, and malignant phyllodes tumors.

TABLE OF CONTENTS/OUTLINE

Introduction Definition Classification Imaging characteristics by mammography and ultrasound Cases Teaching points Summary

BREE-96   Contrast Enhanced Mammography What Residents Need To Know

Awards
Certificate of Merit

Participants
Maria Lopez Mena, MEd, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

To recognize differences between conventional mammography and contrast enhanced mammography To review the image acquisition of contrast enhanced mammography To review the clinical applications and contraindications of contrast enhanced mammography To describe typical artifacts of contrast enhanced mammography

TABLE OF CONTENTS/OUTLINE

Introduction Image protocol and acquisition Clinical applications and contraindications Typical artifacts Cases Teaching points Summary

BREE-97   The Money Behind Mammo: A Dive Into The Finances Of Breast Imaging

Participants
Sean Raj, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Digital breast tomosynthesis (DBT) is an emerging and adjunctive modality in the breast imager's repertoire, improving cancer detection rates and decreasing recall rates 2. DBT can be integrated effectively and economically into any breast imaging practice 3. Reimbursement for DBT and DBT-based procedures is substantially different from traditional 2D mammography and has a significant impact on the bottom line of a professional practice 4. Breast imaging has historically been considered 'money losers' to Radiology practices; however, in the age of DBT and with increasing state mandates for DBT coverage, breast imaging can potentially be the most financially rewarding section in a practice. 5. Understanding the interplay between RVUs, CPT codes, reimbursements (professional and technical), and practice expenses is critical to comprehending compensation

TABLE OF CONTENTS/OUTLINE

1. Summarize current literature on DBT including its impact on cancer detection rate (sensitivity) and positive predictive value (specificity) 2. Review breast density legislation and impact on screening with DBT 3. Discuss current indications in screening and diagnostic settings and procedures 4. Discuss financial models and reimbursement; HCPCS/CPT codes and CMS Physician Fee Schedule; geographic modifiers 5. Review RVUs per exam/procedure; AAARad data and implications 6. Upstream and downstream financial impact of DBT machine acquisition and utilization, including RVUs generated per day and Radiologist staffing considerations

BREE-98   Radiomics In Breast Imaging For Noob

Participants

Nazimah Ab Mumin, MBChB, Sg Buloh, Malaysia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.Radiomics is a method for the mathematically quantify medical images. 2.Radiomics analyses in breast imaging require a methodical step-by-step approach 3.Various factors influence radiomics features in the radiomics workflow 4.Guidelines and quality checklists should be used to improve radiomics studies' quality. 5.Using a freely available software may be helpful for AI noob

TABLE OF CONTENTS/OUTLINE

1.Background: what is radiomics (artificial intelligence vs machine learning vs deep learning) ? 2.Radiomics: step by step guide for a newbie 3.What are the limitations of radiomics? 4.What are the available software for machine learning in breast imaging? 5.The future of radiomics: the rise of the machines.

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Abstract Archives of the RSNA, 2021

Sub-Events

NREE-1   Endoscopic Skull Base Surgery: Surgical Anatomy For The Radiologist

Participants
Rachel Stein, DO, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Describe the relevant anatomy of the nasal sinuses and ventral skull base essential for understanding the endoscopic skull base surgical approach from both the otolaryngology and neurosurgical perspectives - Outline the imaging considerations for evaluation on pre-operative imaging of skull based lesions - Describe the classification system of the clivus for pre-operative approach planning and highlight the relevant anatomy in each section of the clivus - Define the postoperative appearance and complications on immediate post-operative and follow-up imaging

TABLE OF CONTENTS/OUTLINE

- Historical Overview of Endoscopic Skull Base Surgery - Anatomical Review of the Pertinent Surgical Anatomy - Imaging Consideration of the Sinus - Imaging Considerations of the Skull Base - Postoperative Appearance and Complications

NREE-10   MRI And PET Imaging Features Of Retired Athletes With Repetitive Mild Traumatic Brain Injury

Participants
Mari Miyata, MD, Chiba, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

After following this exhibit, the reader will be able to: (1) understand the clinical manifestations of repetitive mild traumatic brain injury (rmTBI) and the common pathological hallmarks of chronic traumatic encephalopathy (CTE) in retired athletes; (2) review the unique findings of conventional magnetic resonance imaging (MRI) in retired athletes with rmTBI related to gross neuropathological features of advanced CTE; (3) review the uptake patterns of [18F]-PM-PBB3 (tau-positron emission tomography [PET]) images in retired athletes with rmTBI similar to postmortem neuropathological studies of CTE; (4) find it helpful to differentiate rmTBI from other forms of young-onset dementia.

TABLE OF CONTENTS/OUTLINE

1. Indication to rmTBI and CTE in retired athletes / 2. MRI finding in retired athletes with rmTBI 2.1 Cavum septum pellucidum 2.2 Enlarged perivascular spaces 2.3 Atrophy of the thalamus 2.4 Shrinkage of the mammillary bodies 2.5 Thinning of the corpus callosum 2.6 Enlargement of the lateral and third ventricles 2.7 Atrophy of the brainstem 2.8 Depigmentation of the substantia nigra (absence of "Swallow Tail Appearance" on susceptibility-weighted images) 2.9 Negative findings / 3. PET imaging finding of retired athletes with rmTBI 3.1 Tau-PET ([18F]-PMPBB3) images 3.2 Amyloid-PET ([11C]-PiB) images

NREE-100   What Is The Problem? Isn't It Just A Cyst? A Practical Diagnostic Approach To Cystic Or Cyst-like Lesions Of The Posterior Fossa

Participants
Larissa Martins, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: -To review the patterns and differential diagnoses of cystic or cyst-like lesions of the posterior fossa.-To discuss the spectrum of common and uncommon posterior cysts lesions in case-based approach. -To emphasize the key imaging to propose a specific diagnoses.

TABLE OF CONTENTS/OUTLINE

-Introduction -Anatomy and embryology of the posterior fossa-Diagnostic algorithm for cystic or cyst-like lesion of the posterior fossa Discussion of the main differential diagnoses in the context of relevant clinical and epidemiological scenarios-Review of patterns of image findings-Conclusion.

NREE-101   Function And Fibers - Functional MRI And DTI Fiber Tractography Application In Brain Tumor Resection

Participants
Matthew White, MD, Omaha, Nebraska (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review the pre-operative appearance of fMRI activations and white matter tracts with

correlation to the neurological outcomes. 2. To explain the utility of fMRI and DTI fiber tractography in brain tumor resection.

TABLE OF CONTENTS/OUTLINE

Analysis of extraaxial, intraaxial, benign and malignant brain tumors included oligodendrogliomas, astrocytomas, ependymomas, meningiomas, AVMS and metastatic tumors. The pre-operative functional status was compared to the post-operative status. Neurological functions and the associated WM tracts evaluated included the vision, language, motor, and sensory systems. mBAND task based FMRI paradigms are discussed and compared to conventional fMRI sequences accelerated with parallel imaging techniques. Resting State FMRI applications are demonstrated and compared to conventional task based fMRI sequences. The effect on white matter tracts by tumors are analyzed by DTI fiber tractography and utilizing color fractional anisotropy maps. Also reviewed are the differential effects of myelination on T2 FLAIR images that demonstrate white matter tract involvement by tumor. The technical difficulties and limitations of fMRI and DTI analysis are demonstrated. The limitations of DTI tractography due to effects of mass effect, edema and infiltrating tumor are outlined.

NREE-102   **Don'T Forget The Big Twelve! A Pictorial Review Of Cranial Nerve Anatomy And Pathology.**

Participants
Karol Cardenas, MD, Quito, Ecuador (*Presenter*) Nothing to Disclose

TEACHING POINTS

There is a wide range of possible pathologies related to cranial nerves, which is why imaging plays a major role in detecting lesions at this level. However, imaging assessment of cranial nerves is often undermined. To overcome missing important pathologic findings, radiologists must become familiar with the anatomy, imaging techniques and pathology. The purposes of this exhibit are: (1) to present a simple illustrative and dynamic review of the anatomy of the cranial nerves, (2) to identify the visible course of each cranial nerve in imaging techniques, both MRI and CT, (3) to provide a systematic review of common and uncommon pathology of the cranial nerves based on case studies.

TABLE OF CONTENTS/OUTLINE

Introduction; imaging techniques for evaluation of cranial nerves; illustrative and radiologic anatomy of the real and apparent origin and course of the cranial nerves; overview and systematic approach for the differential diagnosis of cranial nerve pathology; examples of some of the most common and interesting pathological cases (e.g. viral neuritis, cranial nerve hypoplasia, neural sheath and meningeal tumors, leptomeningeal spread of tumor, among others); summary.

NREE-103   **Role Of Diffusion Weighted Imaging In Optic Pathway Pathologies**

Participants
Vikrant Khare, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

DWI can aid in differentiating the location and laterality of optic nerve involvement when other modalities are equivocal. By utilizing additional information gained from DWI and ADC maps, radiologists can aid in determining the underlying etiology of multiple disease processes and help in looking at overall prognosis.After viewing this exhibit, the reader will become familiar with the anatomy of the optic pathway, utilize DWI as an additional parameter to aid in diagnosis of pathologies ranging from inflammatory, infectious, vascular, and neoplastic in origin, and help predict likely clinical outcome based on qualitative and quantitative DWI & ADC data. Furthermore, the reader will be able to differentiate various causes of optic neuritis and optic neuropathies; gain a sensitive marker for papilledema & increased intracranial pressure; assess clinical outcomes in traumatic optic neuropathy; and use DWI and ADC values in differentiating benign from malignant tumors.

TABLE OF CONTENTS/OUTLINE

1. Outlining the anatomy of the optic pathway and associated visual field defects; 2. Brief overview of DWI and ADC;3. Case sets, broken down by region of the optic pathway which is affected, discussing:a. Differentiating benign from malignant tumor types; b. Differentiating between various inflammatory and infectious processes; c. Use of DWI in trauma and clinical outcome; d. Use of DWI in global brain processes, such as ischemia.

NREE-104   **Terrible Tremors: Imaging Review Of Focal Epilepsy Causing Lesions In Adults.**

Participants
Karla Jonguitud, MD, Nuevo Laredo, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: Review the most common manifestations in the imaging of epilepsy in adults.To know the purpose of radiological imaging of epilepsy in adults.Explain the most common manifestations encountered with neuroimaging and assess their role in the initial diagnosis and monitoring of epilepsy in adults. Discuss the imaging findings of differential diagnosis of focal epilepsy causing lesions in adults.

TABLE OF CONTENTS/OUTLINE

General features of epilepsy in adults. Clinical correlates of seizure foci. Diagnostic procedures in evaluating the patient with seizures. Purpose of radiological imaging in focal epilepsy in adults. Imaging protocols for the evaluation of focal epilepsy in adults. Imaging findings of the major causes of focal epilepsy in adults. Mesial temporal sclerosis. Abnormalities of neuronal proliferation, migration, organization: Focal cortical dysplasia. Periventricular nodular heterotopia. Polymicrogyria. Schizencephaly. Neurocutaneous syndromes: Tuberous sclerosis. Sturge Weber syndrome. Neoplasm or mass: Ganglioglioma. Dysembryoplastic neuroepithelial tumor. Pleomorphic xanthoastrocytoma. Oligodendroglioma. Astrocytoma. Hypothalamic hamartoma. Multinodular and Vacuolating Neuronal Tumor. Encephaloceles. Vascular lesions: Infarct. Cavernous malformation. Arteriovenous malformation. Trauma. Infection. Controversial: Incomplete hippocampal inversion. Diagnostic considerations and pearls in focal epilepsy in adults. Conclusions.

NREE-105   Multi-mechanisms Of Viral Induced Neurological Manifestations: Lessons Learned From Emerging And Re-emerging Infections

Awards
Certificate of Merit

Participants
Carolina Rimkus, MD,PhD, Sao Paulo, Brazil (*Presenter*) Speaker, F. Hoffmann-La Roche Ltd

TEACHING POINTS

To review the pathogenesis of viral-induced neurological manifestations, focusing on emerging and re-emerging agents: John Cunningham virus, human immunodeficiency virus, measles, zika virus, and SARS-CoV-2To discuss, through a case-based approach, clinical and imaging tips that help identify the etiological agent and the possible pathological mechanism involved

TABLE OF CONTENTS/OUTLINE

IntroductionViral infection can trigger neurological syndromes through different mechanisms: (1) Direct infection; (2) Immune-mediated mechanism; (3) Systemic inflammation / cytokine storm. Confirming the role of an infectious agent in a neurological syndrome is challenging because: (1) diseases depend on complex interactions between environmental, host and microbial characteristics; (2) microorganisms might act in a hit-and-run manner, and be undetectable by symptoms onset; (3) MRI presentation is often non-specific. A systematic analysis of epidemiological factors, clinical, laboratorial and imaging signs might help to identify the etiological agent and the probable pathological mechanismClinical and Imaging features1. Epidemiology: JC-virus and high-efficacy immunomodulatory drugs; HIV in pre and post-HAART era; Measles and decreases in vaccination rates; Zyka virus and Aedes sp; Sars-CoV-2 pandemic2. Signs and symptoms- Paraclinical exams; Cerebral spinal fluid (direct viral infection vs immune-mediated response); EEG; Laboratory markers of systemic infection / cytokine storm3. MRI presentationTake-home messages

NREE-106   Post-operative Imaging Of Craniosynostosis: A Simplified Approach.

Participants
Maria Clara Lorca, MD, Pittsford, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. In this exhibit, we will review the role of low dose CT and 3D volumetric reformations in depicting imaging appearances of various types of craniosynostosis surgery2. Describe the expected post-operative findings and complications seen after craniosynostosis surgery. 3. Describe with clinical pictures and 3D reformations the long-term appearance/correction of the calvarium, orbits and facial bones after surgery.

TABLE OF CONTENTS/OUTLINE

Describe the role of low dose CT and 3D volumetric reformations in the preoperative evaluation of craniosynostosis including alerting surgeons about findings that could lead to potential complications during surgery. Depict the imaging appearances of various types of craniosynostosis surgery. Review with clinical pictures, case examples and illustrations the expected post-operative findings, including comparison of pre and post-operative imaging to track long-term appearance/correction of the calvarium.

NREE-107   Neurosarcoidosis Association With The Glymphatic-lymphatic Fluid Transport System

Awards
Certificate of Merit

Participants
Shotaro Naganawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Gain a deeper understanding of the Glymphatic-Lymphatic fluid transport system with recently updated concepts.2. Briefly review the imaging findings of pulmonary sarcoidosis for comparison with Neurosarcoidosis3. Review several neurosarcoidosis cases and explore their association with the Glymphatic-Lymphatic Fluid Transport System

TABLE OF CONTENTS/OUTLINE

Glymphatic-Lymphatic Fluid Transport System-Glymphatic system-meningeal lymphatic vessels-CSF influx and efflux Imaging of pulmonary sarcoidosis-perilymphatic distribution-well-defined nodules-hilar and mediastinal lymphadenopathy Imaging of neurosarcoidosis-pachymeningeal involvement-leptomeningeal involvement-pituitary and hypothalamic involvement-cranial nerve involvement-parenchymal involvement-optic nerve lesion-spinal cord involvement Other diseases involving Glymphatic-Lymphatic system-carcinomatous meningitis-lymphoma

NREE-108   Craniosynostosis: A Didactic Approach

Awards
Certificate of Merit

Participants
Danielly Santos SR, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review the normal anatomy of the pediatric skull. To discuss imaging features of various types of craniosynostosis, score the CT findings that impact the choice of surgical repair, and describe expected postoperative appearance after such repairs.

TABLE OF CONTENTS/OUTLINE

Craniosynostosis is the premature fusion of cranial sutures, resulting in characteristic deformities of the skull, in addition to facial asymmetries accompanied by functional consequences, such as increased intracranial pressure, visual impairment, deafness, and

cognitive deficits. The incidence is about 1: 2,500 live births. Sagittal suture is the most involved (39 -57%). It is classified as simple (single suture) versus complex (multiple sutures) and isolated (75%) versus syndromic. Imaging exams are essential for an accurate diagnosis, identification of anomalies and coexisting complications, surgical planning, and post-treatment evaluation. The surgical options for the treatment of craniosynostosis are diverse and the radiologist needs to know the main surgical techniques and the tomographic findings that influence the choice of technique.

NREE-11 Imaging Of The Ventricular Shunt Systems : How Can We Help The Neurosurgeons

Awards
Certificate of Merit

Participants
Amit K. Agarwal, MD, MBBS, Jacksonville, Florida (*Presenter*) Consultant, Authentic4D;Stockholder, Gilead Sciences, Inc

TEACHING POINTS

1. To illustrate imaging appearances of the ventricular shunt system2. Identification of common shunt complications and causes of shunt malfunction3. Update on the latest/new programmable shunt catheters

TABLE OF CONTENTS/OUTLINE

1. Types and Components of CSF Shunts-Programmable Ventricular Shunt System-Non-Programmable (fixed-pressure) Ventricular shunt system2. Imaging Evaluation of CSF Shunts 3. Complications of CSF Shunt and Shunt Malfunction -CSF Shunt Placement -CSF Shunt Obstruction -CSF Collections -Infection -Overdrainage4. Summary

NREE-110 Neurolisteriosis, Thinking Beyond Rhombencephalitis

Participants
Aimpavee Keeratiratwattana, MD, Bangkok, Thailand (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Imaging findings of listeria monocytogenes brain infection. 2. Imaging appearance of characteristic brain abscess with worm-like appearance** in neurolisteriosis. 3. Differential diagnosis of brain infection with worm-like appearance**Worm-like appearance was defined as a linear/curvilinear tubular shape lesion in the brain parenchyma. This appearance is typically described on post contrast T1-weighted image, but can also be seen on other sequences. This worm-like appearance portrays transaxonal cell-to-cell spread of listeria infection. This worm-like appearance can occur in isolation or as part of a brain abscess.

TABLE OF CONTENTS/OUTLINE

1. Describe imaging findings of Listeria monocytogenes brain infection2. Example cases of neurolisteriosis with characteristic brain abscess with worm-like appearance3. Show example cases of neuromelioidosis and cerebral sparganosis which are important differential diagnosis of brain infection with worm-like appearance.

NREE-111 Don't Forget To Look At The Base Of The Skull: Benign And Malignant Diseases Of The Clivus

Participants
Pablo Penalver Calero, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To review the embryology, anatomy and anatomical relationships of the clivus and its typical appearance on CT and MRI scans depending on age. -To highlight the importance of studying this anatomical region in every brain imaging test due to the variety of lesions that can settle on it. -To describe the different benign and non-tumor lesions that affect this bone and their radiological features. -To present the different malignant lesions that affect the clivus, their radiological appearance and the important complications derived from the infiltration of significant neighboring anatomical structures.

TABLE OF CONTENTS/OUTLINE

-Introduction: clivus anatomy, embriology and changes in appearance with age -Benign clival tumors: meningioma and macroadenoma -Malignant clival tumors: metastasis, lymphoma, chordoma, plasmocytoma and nasopharyngeal carcinoma -Non-tumor clival lesions: fibrous dysplasia, arrested pneumatization of the skull base, ecchordosis physaliphora and fossa navicularis magna -Conclusions

NREE-112 Pocket Survival Guide To Whole Spine Radiography: What The Surgeon Needs Us To Report

Participants
Tomas Bernstein, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand the unique characteristics of whole spine X-ray. 2. Learn to quantify classic radiographic alignment measures 3. Apprehend pelvic parameters uncommonly reported but essential for the surgeon. 4. Develop a systematic approach to whole spine radiography

TABLE OF CONTENTS/OUTLINE

1. Anatomy and biomechanics of spinal alignment 2. Special characteristics and different projections of whole spine X-ray 3. Causes of spinal deformities 4. Classic spinal alignment measures 5. Other essential angles that needs the surgeon 6. Post-surgical assessment

NREE-114 Exploring The Cerebral Cortical Veins And Bridging Veins Of The Skull Base In Preoperative Evaluation Of Craniotomies: Beyond Conventional Imaging

Participants
Sayani Mahal, MBBS, Jodhpur, India (*Presenter*) Nothing to Disclose

Cerebral cortical veins and bridging veins of skull base as insignificant in size as they may seem, have the potential to wreak havoc if injured during surgeries. To add to this, is the abundance of variant anatomy that makes it mandatory to competently trace the course of such veins. Preoperative assessment aids in localizing the exact site of corticectomy by identifying the corridor in between the cortical veins and prevents their inadvertent injuries. Computed tomographic (CT) venography and MR venography (TOF and phase-contrast) can depict the convexity veins that drain the surface of the brain. But traditional preoperative imaging in 2D planes is not capable of adequately displaying the inconspicuous anatomy of the bridging veins and veins at the skull-base which show a curved course. Curved multiplanar maximal intensity projection reformats on 3D post contrast T1 gradient images are better suited for demonstration of this cerebral venous anatomy and their variants.

TABLE OF CONTENTS/OUTLINE

1. Overview of the standard craniotomy approaches and the venous structures at risk of injury in each type. 2. Anatomy of the cortical veins and bridging veins of the skull-base and demonstration of precise anatomic planes for reformatting skull-base veins. 3. Anatomic variations in their course and drainage patterns.

NREE-115   Potholes On The Pathway! Imaging Spectrum Of Middle Cerebellar Peduncle Lesions

Participants
Surbhi Singh, MD, Bangalore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To describe the imaging anatomy of middle cerebellar peduncle with emphasis on cortico-cerebellar pathways. - To discuss various pathologies that have predilection to middle cerebellar peduncle with clinical implications and management. - To highlight clinical and imaging clues that would enable radiologists to narrow their differentials.

TABLE OF CONTENTS/OUTLINE

Retrospective review of 3000 MRI brain studies at our institute from June 2018 to March 2021 yielded 126 cases with lesions that involved middle cerebellar peduncles. Cases are broadly classified into: 1. Cerebrovascular: Ischemic Infarcts, pontine hemorrhages 2. Infective: Tuberculomas, bacterial abscess 3. Neoplastic: Gliomas, Lymphoma, medulloblastoma, neurofibromatosis 4. Neurodegenerative: MSA, Spinocerebellar ataxia, Wallerian degeneration 5. Vascular Malformations: Cavernomas, AVM 6. Demyelinating: Neuromyelitis Optica, Multiple Sclerosis 7. Metabolic: Wilson's disease, Osmotic demyelination 8. Iatrogenic: Radiation necrosis, Post-surgical gliosis This spectrum would be presented in a case-based approach with clinical/imaging pearls and pitfalls.

NREE-116   The Last, But Not Least Diagnostic Hypotheses: CNS Dural Arteriovenous Fistulas Non-invasive Imaging.

Participants
Daniela Vasconcellos, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:- To discuss and ilustrate many types of imaging presentation of dural arteriovenous fistulas (dAVF) focusing on early diagnosis by non-invasive methods.- To purpose a classification of clinical manifestations based on gravity of the symptoms, between benign and aggressive, and to exemplify the most relevant imaging features of each one.- To highlight imaging features and red flags that support confident diagnosis of dAVF.

TABLE OF CONTENTS/OUTLINE

- Anatomy, epidemiology and physiopathology- dAVF classification- Low flow versus High Flow- Angiographic classification- Clinical manifestations:- Topographic division- Clinical-radiological correlation- Classifications based on their gravity and their imaging features- Contribution of non-invasive imaging methods to dAVF diagnosis.- Computed tomography- Magnetic resonance imaging- 3D Time-of-flight MR angiography- Arterial spin label- Dynamic-susceptibility contrast MRI perfusion:- Highlight imaging features and red flags that support confident diagnosis of dAVF.- Venous thrombosis- Parenchymal abnormalities: edema, hemorrhage.- Dilated cortical veins without a nidus.- Dilated pial vessels at subarachnoid space.- Flow voids- Evaluation of retrograde arterialized cortical / sinus venous drainage using SWI sequence- Therapeutic options and post-treatment evolution.

NREE-117   Autoimmune Demyelinating Diseases Beyond Classic Multiple Sclerosis.

Participants
María José Risco Fernandez, Toledo, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To review the multiple sclerosis (MS) variants, and other autoimmune demyelinating disorders such as neuromyelitis optica spectrum disorders (NMOSD), acute disseminated encephalomyelitis (ADEM) and anti-myelin oligodendrocyte glycoprotein (anti-MOG) syndromes, their characteristics and distribution.- To illustrate these diseases using images from our database to highlight the imaging findings of each disease in magnetic resonance imaging (MRI).- To analyse key features in order to distinguish these entities from MS and from other etiologies.

TABLE OF CONTENTS/OUTLINE

In the last few decades, MS variants and other types of autoimmune demyelinating disorders including NMOSD, ADEM and anti-MOG disease are recognized as entities of their own. They are frequently misidentified as MS due to the similarities of their clinical manifestations and imaging findings.Knowledge of clinical course, lesion characteristics and distribution could aid in diagnosis of them. MRI is the standard imaging technique of diagnosis of these autoimmune demyelinating diseases. Early and accurate diagnosis of all these conditions is highly important due to different therapeutic approaches depending on the entity.This review is intended to give an overview of the diverse spectrum of autoimmune demyelinating disorders, focused on MS variants, NMOSD, ADEM and anti-MOG, other secondary etiologies and the most common differential diagnosis.

NREE-118   Leptomeningeal Enhancement On Postcontrast 3D-flair Imaging In Multiple Sclerosis: A Retrospective Study In A General Hospital.

Participants
Elton Barud, BMedSc, Uberaba, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. Briefly describe the pathophysiology of leptomeningeal enhancement on postcontrast 3D-FLAIR imaging in multiple sclerosis.2. Pictorial review of leptomeningeal enhancement on postcontrast 3D-FLAIR imaging in multiple sclerosis from our archives (from January 2017 to April 2021 and a review of the literature.3. Evaluate the difference in sensitivity between 1,5T and 3T MRI scanners, as well as time-to-acquisition after gadolinium injection for leptomeningeal enhancement detection.

TABLE OF CONTENTS/OUTLINE

A- Pathophysiology of leptomeningeal enhancement on postcontrast 3D-FLAIR imaging in Multiple Sclerosis.B- Pictorial case review from our collection and a review of the literature. C- Imaging appearance.D- Patterns and localization of leptomeningeal enhancement.E- Atypical imaging appearance: red flags and pitfalls.

NREE-119   **Tertiary Center Experience In Fast Neuroradiology Protocol Development And Implementation**

Awards
Identified for RadioGraphics

Participants
Laura Eisenmenger, MD, Middleton, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Review techniques employed in the development and execution of Fast Abbreviated Survey Technique (FAST) protocols• Outline the FAST Neuroradiology protocols currently employed at tertiary academic center• Understand the role of FAST protocols in Neuroradiology

TABLE OF CONTENTS/OUTLINE

Introduction Definition of a "FAST" protocol General acquisition and reconstruction techniques Clinical applications in neuroradiologyFAST Neuroimaging MR Stroke Protocols (with MRA) FAST Stroke without contrast Indications Sequences, parameters, acquisition times Limitations Case examples FAST Stroke with contrast Indications Sequences, parameters, acquisition times Limitations Case examplesFAST Neuroimaging MR Brain Protocols (without MRA) FAST Brain without contrast Indications Sequences, parameters, acquisition times Limitations Case examples

NREE-12   **The Dangerous Waters Of Western Australia**

Participants
James Waldron, MBBS, Perth, Australia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) To present an overview of spinal injury imaging findings in patients with water-related accidents (surfing, diving, body boarding, and miscellaneous other activities) in Western Australia. 2) To identify common mechanisms of injury from different water-related traumatic spine injuries. 3) To recognize types and radiological hallmarks of bony, soft tissue and spinal cord injuries on imaging, incurred from water-related accidents.

TABLE OF CONTENTS/OUTLINE

1) Introduction 2) Surfing injuries: Mechanism, Pathology (extension teardrop fracture, spinal cord compression and traumatic disc herniation) - Imaging correlates identified on CT and MRI.3) Diving injuries: Mechanism, Pathology (vertebral fractures and soft tissue injuries) - Imaging correlates identified on CT and MRI4) Wave-related injuries: Mechanism, Pathology (spinal cord haemorrhage and vertebral artery injury) - Imaging correlates identified on CT and MRI5) Miscellaneous injuries: Morel-Lavallée Lesion

NREE-121   **Neurological Disorders In Pregnancy: What The Radiologist Needs To Know**

Participants
Angelo Duarte, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:- Discuss the reasons that make diagnosing neurological disorders in pregnancies, childbirth, and puerperium so challenging- Review the physiology of pregnancy and its relationship with the occurrence of new neurological disorders and exacerbation of pre-existing diseases- Describe the main neurological diseases of pregnancy, emphasizing their radiological findings and clinical presentation to stimulate clinical reasoning- Review the main pre-existing diseases that may exacerbate during the gestation period*?aß?e ?? ???te?ts/??t???e • Introductiono Factors that contribute to the variety of neurological symptoms in pregnancyo Review of physiological changes in pregnancy and their role in the occurrence of neurological disorders• Neurological disorders related to pregnancy and childbirtho Cerebrovascular diseaseso Pituitary disordero Metabolic disordero Related to medical procedures• Exacerbation of pre-existing neurological condition o Demyelinating diseaseso Tumors

NREE-122   **Different Strokes: A Comprehensive Review Of Radiological Stroke Mimics**

Awards
Cum Laude

Participants
Cillian McNamara, BMBCh,MSc, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiological stroke mimics are non-vascular disorders that have imaging appearances in common with an infarct, such as diffusion or

perfusion abnormalities.Accurate identification of mimics depends on the neuroradiological expertise of the reporting center.Common stroke mimics are seizures, metabolic disturbances, tumors, infection and migraine.Rarer stroke mimics include mitochondrial disorders, radiotherapy complications, and autoimmune disorders.Retrospective imaging review often reveals clues that could have helped identify a stroke mimic from the outset.Often, the only way to definitively diagnose a stroke mimic is to interpret the imaging in light of in-depth clinical information and laboratory results.With the use of clinical, lab data and MR, the inappropriate admission rate for stroke mimics falls to <1%.

TABLE OF CONTENTS/OUTLINE

Frequency of stroke mimics and a review of the relevant terminology.Review of the clinical consequences of inappropriate thrombolysis.A comprehensive case-based review of common and rarer radiologic stroke mimics.A review of the subtle nuances in differentiating very challenging stroke mimics such as transient peri-ictal MRI abnormalities, reversible cerebral vasoconstriction syndrome and migraine.A review of the diagnostic clues on initial imaging studies that could have aided earlier correct diagnosis.A case-based quiz to apply newly learned imaging tips.

NREE-123   Lymph-fomo: Fear Of Missing Out On Central Nervous System Lymphoma In The Immunocompromised Patient

Participants
Olivia Goldberg, BMBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Update on the aetiology and pathophysiology of immunodeficiency-associated CNS lymphomas using illustrative cases of key WHO 2016 subtypes 2. The imaging findings of CNS lymphoma with a focus on the key differences between immunocompetent and immunocompromised individuals 3. Approach to differentiate lymphoma from other complications of immunosuppression, including opportunistic infection and other malignancies 4. Awareness of advanced imaging techniques to aid diagnosis and inform treatment choices

TABLE OF CONTENTS/OUTLINE

Primary CNS lymphoma (PCNSL) has myriad appearances on imaging which are highly dependent on patients' immune status. In the immunocompromised, the classical radiological signs of PCNSL may be absent and there is a risk of misdiagnosis for other pathology such as opportunistic infection. Imaging has a pre-eminent role in the immunosuppressed as biopsy may be precluded by the risk of post-surgical infection. This challenge is compounded by an ever-growing and increasingly complex cohort of immunocompromised patients, secondary to a greater range and usage of immunotherapies, more transplantation (solid organ and haematopoietic cell) and HIV. To meet this challenge, we will provide a diagnostic framework to immunosuppressed patients with possible PCNSL with illustrative cases of many subtypes. The presentation will finish with a glimpse of the future with a spotlight on emerging techniques and novel post processing tools.

NREE-125   Cerebral Amyloid Related Disorders

Awards
Cum Laude

Participants
Lucas Ghisleri, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Cerebral ßA related disorders are Alzheimer's disease (AD), classic and inflammatory cerebral amyloid angiopathy (CAA) and cerebral amyloidoma.- AD dementia is the end point of events that leads to cognitive impairment, with the accumulation of ß amyloid (ßA) plaques as the first detectable change, succeeded by functional and metabolic markers. Structural changes occur later, in a temporal pattern that reflects the histological findings.- Classic CAA can present with a variety of hemorrhagic lesions, including lobar hemorrhages, microbleeds, superficial siderosis and subarachnoid hemorrhage, in addition to ischemic lesions, including cortical microinfarctions and ischemic changes of the supratentorial white matter (WM).- Inflammatory CAA is characterized by an inflammatory infiltrate next to amyloid deposits which manifests as asymmetrical WM edematous lesions in association to classic findings of CAA.- Amyloidoma is a rare pseudotumoral deposit of ßA on the supratentorial WM with marked low T2 signal and avid contrast enhancement

TABLE OF CONTENTS/OUTLINE

- IntroductionCerebral amyloid genetics and physiology- Alzheimer DiseaseEpidemiology and physiopathologyStructural imaging: A mirror of dementia pathologyThe role of imaging biomarkers: Amyloid-PET and FDG-PETLaboratorial detection of Aß: future perspectives- CAAEpidemiologyPhysiopathology of classic and inflammatory CAAImage patterns and differential diagnosis of classic and inflammatory CAA- AmyloidomaImage pattern and differential diagnosis

NREE-126   A Radiologist`s Guide To Interpret Arterial Spin Labeling (ASL) MR Perfusion: A Simplified Review Of The Technique, Clinical Indications And Interpretation Of Findings

Awards
Identified for RadioGraphics

Participants
Tatiana Iutaka, BDS, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Present a practical guide to interpret Arterial Spin Labeling (ASL) MR perfusion;Review the techniques and the methods of the ASL sequence, including technical difficulties;Discuss the main clinical applications and their usefulness in the daily routine of the radiologist; Suggest a simplified approach including a step-by-step of interpreting image findings.

TABLE OF CONTENTS/OUTLINE

Introduction and initial considerations;Techniques and the methods of the ASL sequence;Main clinical applications of ASL sequence and the typical imaging findings;Interpretation approach with a step-by-step;Final remarks.

NREE-127   Imaging Findings Of Intracranial Injuries Post Radiotherapy

Participants
Neomir Fabris, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiation treatment injuries may appear similar to tumor progression and can develop during treatment, months to years later. Radiation injury can be divided into acute, early-delayed and late-delayed on the basis of which time they manifest after radiation therapy, including leukoencephalopathy, pseudoprogression, radionecrosis and secondary neoplasms. Our objectives are: 1. To illustrate most common post radiation injuries to brain. 2. To review the imaging findings in acute, early delayed and late delayed radiation-induced brain injuries. 3. Emphasizing the role of Advanced MRI techniques and its implications in management. 4. To correlate different cases with the local treatment types, such as whole-brain radiotherapy and stereotactic radiosurgery.

TABLE OF CONTENTS/OUTLINE

We will show the best cases of our archive that consists of more than two thousand cases of post-radiotherapy injury from which we will select more cases to illustrate and enrich the presentation. 1) The radiation therapy a) Treatment planning b) Whole Brain Radiotherapy c) Specialized steriotatic machines d) Brachytherapy e) Lesions Commonly Treated with SRS. 2) Treatment Effects a) Radiation Necrosis b) Pseudoprogression and Pseudoresponse c) Pseudoresponse and Antiangiogenic Therapy d) Radiation Vasculopathy e) Radiation-induced Leukoencephalopathy f) SMART Syndrome g)Secondary Malignancies h) Radiation-induced Brain Tumors and Tumor-like Lesions.

NREE-128   The Unusual Suspects: When Brain Tumors Don't Follow The Rules

Participants
Cillian McNamara, BMBCh,MSc, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Atypical imaging presentations of CNS tumors can cause diagnostic confusion and delay.- Glioblastoma multiforme (GBM) accounts for 60% of all primary brain tumors and are usually recognized when presenting in its typical form as a solitary, supratentorial mass. These can evade diagnosis by presenting in unusual locations or as highly vascular variants which may be mistaken for vascular malformations.- Meningiomas comprise 30% of all primary brain tumors with many radiological variants which have distinctive imaging features. Extracranial meningioma metastases occur rarely and are underrecognized.- Rare tumors can cause confusion by presenting in unexpected locations.

TABLE OF CONTENTS/OUTLINE

- Brief introduction to the epidemiology of various primary brain tumors and present an imaging review of several histologically confirmed 'atypical' cases to contrast with more typical presentations.Two subgroups:1) CNS tumors presenting in an unusual location. - GBMs presenting in the posterior fossa, as pituitary masses, and as leptomeningeal disease- Meningiomas presenting in the orbital wall or as metastases- Chordomas presenting in unusual extra-axial and intradural locations- Spinal tumors such as an extra-axial ependymoma and an extradural nerve sheath tumors 2) CNS tumors presenting with unusual imaging features. - Highly vascular GBMs initially diagnosed as vascular malformation- Pediatric tumors which caused diagnostic uncertainty due to atypical imaging features including an embryonal tumor and a pilocytic astrocytoma

NREE-129   Beyond Degeneration: Challenges In Intervertebral Disc Pathology

Participants
Valerio D'Agostino, MD, Naples, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

The objectives of this case-based educational exhibit are:1. To briefly review the radiological features of discopathy.2. To summarize the possible evolutions of degenerative discopathy, with emphasis on the less frequently encountered. 3. To describe and illustrate the imaging findings in the most unusual cases.

TABLE OF CONTENTS/OUTLINE

This educational exhibit will follow this outline:1. Introduction to the pathophysiological mechanisms of degeneration of the intervertebral discs.2. Brief summary of usual clinical and radiological features.3. Review of the possible evolutions of degenerative discopathy, focused on the most unusual ones and the ones that may pose diagnostic challenges.4. Case-based illustration of uncommon progressions of disc degeneration and protrusion / herniation.

NREE-13   Sellar, Suprasellar, And Parasellar Masses: Comprehensive Imaging Review And Surgical Approaches

Participants
Zachary Jenner, MD, Sacramento, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Sellar, suprasellar, and parasellar spectrum of pathologies include neoplastic, congenital, vascular, and inflammatory/infectious etiologies. Symptoms include headache, visual changes, and cranial neuropathy. CT identifies bone involvement, internal calcification, and vascular components. MRI signal characteristics are vital in differentiating similar lesions. While most lesions require histopathologic evaluation, expert knowledge of skull base anatomy and awareness of key imaging features are useful in limiting the differential diagnosis and identifying surgical approaches.

TABLE OF CONTENTS/OUTLINE

1. Sellar Space. Neoplasm: pituitary adenoma, pituitary apoplexy/hemorrhage, meningioma, craniopharyngioma, metastasis. Congenital: Rathke cleft cyst. Vascular: aneurysm. Infectious/Inflammatory: abscess, Wegener's. 2. Suprasellar Space. Neoplasm: optic pathway glioma, germinoma. Developmental: dermoid, lipoma, hypothalamic hamartoma, ectopic pituitary, epidermoid & arachnoid cysts. Inflammatory/Granulomatous: Langerhan's cell histiocytosis (LCH), lymphocytic hypophysitis, sarcoidosis. 3. Central Skull Base. Neoplasm: chordoma, chondrosarcoma, plasmacytoma. Other: encephalocele, epidermoid. 4. Cavernous Sinus. Neoplasm: meningioma, metastasis, lymphoma, perineural tumor, schwannoma, LCH. Vascular: aneurysm, cavernous-carotid fistula,

thrombosis, hemangioma. Infectious/Inflammatory: Tolosa-Hunt, invasive fungal sinusitis, sarcoidosis 5. Surgical approach/techniques

NREE-130   Genetic Disorders Associated With Stroke: What Radiologists Need To Know.

Awards
Cum Laude

Participants
LAÍSE NERI, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To describe the mechanisms of genetic ischemic and hemorrhagic strokes.To recognize the classification of genetic disorders associated with stroke.To illustrate imaging findings related to genetic stroke.

TABLE OF CONTENTS/OUTLINE

IntroductionMechanisms of genetic ischemic and hemorrhagic strokes.Classification of genetic disorders associated with stroke: arteriopathies; metabolic diseases, connective tissue disorders.Illustrative cases : Fabry Disease, Sickle Cell Disease, Cerebral Autosomal Dominant, Arteriopathy With Subcortical Infarcts and Leukoencephalopathy, Cerebral Autosomal Recessive Arteriopathy With Subcortical Infarcts and Leukoencephalopathy, Retinal Vasculopathy With Cerebral Leukodystrophy, Mitochondrial Encephalopathy, Lactic Acidosis, and Strokelike Episodes, Moyamoya Disease, Susac's Syndrome, Arterial Tortuosity Syndrome, ACTA2 mutation, William's syndrome), Conclusion, Take-home messagesReferences

NREE-131   All That Glitters Is Not Gold: Idiopathic Intracranial Hypertension (IIH) And Its Mimics

Awards
Certificate of Merit

Participants
Olivia Goldberg, BMBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Update on the consensus guidelines for the investigation of papilloedema 2. Review of the clinical presentation, neuroimaging findings and proposed aetiology of IIH 3. Approach to distinguishing IIH from its mimics and when those should be considered 4. Current management options in IIH

TABLE OF CONTENTS/OUTLINE

Idiopathic intracranial hypertension (IIH) is an important clinical entity, particularly given the association with obesity which is increasing in incidence. IIH patients often have a distinct clinical phenotype and frequently present with headaches, papilledema and visual changes. Imaging is essential in the workup, particularly in excluding secondary causes. Classical imaging features, such as expansion of the optic nerve sheath complexes, empty sella turcica and cerebellar sagging have variable reliability and are commonly found incidentally in asymptomatic patients. These features are the consequence of longstanding raised intracranial pressure rather than specifically those of IIH. Importantly, other pathologies can masquerade as IIH on imaging, particularly vascular shunts. Ultimately, patients require a thorough workup with IIH being a diagnosis of exclusion. Here we present series of cases that had classical symptoms and signs of IIH in whom the diagnosis was confirmed or an alternative diagnosis was reached, for example dural arteriovenous fistula or a compressive calvarial lesion. We will highlight features where alternative pathology should be suspected, and the crucial role of the radiologist.

NREE-132   Malformation Maladies - Magnetic Resonance Imaging In Congenital Malformations Of Brain

Participants
Suman Prabhakar, MBBS,MD, Bangalore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the basic embryological development of the brain. 2. To illustrate various congenital malformations of the brain with respect to the stages of development. 3. To review the spectrum of congenital malformation of the brain in a quiz format.

TABLE OF CONTENTS/OUTLINE

We discuss the basic embryology of the brain. Being rare and complex, congenital anomalies of the brain needs to be diagnosed on MRI at the earliest for appropriate management, prognostication, and counseling of neurological outcomes. Background: We review the spectrum of congenital malformations of the brain in a quiz format. • Each case has a brief clinical history at the top of the slide followed by representative images and questions. • The following malformations are discussed based on stages of development: Chiari malformations, cephaloceles, corpus callosum agenesis/dysgenesis, polymicrogyria, holoprosencephaly, Joubert's syndrome, agyria--pachygyria complex, Lhermitte - Duclos disease, nodular and lobar heterotopia, septo optic dysplasia, coronal cleft in the pons, cerebellar dysplasia, complete commissural agenesis, megalencephaly, schizencephaly (open and close), lissencephaly, and Dandy-Walker complex. This educational exhibit is presented in a quiz based format targeted to residents and emphasizing on the correlation between the stage of development and resultant malformation.

NREE-133   Radiomic Of Glioma: Multiparametric MRI Correlates Of Genotyping And Molecular Markers.

Participants
Samika Kanekar, Providence, Rhode Island (*Presenter*) Nothing to Disclose

TEACHING POINTS

To discuss the gliomagenesis and associated molecular markers with various gliomas. To correlate the imaging findings with the various Genotyping and molecular markers in low grade and diffuse glioma.

TABLE OF CONTENTS/OUTLINE

We retrospectively reviewed the imaging studies from our PACS system of 55 patients with glioma (low, diffuse gliomas and

glioblastoma), which forms the basis of this exhibit. All patients had undergone basic MRI along plus advanced imaging techniques such as MR spectroscopy, MR perfusion (dynamic susceptibility contrast magnetic resonance (MR) perfusion, DTI, fMRI, and ADC value calculation. 46 of these tumors had a histopathology correlation with the imaging findings. Imaging parameters: site, size, margins, enhancing pattern, nonenhancing component, T2-FLAIR mismatch, necrosis area, percentage of necrosis area inside the enhancing lesion, ADC values, rCBV, multivoxel chemical shift MR spectroscopy, and FA and MD value calculations from DTI. Various imaging markers were correlated with the phenol and genotyping markers. For easy understanding of this exhibit, we have categorized this exhibit under following heading: isocitrate dehydrogenase (IDH) status, O6-Methylguanine-DNA methyltransferase (MGMT), molecular genetics of glioblastoma and gliomagenesis, Alpha-thalassemia/mental retardation syndrome X-linked (ATRX) and TP53 mutations, 1p/19q codeletion as a marker for oligodendroglial tumors, Diffuse midline glioma and H3 K27M-mutant and TERT promoter mutations.

NREE-134 Venous Drainage Of The CNS: Review From Anatomy To Congenital And Acquired Abnormalities And Everything Between

Participants
Fernanda Assuncao, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:To review venous drainage brain embryology and anatomy;To improve knowledge regarding MRI techniques used for assessing the brain venous system;Pictorial review of the main abnormalities involving CNS venous system, including congenital abnormalities, vascular malformation, neoplastic lesions and everything between and potential pitfalls. To emphasize the key imaging points to arrive at a diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Introduction1.1 Embryology1.2 Anatomy1.3 MRI techniques2. Describe the imagine features and patterns of involvement3. Conclusion

NREE-135 Hemangioblastoma Imaging Aspects: Typical And Atypical Lesions And Mimicking Diseases

Participants
Vitória Taumaturgo da Costa, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1- To review the epidemiology of hemangioblastomas and its sporadic or disease-associated presentations (Von Hippel Lindau). 2- To show the hemangioblastomas typical imaging aspects, such as high vascularization, cerebellar and solid-cystic tumor, and vivdly enhancement of the mural solid nodule component as well as the atypical presentations. 3- To exemplify differential diagnosis and situations that mimic hemangioblastomas, such as ependymomas, pilocytic astrocutoma and metastasis.

TABLE OF CONTENTS/OUTLINE

1 - Illustrated cases of hemangioblastomas (HBM) from our neurorradiologic group since 2006 to 2021. 2 - Clinical association of HBM presentations: sporadically HBM, von Hippel Lindau associated HBM, HBM mimmicking other conditions, atypical presentation of HBM. 3- Correlation between imaging findings and hystological aspects such as absence of high grade morphological features, presence of capillary vessels and the specific marker (inhibin A).

NREE-136 Atypical Spinal Cord Tumors: When Expect The Unexpected

Participants
Fernanda Assuncao, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:- Review the epidemiology, clinical scenarios and the typical imaging features of the most common spinal cord tumors;- Illustrated review of a series of cases of atypical spinal cord tumors;- To emphasize the key imaging features to narrow the differential diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Introduction1.1 Epidemiology1.2 Clinical scenarios1.3 Typical imaging features2. Series of cases of atypical spinal cord tumors;3. Conclusion

NREE-138 Spondylotic Myelopathy: An Expanding Spectrum Of Imaging Findings

Participants
Fernanda Assuncao, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:- Review the anatomy, physiopathology and epidemiology of spondylotic myelopathy;- Pictorial review of typical and atypical cases;- Highlight the key imaging features to prompt precise diagnosis and guide proper treatment.

TABLE OF CONTENTS/OUTLINE

1. Introduction1.1 Epidemiology1.2 Typical imaging features2. Series of cases with typical and atypical imaging findings3. Differential diagnosis4. Conclusion

NREE-139 What Could Go Wrong? A Case Collection Of Cerebellopontine Angle Lesions

Participants
Akm Rahman, DO, Pittsford, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Familiarize radiologists with the radiologic presentation of CPA lesions.Recognize characteristic and differentiating factors between lesion types. Understand the post-treatment appearance and recurrence presentation.

TABLE OF CONTENTS/OUTLINE

Anatomy: The exhibit will begin with an overview of the Cerebellopontine angle anatomy. Structure: The different structures will be highlighted with an emphasis on function and relation to other parts of the brain, spinal cord, and body. Lesions: Each lesion will be explained with: Pathology, Key Factors, Case, Imaging. Schwannoma: Benign tumors originating from Schwann cells. Meningioma: Most common meningeal tumor originating from meningocytes. Lipomatous meningioma: Rare benign metaplastic meningioma. Epidermoid liposarcoma: Dedifferentiated liposarcoma containing notable epithelial features. Aneurysm: Confined bulbous blood vessel dilation typically of arterial origin. CPA Arteriovenous Malformation: Vascular malformation characterized by vessels spread through normal brain parenchyma. Trigeminal Schwannoma: Encapsulated tumors originating from trigeminal Schwann cells. Cyst: Fluid filled cavity lined with epithelium. CPA Cavernous Hemangioma: Benign tumor originating from blood vessels.CPA Lipoma: Benign tumors originating from mature adipocytes. Differentiating Factors:The exhibit will conclude with comparisons and contrasts between the lesions to aid in distinguishing between them.

NREE-14   Longitudinal Extensive Transverse Myelitis: Thinking Beyond Neuromyelitis Optica Spectrum Disorders

Participants
Barbara Trapp SR, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching Points:The purpose of this exhibit is:To sediment the imaging findings that define longitudinal extensive transverse myelitis (LETM).To demonstrate the main imaging characteristics of LETM in the scenario of Neuromyelitis Optica Spectrum Disorders (NMOSD).To demonstrate the main differential diagnoses of LETM.To help expand the differential diagnoses through the distinct imaging patterns of LETM through a pictorial essay of the various associated conditions.

TABLE OF CONTENTS/OUTLINE

Table of contents/outline: Powerpoint LayoutDefinition of LETMLETM in NMOSDNMOAnti-MogADEMDifferential diagnosisThe following topics will include a brief clinical and pathological overview and a detailed discussion of the main imaging findings that give clues for the correct etiological diagnosis.Inflammatory disordersSystemic Lupus ErythematosusSjögren syndromeSarcoidosisBehçetMultiple sclerosisInfectious disordersLyme diseaseVaricella-zosterCytomegalovirusHTLVPoliovirusToxoplasmosisTuberculosisNocardiaSyphilis EsquistossomoseNeoplastic disordersAstrocytomaEpendymomaLymphomaMetastasisParaneoplastic disordersVascular disordersSpinal cord infarctionFibrocartilaginous embolism syndromeSpinal cord arteriovenous shuntsTraumatic conditionsMetabolic disordersSubacute combined degenerationDegenerativeSpondylotic myelopathyPost radiotherapyOthersSpinal form of cerebrotendinous xanthomatosisMitochondriopathies

NREE-140   Neurologic Complications Of Immunotherapy

Awards
Cum Laude

Participants
Amit Desai, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand mechanisms of action of a wide variety of immunotherapies. 2. Learn immunotherapy-mediated neurologic complications including clinical presentation and imaging appearance. 3. Review prognosis and management of immunotherapy-mediated neurologic complications.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Review of immunotherapies including clinical indications and mechanisms of action. Therapies will include but are not limited to:a. Ipilimumbab b. Nivolumab c. Pembrolizumab d. Natalizumab e. Cabozantinib f. Rituximab g. Bevacizumab h. Bapineuzumab i. CAR T cells j. Vaccines 3. Clinical Cases: Review clinical and imaging presentations of immunotherapy-mediated neurologic complications followed by prognosis and management. Complications will include but are not limited to:a. Hypophysitis b. Aseptic Meningoecephalitis c. Acute or Chronic Encephalopathy d. Seizures e. PRES f. Pseudoprogression & Tissue Necrosis g. PML-IRIS ADEM Myelopathy h. Demyelinating Polyneuropathy4. Conclusion.

NREE-141   Outcome Prediction For Head And Neck Cancer Patients: How Can We Improve Further?

Awards
Certificate of Merit

Participants
Maryam Vejdani-Jahromi, MD,PhD, Cambridge, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Outcome prediction is crucial for head and neck cancer (HNC) patient care to individualize the treatment for a better outcome. TNM calcification has been used for years, primarily based on the size, location, and extent of the primary lesion. However, not only size or extent but also the histological type or degree of differentiation is important to predict the outcome. More recently, we learned the viral status such as HPV and EBV, and immunohistochemistry feature is also crucial to determine the outcome. With the advancement of imaging technology and clinical knowledge, numerous clinical and imaging data are currently available for each patient. Therefore, the development of reliable artificial intelligence, specifically machine learning (ML) and deep learning (DL) applications, has been anticipated to utilize such data for more accurate diagnosis and outcome prediction. The purposes of this exhibit are: 1) to review the historical and current practice for HNC outcome prediction and treatment planning, 2) to review currently available clinical and imaging biomarkers for HNC, 3) to review ML and DL approaches for predicting outcome, and 4) to discuss the future directions and radiologists' roles in predicting outcome and treatment individualization for HNC patients.

TABLE OF CONTENTS/OUTLINE

1. Review of the AJCC TNM classification. 2. Review of clinical biomarkers. 3. Review of imaging biomarkers. 4. Review of ML/DL

1. Review of the AJCC TNM classification. 2. Review of clinical biomarkers. 3. Review of imaging biomarkers. 4. Review of ML/DL approaches for HNC outcome prediction. 5. Discussion on the future direction and radiologists' roles.

NREE-142   When Should I Think About Parasitic Brain Infections? Tips And Traps

Participants
Fernanda Assuncao, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:- Review the epidemiology and pathophysiology of different parasitic infections that affect the central nervous system (CNS); - Pictorial review of the main neuroparasitosis;- Highlight the key imaging features to narrow the differential diagnosis and guide proper treatment.

TABLE OF CONTENTS/OUTLINE

1. Introduction1.1 Epidemiology1.2 Clinical scenarios2. Describe the imaging features and patterns of involvement of the main neuroparasitosis; 3. Differential Diagnosis 4. Conclusion

NREE-143   Tuberous Sclerosis: Not Merely A Collection Of Findings. A Global Neuronal Migration Disorder Point Of View.

Participants
Lee Van Diniz, MD, Botucatu, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Tuberous sclerosis is a neurocutaneous disorder characterized by the development of multiple benign tumors of the embryonic ectoderm. The condition arises from mutation in tumor suppressor genes involved in the mTOR pathway. We are going to examine the spectrum of brain abnormalities encountered in TSC and presents them as not merely a collection of lesions but more cohesively in the context of a global neuronal migration disorder. Our purpose is to review the pathophysiology of tuberous sclerosis complex (TSC) and mTOR pathway and learn about the different presentations and imaging findings in TSC.

TABLE OF CONTENTS/OUTLINE

Tuberous sclerosis has a number of multiorgan manifestations. We are going to review a step-by-step approach to the central nervous system manifestations of TSC discussing about: 1) Brain embriology and the mTOR pathways abnormalities in neuronal migration. 2) The classical findings in patients with TEC: Cortical/subcortical tubers , white matter abnormalities, subependymal hamartomas and Subependymal Giant Cell Astrocytoma. 3) The findings of TSC in fetal MRI. 4) The role of Perfusion Weighted Imaging, Spectroscopy and Diffusion Tensor Imaging in the spectrum in the diagnosis of TSC lesions. 5) Review the non-parenchymal findings in brain studies: Shagreen patches, retinal hamartomas, osseous manifestations, and other abnormalities in TSC. 5) Review the findings of other diseases related to the mTOR pathway and neuronal migration disorders. 6) Focus on the differential diagnosis of TSC in brain MRI.

NREE-145   Neurogenetics And Imaging Of Ataxia.

Participants
Sangam G. Kanekar, MD, Hershey, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To discuss the etiology, pathogenesis and neurogenetics of ataxia and illustrate the neuroimaging patterns in different types of ataxia. 2. To discuss the clinical, genetic and imaging approach of inherited ataxia.

TABLE OF CONTENTS/OUTLINE

Ataxia is defined as "an inability to coordinate voluntary muscular movements." Clinically, identifying the etiology of ataxia can be a complex task. In this exhibit we focus on highlighting the salient points in distinguishing the various types and causes of ataxia and discuss the neurogenetics of the respective ataxic disorder. Differentiating acquired from inherited forms of ataxia can help determine the expected disease course. Inherited etiologies involve a genetic or biochemical defect which leads to the formation of ataxia. For better understanding we classify ataxia into autosomal dominant, autosomal recessive and X-linked ataxia.

NREE-148   Traumatic Spinal Cord Injury - Mechanism, Clinical Presentation And Imaging Features.

Participants
Savith Kumar, MBBS, MD, Bangalore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Spinal cord damage may be due to primary or secondary injury. Primary injury is caused by the initial mechanical force which bruise or tear into the spinal cord tissue and secondary injury leads to progressive damage. MRI findings in TSCI ranges from concussion which is normal on imaging to cytotoxic edema, edema, hemorrhagic contusion, hematoma and cord transection. Intramedullary damage in TSCI can be quantified based on the distinct pattern of signal intensity on T2 weighted image which has prognostic implication..

TABLE OF CONTENTS/OUTLINE

Traumatic spinal cord injury(TSCI) is a debilitating neurological condition. Spinal cord damage after trauma is due to primary insult at the site of injury and secondary cascade of changes occurring at and remote from the site of injury. The type and extent of cord injury determines the severity of the initial neurological impairment and improvement over time. The main mechanisms of injury are impact with compression, distraction and transection. MRI is the imaging modality of choice and imaging features range from cytotoxic edema, edema, hemorrhagic contusion, hematoma and cord transection. MRI based imaging metrics or scoring system are also available for prediction of neurological and functional recovery. Contents Illustration of mechanism of spinal cord injury. Description and Illustration of Clinical features and clinical classification. Case illustration of various imaging features in spinal cord trauma. Illustration of MRI based imaging metrics or scoring system.

NREE-149   Multiple Sclerosis Lesions In The Spinal Cord: Mimics

Participants
Akm Rahman, DO, Pittsford, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the general pathophysiology and clinical presentation of multiple sclerosis.To understand the radiologic findings associated with multiple sclerosis as it presents in the spinal cord through a case-based presentation.To systematically classify and identify etiologies for spinal cord lesions in the form of a comprehensive differential diagnosis.To explore the radiologic features of each lesion etiology in terms of their distinguishing characteristics, incorporating correlations to their clinical pathophysiologies when relevant

TABLE OF CONTENTS/OUTLINE

Learning ObjectivesMultiple SclerosisEpidemiologyPathogenesisClinical PresentationDiagnostic CriteriaClinical CriteriaLaboratory FindingsRadiological FindingsBrain MRISpinal Cord MRITreatmentTreatment Complications (PML)Case Presentation: Multiple Sclerosis of the Spinal Cord with Wallerian DegenerationDifferential DiagnosisAutoimmune DemyelinatingNMOSDTransverse myelitisADEMBalo's Concentric SclerosisAutoimmune Non-DemyelinatingSarcoidosisSLENeuro-Behçet's DiseaseInfectiousLyme DiseaseHTLV-1-Associated MyelitisHIV-Associated MyelitisNeurosyphilisVascularAnterior Cord SyndromePosterior Cord SyndromeMetabolicVitamin B12 DeficiencyNitrous Oxide ToxicityNeoplasticGlioblastomaEpendymomaCase Quizzes: Image MatchingKey Takeaways

NREE-15   Brain MRI Findings And Clinical Features Of Triplet Repeat Diseases

Awards
Certificate of Merit

Participants
Ryo Kurokawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand the concept of triplet repeat disease (TRD) 2. Demonstrate the brain MRI findings of TRD 3. Show how clinical features can contribute to the diagnosis of TRD

TABLE OF CONTENTS/OUTLINE

I. What is TRD?: The concept of TRD; Pathomechanisms of TRD (loss-of-function, polyglutamine disease,toxic gain-of-function [RNA], polyalanine disease, unknown mechanisms) II. Loss-of-function: Fragile X syndrome (FXS), Fragile XE syndrome (FRAXE), Friedreich's ataxia (FRDA) III. Polyglutamine disease: Huntington disease (HT), Dentatorubral-pallidoluysian atrophy (DRPLA),Spinocerebellar ataxia 1 (SCA1), SCA2, SCA3, SCA6, SCA7, SCA17,Spinal and bulbar muscular atrophy (SBMA) IV. Toxic gain-of-function (RNA): Fragile X-associated tremor ataxia (FXTAS), Myotonic dystrophy type 1 (DM1) V. Polyalanine disease: Cleidocranial dysplasia (CCD), Holoprosencephaly 5 (HPE5),Oculopharyngeal muscular dystrophy (OPMD) VI. Unknown mechanism: Neuronal intranuclear inclusion disease (NIID), Oculopharyngeal myopathy with leukoencephalopathy (OPML), Oculopharyngodistal myopathy (OPDM), SCA8, SCA12, Huntington disease-like 2 (HDL2)Summary 1. TRDs have different pathomechanisms, including loss-of-function, polyglutamine disease,toxic gain-of-function (RNA), polyalanine disease, and unknown mechanisms. Summary 2. Some TRDs have pathognomonic radiological features that can help in differentiation. Summary 3. Clinical features can help diagnose TRDs, especially when radiological findings are similar to others.

NREE-150   Imaging Of Gliomas In 2021. What Is New In The 5ThEdition Of The Who Classification?

Awards
Certificate of Merit

Participants
Octavio Arevalo, MD, Shreveport, Louisiana (*Presenter*) Nothing to Disclose

TEACHING POINTS

- The new WHO classification of the CNS tumors simplifies the glial tumors to three main categories: Astrocytoma IDH-wildtype, Astrocytoma IDH-mutant, Oligodendroglioma IDH-mutant and 1p/19q co-deleted.- The pediatric and adult gliomas are now believed to be two different group of diseases. - There are imaging signs with a high specificity and PPV for a preoperative prediction of tumor molecular status such as the T2/FLAIR mismatch, the heterogeneous texture, and the pattern of calcification among others.- Certain molecular drivers are promising targets for guided therapies.

TABLE OF CONTENTS/OUTLINE

- Background- 4th edition of the WHO classification for CNS tumors- cIMPACT-NOW updates- 5th edition of the WHO classification for the CNS tumors. What changed?- Imaging biomarkers for specific tumor genotypes- The role of advanced imaging in the molecular diagnosis era- Illustrative cases- Summary

NREE-151   The Need For Speed: Sequence Innovations For Accelerated Neuro MRI Protocols

Awards
Magna Cum Laude

Participants
Michael Hoch, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Reducing patient scan time with accelerated acquisition techniques can decrease waiting lists, motion artifacts and incomplete exams. 2) Familiarize yourself with recently introduced accelerated MRI techniques and gain a conceptual understanding of image reconstructions. 3) Learn clinical scenarios where accelerated MRI techniques are useful such as screening exams, head and neck imaging, and for neurosurgical planning.

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Aggressive Parallel Imaging - Ultrahigh coil element density providing excellent SNR and rapid acquisition. Take advantage of aliasing with reconstructions based on coil sensitivity due to location. Increase patient throughput.Simultaneous Multislice - Concurrently acquire multiple diffusion slices during each acquisition with controlled aliasing and partially parallel reconstructions. Once reserved for only research subjects, can now be used in clinical patients and for tractography applications.Radial VIBE - k-space sampling along rotated spokes. Accelerate acquisition by reducing the number of spokes with maintained diagnostic image quality. Benefits head & neck imaging by reducing artifacts.Compressed Sensing - Uses incoherent under-sampling of k-space and iterative reconstruction to accelerate acquisitions. Advantageous for screening such as IAC and metastasis protocols.Deep-Learning Denoising - MP-PCA isolates and removes thermal noise. Allows shorter scan times to achieve similar image quality. May prove useful for functional neurosurgery planning.

NREE-152   Tips And Tricks For Application Development Using Pretrained Medical AI Models.

Participants
Hiroto Yamashiro, RT,MS, Toyoake, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Deep learning has begun to be used as essential tool in radiology. However, preparation of expensive hardware and difficulty in collecting images data by ethical and time constraints makes barrier in development of deep learning using medical images. Therefore, we can solve these challenges by using pretrained deep learning model provided from cloud resources. The purpose of this exhibition is to show what kind of deep learning model will be useful for the study. And we introduce our study applicating Clara that is framework provided by NVIDIA as an example.Major teaching points of this exhibit are:1.Deep learning research using medical images have some challenges.2.Pretrained models using natural images show some solutions.3.NVIDIA Clara project and application example using the segmentation model.

TABLE OF CONTENTS/OUTLINE

1.Research of deep learning using medical images-Barriers to use medical images -Solution using pretrained models2.What is the NVIDIA Clara project?3.Fully automated grading system of glioma using Clara segmentation model

NREE-153   A New Insight Into Imaging Of Gliomas: PET-MRI. Here Is How We Do It.

Participants
Yukiyoshi Kimura, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To recognize the typical and atypical imaging features of high and low-grade gliomas.- To explain and illustrate the importance of the distinction between recurrence and pseudoprogression.- To describe the main distinctive imaging and molecular characteristics between recurrent gliomas and pseudoprogression. - To understand how to evaluate the response of surgical and chemoradiation therapy through different imaging modalities and its advantages and limitations. - To review the recent advancements in hybrid imaging (PET-MRI) in the assessment of recurrent gliomas vs. treatment-related changes.

TABLE OF CONTENTS/OUTLINE

-Introduction-Indications-PET MRI Protocol (patient preparation, PET radiotracer selection, radiotracer's advantages and limitations, MR sequences, and acquisition times).-Advanced MRI sequences (DWI, DSC and DCE, and spectroscopy) in the evaluation of recurrence vs. pseudo-progression. -PET-MRI fusion evaluation with different radiotracers. -Pictorial review of recurrent disease and pseudo-progression with illustrative cases. -Take-home points-References

NREE-154   Multi-delay ASL And SWI: An Effective Combination In Clinical Routine

Awards
Certificate of Merit

Participants
Jerome Hodel, Paris, France (*Presenter*) Nothing to Disclose

TEACHING POINTS

To understand the value of Arterial Spin labeling (ASL) and Susceptibility-weighted Imaging (SWI) combined in the daily routine practice.To learn how to distinguish between acute stroke, migraine and seizure using ASL/SWI.To understand the specific value of ASL/SWI for the detection of small arteriovenous shunt and for the characterization of brain tumors.To understand the potential role of ASL/SWI in avoiding GBCA use.

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Table of Contents1/ Technical aspects (including FSE read-out, multidelay ASL, TOF effect), post-processing.2/ Dedicated MRI protocol according to the clinical context.3/ Pictorial review: combined used of ASL and SWI in a wide range of pathologies, comparison with conventional MR imaging including post-contrast imaging.4/ Diagnostic algorithm with corresponding imaging findings.5/ Pitfalls and mimics.6/ Take home messages.OutlineThe combined use of SWI and ASL improves the diagnostic accuracy of MRI.ASL is sensitive to the arterial transit time explaining the specific value of multidelay ASL.Routine evaluation of ASL/SWI helps: (i) to distinguish stroke mimics from acute stroke, (ii) to detect small arteriovenous shunt, (iii) to characterize brain tumors. ASL artifacts are useful markers of pathology.ASL/SWI may be potentially promising to avoid GBCA in selected cases.

NREE-155   First Seizure In Adults: How To Image?

Participants
Jerome Hodel, Paris, France (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To learn how to optimize imaging protocol in patients with first seizure- To understand the specific value of specific MR sequences such as DWI, SWI, ASL and high resolution MPRAGE in such patients- To learn how to distinguish between seizure, acute stroke and migraine using MRI

NREE-156   Brain Under Attack: Identifying Penumbra Areas In The Normal-appearing White Matter

Participants
Jonadab Dos Santos Silva, MS, Niteroi, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Multiple sclerosis has a broad spectrum of hidden white matter lesions that may not always be visually identifiable. Nevertheless, subtle changes in normal-appearing white matter signal may still correlate with disease progression, proving a more objective parameter in the analysis of MS images.Identifying white matter regions with a higher likelihood of becoming lesions may be a step for monitoring patient treatment and subclinical disease activity.By combining multiple MR sequences, we can optimize detection of penumbral lesions, which may represent a spectrum of regions of altered signal that may have a higher potential of evolving into active lesions.

NREE-158   MRI Evaluation Of Thrombectomy Candidates In Acute Ischemic Stroke (AIS): Is It Time For A Change?

Participants
Emmanuel Alejandro Gamarra Aviles, MD, Castelli, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

Describe the role of MR imaging in the evaluation of thrombectomy candidates in acute ischemic stroke. Understand the relevance of DWI-ASPECTS and DWI-FLAIR MISMATCH and know the cutoff values for predicting unfavorable outcomes in a case-based approach.Explain the contribution of SWI to provide information on thrombus localization and composition.Identify stroke mimics and offer differential consideration for emergency "code stroke" cases.Review recent evidence-based guidelines for triage in AIS and how to interpret them.Recognize periprocedural complications in endovascular stroke treatment.Notice the utility of AI concerning workflow and image interpretation in patients with acute stroke.

NREE-159   An Anatomic Approach To Sellar Lesions

Participants
Tabassum A. Kennedy, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The differential diagnosis for sellar masses includes neoplastic and non-neoplastic conditions.2. Generating a differential diagnosis for sellar lesions is best organized from utilizing an anatomic approach.3. Understanding the clinical considerations are important for surgical management of sellar lesions.

NREE-16   The Brain Circuits And Tracts

Awards
Certificate of Merit

Participants
Ryo Kurokawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The aim of this review is to 1. Understand the anatomy of the brain circuits and tracts 2. Demonstrate the pathological conditions that involve the brain circuits and tracts 3. Know the clinical symptoms caused by the diseases

Anatomy; cortico-pontocerebellar tract (afferent); Dentaro-rubro-thalamic tract (efferent); Diseases: crossed cerebellar diaschisis; brain contusion and diffuse axonal injury; Listeria brainstem encephalitis 4. Guillain-Mollaret triangle Anatomy; Diseases: germinoma; cavernous malformation; pontine infarction 5. Cortico-basal ganglia-thalamo-cortical (CBGTC) loop Anatomy; Parkinson's disease 6. Pyramidal tract Anatomy; Diseases: horizontal gaze palsy with progressive scoliosis (HGPPS); adrenoleukodystrophy; Krabbe disease; amyotrophic lateral sclerosis 7. Optic pathway Anatomy; Diseases: Leber hereditary optic neuropathy; lymphoma; glioblastoma; postoperative degeneration 8. Auditory pathway Anatomy; Diseases: adrenoleukodystrophy; glioblastoma

NREE-160-HC Clinical Experience Using Novel Multidimensional Diffusion Magnetic Resonance Imaging For Characterization Of Tissue Microstructure In Various Brain Pathologies

Participants
Vasanth Venugopal, MD, New Delhi, India (*Presenter*) Chief Medical Officer, CARPL.ai

TEACHING POINTS

Multidimensional diffusion (MDD) MRI is a novel imaging technique that provides information enabling better discrimination of the average rate, microscopic anisotropy, and orientation of diffusion within microscopic tissue environments. We share our experience in the evaluation of MDD's clinical feasibility in various brain pathologies, where we employed Diffusion Tensor Distribution (DTD) imaging to retrieve nonparametric intravoxel DTDs. DTD allows separation of tissue-specific diffusion profiles of the main brain components, e.g., white matter, grey matter, cerebrospinal fluid and pathological tissue environments such as edema through so-called 'bins', namely the 'thin', 'thick', 'big', and the new fourth bin, 'sparse'. Microscopic anisotropy is not confounded by cell alignment over the voxel scale, unlike conventional fractional anisotropy. Long processing times (a few hours) are needed to generate DTD maps. Current MDD sequences, albeit optimized, feature longer TE compared to conventional diffusion sequences. This imposes a lower image resolution (3x3 mm2) in order to maintain reasonable signal-to-noise ratio. Distortion artefacts could be corrected upon acquisition of a reverse phase-encoding b0 image (for 'topup' processing).

TABLE OF CONTENTS/OUTLINE

1. Basic physics underlying MDD MRI 2. Pros and cons of the sequence 3. Highlight key differential diagnostic points in different brain indications: infections - tuberculomas and cysticercosis, sudden onset of loss of balance, fits, radiation damage and seizures

NREE-161-CS Imaging Diagnosis Of Dural Arteriovenous Fistula: Findings, Pitfalls, And Virtual 3D Tour Of Anatomy

Awards
Magna Cum Laude

Participants
Leanne Lin, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Diagnosing dural arteriovenous fistula (dAVF) is difficult on cross sectional imaging • Dilated leptomeningeal vessels and visualization of early venous drainage can suggest presence of dAVF, however this is highly dependent on contrast bolus timing • Often multiple modalities are required to make the diagnosis of dAVF • Cerebral angiogram is still gold standard to fully characterize the fistula, particularly to visualize venous reflux

TABLE OF CONTENTS/OUTLINE

• Background o Clinical manifestations of dAVF o Classification schemes § Borden § Cognard o Likelihood of hemorrhage • Interactive 3D tour of anatomy • Non-invasive imaging findings o Basic vascular anatomy o Imaging modalities for diagnosis o Imaging pitfalls, mimics and differential diagnosis • Case based review and 3D reconstructions o Cognard type I dAVF from posterior division of left ascending pharyngeal artery to left internal jugular vein o Cognard type IIa dAVF from left STA and occipital branches to sigmoid sinus. o Cognard type IIb dAVF from right occipital to sigmoid/jugular junction o Cognard type III right parietal MMA to cortical vein AVF o Cognard type IV cerebellar AVF with multiple meningeal and external carotid branch feeding arteries • Treatment options • Summary

NREE-162-CS Preoperative Surgical Planning Using Augmented And Virtual Reality

Participants
Noam Peled, PhD, Somerville, Massachusetts (*Presenter*) Co-founder, FIND Surgical Sciences Inc

TEACHING POINTS

Multimodal imaging and neurophysiology are critical for neurosurgical planning and crucial for neuroscience research in the diseased and healthy brain. 3D and 4D visualization of the data affect the decision-making process, the extent of invasive investigations, and the number of steps taken in epilepsy surgery. For both clinical practice and research, developing composite measures becomes possible once quantitative datasets from different modalities such as PET, MEG, fMRI, EEG, and invasive EEG are co-registered. This data fusion improves the detection of epileptogenic lesions and decreases the need for invasive monitoring. We implemented a multimodal analysis and visualization platform (mmvt.org). This platform enables clinicians to interpret multi-modality neuroimaging datasets for better surgery readiness and surgery outcomes. To simulate as closely as possible the actual brain surgery, we are developing an Augmented Reality (AR) where the clinicians can see a hologram of the subject's head and brain, which is constructed from a pre-operative MRI. The surgeons can directly visualize the neural activity on the 3D brain. Our AR application enables free hands while performing surgery-like operations. Neurosurgeons can seamlessly use "realistic operation planning tools" in a way that mimics the interaction they are about to perform, which can increase surgery readiness dramatically.

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1. Multimodal integration2. Multimodal analysis3. Multimodal visualization4. AR/VR in surgical planning

NREE-17 Role Of Multi Delay Arterial Spin Labelling Using Arterial Cerebral Blood Volume As A Novel Imaging Biomarker For Magnetic Resonance Imaging Grading Of Glial Neoplasms As Compared To T2 Dynamic Contrast Susceptibility Perfusion Technique

Participants
Krishna Pratap Senger JR, MD, MBBS, Trivandrum, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. ASL derived aCBV as a non invasive novel imaging biomarker for grading brain gliomas.2. Early recognition of glial neoplasm dedifferentiation to higher grades on follow up.

TABLE OF CONTENTS/OUTLINE

SYNOPSIS: Gliomas are primary brain neoplasms requiring perfusion imaging for grading. This study is evaluating a novel parameter aCBV (arterial cerebral blood volume) derived from multidelay arterial spin labelling(ASL) for grading primary glial neoplasm. BODY: Purpose Histo-genetic makeup defines a glioma. Perfusion parameter derived from multidelay ASL - (aCBV) can serve as a novel non invasive imaging biomarker. This study, the first of its kind, is undertaken to find the diagnostic utility of multi delay ASL derived aCBV as compared to DSC (rCBV) parameters. Materials and Methods: This is a pilot study involving 15 patients of brain gliomas. aCBV maps were generated and normalised values compared with rCBV. Results In our study of 15 patients (06 cases- low grade glioma and 09 cases- high grade gliomas). In the statistical analysis (using R software version 4.0.3) the AUC for normalised aCBV of multidelay ASL perfusion is 1.00 with sensitivity and specificity of 100 % each for a cut off of 1.1 and for normalised rCBV of DSC perfusion is 1.0 with sensitivity and specificity of 100% each for a cut off of 1.0 between low and high grade lesions. Pearson correlation coefficient was , 0.94 p<0.001Conclusion Using multidelay ASL derived aCBV we can differentiate between high and low grade gliomas with good statistical correlation with DSC derived rCVB.

NREE-18   Not Just Scoliosis: An Imaging Overview Of Juvenile Spinal Disorders

Participants
Aparna Madhavan, MBChB, Bury, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

The learning objectives for this educational exhibit are:-To discuss the spectrum of aetiologies affecting the juvenile spine-To provide an approach in the image interpretation of the juvenile spine-To illustrate the radiological features of the various spinal diseases in the juvenile spine

TABLE OF CONTENTS/OUTLINE

The content of the exhibit will include:• Imaging protocols in the assessment of the juvenile spine• Radiological features of the spectrum of aetiologies affecting the juvenile including those that are unique to the juvenile spine. Example cases include:- Juvenile Idiopathic Arthritis and post treatment complications- Hirayama's disease- Scheuermann's disease- Spondylolysis and pars defects-Posterior ring apophyseal fracture (PRAF)

NREE-19   Gadolinium Retention On Brain MRI: Pearls And Pitfalls

Participants
Nathan Hyson, MD, Detroit, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the risk factors and suspected etiology of gadolinium retention.2. Gadolinium contrast retention within the subdural space, subarachnoid space, ventricles, internal auditory canals, and globes can be an important mimic of pathology on brain MRI examinations.3. Discordance between globe signal and ventricle signal on FLAIR imaging can be an important clue gadolinium retention may be present.4. This is an important entity for radiologists to be aware of so as to ensure appropriate follow-up and avoid misdiagnosing more sinister pathologies.

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1. Review the risk factors for gadolinium retention, most importantly decreased renal function.2. Utilizing a system-based and pathophysiologic-based outline, illustrate examples of the potential pitfalls of gadolinium retention.3. Examples will include mimics of hemorrhagic conversion of an infarct, labrynthitis, meningitis, perilesional hemorrhage, ventriculitis, and hypophysitis.4. Illustrate the importance of follow-up in distinguishing mimics of pathology from true pathology.

NREE-2   Voxel-based Brain Tumor Segmentation: 10 Steps Towards Volumetric Accuracy

Participants
Jonadab Dos Santos Silva, MS, Niteroi, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Voxel-based morphometry (VBM) is a fast and reproducible image processing technique and can be performed through a semiautomated analytical pipeline;2. This proposed protocol optimizes tumor-to-parenchyma contrast ratio, facilitating tumor tissue delimitation;3. Accuracy is proportional to voxel size, thus 3D isotropic MRI volumes are preferred for spatial resolution purposes;4. VBM allows for detection of the actual tumor architecture, providing a more accurate tumor volume estimation

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Steps from the raw image to tumor volume estimation:1. DICOM to NIfTI conversion;2. T1 intensity normalization;3. T1 skull stripping;4. Linear registration of T1+C to T1 space;5. T1+C brain extraction using the T1 brain mask as a template;6. Intensifying contrast-enhancing regions;7. Signal thresholding to isolate highly contrast-enhanced regions;8. Filling the holes within the tumor;9. Cleaning voxel clusters other than the tumor;10. Tumor volumetric measurement.

NREE-20   Primary Lymphomas Of The Central Nervous System: Subtypes Of A Great Imitator And Their Radiopathologic Correlations.

Participants
Nadia Lorite Diaz, MD, Sabadell, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Primary lymphomas of the central nervous system (CNS) have a wide spectrum of manifestations on imaging studies. MRI is the imaging modality of choice. Although there is classic pattern of MRI findings, radiologists need to be familiar with atypical findings

that can be mistaken for manifestations of other conditions, including those that do not present with masses (e.g., vasculitis, infections, granulomatous diseases, etc.). This presentation describes the diverse manifestations of the different subtypes of primary CNS lymphomas on imaging studies, correlating these findings with the pathology findings according to the latest WHO classification of CNS tumors.

TABLE OF CONTENTS/OUTLINE

I - Introduction to primary CNS lymphomas. II - New WHO classification (2016) of primary CNS lymphomas (8 subgroups). III - Typical imaging findings and patterns of dissemination. IV - Case series illustrating the different subtypes of primary CNS lymphomas and the particularities of each on neuroimaging and pathology studies, with special emphasis on atypical findings that can lead to confusion with other conditions and on the differential diagnoses with these conditions. V - Conclusions.

NREE-21   **MRI Findings Of Tumors Of CNS Along With cIMPACT-NOW Looking Ahead To The Who Classification 2021**

Awards
Identified for RadioGraphics

Participants
Ryo Kurokawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this presentation is to summarize the practical recommendations on CNS tumor classification proposed in the Consortium to Inform Molecular and Practical Approaches to CNS Tumor Taxonomy-Not Official WHO (cIMPACT-NOW), and to contrast the MRI images with histological and molecular information while looking ahead to the WHO classification 2021.

TABLE OF CONTENTS/OUTLINE

Content organization What is cIMPACT-NOW? Update 1: Not otherwise specified (NOS) and not elsewhere classified (NEC). Update 2: Clarification of diffuse midline glioma, H3 K27M-mutant, and diffuse astrocytoma/anaplastic astrocytoma, IDH-mutant. Update 3: Recognizing histologically lower-grade astrocytic gliomas, IDH-wild type as glioblastoma, WHO grade IV. Update 4: Pediatric-type diffuse glioma with mutations in the MAPK and mTOR pathways. Update 5: Grading of IDH-mutant astrocytomas based on homozygous CDKN2A/B deletion status. Update 6: Various new entities and suggested name modifications. Update 7: Classification of ependymal tumors based on molecular status.

NREE-22   **Infectious Diseases And Mimickers Presenting As Dural Based Masses: The Role Of Magnetic Resonance Imaging**

Participants
Thiago B. Matias, MD, Campinas, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:• Review and illustrate the imaging findings of infectious diseases presenting as dural based masses and mimicking entities.• Describe the main imaging patterns of these entities, including tuberculosis, paracoccidioidomycosis, subdural empyema and differential diagnosis, highlighting key points to the differential diagnosis.

TABLE OF CONTENTS/OUTLINE

• Imaging patterns of infectious diseases presenting as dural based lesions and mimickers:o Tuberculosis.o Paracoccidioidomycosis.o Subdural empyema.• Differential diagnosis based on a pictorial review using representative cases from a tertiary hospital database.• Final remarks.

NREE-23   **Hypophysitis: Radiologic-Pathologic Correlation**

TEACHING POINTS

1. Provide an overview of normal pituitary gland development, anatomy, and histology.2. Review the pathophysiology of hypophysitis.3. Discuss differential diagnoses of primary versus secondary hypophysitis.4. Identify common imaging findings of hypophysitis and associated changes with disease progression.5. Describe correlating histopathological features of varying etiologies of hypophysitis.6. Review indications for medical versus neurosurgical management of hypophysitis.

TABLE OF CONTENTS/OUTLINE

I. IntroductionA. Definition and epidemiologyB. Clinical manifestationsII. Development, anatomy, and histology of the normal pituitary glandII. Pathophysiology of hypophysitisA. Natural history and role of imaging in monitoring disease progressionIV. Case-guided review of imaging findings and correlating histopathology including, but not limited to, the following differential diagnosesA. Primary hypophysitis (Lymphocytic, Granulomatous, Xanthomatous, IgG4-related, Necrotizing)B. Secondary hypophysitis (Medication-induced, adjacent sella/parasella pathology [pituitary adenoma, pituitary hyperplasia, infection, Rathke's cleft cyst, craniopharyngioma, metastases, etc], systemic disease [sarcoidosis, granulomatosis with polyangiitis, Langerhans cell histocytosis, etc])V. Factors influencing medical management versus neurosurgical intervention

NREE-24   **Cystic Malformations Of Posterior Fossa Made Easy**

Participants
Abdullah Ameen, MBBS, Karachi, Pakistan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) To discuss the brief anatomy of the posterior fossa 2) To describe different types of cystic posterior fossa malformation, their pathophysiology, and outcome 3) To describe the role of MR imaging in diagnosing and differentiating different types of posterior fossa cystic malformations 4) To enable the attendees and participants of diagnosing the posterior fossa cystic malformations quickly and easily by using a predefined approach.

TABLE OF CONTENTS/OUTLINE

Cystic malformations within the posterior fossa are rather common findings in pediatric neuroimaging. Differentiation between the various posterior fossa cystic malformations is important in terms of diagnosis, management, prognosis, and counseling of the affected families. A spectrum of disorder is included in posterior fossa cystic malformations including Dandy-Walker malformation, vermian hypoplasia, mega cisterna magna, Blake's pouch cyst, and arachnoid cyst. We will discuss how to differentiate these different types of malformation quickly and easily by looking at the mid-sagittal MR section and evaluating the images for the following parameters - Posterior fossa (Enlarged or normal) - Vermis (Normal or atrophied) - 4th ventricle (Enlarged or normal) - Tegmento-vermian angle (Normal or increased) (Normal is close to zero degrees however less than 18 degrees is widely considered normal) - Hydrocephalus (Present or absent)

NREE-25   A New Tool: 18-FCH PET/CT In Baseline Staging And Response Assessment Of Primary CNS Lymphoma

Participants
George Bitar, MBBS, MSc, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Central nervous system (CNS) lymphomas are uncommon but devastating diseases.The primary form is restricted to the CNS at diagnosis, constituting 2-4% of all primary brain malignancies. Secondary CNS involvement occurs early following the diagnosis of aggressive non-Hodgkin lymphomas, with a median interval of 5-12 months from diagnosis to detection. Both sub-types have a poor prognosis. 2. Contrast-enhanced magnetic resonance imaging (CE-MRI) is the current standard for baseline staging and response assessment of CNS lymphoma. However, differentiating viable disease from other causes of enhancement can be challenging. 3. Non-neoplastic causes of abnormal brain enhancement can limit accurate staging and overall prognostic efficacy of CE-MRI. 4. Abnormal choline metabolism is a hallmark of oncogenesis and cancer progression. We describe the novel use of 18F-fluoromethylcholine as a tracer within the context of baseline staging, interim and 'end-of- treatment' response assessment of CNS lymphoma.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Goals and challenges in imaging of CNS lymphoma 2(a) Non-neoplastic causes of abnormal brain enhancement on CE-MRI. 2(b) Absence of a validated prognostication tool for CNS lymphoma treatment 3. 18F-fluoromethylcholine positron emission tomography/computed tomography: The principles 4. Clinical relevance and applications 4 (a) Baseline assessment 4 (b) Interim response 4 (c) End of treatment assessment 5. Pitfalls 6. Future Directions

NREE-26   The Many Faces Of Bevacizumab: A Case-based Review Approach

Awards
Certificate of Merit

Participants
Camila Amancio, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:- Review the timeline of glioblastoma treatment with focus on antiangiogenic therapy with Bevacizumab (BEV), also giving practical information for radiologists about administration and mechanisms of action.- Review and application of the Response Assessment in Neuro-Oncology (RANO) criteria.- Review the literature in a case-based approach focusing on high grade gliomas, giving teaching points for each demonstrative case that will allow the reader to recognize patterns of imaging after or during BEV therapy and possible interpretations.

TABLE OF CONTENTS/OUTLINE

- Review of BEV therapy: what/ where/ how/ and when to use this medication in the context of glioma. The mechanisms of action will be shown through schematic drawing.- Timeline with the evolution of glioblastoma treatment and focus on the RANO criteria. Application of RANO criteria on MRI.- Review of the literature with teaching points in a case-based approach of high grade glioma:*Effects of BEV;*Restricted diffusion induced by BEV: viable tumor vs coagulative necrosis;*Possible imaging biomarkers of BEV therapy response: cerebral blood volume (CBV), Ktrans , ADC values;*Radiological progression patterns after BEV failure (classification);*Patterns of perfusion imaging;- Limitations and future perspectives in MRI Assessment of BEV therapy - An original case of application of chemical exchange saturation transfer (CEST) MRI and our interpretation in a patient in BEV therapy.

NREE-27   ABC Of Non-compressive Myelopathy: Tips And Tricks For General Radiologists

Participants
Mohamed Elsakka, MBBCh,MRCS, Watford, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Windowing the MR sequences can help depict the abnormal cord signal clearer.- Using a systematic approach through combing the symptom onset and the signal characterisation, such as the one proposed in our article, can help the radiologist narrow down the differentials and can direct the clinical history/examination.- Acute onset myelopathy is likely to represent as vascular, demyelinating or infective causes. Consider adding Diffusion weighted imaging (DWI) sequence for infarction and brain/contrast imaging for demyelinating/infective causes in acute onset myelopathy.- Subacute onset myelopathy is likely to represent as neoplastic, neuro-degenerative or metabolic causes. Consider cord expansion for neoplastic causes and brain imaging for degenerative causes.- Not all neoplasm cause cord expansion, such as intra-vascular lymphoma.- Infective causes can present as either acute or subacute onset myelopathy.- A normal cord signal does not rule out myelopathy if the clinical picture fits.

TABLE OF CONTENTS/OUTLINE

- Algorithmic approach for non-compressive myelopathy (more extensive).- Acute onset myelopathy.- Subacute onset myelopathy.- Application of algorithmic approach on cases from our institute.- Normal cord signal myelopathy.- Take home message.

NREE-28   CSF, You Should Not Be Here! How To Recognize CSF Leak In CT-cisternography And CT-myelography Images

Participants
Mika Shibuya, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

CSF leak results from direct communication of the CSF to extra-cranial / extra-spinal space, and may have different etiologies, clinical manifestation and image depending on their location. CSF leaks from the skull base are related to symptoms such as rhinorrhea / otorrhea; and when located in the spine, they are commonly related to orthostatic headache due to hypovolemia. High-resolution CT with or without intrathecal contrast administration (CT-cisternography) shows bone defects and extravasation of the contrast material in the extracranial compartmeeds, especially in the anterior cranial fossa. CT-Myelography / Digital Subtraction Myelography (DSM) shows findings such as extravasation of the contrast material in the epidural compartments and along the axilla of the nerve root or, more rarely, extravasation into a paraspinal vein (CSF venous fistulas), mainly in the thoracic spine and thoracolumbar junction. It's extremely important for radiologists to recognize the main locations and imaging findings of CSF leaks, which are often subtle, especially in cases of CSF venous fistulas, since the diagnosis and therapeutic success of these patients depend, at least in part, on their correct location.

TABLE OF CONTENTS/OUTLINE

Introduction. How to investigate - The role of imaging. Where to look? Why should we recognize this entity?

NREE-29   Diffuse Midline Glioma: Basic And Advanced Neuroimaging

Participants
Ryo Kurokawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To review the characteristics of diffuse midline glioma (DMG) 2. To show conventional neuroimaging findings in DMG 3. To demonstrate how advanced neuroimaging modalities help in the diagnosis of DMG

TABLE OF CONTENTS/OUTLINE

1. What is DMG? - Epidemiology; - H3 K27M-mutant and H3 G34R-mutant; - Genetic associations, molecular updates, and future molecular targeted therapies 2. Conventional neuroimaging findings in DMG- Conventional CT and MRI imaging findings in DMG in the brain and spinal cord 3. Advanced neuroimaging findings in DMG - Dynamic susceptibility contrast (DSC); -MRI perfusion images; - Amide proton transfer-weighted (APTw) images; - Magnetic resonance spectroscopy (MRS); - Texture analysis

NREE-3   Susceptibility-weighted Imaging (SWI) Sequence, Principles And Clinical Applications: A Primer For Residents

Participants
Michaela Cellina, Milan, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To report the principles of SWI. 2. To show the importance and the role of SWI in neurological disorders. 3. to provide an overview of clinical cases showing SWI usefulness.

TABLE OF CONTENTS/OUTLINE

SWI is a relatively new magnetic resonance imaging (MRI) technique that is being used to help the differential diagnosis of many brain diseases. It is based on differences in magnetic susceptibility of various components, such as deoxygenated blood, blood products, iron, copper, calcium, allowing for a new source of contrast in MRI. SWI is a fully flow compensated, three-dimensional, high spatial resolution, gradient-echo sequence using magnitude and phase images either separately or in combination with each other.SWI can be applied in different neurological scenarios: to assess small injuries, subtle subarachnoid hemorrhages, and diffuse axonal injury in the traumatic context, to provide information adjunctive to those of DWI in ischemic stroke, and to highlight its hemorrhagic transformation, to identify brain microbleeds, characteristics of different pathological conditions (e.g. amyloid angiopathy, hypertensive encephalopathy), to help the detection of vascular malformations, to visualize the iron deposition in neurodegenerative disorders and in multiple sclerosis plaques. Moreover, the use of SWI can help the grading of cerebral malignancy thanks to the identification of intralesional hemorrhagic and calcified foci.

NREE-30   DISH - The Forgotten And Neglected Spondyloarthropathy

Participants
Jawad Hussain, MD, Mineola, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1 - Radiologists and trainees should have a working knowledge of Diffuse Idiopathic Skeletal Hyperostosis (DISH) and its associated extra-thoracic bony and non-bony findings. 2 - Radiologists must understand prevalence of DISH along the spine; cervical, thoracic, and lumbar. 3- Radiologists should be alert for co-morbidies of DISH via compression of adjacent structures and its associations with metabolic syndrome.

TABLE OF CONTENTS/OUTLINE

After reviewing this exhibit, learners should be able to identify the imaging characteristics of DISH and its associated complications. A. Describe the Resnick and other criteria for diagnosing DISH and, treatment, if needed. B. Review the extra-thoracic bony and non-bony involvement of DISH and its prevalence along the spine; cervical, thoracic, and lumbar. C. Understand the associating complications from compression of adjacent structures and correlation with Metabolic Syndrome. D. Utilizing imaging and clinical data in deciphering DISH from ankylosing spondylitis. E. Review the relevant radiology literature on this topic.

NREE-31   Multiple Sclerosis Imaging: Today And Tomorrow

Participants
Jonadab Dos Santos Silva, MS, Niteroi, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. In multiple sclerosis imaging, we have done:- 3D FLAIR: Cortical and periventricular demyelinating lesions. - 3D T1: Black holes.- T2: Infratentorial lesions.- Post-contrast T1: Acute inflammatory lesions.2. We are starting to do:- 3D T1 volumetric analysis: Quantitative volumetric assessment.- Post-contrast SWI: Central vein sign.- DIR and PSIR: Juxtacortical lesions.3. What we can implement in our analyses:- SWI: Smoldering lesions.- PET: Microglial activation.- DTI: Lesions in normal-appearing white matter.- rs-fMRI: Disruptions in the default-mode network.4. What imaging can tell us about multiple sclerosis:- Demyelination and lesion load- Dissemination in space and time- Distinction between chronic and acute lesions- Global and focal changes in cerebral structure

TABLE OF CONTENTS/OUTLINE

1. Today: What we have done - 3D FLAIR - 3D T1 - T1 - Post-contrast T12. Today: What we are starting to do - 3D T1 volumetric analysis - Post-contrast SWI - DIR/PSIR3. Tomorrow: What we can do - SWI/PET - DTI - rs-fMRI4. What imaging can tell us about MS - Demyelination and lesion load - Dissemination in space and time - Distinction between chronic and acute lesions - Global and focal changes in cerebral structure

NREE-32   Diagnostic Approach To Intraventricular Neoplasms

Participants
Irene Cifuentes Garcia, BMBS, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To illustrate the basic anatomy of the cerebral ventricles. 2. To list and illustrate the most important imaging features of common cerebral intraventricular tumors. 3. To analyze differential diagnosis of these lesions.

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There is a wide variety of intraventricular tumors and in many cases they can be asymptomatic and can be discovered as casual findings, or they can present with different symptoms depending on the location and size (including intracranial hypertension, headaches, ataxia, paresis or focal neurological deficits).It is important to know the anatomy and function of the ventricles to understand the different entities that can occur in the cerebral ventricles and understand the symptoms that cause these neoplasms.The imaging findings of different intraventricular neoplasms types, can be similar. Therefore, it is important to know not only the main CT or MRI imaging findings, but also, location of these neoplasms and patient's age and gender, in order to narrow the differential diagnosis.We review the basic anatomy of the ventricles and provide the main imaging features of the most common intraventricular tumors.

NREE-33   Paget Disease Of The Temporal Bone And Skull: A Pictorial Review.

Participants
Sofía Ventura- Diaz, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the basic anatomic architecture of the temporal bone and the petrous apex. 2. To recognize the radiologic spectrum through different imaging modalities of cranial and temporal Paget disease. 3. To know the differential diagnosis of temporal Paget disease. 4. To revise the possible complications of cranial Paget disease.

TABLE OF CONTENTS/OUTLINE

Introduction: definition, epidemiology, physiopathology and diagnosis. Normal anatomy of the temporal bone. Radiographic features and stages: multimodality imaging review. Differential diagnosis of petrous apex: case-based imaging review. Complications of cranial Paget disease. Basic epidemiology and brief retrospective analysis of the Paget disease cases recorded in our institution the last 12 years, analyzing the relationship to hearing loss and polyostotic affection. Conclusions.

NREE-34   Subcortical U-fiber: A Diagnostic Key To White Matter Disease

Awards
Certificate of Merit

Participants
Shu Suzuki, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

White matter diseases comprise a very broad differential diagnosis. Subcortical U-fibers are known as short association fibers and have unique features. We aim to familiarize radiologists with identifying the presence or absence of subcortical U-fiber involvement.

TABLE OF CONTENTS/OUTLINE

•Anatomical and pathological features of subcortical U-fibers•Radiologic pattern of white matter disease•Cases in which subcortical U-fibers are generally spared-Chronic small-vessel ischemic disease-Delayed post-hypoxic leukoencephalopathy-Post-radiation therapy•Cases in which subcortical U-fibers are preferentially affected1. Autoimmune/demyelinating-Progressive multifocal leukoencephalopathy (PML) -Multiple sclerosis (MS)-Acute disseminated encephalomyelitis (ADEM) 2. Metabolic-Wilson disease-Kearns-Sayre syndrome/chronic progressive external ophthalmoplegia -L-2 hydroxyglutaric aciduria 3. Vascular-Posterior reversible encephalopathy syndrome (PRES)-ECMO-related multiple microbleeds (COVID-19 case) 4. Neurodegenerative-Neuronal intranuclear inclusion disease (NIID)

NREE-35   What Is The Extracellular Ph Of Brain Tumors And How Can We Detect Brain Tumors Using Gadolinium-based-contrast Agents?

Participants
Yuki Matsumoto, MS, Tokushima, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The relaxivity of contrast agents depends on the pH value.2. pHe mapping of brain tumors might help to evaluate the malignancy of a tumor.

TABLE OF CONTENTS/OUTLINE

[Purpose] The purpose of this study was to investigate the relaxivity in relation to the pH value of each contrast agent. Moreover, pHe mapping was conducted to assess brain tumors. [Materials and Methods] A phantom experiment was performed using gadobutrol and gadoteridol. We prepared different pH-solution samples with known acidity (pH 6.0 to 7.8) that were used with different concentrations (0.1, 0.2, and 0.4 mmol) of contrast agents. Imaging was performed using a 3T MRI system (FUJIFILM Healthcare Corporation) to measure the T1 value. A single coronal-slice scan was performed using a fast spin-echo-based inversion recovery (FSE-IR) protocol, and the relaxivity values were calculated individually for each pH. The pH can then be calculated using leasts-squares fitting of the Hill-modified Henderson-Hasselbalch equation (relaxivity-pH curve). Finally, the pH map of the brain tumor was calculated using the nonlinear function obtained from the phantom experiments. [Results] The phantom experiments indicated that the relaxivity-pH curve was different from that of the contrast agent. The mean pHe value showed the trend that tumor malignancy gives lower pHe value, primary brain tumor was significantly lower than other brain diseases (P<0.001).

NREE-36   Brave New World: Current Concepts In Cortical Development Malformations

Participants
Barbara Trapp SR, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching points:The purpose of this exhibit isTo simplify the understanding of the embryological processes and the main genetic pathways that can lead to malformation of the cortical development.To explore the most recent definition and classification of malformations of cortical development.To show a pictorial essay of the main magnetic resonance imaging findings of cortical development malformations divided into subgroups, and its etiological correlation when applicable.

TABLE OF CONTENTS/OUTLINE

Table of contents/outline:Powerpoint layoutIntroduction: Normal embryology overview, characterizing the three major stages of cortical development: cell proliferation and apoptosis, cell migration, post-migrational development. Considerations about normal cortex imaging and conspicuity of malformation of the cortical development according to age-related image changes (myelination and maturation). Proposed magnetic resonance imaging protocol.Definition and imaging features of malformation of the cortical development: Microcephaly. Macrocephaly. Focal cortical dysplasia - Types I to III. Grey matter heterotopia: Periventricular nodular, Subcortical (transmantle, ribbon-like, "brain in brain" malformation, aventriculy). Lissencephaly- Agyria, Pachygyria, Subcortical band heterotopia. Cobblestone malformation. Polymicrogyria. Schizencephaly - open lip, closed-lip. Disgyria.

NREE-37   A New Global Tool For CNS Lymphoma Imaging: Treatment Response Assessment Maps

Participants
George Bitar, MBBS, MSc, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Central nervous system (CNS) lymphomas are uncommon but devastating diseases. The primary form is restricted to the CNS at diagnosis, constituting 2-4% of all primary brain malignancies. Secondary CNS involvement occurs early following the diagnosis of aggressive non-Hodgkin's lymphomas, with a median interval of 5-12 months from diagnosis to detection. Both subtypes have a poor prognosis.2. Contrast-enhancement magnetic resonance imaging (CE-MRI) is the current standard for baseline staging and response assessment of CNS lymphoma. However, differentiating viable disease from other causes of enhancement can be challenging.3. Non-neoplastic causes of abnormal brain enhancement can limit accurate staging and overall prognostic efficacy of CE-MRI.4. We describe the role of a novel tool, Treatment Response Assessment Maps (TRAMs) in characterisation the nature of any abnormal enhancement on CE-MRI and in determining whether there is viable tumor.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Challenges in imaging of CNS lymphoma including the limitations of contrast-enhanced MRI. 3. The principles of Treatment Response Assessment Maps 4. Clinical relevance and applications 4 (a) Baseline assessment 4 (b) Interim response 4 (c) End of treatment assessment 5. Pitfalls 6. Future Directions

NREE-38   From The Fragile X Premutation To The Hot Cross Bun: An MRI Unique Guide For Assessment Of Posterior Fossa Adult Diseases

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To discuss the spectrum of posterior fossa adult diseases through MRI, emphasizing degenerative, autoimmune, genetic, drug-related, and infectious diseases. To illustrate some diseases' typical imaging presentations, like the hot cross bun sign in multiple system atrophy-C (MSA-C) and the middle peduncle abnormalities on fragile X - tremor associated/ ataxia syndrome (FXTAS). To demonstrate the imaging pearls, etiology, physiopathology, and clinical highlights of posterior fossa adult diseases.

TABLE OF CONTENTS/OUTLINE

1. Background. 2. Imaging protocol. 3. Clinical perspective and importance of analysis of posterior fossa diseases through MRI. 4. The genetical cascade of events implicated in the FXTAS premutation. 5. Imaging pearls, including the middle cerebellar peduncles abnormalities on FXTAS and the hot cross bun sign in MSA-C. 6. Other diagnoses including alcoholic cerebellar degeneration, drug-induced cerebellar degeneration, autoimmune, cerebellar PRES, and infectious cerebellitis. 7. Flowchart for assessment of posterior fossa abnormalities presenting in adults. 8. Take-Home messages.

NREE-39   The Brain Is Love, Anger, Hatred, And Passion: Unraveling The Functional Anatomy And Disorders Of The Limbic System In Minutiae

Participants

Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To exhibit the macroscopic anatomy of the limbic system through 3T MRI and illustrations. To explain the limbic components' functionality, including the de amygdala, the hippocampus, cingulate gyrus, parahippocampal gyrus, dentate gyrus, and the hypothalamus. To demonstrate the correlation between anatomy, functionality, and human behavior. To exemplify the importance of MRI limbic assessment in demonstrating disorders of the limbic system.

TABLE OF CONTENTS/OUTLINE

1. Background. 2. Phylogenetic evolution of the limbic system. 3. Functional and imaging anatomy, including the cingulate gyrus, parahippocampal gyrus, hippocampus, amygdala, and mammillary bodies. 4. Clinical perspective: limbic relationship with appetite, sleeping disorders, emotional disorders, olfaction, sexual behavior, memory, addiction, motivation, and cognition. 5. Imaging assessment of the limbic diseases, including dementia, encephalitis, global transitory amnesia, tumors, and epilepsy. 6. Take-Home messages.

NREE-4 **NOWinBRAIN - A Systematic, Comprehensive, Extensive And Spatially Correlated Image Repository Of Surface And Planar Anatomy Of The Brain, Head And Neck**

Participants
Wieslaw Nowinski, DSc,PhD, Warsaw, Poland (*Presenter*) Nothing to Disclose

TEACHING POINTS

The exhibit: 1) Demonstrates correlated planar and joint surface-planar anatomy of the brain, head and neck; planar (2D) anatomy represented as MR (axial, coronal and/or sagittal) triplanar is labeled and surface (3D) anatomy represented as polygonal virtual models is parcellated by color and labeled; 2) Provides novel image display as sequences of spatially correlated 2D-3D image pairs located in a stereotactic coordinate system, facilitating understanding 3D relationships and structure localization; 3) Presents a wide spectrum of images, in total over 5,700 images systematically organized, named and grouped into almost 500 albums (folders); 4) Is suitable for medical students and residents, and educators to prepare presentations.

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The repository contains 6 anatomic galleries derived from 3D brain atlases constructed from multiple 3/7 T MR and CT scans of a living brain. Galleries G1-G5 created earlier contain surface anatomy fully parcellated by color and labeled, and organized into image (appearance and context) sequences. For RSNA 2021 this repository is extended, enhanced, and a radiologic gallery (G6) added with correlated surface and planar anatomy of the brain, head and neck placed in a stereotactic coordinate system. G1 contains primary tissue classes from which the other classes are constructed. G2, G3, G4 comprise double-tissue, triple-tissue and quadruple (or more)-tissue classes, respectively. G5 contains context tissue classes. The repository is publically available at www.nowinbrain.org

NREE-40 **The Good , The Bad And The Ugly - Multifaceted Imaging Of Radiation Necrosis In High Grade Gliomas**

Participants
Jitin Goyal, MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. High-grade gliomas have a meager 5-year survival rate of just 10% . Initial treatment with surgical exploration involves removing the enhancing component of the tumor with further adjuvant treatment by radiation with a combination of chemotherapy. During this period of follow-up, radiation necrosis (RN) may occur in neuroparenchyma with a reported incidence of 3%-24%. 2. Perfusion and diffusion-weighted MR imaging have been advocated in the follow-up of these tumors, where differentiation of RN and tumor are pivotal from a management viewpoint. 3. Central restriction with high ADC values, lesion quotient less than 0.3 [defined as the ratio of the area of T2WI hypointensity and area of tumor enhancement] and lower rCVB values on perfusion images are imaging features favoring RN. 4. Radiation-induced changes may be classified as either pseudoprogression, those occurring within the first 6 months with a self-limiting clinical course and late radiation necrosis, occurring 12-18 months post radiation therapy with progressive enhancing lesions. Both are clinically distinct entities but bound by similar histological resemblances and imaging appearances. 5. Progressive enhancement and involvement of corpus callosum have been ascribed to tumor recurrence, but there exists an overlap in imaging features between RN and tumor recurrence.

TABLE OF CONTENTS/OUTLINE

Clinical cases depicting easy (good), bad (tricky) and ugly (difficult) cases of RN with conventional, diffusion and perfusion imaging in post treated cases of high-grade gliomas.

NREE-41 **Don't Lose Your Sleep Over This: A Review Of The Pineal Region Anatomy And Conditions**

Awards
Certificate of Merit

Participants
Flavia Sprenger, MD, Curitiba, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

• There is a broad spectrum of pineal region lesions and imaging findings may overlap• Locating the lesion epicenter is fundamental to establish differential diagnosis• Neuraxis evaluation is indispensable on some neoplasms• Communication with the surgery plays a major role and the reports must include necessary information to surgical planning

TABLE OF CONTENTS/OUTLINE

TABLE OF CONTENTSAnatomyThe pineal is a small endocrine organ located inside the posterior aspect of the third ventricle, between the superior colliculi and connects to the diencephalon by the gland's stalk.A myriad of lesions can arise from the pineal regions. Conditions can be separated in congenital and benign lesions, primary malignancies and related structures tumors. We

present 16 emblematic cases, with surgical and pathological correlation and differential diagnosis.Congenital and benign lesions• Pineal cyst• Dermoid cyst• Epidermoid cyst• LipomaNeoplasms• Pineocytoma• Pineoblastoma• Atypical theratoid rabdoid tumor• Papillary tumor of the pineal region• Pineal parenchymal tumor of intermediate differentiation• Germinoma• Medulloblastoma• Glioblastoma• Trilateral retinoblastomaRelated structures conditions• Meningioma• Thalamic glioma with pineal invasion

NREE-42   The Biggest Challenge Of Neuroradiology: Reviewing Encephalic Congenital Abnormalities And Their Genetic Correlation

Participants
Heber Colares Costa, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the spectrum of encephalic congenital abnormalities along with their genetic relationship. To explain the cascade of the genetic mechanisms involved in encephalic's congenital structural disorders. To demonstrate the mechanisms of proliferation, migration, and organization of neuronal precursor cells and the respective morphologic abnormalities counterparts. To depict the differential diagnoses and a flowchart for assessment of congenital encephalic disorders.

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1. Background. 2. Imaging protocol. 3. Clinical perspective and importance of analysis of congenital abnormalities. 4. The genetical cascade of events implicated in encephalic development. 4. Imaging assessment and their correlation with the genetic abnormalities. 5. Imaging pearls correlated with proliferation, migration, and organization of the precursor cells. 6. Differential diagnoses including congenital infections. 7. Flowchart for assessment of congenital encephalic disorders. 8. Take-Home messages.

NREE-43   Fast-stroke-MRI In A Time-counted Stroke-unity: The Protocol, The Advantages, The Imaging Pearls, And The Therapeutic Applicability

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To depict the Fast-MRI protocol to the assessment of acute ischemic stroke in the emergency room. To explain the indications of the protocol, including wake-up stroke, the prolonged onset of symptoms, and differential diagnosis evaluation. To explain the advantages and disadvantages of utilizing MRI for acute stroke evaluation. To demonstrate that fast stroke MRI protocol can be complementary to CT for indication of endovascular therapy in stroke patients with prolonged evolution time, establishing ischemic penumbra, and supporting the therapeutic.

TABLE OF CONTENTS/OUTLINE

1. Background. 2. Fast-MRI protocol. 3. Clinical perspective and importance of establishing the correct diagnosis of stroke, considering stroke-mimics. 4. Fast MRI indications. 5. Advantages and disadvantages. 6. The search for mismatch FLAIR-DWI in patients with unknown onset of symptoms and wake-up stroke. 7. The therapeutic implications of the mismatch perfusion-diffusion in patients with prolonged onset of symptoms. 8. Imaging pearls and their correlation with therapeutic management. 9. Differential diagnoses of stroke and the MRI importance. 10. Flowchart for assessment of acute ischemic stroke with emphasis on MRI assessment. 11. Take-Home messages.

NREE-44   Vasculopathy From An Evolving Evil: Neuroimaging Assessment Of The COVID-19 Vascular Complications And Beyond

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the imaging spectrum of encephalic vascular complications related to SARS-CoV-2 infection. To explain the vascular complications that could be related to the COVID-19 spectrum, including large vessel stroke, intracranial hemorrhage, microhemorrhage, hypoxic-ischemic lesions, and venous thrombosis. To explain the cascade of thrombophilic conditions involved in the physiopathology of the vascular complications. To demonstrate the hemorrhagic complications related to the SARS-CoV-2, including those related to the treatment against the pro-thrombotic state. To depict the post-COVID-19 symptoms that could be related to the vascular spectrum of the disease.

TABLE OF CONTENTS/OUTLINE

1. Background. 2. Imaging protocol. 3. Clinical perspective and importance of analysis of the CoVID-19 vascular spectrum. 4. The cascade of thrombophilic conditions involved in physiopathology. 5. Imaging assessment and their correlation with thrombophilic conditions. 6. Imaging pearls correlated with large vessel stroke, intracranial hemorrhage, microhemorrhage, hypoxic-ischemic lesions, and venous thrombosis. 7. Post-COVID-19 symptoms that could be related to the vascular spectrum of the disease. 8. Flowchart for assessment of neovascular-COVID-19 disease. 9. Take-home messages.

NREE-45   The Virus And The Nerve: Imaging Post-COVID-19 Neuropathies In Children

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the MRI spectrum of post-COVID-19 neuropathies in children. To depict the physiopathology involved and the clinical aspects of post-COVID-19 neuropathies. To explain the many subtypes of COVID-19 related neuropathies, including Guillain-Barré syndrome, multiple cranial neuropathies, neuritis optica, and olfactory nerves involvement.

TABLE OF CONTENTS/OUTLINE

1. Background. 2. Best Imaging protocol related to the kind of involvement. 3. Clinical perspective and importance of analysis of post-COVID-19 involvement in children. 4. The physiopathological mechanisms implicated in COVID-19-induced neuropathies,

including the immune-mediated and direct invasion by the virus. 5. Imaging post-COVID-19 Guillain-Barré Syndrome, multiple cranial neuropathies, neuritis optica, and olfactory nerve involvement. 6. Differential diagnoses including another virus, bacteria, systemic conditions, demyelinating diseases, and tumoral involvement. 7. Flowchart for assessment of post-COVID-19 neuropathies. 8. Take-Home messages.

NREE-46   The White Plaque In The Black Blood: A New Perspective In The Assessment Of Atheromatous Plaques Through Encephalic Vessel Wall Imaging

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the spectrum of intracranial atheromatous disease through vessel wall imaging: stenosis and occlusion evaluation, plaque´s morphologic and extension, hemorrhagic, and inflammatory /angiogenic components. To explain the clinical and therapeutic relevance of the vessel wall imaging evaluation of intracranial atheromatous disease together with its parenchymatous and functional encephalic effects. To demonstrate that the vessel wall imaging assessment of atheromatous plaques is superior to traditional MRI angiography in demonstrating the patent lumen and plaque morphology. To identify potential imaging pitfalls, differential diagnoses, and post-therapeutic assessment.

TABLE OF CONTENTS/OUTLINE

1. Imaging techniques, protocol, and pitfalls. 2. Clinical standpoint and importance of analysis of intracranial atheromatous plaques through vessel wall imaging and conventional MRI angiography. 3. Comparison between vessel wall imaging and conventional MRI angiography. 4. Vessel wall imaging point of view. 5.Atheromatous disease´s parenchymatous consequences and functional abnormalities. 6.Post-therapeutic evaluation through MRI vessel wall imaging. 7. Differential diagnoses, including vasculitis. 8.Take-Home messages.

NREE-47   A Primer On Medium Vessel Occlusion Stroke

Awards
Cum Laude

Participants
Johanna Ospel, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Definition of medium vessel occlusion (MeVO) stroke- Reporting MeVO stroke imaging (what the clinician wants to know)1) Location of MeVO stroke: anterior, middle, posterior cerebral artery 2) Primary & secondary MeVOs 3) Tissue viability

TABLE OF CONTENTS/OUTLINE

What are MeVOs? - Vessel occlusion of medium-sized intracranial arterial vessels (M2/3, A2/3, P2/3 segments) - Disabling deficit (depending on MeVO location: eg. hemianopsia > PCA, leg palsy > ACA) - Poor outcomes of MeVO stroke with medical treatment > mechanical thrombectomy as an emerging therapyWhat are typical imaging findings of MeVOs? - Small vessels and relatively distal location > subtle imaging findings > MeVO detection is challenging - Advanced imaging techniques can help:--multiphase CT angiography (mCTA) --color-coded mCTA maps --mCTA tissue level perfusion maps --CT perfusionHow to differentiate primary vs. secondary MeVOs?- Primary ("de novo") MeVOs- Secondary MeVOs (large vessel occlusion > MeVO): --Spontaneous thrombus migration --Iatrogenic after IV thrombolysis--Iatrogenic procedure-related (during thrombectomy)- Imaging findings in secondary MeVOs:--Ischemic changes outside the MeVO territory ("discrepant infarct pattern")--Multiple MeVOsHow to assess tissue viability MeVO stroke? - ASPECTS generally high in MeVO stroke due to the distal occlusion location & cannot be used to assess ischemic changes for anterior ACA and PCA MeVOs - Alternatives: mCTA collateral status & mCTA perfusion/CTP maps

NREE-48   The Immunity Against The Humanity: MRI Assessment Of Auto-immune Diseases From The Neocortex To The Spine

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the spectrum of MRI features of autoimmune diseases manifesting in the central nervous system. To explain the cascade of the immuno-mediated mechanisms involved in each autoimmune disorder. To demonstrate the imaging pears and highlights of some disorders, and the etiology, physiopathology, clinical issues, and differential diagnoses.

TABLE OF CONTENTS/OUTLINE

1. Background. 2. Imaging protocol. 3. Clinical perspective and importance of analysis of autoimmune diseases. 4. Graphics for the immune-mediated cascade of physiopathology events implicated in autoimmune diseases. 5. Imaging assessment of the autoimmune diseases, including autoimmune encephalitis, lupus, antiphospholipid syndrome, catastrophic antiphospholipid syndrome (CAPS), Bechet disease, and neuromyelitis optica spectrum disorders. 6. Differential diagnosis. 7. Flowchart for imaging assessment of autoimmune -diseases. 8. Take-Home messages.

NREE-49   The Future That Awaits Us: A Brief Treatise Of The Most Recent Genetic Complexity Of CNS Neoplasms

Participants
Heber Colares Costa, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the most recent genetic alterations described in the CNS tumors and correlate with the pathology, imaging, and prognosis.To identify the most recent updates based on cIMPACT-NOW updates and the last available edition of the WHO classification. To demonstrate the news families of tumors and the importance of comprehensive molecular classification of tumor types.

NREE-5 Demyelinating And Dysmyelinating Disorders Of The Central Nervous System: A Case-based Review

Participants
Philip Lee, BA, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

The demyelinating and dysmyelinating disorders of the CNS are a heterogenous group of pathologies with significant clinical and neuroradiological overlap. While most imaging findings are non-specific, there are certain key findings that are highly suggestive for certain disorders. We highlight these best diagnostic clues and review the spectrum of demyelinating and dysmyelinating CNS diseases in a case-based quiz format.

TABLE OF CONTENTS/OUTLINE

- Demyelinating and dysmyelinating disorders o Broad overview normal myelination - Autoimmune demyelinating o Multiple sclerosis (MS) o Neuromyelitis Optica Spectrum (NMO) o Tumefactive demyelinating lesion (TDL) - Infectious demyelinating o Acute disseminated encephalomyelitis (ADEM) o Progressive multifocal leukoencephalopathy (PML) o Differentiation from HIV Encephalitis/Toxoplasmosis - Inflammatory o Sarcoidosis o Lupus o Susac syndrome o Autoimmune limbic encephalitis o Cytotoxic lesions of the corpus callosum - Dysmyelinating disorders o Metachromatic Leukodystrophy o X-Linked Adrenoleukodystrophy o Leigh Syndrome o Canavan Disease

NREE-50 CT Angiography Findings In Symptomatic Carotid Disease- It's Not All About Stenosis!

Participants
Johanna Ospel, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Role of carotid CT angiography (CTA) in acute stroke imaging- Systematic assessment of extracranial carotid disease - High risk imaging features on CTA- Definition of Symptomatic Non-Stenotic Carotid disease (SyNC): 2 mandatory components: 1) high risk carotid plaque features 2) ischemic changes in the ipsilateral internal carotid artery (ICA) territory

TABLE OF CONTENTS/OUTLINE

Role of CTA in acute stroke- Carotid CTA recommended for all patients with suspected acute stroke- Traditionally, degree of stenosis has been considered the most important feature for determining stroke risk- BUT: increasing evidence that features other than stenosis are also associated with high stroke risk (SyNC)- Radiologists can be the first to suggest SyNC and thereby guide further patient management High risk imaging features on carotid CTA- Degree of stenosis: measured with NASCET criteria: <50% vs. 50-70% vs. >70%- Plaque thickness: measured perpendicular to the vessel centerline- Calcifications: extensive calcifications > lesser stroke risk vs. extensive soft-plaque component > greater stroke risk - Surface irregularity & ulceration- Plaque density: low density (lipid-rich) vs. intermediate density (intra-plaque hemorrhage), quantitative measurements (Hounsfield Units)- Carotid web: shelf-like projection into the carotid lumen, not a truly atherosclerotic lesion but increases stroke risk- Changes in plaque morphology over time: suggests plaque instability, requires prior imaging for comparison

NREE-51 (Mis)match Point For MRI Assessment In Neoplastic Lesions: Changing The Game

Participants
Heber Colares Costa, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the importance of evaluating the signal intensity in T2 and FLAIR to suggest a diagnosis of astrocytoma or oligodendroglioma. To illustrate that a hyperintense lesion in T2 and a hypointense lesion in FLAIR (mismatch FLAIR-T2) suggest the absence of the 1p-19q codeletion (astrocytoma) and could be found in DNETs. To explain that the absence of the mismatch is non-specific. To correlate the Imaging finding with the patient prognosis: oligodendrogliomas have a slightly better outcome than astrocytomas, and DNETs have a favorable prognosis.

TABLE OF CONTENTS/OUTLINE

1. Histopathological and genetic considerations of oligodendrogliomas and astrocytomas (grade 2), based on the last genetic updates (cIMPACT-NOW) and WHO classification. 2. Histopathological and genetic considerations of DNETs (grade 1), based on the last genetic updates (cIMPACT-NOW) and WHO classification. 3. Flowchart of T2-FLAIR signal evaluation. 4. Mapping the imaging pearls contemplating T2 and FLAIR signal on astrocytomas and oligodendrogliomas. 5. Imaging pearls contemplating T2 and FLAIR signal on DNETs. 6. Take-home messages.

NREE-52 Imaging Pearls For Assessment Of Granulomatous Lesions: The Easy, The Problematic, And The Rare

Participants
Heber Colares Costa, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the typical and atypical imaging features and etiologies of the granulomatous lesions. To differentiate granulomatous diseases from neoplasms such as lymphoma. To distinguish granulomatous lesions from other inflammatory and infectious conditions.

TABLE OF CONTENTS/OUTLINE

1. Background. 2. Typical imaging features of granulomatous lesions, including tuberculosis, neurotoxoplasmosis, fungi, and syphilis.

3. The atypical and rare presentations, including parenchymatous syphilis lesion. 4. Differential diagnoses including lymphoma and other lymphoproliferative diseases. 5. T2 vs. diffusion mismatch in the diagnosis of granulomatous diseases versus lymphoma. 6. The imaging features distinguishing between granulomatous lesions and other inflammatory lesions, such as a pyogenic abscess. 7. Flowchart of assessment of granulomatous lesions. 8. Take-home messages.

NREE-53 Know What Is Hiding At The Crossroads: A Radiologist's Guide To Corpus Callosum Abnormalities

Awards
Certificate of Merit

Participants
Loai Aker, MD, Doha, Qatar (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- Review the radiological anatomy of the corpus callosum. 2- Categorize various pathologies of the corpus callosum. 3- Clinically correlate the imaging features to aid narrow the differential diagnoses. 4- Analyze the imaging features of different corpus callosum pathologies in a case-based approach. 5- Correlate radiological features of corpus callosum mass lesions with their histopathological counterpart whenever applicable.

TABLE OF CONTENTS/OUTLINE

1- Radiological anatomy of the corpus callosum (CC). 2- Categories of corpus callosum pathologies. 3- Signs and symptoms of corpus callosum affection. 4- Case scenarios demonstrating imaging features of different corpus callosum pathologies such as: * Dysgenesis of CC. * Infarction of CC. * Demyelinating lesions of CC (MS, Suzac syndrome, etc.). * Cytotoxic Lesions of CC. * Lymphoma involving CC. * High grade glioma involving CC. * Lipoma of CC. * Diffuse Axonal Injury. * Cerebral fat embolism. * Critical illness associated micro-bleeds involving CC.

NREE-54 Angiographic Neurovascular Anatomy (part 1): Internal Carotid Artery, Important Branches And Variants

Participants
Dylan Wolman, MD, Palo Alto, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

A detailed understanding of neurovascular anatomy is critical to safe and effective diagnostic and interventional neuroangiography, including a knowledge of fine arterial branches typically below the resolution of CT or MR angiography. However, comprehensive summary pictorial references are limited. This five-part educational series aims to incorporate extensive annotated digital subtraction angiography (DSA) images to review the anatomy of the anterior and posterior circulation most critical to the neurointerventionalist. This first portion of the series aims to:• Review the segmental anatomy of the internal carotid artery.• Review the branches of the internal carotid artery and their important anastomoses and supply.• Review common aneurysms and congenital anomalies of the internal carotid artery.

TABLE OF CONTENTS/OUTLINE

These educational exhibits will be presented as computer exhibits with illustrative digital subtraction angiography case examples throughout. The topics to be covered in this section include:• Embryologic development of the internal carotid artery.• Internal carotid artery segmental nomenclature.• Internal carotid artery branch nomenclature, supply, and important anastomoses.• Relationship of the segments of the internal carotid artery to the dural rings.• Aneurysms of the internal carotid artery.• Congenital anomalies, including persistent caroticobasilar anastomoses, aplasia of the of the internal carotid artery, and aberrant internal carotid artery.

NREE-55 Angiographic Neurovascular Anatomy (part 2): Middle Cerebral Artery, Important Branches And Variants

Participants
Dylan Wolman, MD, Palo Alto, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

A detailed understanding of neurovascular anatomy is critical to safe and effective diagnostic and interventional neuroangiography, including a knowledge of fine arterial branches typically below the resolution of CT or MR angiography. However, comprehensive summary pictorial references are limited. This five-part educational series aims to incorporate extensive annotated digital subtraction angiography (DSA) images to review the anatomy of the anterior and posterior circulation most critical to the neurointerventionalist. This second portion of the series aims to:• Review the segmental anatomy of the middle cerebral artery.• Review bifurcation and trifurcation patterns of the middle cerebral artery.• Review territorial supply patterns of the middle cerebral artery.• Review distal branch nomenclature and supply.• Review anatomic variants of the middle cerebral artery.

TABLE OF CONTENTS/OUTLINE

These educational exhibits will be presented as computer exhibits with illustrative digital subtraction angiography case examples throughout. The topics to be covered in this section include:• Middle cerebral artery segmental nomenclature.• Bifurcation and trifurcation patterns of the middle cerebral artery.• Perfusion patterns of the middle cerebral artery as a predictor of sites of occlusion in ischemic stroke, and relevant branch anatomy for endovascular thrombectomy.• Middle cerebral artery distal branch nomenclature and supply.• Anatomic variants, including Manelfe variants and fenestrations.

NREE-56 Angiographic Neurovascular Anatomy (part 3): Anterior Cerebral Artery, Important Branches And Variants

Participants
Dylan Wolman, MD, Palo Alto, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

A detailed understanding of neurovascular anatomy is critical to safe and effective diagnostic and interventional neuroangiography,

including a knowledge of fine arterial branches typically below the resolution of CT or MR angiography. However, comprehensive summary pictorial references are limited. This five-part educational series aims to incorporate extensive annotated digital subtraction angiography (DSA) images to review the anatomy of the anterior and posterior circulation most critical to the neurointerventionalist. This third portion of the series aims to:• Review the segmental anatomy of the anterior cerebral artery.• Review the cortical branches of the anterior cerebral artery and their supply.• Review anatomic variants of the anterior cerebral artery.

TABLE OF CONTENTS/OUTLINE

These educational exhibits will be presented as computer exhibits with illustrative digital subtraction angiography case examples throughout. The topics to be covered in this section include:• Anterior cerebral artery segmental nomenclature.• Anterior cerebral artery branch nomenclature and supply.• Anatomy of the anterior communicating artery complex and its common variants.• Anatomy and supply of the recurrent artery of Heubner and medial lenticulostriate perforators.• Anatomic variants of the anterior cerebral artery, including the azygous anterior cerebral artery, infraoptic origin of the anterior cerebral artery, persistent primitive olfactory artery, and bihemispheric anterior cerebral arteries.

NREE-57   Angiographic Neurovascular Anatomy (part 4): Posterior Cerebral Artery And Important Branches

Participants
Dylan Wolman, MD, Palo Alto, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

A detailed understanding of neurovascular anatomy is critical to safe and effective diagnostic and interventional neuroangiography, including a knowledge of fine arterial branches typically below the resolution of CT or MR angiography. However, comprehensive summary pictorial references are limited. This five-part educational series aims to incorporate extensive annotated digital subtraction angiography (DSA) images to review the anatomy of the anterior and posterior circulation most critical to the neurointerventionalist. This fourth portion of the series aims to:• Review the segmental anatomy of the posterior cerebral arteries.• Review the distal branch anatomy of the posterior cerebral arteries, including important variants.• Review the arterial supply and infarct patterns of the thalamus.

TABLE OF CONTENTS/OUTLINE

These educational exhibits will be presented as computer exhibits with illustrative digital subtraction angiography case examples throughout. The topics to be covered in this section include:• Embryologic development of the posterior cerebral arteries.• Posterior cerebral artery segmental nomenclature.• Distal branch nomenclature and supply.• Thalamic arterial supply.• Important anatomic variants, including hemodynamic balance between anterior choroidal and posterior cerebral arteries, the Artery of Percheron, and the Artery of Davidoff and Schechter.

NREE-58   Angiographic Neurovascular Anatomy (part 5): External Carotid Artery And Important Anastomoses

Participants
Dylan Wolman, MD, Palo Alto, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

A detailed understanding of neurovascular anatomy is critical to safe and effective diagnostic and interventional neuroangiography, including a knowledge of fine arterial branches typically below the resolution of CT or MR angiography. However, comprehensive summary pictorial references are limited. This five-part educational series aims to incorporate extensive annotated digital subtraction angiography (DSA) images to review the anatomy of the anterior and posterior circulation most critical to the neurointerventionalist. This fifth portion of the series aims to:• Review the anatomy of the major branches of the external carotid artery.• Review important external to internal carotid or vertebrobasilar anastomoses. • Review detailed anatomy of each major external carotid artery branch, with particular attention to the ascending pharyngeal, middle meningeal, and distal internal maxillary arteries.

TABLE OF CONTENTS/OUTLINE

These educational exhibits will be presented as computer exhibits with illustrative digital subtraction angiography case examples throughout. The topics to be covered in this section include:• Major branches of the external carotid artery.• Detailed angiographic anatomy of each major branch, including the: Superior thyroid, lingual, facial, ascending pharyngeal, occipital, superficial temporal, middle meningeal, and distal internal maxillary arteries• Clinically relevant external carotid to internal carotid or vertebrobasilar anastomoses. • External carotid branch cranial nerve supply.

NREE-59   Imaging Features Of Molecularly-defined Ependymal Tumors: Essential Classification Updates

Participants
Samantha Pisani Petrucci, MD, PhD, San Francisco, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Genomic profiling data informing the upcoming WHO CNS tumor classification update has demonstrated that ependymal tumors are genetically- and molecularly-distinct entities according to the anatomic compartments at which they arise. Supratentorial, posterior fossa, and spinal cord ependymomas are further divided into subtypes based on gene fusions, methylation profiles, and gene amplification, respectively.2. Numerous studies demonstrate characteristic clinical and pathological features of each new molecularly-defined ependymoma subtype; despite the essential clinical role of medical imaging, descriptions of representative MRI features are scarce.3. Interpreting radiologic findings in the context of molecular-genetic tumor characteristics can directly impact patient care by improving diagnostic precision, prognostication, and disease monitoring.

TABLE OF CONTENTS/OUTLINE

I. Overview of the molecularly-based restructuring of the ependymal tumor group as to be included in the upcoming 5th edition of the WHO Classification of CNS tumors, including key clinicopathologic features.II. Characteristic imaging features of each ependymoma subtypea. Supratentorial ependymomai. C11orf95-RELA fusion-positiveii. YAP1 fusion-positiveb. Posterior fossa ependymomai. Group PFAii. Group PFBc. Spinal ependymomai. MYCN-amplifiedii. Myxopapillary ependymomaIII. Summary and Quiza. Summary of key imaging features of each subtypeb. Quiz: apply this new knowledge to a few example cases to improve diagnostic

precision

Participants
Ana Paula Fonseca, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are: Review the anatomy of the thalamus and basal ganglia, including its anatomical limits, vascularization characteristics and normal CT and MR imaging findings and related clinical syndromes. Discuss and illustrate the imaging patterns of the main lesions in the thalamus and basal ganglia, including vascular, metabolic, traumatic, tumoral, inflammatory, infectious, among others. Describe through illustrative cases the scenarios for diagnosis, focusing on typical imaging patterns, unexpected findings and red flags that aid the diagnosis.

TABLE OF CONTENTS/OUTLINE

Anatomy of the thalamus and basal ganglia. Main pathologies involving the thalamus and basal ganglia.Metabolic disorders - Hyperammonemia; Non-ketotic hyperglycemia; Hypoglycemia; Leigh's disease; Wilson's disease; Osmotic myelinolysis; Wernicke's encephalopathyVascular disorders - Cerebral venous thrombosis; Arterial occlusion (artery of Percheron territory infarct); Hypoxic-ischemic encephalopathy.Degeneratives disorders - Neurodegeneration with brain iron accumulation; Creutzfeldt-Jakob disease; Fahr diseaseInflammatory and infectious - Behçet's disease MS, NMOSD, MOG; ADEM; Viral encephalitis; COVID-19; Toxoplasmosis; Tuberculosis; Primary CNS vasculitisNeoplasms - Glioma; CNS lymphoma; Neurofibromatosis type 1; GerminomaTraumatic - Traumatic axonal injuryToxic poisoning - Carbon monoxide; Methanol; Vigabatrin poisoning; CarbamateRed flags and diagnostic approach.

Participants
Barbara Trapp SR, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:To discuss basic MR technical requirements and protocol suggestions for a good quality vessel wall imaging. To show main applications in clinical practice of this recently available MR sequence. To show, through a pictorial review, imaging characteristics of several intracranial and cervical vascular diseases.

TABLE OF CONTENTS/OUTLINE

Powerpoint Layout:Technical considerations and protocol recommendations. VWI MR applications: Atherosclerotic disease; Arterial dissection; Post-thrombectomy changes; CNS vasculitis - infectious (including neurosyphilis, neurotuberculosis, bacterial, viral...) and non infectious; Reversible cerebral vasoconstriction syndrome; Intracranial aneurysm - rupture risk; ruptured aneurysms and instability signs; Moyamoya disease; Amyloid angiopathy; Arteriovenous malformations; Carotid web; CADASIL; Brain metastasis (versus T1 CE SPGR); Perineural spread (versus T1 CE SPGR); Tumoral venous sinus invasion.

Participants
Joshua Breeden, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The anatomy of the skull base can be a challenging topic for radiologists of all levels and subspecialty training. Non-contrast enhanced head CT (NECT head) is one of the most frequently ordered studies in the emergent setting to rule-out and rule-in numerous pathologies. The field-of-view for NECT head typically begins at the level of the foramen magnum and ends at the vertex of the skull. Radiologists, therefore commonly encounter the skull base and a familiarity with anatomy and pathology of the skull base is requisite to interpreting NECT head. Additionally, radiologists often utilize complex imaging studies, such as MRI, to further characterize and identify pathology of the skull base. We will identify and describe the basic anatomy that defines the skull base, dividing the skull base into anterior, central and posterior. We will go onto describe the detailed anatomy of the skull base, highlighting important structures that are often involved in pathology. Utilizing this foundational anatomy, we will highlight an approach to pathology of the skull base by providing a plethora of cases with broad pathology. This image-rich review will highlight teaching points that will aid radiologists in narrowing their differential diagnosis for pathologic entities in the skull base.

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Introduction; Basic skull base anatomy; Detailed skull base anatomy; Quiz Yourself; Image-rich case review: Pathology to Highlight Anatomy

Participants
Tatiana Iutaka, BDS, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:Review the neurovascular involvement related to COVID-19. Discuss the physiopathology of neurovascular injury related to COVID-19.Describe and demonstrate through clinical cases, the main clinical and imaging scenarios of common and uncommon findings of COVID-19-related neurovascular injury, including ischemic stroke, hemorrhages, hypoxic-ischemic injury, cerebral venous thrombosis, spinal cord ischemia and posterior reversible encephalopathy syndrome.

TABLE OF CONTENTS/OUTLINE

Pathophysiology of neurovascular injury related to COVID-19.Common and uncommon findings of neurovovascular involvement by COVID-19.Ischemic stroke. Large artery ischemic stroke. Lacunar ischemic stroke. Hemorrhages. Intracerebral hemorrhage. Small focal hemorrhage, diffuse microhemorrhages. Subarachnoid hemorrhage. Intraventricular hemorrhage. Acute hemorrhagic necrotizing

encephalopathy.Hypoxic-ischemic injury.Cerebral venous thrombosis.Spinal cord ischemia.Posterior reversible encephalopathy syndrome.Final remarks

NREE-63   3-dimensional High-Resolution Magnetic Resonance Vessel Wall Imaging For The Evaluation Of Rare Cerebrovascular Pathologies

Participants
Zelan Ma, Guangzhou, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. High-resolution magnetic resonance vessel wall imaging (HRMR-VWI) provides added diagnostic capacity relative to conventional luminal imaging techniques.2. HRMR-VWI may boost diagnostic confidence of rare cerebrovascular pathologies and reducing diagnostic delay.3. Typical HRMR-VWI features of various kinds of rare cerebrovascular diseases.

TABLE OF CONTENTS/OUTLINE

1. HRMR-VWI is a modern imaging technique in the characterization of cerebrovascular vessel wall pathology.2. MR sequences and protocols for HRMR-VWI of cerebrovascular pathologies.3. Case based review of typical imaging features of rare vessel wall pathologies such as vasculitis, dissection and carotid web, etc.4. Summary

NREE-64   Diffusion Weighted Imaging Of The Brain: When The Tale In Black And White Adds More Color To The Plot

Awards
Certificate of Merit

Participants
Loai Aker, MD, Doha, Qatar (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- To review the basic physical and technical principles of diffusion weighted imaging (DWI). 2- To simplify the approach to practical interpretation of DWI sequence. 3- To demonstrate the various clinical applications of DWI sequence. 4- To emphasize the importance of DWI sequence as a part of functional multi-parametric imaging. 5- To present case-based scenarios to illustrate DWI features associated with different pathologies. 6- To review the potential limitations of DWI that the neuroradiologist should consider in daily practice.

TABLE OF CONTENTS/OUTLINE

1- The basic technical principles. 2- Practical approach to the interpretation of DWI sequence. 3- Limitations. 4- Clinical applications: - Ischemia. - Neoplastic conditions. - Infections. - Inflammatory conditions. - Post operative and therapeutic follow up. - Developmental and congenital pathologies.

NREE-65   Infectious Myelitis And Mimickers: How MRI Can Help?

Participants
Fabiano Reis, Campinas, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:• Review the main imaging findings of infectious myelopathies disorders and main mimicking entities.• Describe the main imaging patterns of these diseases, including paracoccidioidomycosis, schistosomiasis, cysticercosis, histoplasmosis, tuberculosis, HIV, pyogenic spondylodiscitis and differential diagnosis, highlighting the role of MRI differentiating these entities.• Suggest a MRI-based algorithm to approach these cases, emphasizing the spinal cord imaging red flags and how they can help the radiologist reach the correct diagnosis.

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• Imaging patterns on MR of spinal cord infections and mimickers:Paracoccidioidomycosis;Schistosomiasis;Cysticercosis;Histoplasmosis;Tuberculosis;HIV;Pyogenic spondylodiscitis;Vascular disorders, such as arterial and venous infarction;Demyelinating diseases, such as multiple sclerosis, neuromyelitis optica spectrum disorders and acute disseminated encephalomyelitis (ADEM);Spinal cord neoplasms, such as ependymoma, hemangioblastomas, meningioma and metastasis;Hypertrophic pachymeningitis;Transverse myelitis.• Assessments of possible differential diagnosis based on real cases from the archive of a Tertiary University Hospital.• Diagnostic algorithm.• Final remarks.

NREE-66   The Mechanism Of The Aneurysms: Saccular, Blood Blister, Fusiform, And Pseudoaneurysms To Blow The Mind!

Awards
Certificate of Merit

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the assessment of intracranial aneurysms by CT angiography, MRI angiography, and digital subtraction angiography. To describe the terminology, etiology, physiopathology, most frequent locations, disease associations, and treatment options for intracranial aneurisms. To explain the genetic abnormalities that are involved in physiopathology.

TABLE OF CONTENTS/OUTLINE

1. Background. 2. MRI and CT angiography imaging protocol. 3. Genetic abnormalities involved in physiopathology and related disorders. 4. Imaging assessment of intracranial aneurysms emphasizing saccular, blood-blister, fusiform, mycotic, and pseudoaneurysms. 5. Digital subtraction angiography assessment with emphasis on therapeutics. 6. Flowchart for assessment of

intracranial aneurisms. 7. Take-Home messages.

NREE-67 The Odorless Scent Of The COVID-19 Pandemic: A Look At The Anosmia Through MRI Evaluation Of The Olfactory Bulbs

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To demonstrate that anosmia is a common symptom during COVID-19 and can remain persistent for long periods even after the disease's cure. To discuss the physiopathology implicated in the post-COVID-19 olfactory bulbs' involvement.To explain the best MRI protocol for assessment of the olfactory bulbs. To illustrate the involvement of olfactory bulbs in patients with COVID-19-related anosmia through MRI, including the volume, morphology, signal, and nerve filia.

TABLE OF CONTENTS/OUTLINE

1. Revision of epidemiology and clinical presentation of COVID-19 related anosmia. 2. Physiopathology implicated in the olfactory bulb's involvement. 3. Imaging protocol for the best assessment of the olfactory bulbs. 3. Imaging pearls of the involvement of olfactory bulbs, including the volume, morphology, signal, and nerve filia. 4. Flowchart of MRI evaluation. 5. Treatment options in patients with persistent anosmia after the cure of COVID-19. 6. Take-home messages.

NREE-68 Where's Wally? The Benefits Of 3D-FLAIR Reconstruction Post-processing Technique To Assess Focal Cortical Dysplasia

Participants
Thyago Queiroz, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Focal cortical dysplasia (FCD) is part of a large and heterogeneous group of malformations of cortical development. It is characterized by disordered cortical lamination with or without abnormal cell types. Magnetic resonance images (MRI) are essential for diagnostic and surgical planning, however, it is well known that FCD may affect small areas of the cortex and be difficult to detect even by an experienced neuroradiologist. The purpose of this exhibit is to present through illustrative cases, the benefits of the 3D-FLAIR reconstruction to increase the accuracy of detection and preoperative evaluation of FCD.

TABLE OF CONTENTS/OUTLINE

Case-base review: - Introduction - Physiopathology, clinical aspects, and classification of FCD - A range of 3T brain MRI of FCD will be provided, always including the perspective of 3D-FLAIR reconstruction, supporting its benefits in the assessment of this cortical malformation - Conclusion - References

NREE-7 Brainstem Stroke Quiz: An Illustrative Insight Into The Classic Syndromes

Participants
Martin Saenz, MBBS, Bilbao, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Due to its complex internal anatomy, brainstem strokes produce location-dependent symptomatology.Classic brainstem stroke syndromes result from predominantly ischemic lesions in specific locations.High-resolution MR images that provide good anatomic detail, as well as a precise understanding of the functional anatomy of the brainstem, are essential tools that will enable radiologists to make a correct interpretation of the sometimes subtle imaging findings in this anatomic area.

TABLE OF CONTENTS/OUTLINE

Objective The aim of this presentation is to illustrate and help the reader understand the complex location-related symptomatology of the brainstem infarcts, therefore facilitating their MRI-based detection.Background Brain stroke is a leading cause of morbidity and mortality worldwide, and approximately %10-15 of them occur in the brainstem.Anatomy The brainstem contains several cranial nerve nuclei and it is crossed by multiple tracts connecting the brain and the spinal cord. Cross-sectional labeled illustrations are included.Symptomatology Big clinical differences are noted depending on the exact location of the stroke within the brainstem. Numerous classic syndromes result from ischemic lesions in specific locations.Imaging findings: Unlike CT, which has poor sensitivity in the posterior fossa, high-resolution MR images allow much better detection and spatial location of the ischemic lesions.Illustrated quiz-mode cases will be presented with an educational purpose.Conclusions: See the teaching points.

NREE-70 Imaging Findings Of Neurologic Complications In Oncologic Patients

Awards
Cum Laude

Participants
Gabriela Bandeira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To describe the neurological complications of cancer found in oncologic patients and their mechanisms.- To describe the neurological complications of various modalities of current cancer treatment (chemotherapy, radiotherapy and immunotherapy) found in oncologic patients and their mechanisms.- To illustrate imaging findings of neurologic complications in oncologic patients.

TABLE OF CONTENTS/OUTLINE

- Introduction- Neurological complications of cancer found in oncologic patients : hemorrhagic stroke, ischemic stroke, (including Trousseau syndrome), autoimmune encephalitis, wernick encephalopathy, infectious complications.- Neurological complications of various modalities of current cancer treatment : SMART syndrome, mineralizing angiopathy, leukoencephalopathy, RCVS (reversible cerebral vasoconstriction syndrome) , radionecrosis, pseudoprogression, hypophysitis.- Illustrative cases with the imaging findings of neurologic complications in oncologic patients.- Conclusion

Autoimmune Diseases Of The Central Nervous System

Awards
Certificate of Merit

Participants
Graham Tooker, MD, East Thetford, Vermont (*Presenter*) Nothing to Disclose

TEACHING POINTS

Discuss pathophysiology of autoimmune diseases within the central nervous system.Review imaging findings for common and rare autoimmune disordersUnderstand the overlap between different autoimmune disordersRecognize autoimmune syndromes that may be amenable to treatment

TABLE OF CONTENTS/OUTLINE

This exhibit will present a case based study of the pathophysiology and imaging findings of common and rare autoimmune disorders of the central nervous system including:Systemic Lupus Erythematosus, Antiphospholipid Antibody Syndrome, Neuromyelitis Optica, Multiple Sclerosis including Balo's Concentric Sclerosis and Marburg subtypes, Neurosarcoid, IgG4 related disease, Behcets Disease, Susac Syndrome, Chronic Lymphocytic Inflammation with Pontine Perivascular Enhancement Responsive to Steroids (CLIPPERS), Giant Cell Arteritis, Takayasu Arteritis, Primary Central Nervous System Vasculitis, Granulomatous Polyangiitis

NREE-72 **Am I Seeing Dots?! The Imaging Patterns And Significance Of Cerebral Microhaemorrhages**

Participants
Namir Asmar, MBBCHIR, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Overview of the MR techniques and technical considerations in imaging cerebral microhaemorrhages (CMH)2. Review the wide spectrum of diseases associated with CMHs and their associated imaging patterns3. Recognise the role of the characteristic distribution of CMHs in elucidating the underlying pathology4. Insight into the clinical significance and management of patients with CMH

TABLE OF CONTENTS/OUTLINE

Cerebral microhaemorrhages (CMH) are defined as small foci of blood (up to 5-10 mm) within the brain parenchyma, which are increasingly identified on magnetic resonance (MR) imaging due to increased use of higher field strengths and dedicated sequences such as susceptibility weighted imaging.The presentation illustrates, with examples, the wide spectrum of diseases associated with CMH, including their presence in critical illness most recently in association with COVID-19 infection. Particular attention is given to the characteristic morphology and distribution of CMHs on MR as this can often help guide or arrive at the diagnosis. There remains controversy surrounding the clinical significance of CMHs, however, as they also have a strong association with normal aging. Nonetheless they play an important role not only in diagnosis but also in prognostication; for example, their presence being an increasingly recognised marker of worse outcome in stroke patients. The presentation concludes by exploring the role the of CMHs in guiding management decisions, such as in the adjustment of anticoagulation therapy in these patients.

NREE-73 **Imaging Spectrum Of Congenital Spine And Spinal Cord Anomalies**

Participants
Zoya M. Patni, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate different MRI imaging features of spinal dysraphism. MRI is an excellent modality for classifying and evaluating the different congenital spine and spinal cord abnormalities.To understand other anomalies associated with spinal dysraphism.

TABLE OF CONTENTS/OUTLINE

MRI has proven to be superior in evaluation of Spinal dysraphism's due to its superior soft tissue contrast and multiplanar capabilities. We present a pictorial review of 87 patients with spine and spinal cord abnormalities whom were imaged on a 1.5-T MR system. Imaging features were evaluated and it was found that a total of 29 patients had Spinal dysraphism, 66 had spondylodysplasia and 8 had anomalies associated with spinal dysraphism. The most common type were Closed dysraphism (82.75%).The most common open dysraphism were myelomeningocele. The commonest associated anomaly with open & closed dysraphism was tethered cord with dural ectasia (24 %). Lipoma was the commonest closed dysraphism without any associated anomaly. In total 66 patients had spondylodysplasia with segmentation anomalies being the commonest. Partial block vertebra was the most common segmentation anomalies, seen in 36 % of patients followed by complete block vertebra in 28.8%.

NREE-74 **Multimodality Imaging Of Vertebral Artery Dissections: What Radiologists Need To Know**

Participants
Arijit Chakraborty, DO, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Vertebral artery dissections of several etiologies are an important cause of strokes, particularly in younger patients.2. The anatomical differences between the extracranial and intracranial components of the vertebral arteries must be understood to assess the potential consequences of dissections.3. The various morphologic appearances of dissections have characteristic imaging findings on CTA, MRI/MRA and DSA imaging.4. Vessel wall MR imaging is an emerging tool used to further characterize and increase sensitivity in the detection of arterial dissections.5. Each modality is susceptible to particular limitations in the postoperative setting.

TABLE OF CONTENTS/OUTLINE

1. General overview of the pathophysiology of a dissection2. Discussion of the typical, atypical and variant imaging findings regarding extra- and intracranial vertebral artery dissections3. General overview of vessel wall MR imaging4. Review CTA, MRI, and DSA correlative findings in addition to vessel wall MR imaging through case examples5. Review postoperative appearance and

evaluation of vertebral artery stenting

NREE-76   Amide Proton Transfer, Perfusion And Diffusion Weighted Imaging Of Pediatric Brain Tumors With Pathological Correlation

Participants
Sevcan Turk, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Amide proton transfer weighted imaging (APTw) shows exchangeable amide protons of mobile protein in the tissue which provides additional molecular information to assess the lesion-APTw demonstrates high signals not only in hypercellular components of tumor but also affected by extracellular tumor matrix.-APTw is useful in the detection of recurrent or residual tumor.-APTw can show perilesional tumor invasion and white matter tumor infiltration.-APTw signal is higher in tumor progression than pseudoprogression.-APTw is with less distortion and susceptibility artifact than DSC perfusion.-Pros and cons of different modalities including APTw, DWI, and PWI and discuss the pitfalls.

TABLE OF CONTENTS/OUTLINE

- Overview of imaging characteristics of supratentorial and infratentorial pediatric brain tumors including pilocytic/pilomyxoid astrocytoma, low and high grade infiltrating astrocytoma, diffuse midline glioma, ependymoma, medulloblastoma, and other embryonal tumors with emphasis on perfusion (DSC, DCE, ASL), diffusion and APTw imaging maps-Discuss pearls and pitfalls in interpreting APTw in comparison with DWI and PWI in pediatric brain tumors.-Grading and genetic mutation correlation with diffusion and APT parameters.-APTw imaging potential for treatment response assessment.- Blood products, necrosis, calcifications, and extracellular matrix affect the signals on APTw imaging.

NREE-77   Mechanical Thrombectomy For Transcatheter Aortic Valve Implantation (TAVI) Peri-procedural Stroke

Participants
Jose Pablo Martinez, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Embolic large brain vessel occlusions must be investigated in patients with acute neurologic deficits early after TAVI.Understanding the origin and composition of the embolus we aim to retrieve during mechanical thrombectomy will help us choose the most appropriate recanalization strategy, for what CT and DSA findings are crucial.Direct aspiration through a wedge-positioned catheter is an adequate first-choice technique for TAVI-related brain emboli removal.Dual-stentriever techniques should be considered after failed attempts to retrieve solid emboli straddling brain large artery bifurcations.

TABLE OF CONTENTS/OUTLINE

Background: TAVI is the first-line treatment for patients with symptomatic severe aortic valve stenosis and high surgical risk. Stroke is a common complication that significantly increases mortality. Causes: Peri-TAVI stroke is usually related to embolism during the procedure. New-onset atrial fibrillation and brain hypoperfusion during the intervention are less frequent. Diagnosis Exhaustive neurological examination must always be performed immediately after TAVI. Patients with neurologic deficits will benefit from CT and angio-CT.Treatment: Mechanical thrombectomy is the first-line treatment for hyperacute brain large vessel occlusions. We present four cases of mechanical thrombectomy for the treatment of TAVI-related stroke performed at our institution: emboli of different origins, including fragments of native and prosthetic valves, were retrieved using classic and novel techniques.

NREE-78   Amide Proton Transfer, Diffusion And Perfusion Weighted Imaging Of Adult Gliomas

Participants
Sevcan Turk, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Amide proton transfer weighted imaging (APTw) shows exchangeable amide protons of mobile protein in the tissue which provides additional molecular information to assess the lesion-APTw correlates well with WHO grade of gliomas and predicts IDH mutation status.-APTw is useful to show perilesional invasion and white matter tumor infiltration.-APTw signal is higher in tumor progression than pseudoprogression, accuracy is more than 85% in the literature.-APTw is with less distortion and susceptibility artifact than DSC perfusion which is limited due to signals from normal vascular structures such as choroid plexus.-Pros and cons of different modalities including APTw, DWI, PWI, and their pitfalls will be discussed.

TABLE OF CONTENTS/OUTLINE

-Overview of imaging characteristics of adult low and high-grade gliomas with emphasis on APTw, PWI (DSC, DCE, ASL), and DWI-Grading and genetic mutation correlation with APTw, perfusion, and diffusion parameters.- Emphasis on the observations that APTw demonstrates non-enhancing component of tumor, tumor infiltration in the white matter with or without vasogenic edema.-Differentiation of treatment affects including postsurgical changes, pseudoprogression, and radiation necrosis from true tumor progression, using APTw, PWI, DWI.- Effect of blood products, necrosis, calcifications, and extracellular matrix on APTw imaging.

NREE-79   Dentate Nucleus Involvement In Various Diseases - A Pictorial Assay

Participants
Isha Pasari JR, MBBS,MD, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Knowing the anatomy of the deep cerebellar nuclei is important. 2. Many pathologies affect the dentate nuclei of the cerebellum. 3. The presence and pattern of dentate nucleus involvement in the presence of other associated imaging findings can even provide a clue to the diagnosis in certain cases.

TABLE OF CONTENTS/OUTLINE

1. Discuss the normal anatomy and appearance of dentate nucleus. 2. Enlist multiple conditions involving dentate nucleus. 3.

Describe various diseases affecting dentate nucleus with associated other imaging findings. 4. Focus on clinical history correlation for reaching a diagnosis. 5. Discuss few specific pattern of dentate nucleus involvement in certain diseases.

NREE-8   Imaging Review Of Neurological Emergencies In Oncology

Participants
Sannidhi Dewan, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Most common neurological emergencies in a known case of cancer are due to mass effects of the primary and/or metastatic neuro-parenchymal lesions and associated severe vasogenic edema. 2. High suspicion for adverse neuro-effects of various chemotherapeutic agents should be considered when a patient's imaging shows bilateral symmetrical acute lesions which cannot be explained by the primary disease. 3. Post contrast CT/MR venography is an excellent tool to evaluate Dural venous sinuses and radiologist plays an important role in detection and management of sinus thrombosis. 4. Cancer patients are vulnerable to severe CNS infections and detailed knowledge of these pathologies is essential for an on-call radiologist and helps differentiating mass forming infective lesions from primary/metastatic disease.

TABLE OF CONTENTS/OUTLINE

1. Review the classification, pathophysiology and clinical features of neurological emergencies in adult oncology. 2. Describe cross-sectional imaging features of neurological emergencies using typical and atypical cases as examples. 3. Describe role of radiologist in timely diagnosis and management of these conditions.

NREE-80   Let's Go With The Flow! The Use Of 3D T2-CUBE And SPACE Flow Void Artifact To Evaluate CSF Dynamics In Different Clinical And Surgical Conditions

Participants
Ferdinand Cabrera Filho, MD, Niteroi, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

There are different clinical settings in which evaluating the presence (or absence) of CSF flow in the ventricular system or between the ventricular system and adjacent structures may help to the determine the diagnosis or best management strategy. In addition to detailed anatomical information, three-dimensional isotropic Turbo Spin Echo sequences, such as the SPACE (Siemens) and CUBE (GE), can provide functional data on the CSF dynamics through the artifact produced by the flow. The radiologist's familiarity with these sequences can be a valuable tool for the interpretation of several pathologies that involve CSF dynamics, such as obstructive hydrocephalus, congenital malformations and evaluation of postsurgical complications. The objective of our work is to discuss and present several clinical and surgical cases using the SPACE and CUBE techniques, where the presence or absence of the CSF flow void was an important element for diagnostic conclusion and patient treatment.

TABLE OF CONTENTS/OUTLINE

- The physics of SPACE (Siemens) and CUBE (GE) sequences and their CSF flow void artifact. Potential clinical applications of MRI T2 flow void artifact and imaging findings: - Obstructive hydrocephalus. - Postsurgical pseudomeningoceles. - Congenital malformations. - Assessment of patency and integrity of third ventricle floor in third-ventriculostomy (surgical and spontaneous). - Assessment of patency in surgically fenestrated arachnoid cysts.

NREE-81   "Let'S Filter It": A Neuroradiological Review Of The Main Renal Diseases"

Participants
Raissa Leite, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Renal failure affects the nervous system with high frequency. Uremia, a direct metabolic consequence of kidney failure, can affect the central and peripheral nervous system. Kidney transplantation and immunosuppressive drugs with high frequency cause neurological problems in the postoperative period, such as: infections, post-transplantation lymphoproliferative disorders and movement disorders secondary to the use of cyclosporine. Dialysis is associated with a variety of complications. Important aspects of pathophysiology, clinical manifestations, together with image changes are essential and highlighted in this study for investigation and appropriate treatment.

TABLE OF CONTENTS/OUTLINE

Kidney diseases manifest themselves in different ways under the central nervous system and with a high frequency, whether peripheral or central. They can be of several causes, standing out toxic-metabolic and endocrine, that culminate in renal failure and exhibit peculiar alterations of image in the neuroimaging, being associated to a variety of complications. The objective of this work was to update the main neuroradiological manifestations of kidney diseases, so that the radiologist can identify them early, aiming at the diagnosis and appropriate treatments.

NREE-82   Clinical And Neuroimaging Patterns Of Thrombotic Microangiopathies

Participants
Heber Colares Costa, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the spectrum of thrombotic microangiopathies, including disseminated intravascular coagulation (DIC), thrombotic thrombocytopenic purpura (TTP), hemolytic uremic syndrome (HUS), and antiphospholipid antibody syndrome (AAS). To demonstrate the common MRI pattern of thrombotic microangiopathies, which includes multiple foci of hemorrhagic material, ischemic lesions, and a posterior reversible encephalopathy pattern. To associate the clinical profile of the patient with the corresponding type of thrombotic microangiopathy for a specific diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Imaging protocol: emphasis on SWI and Phase Map for bleeding identification, as well as diffusion for recent ischemic lesions.

2.Thrombotic microangiopathies: clinical and etiological concepts. 3. Main MRI patterns: hemorrhagic, mixed, and PRES-like. 4. MRI features and correlation with the clinical context: DIC, TTP, HUS, AAS. 5. Conclusion: Differential diagnosis based on clinical and imaging highlights.

NREE-83   Neuroimaging Spectrum In Patients With Altered Sensorium In A Critical Care Setting: A Comprehensive Pictorial Review

Participants
Sayani Mahal, MBBS, Jodhpur, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Serial neurological examination and use of neuroimaging forms the core of neurocritical care practice in intensive care unit. Computed tomography of head with added angiographic and perfusion imaging is the workhorse in critical care scenario providing a massive advantage of fast imaging and competence. It can detect the most common causes of intensive care admissions like acute trauma, ischemic stroke, intracranial hemorrhage and its outcome like brain herniation. Magnetic resonance imaging of brain, given the better resolution, is the problem-solving investigation in CT negative patients. Although most of the diagnoses in critical care patients are characteristic as far as imaging is concerned, there exist a conundrum of conditions which are exceedingly rare to come across in critical practice. This pictorial is aimed at demonstrating spectrum that ranges from the cases with classical neuroimaging features to those rare extra-ordinary findings.

TABLE OF CONTENTS/OUTLINE

1. Neuro-Intensive Care Section recommendation for critically ill patients. 2. Imaging algorithm for patients with altered sensorium in intensive care unit. 3. Step-wise approach and diagnosis of an array of conditions causing altered sensorium.

NREE-84   Neuroradiological Findings In Psychiatric Organic Diseases: A Pictorial Review

Participants
Hudson Silva, MD, Recife, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibition is to: -Describe the main organic pathologies commonly presented with psychiatric manifestations, subdivided into endocrine/metabolic, internal medicine, and neurological diseases. -Illustrate in a didactic approach the main neuroradiological findings, highlighting the key features that allow the differential diagnosis.

TABLE OF CONTENTS/OUTLINE

Introduction Main neuroimaging findings in psychiatric organic diseases according to three subgroups -Endocrine and metabolic diseases: osmotic demyelination, hypoglycemia, and Wernicke encephalopathy. -Internal medicine diseases: High-altitude cerebral edema (HACE), Neuroacanthocytosis, Whipple's disease, hepatic and uremic encephalopathies, HIV angiopathy, Progressive multifocal leukoencephalopathy (PML), malaria, neurosyphilis, Bechet's disease, limbic encephalitis, meningeal lymphoma and carcinomatosis. -Neurological diseases: posttraumatic brain injury, cerebral neoplasia, anti-NMDA encephalitis, neurodegenerative diseases, normal pressure hydrocephalus. Propose a systematic approach to the differential diagnosis. Conclusions References

NREE-86   The S Rule For Hemorrhagic Stroke: A Pictorial Update On CT Spontaneous Intracerebral Hemorrhage Expansion Markers

Participants
Carlos Suevos, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To summarize the basic Computed Tomography (CT) features of Intracerebral Hemorrhage (ICH) which determine its management in current clinical practice.2. To explore brand-new ICH Expansion Biomarkers which help predict its evolution in order to develop a deeper understanding of its prognosis. 3. To propose an useful guidance for analyzing ICH according to the S rule as a quality assurance (QA) to reach an homogenous report amongst different radiologist profiles.

TABLE OF CONTENTS/OUTLINE

1. Introduction.2. Classical ICH CT features.3. New developing ICH CT Expansion Markers.4. ICH Structured Reporting in Clinical Practice.5. Conclusion

NREE-87   Intracranial Arteriovenous Malformation In Infants: A Pattern Through Images.

Participants
João Victor Rodrigues SR, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are: • Describe the physiopathology of arteriovenous malformations in infants. • Within each arteriovenous malformation, discuss and illustrates the key clinical and radiological features. • Review illustrative cases in different imaging modalities.

TABLE OF CONTENTS/OUTLINE

• Pediatric brain arteriovenous shunts usually have a higher incidence of multifocal and high-flow lesions, induced remote arteriovenous shunts, venous thrombosis/ectasias, rapid cerebral atrophy, and systemic manifestations. • Although most classification of vascular malformation is based on angioarchitectural and histomorphological features, certain vascular malformations do not fit into any categories, point toward a spectrum of overlapping disease entities. • Classifying those shunt types according to anatomical space with recognition of the venous drainage enables to identify and predict potential consequences through its venous function on a developing brain. • Therefore we propose a sample recognition of the high flow arteriovenous shunts according to the specific pattern through image cases by a retrospective and descriptive study of brain MRI and angiography in our institution.

NREE-88   Contrast-enhanced 3D T2-FLAIR Imaging Of The Brain: What Should Radiologists Know?

Awards
Certificate of Merit

Participants
Minako Azuma, Miyazaki, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Three-dimensional T2 fluid-attenuated inversion-recovery (3D T2-FLAIR) MR imaging is sensitive to low concentrations of gadolinium (Gd) and slow flow compared with T1-weighted imaging. 2. Contrast-enhanced (CE) 3D T2-FLAIR imaging is thought to show only signals of Gd in the interstitial space and in contact with fluid because the signal from inside the blood vessel is suppressed. 3. Knowing the characteristics of CE-3D T2-FLAIR imaging will help in the accurate diagnosis of brain lesions.

TABLE OF CONTENTS/OUTLINE

1. Basics of 3D T2-FLAIR sequence (1) The relationship between the Gd concentration and the signal intensity of CE-3D T2-FLAIR (2) The relationship between the velocity of flow and the signal intensity of CE-3D T2-FLAIR 2. Clinical application of CE-3D T2-FLAIR imaging (1) Normal appearance of the brain: Circumventricular organs (posterior lobes of the pituitary gland, pineal gland, area postrema, vascular organ of the lamina terminalis, subfornical organ, subcommissural organ, choroid plexus) (2) Pericortical enhancement in normal aging, mild cognitive impairment, and Alzheimer disease (3) Leptomeningeal enhancement: Infectious leptomeningitis, leptomeningeal carcinomatosis, sarcoidosis, Wernicke encephalopathy (4) Wall enhancement of cystic pituitary lesions: discrimination of craniopharyngioma from Rathke's cleft cyst, "Donut-like enhancement" of cystic pituitary adenoma 3. Take home points 4. References

NREE-9   Neuro-Behçet Disease: Spectrum Of Imaging Findings

Awards
Magna Cum Laude

Participants
Eugenio Gil, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1 - Understand basic pathophysiology and clinical presentation.2 - Recognize typical imaging findings.3 - Recognize atypical and uncommon presentations that should not be missed or misinterpreted.4 - Realize important imaging or clinical clues that should help with differential diagnosis.

TABLE OF CONTENTS/OUTLINE

1 - Basic pathophysiology and clinical presentation.2 - Typical imaging findings: a) Parenchymal: Brainstem, basal ganglia, lobar involvement.b) Non-parenchymal: Venous thrombosis, Intracranial hypertension, aseptic meningitis.3 - Uncommon presentationsa) Longitudinally extensive myelitis.b) Pseudotumoral presentation.c) Carotid pseudoaneurysm.c) Progressive cerebellar and brainstem atrophy.4 - Differential diagnosis: a) Inflammatory demyelination: neuromyelitis optica, multiple sclerosis.b) Other inflammatory diseases: Neuro-Sweet syndrome.c) Infection: listeria rhombencephalitis, neurosyphilis.d) Vascular: brainstem AV-fistula

NREE-90   Prematurity, Periventricular Leukomalacia, And Hemorrhage Of The Germinal Matrix: A Mind Map To Pathophysiology, Imaging, And Prognosis

Awards
Certificate of Merit

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the imaging patterns of hypoxic-ischemic injuries in the preterm infant. To demonstrate the physiopathological mechanisms and differences between mild and severe hypoxic-ischemic events in preterm infants and the prognosis. To illustrate the MRI features of germinal matrix hemorrhage and its graduation. To present the differences between preterm and full-term hypoxic-ischemic imaging patterns.

TABLE OF CONTENTS/OUTLINE

1. Background/Introduction. 2. Imaging modalities, including MRI and ultrasonography. 3. MRI protocols and basics of interpretation. 4. Physiopathological mechanisms of hypoxic-ischemic injuries in the preterm infant. 5. Normal magnetic resonance imaging of the preterm and myelination patterns. 6. Imaging the mild-to-moderate hypoxic-ischemic injury. 7. White matter injury of prematurity or periventricular leukomalacia. 8. Germinal matrix-intraventricular hemorrhage. 9. The severe hypoxic-ischemic lesion in the preterm. 10. Disparities between preterm and full-term infants hypoxic-ischemic imaging patterns. 11. Flowchart of evaluation. 12. Take-home messages.

NREE-91   Neuroimaging Of Progressive Multifocal Leukoencephalopathy In Diverse Clinical Scenarios

Participants
Yoshiaki Ota, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To review pathogenesis of progressive multifocal leukoencephalopathy (PML) 2. To demonstrate imaging features based on different clinical backgrounds3. To illustrate imaging mimics and pitfalls.

TABLE OF CONTENTS/OUTLINE

1. Pathogenesis- Non-inflammatory demyelination2. Background- HIV infection- Multiple sclerosis under natalizumab treatment-

Hematologic and oncologic conditions under immunosuppressant treatment- Rheumatologic diseases under immunosuppressant treatment- Organ transplantation3. Imaging features of PML- Conventional MRI: typically T1 hypointense and T2 hyperintense lesions in the subcortical U-fiber rather than in periventricular white matter- Enhancement: typically not associated with enhancement, but commonly seen in the setting of natalizumab-associated PML, which may depend on patient's immunological status- DWI: DWI hyperintensity at the lesion margin.- SWI: hypointensity along cortical-subcortical junction adjacent to PML demyelinating lesions - MR spectroscopy: increase of Choline peak, decrease of NAA peak- DSC perfusion MRI: usually decreased rCBV and rCBF seen in the lesion- PET-CT: different FDG uptakes varying based on immunological status- Diffusion tensor image: early detection of demyelination4. Mimics and pitfalls- Posterior reversible encephalopathy syndrome (PRES)- PML-IRIS- CNS lymphoma

NREE-92   Don't Break The Flow! - Review Of Cerebrospinal Fluid Circuit And Intraventricular Lesions.

Participants
Julia Brunelli, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Through this pictorial essay will be made a review based on cases and original drawings about the cerebrospinal fluid (CSF) circuit, and intraventricular lesions that can interrupt this flow. Intraventricular pathologies will be addressed by typical imaging patterns (such as diffusion restriction, cysts, solids with or without enhancement) and an algorithm to narrow differential diagnoses. The purpose of this exhibition is to:- Review the anatomy of the Ventricular System;- Describe how is the cerebrospinal fluid circulation according to the classic and the new theories;- Recognize the main etiologies of intraventricular lesions, according to their main MR imaging findings;- Organize the radiologic reasoning with an algorithm.

TABLE OF CONTENTS/OUTLINE

ANATOMICAL CONCEPTS - Ventricular system and MRI anatomyCEREBROSPINAL FLUID DYNAMICS- Classical CSF Flow- The new CDF DynamicsINTRAVENTRICULAR LESIONS - Didactic algorithm of imaging differential diagnosis- Imaging aspects of intraventricular pathologiesINTERACTIVE CASE-BASED DIDACTICS - Sample cases to illustrate and solidify the concepts

NREE-93   Pediatric Craniofacial Vascular Lesions In The Age Of Genomics And Proteomics

Participants
Abdullah Khan, MD, Sacramento, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Describe current concepts of genomics and proteomics in syndromic pediatric craniofacial vascular lesions. 2) Describe the role of the radiologist in defining imaging-based approaches. 3) Understand the difference between syndromic, sporadic and related lesions

TABLE OF CONTENTS/OUTLINE

There is increasing evidence that abnormal expression of certain genes underlies CNS vascular lesions. Upregulation or downregulation of genes influences embryogenesis, vasculogenesis and angiogenesis signaling pathways, generally through protein assembly. Genomics have been clearly linked to various syndromic lesions in craniofacial vascular malformations, i.e. HHT, PHACE syndrome, RASA1 mutation, CLOVES, Macrocephaly capillary malformation syndrome, CLAPO, NF1, Klippel-Trenaunay and Sturge Weber syndrome, syndromic AVMs (CM-AVM, CAMS), and some forms of Moyamoya. Radiologists are uniquely positioned to design imaging-focused approaches for improved definitions of such syndromes. Genome wide association studies have also suggested abnormal gene expression in sporadic vascular lesions, i.e. low-flow vascular anomalies, including venous/lymphatic/capillary/mixed malformations, AV-fistulas and AVMs. Lastly, somecerebrovascular vascular lesions are more clearly understood to result from underlying conditions, such as sickle cell disease, cardiac conditions or coagulopathies.

NREE-94   Ocular And Visual Disturbances - Inside The Brain, What Remain?

Awards
Certificate of Merit

Participants
Guilherme Chaves, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Neuro-ophthalmic disorders have a broad spectrum of differential diagnosis and many diseases with ophthalmic manifestations may have a normal orbital evaluation. The objective of this pictorial essay is to review optic tract anatomy, focusing on the encephalic regions related to vision and to discuss the main brain disorders with ophthalmic manifestations. The retrochiasmatic visual pathway is composed by optic tracts, lateral geniculate bodies, optic radiations and visual cortices, while the brainstem and cerebellum are involved in efferent visual function. Many pathological processes can manifest as visual disturbances, such as hypoxic/ischemic injuries, hemorrhage, demyelination, neurodegenerative diseases, genetic disorders, tumors, infections/inflammatory diseases, vascular malformations and post radiotherapy disorders. Localizing the cause of visual disturbances sometimes requires looking beyond the eyes. Clinical findings may help to determine the lesion location and neuroradiologists should understand these clinical manifestations to know where to search.

TABLE OF CONTENTS/OUTLINE

1. Review optic tract anatomy; 2. Describe the afferent and efferent visual pathways; 3. Anatomical view of primary and secondary cortices; 4. Differential diagnosis of ocular and visual disturbances based on anatomic correlation: cortex, white matter, brainstem, cavernous sinus and optic chiasm.

NREE-95   Common And Unusual Intradural Extramedullary Masses. Are You Sure You Have Seen It All?

Awards
Certificate of Merit

Participants
Sofia Velasco, MD, MPH, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the intradural extramedullary space lesions, emphasizing key imaging findings that lead to a diagnosis.To illustrate the use of imaging landmarks to precisely localize a lesion in the intradural extramedullary space in challenging scenarios.Lesions associated with syndromes will be highlighted along with recommendations for further imaging workup.

TABLE OF CONTENTS/OUTLINE

Approach - Location- Each pathology will include clinical features with cases illustrating key imaging findings - Pearls.- Schwannoma- Schwannomatosis- Meningioma Key signs including Arachnoid isolation sign and Gingko leaf sign- Calcified meningioma and surgical implications- Neurofibromas Neurofibromatosis type 1 and Neurofibromatosis type 2- Multiple Inherited Schwannomas, Meningiomas, Ependymomas- Myxopapillary ependymoma encapsulated vs. non-encapsulated- Paraganglioma- Leptomeningeal metastases - 4 different patterns including rare case of metastatic GBM.- Lymphoma- Benign Lesions of the Conus Medullaris-Summary

NREE-96   Stroke-like Migraine Attacks After Radiation Therapy (smart) Syndrome: What We Know And What Remains Unknown

Participants
Yoshiaki Ota, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To review the postulated pathophysiology of SMART syndrome2. To present typical and atypical MRI findings of SMART syndrome3. To demonstrate other delayed complications of radiation therapy

TABLE OF CONTENTS/OUTLINE

1. Pathophysiology of SMART syndrome- Late ionizing radiation effects upon mitochondrial DNA- Vessel narrowing or occlusion due to delayed radiation effects 2. Neuroimaging of typical and atypical SMART syndrome- Typical MRI findings: gyriform enhancement and correlative abnormal T2 and fluid-attenuated inversion recovery (FLAIR) signal - Atypical MRI findings: locally restricted diffusion, brainstem lesion 3. Advanced imaging assessment- DCE-MRI: locally increased permeability- DSC-MRI: local increased cerebral blood volume- Arterial spin labeling (ASL): local increased perfusion- MR spectroscopy: reduced N-acetyl-aspartate (NAA) signal without increased choline and large lipid peak - FDG PET-CT: low FDG uptake 4. Other delayed complication of radiation therapy- Microhemorrhage/cavernoma/meningioma/siderosis/basal ganglia calcification

NREE-97   Differential Diagnosis Of Inflammatory And Auto-immune Diseases Of The Spinal Cord

Participants
Marina De Freitas, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

* Review and discuss inflammatory and auto-immune disorders that affect the spinal cord, focusing on image patterns and key points to differentiation between demyelinating and non-demyelinating causes. * Exemplify mimicking disorders in order to scrutinize a practical approach for the differential diagnosis. * Review the main diagnostic modalities that are used evaluate.

TABLE OF CONTENTS/OUTLINE

* Introduction on the theme and epidemiology. * Didactic illustration and presentation of the main inflammatory and auto-immune disorders that affecting the spinal cord. * Discuss and review selected cases of the different diseases of transverse myelitis, including: -- Demyelinating diseases, such as multiple sclerosis, neuromyelitis optica spectrum disorder (NMOSD), myelin oligodendrocyte glycoprotein antibody-associated disease (MOGAD), acute disseminated encephalomyelitis (ADEM) -- Non-demyelinating diseases, such as rheumatoid diseases (systemic lupus erythematosus - SLE, dermatomyositis, Sjogren syndrome, Behçet disease), sarcoidosis, autoimmune glial fibrillary acidic protein astrocytopathy (GFAP), Guillain-Barré syndrome and Miller Fisher variant, paraneoplastic syndromes, IgG4 related disease, radiation-induced myelopathy. * Review the clinical and radiologic features of each inflammatory and auto-immune spinal cord diseases, identifying their typical findings and patterns. * Conclusion.

NREE-98   Dissecting The Intracranial Corticospinal Tract: A Review Of MRI Techniques To Understand The Anatomy, Pathophysiology And Clinical Correlations Of CST Disorders

Participants
Tatiana Iutaka, BDS, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review the anatomy, embryology and pathophysiology of corticospinal tract (CST);Describe the clinical findings and the topographic diagnosis of CST disorders;Discuss and illustrate through clinical cases, the clinical and imaging features of CST disorders, organizing them according to the etiology;Discuss the importance and application of the different MRI sequences in CST disorders;Suggest a practical approach according to the topography of CST disorders

TABLE OF CONTENTS/OUTLINE

Anatomy, embryology and pathophysiology of CST.CST DisordersDevelopmental CST hypoplasia or aplasiaHoloprosencephaly;Schizencephaly;Corpus callosum dysgenesiaAbnormal CST Guidance at the MidlineCongenital Mirror Movements;Klippel-Feil Syndrome;Molar Tooth Midbrain-Hindbrain MalformationDegenerative Amyotrophic Lateral Sclerosis;Primary lateral sclerosis;Multiple System Atrophy;Hereditary Spastic ParaplegiaToxic and Metabolic Krabbe Disease (Adult variant);X-Linked Adrenoleukodystrophy (Adult variant);Cerebrotendinous Xanthomatosis;Adult-Onset Leukoencephalopathy with Axonal Spheroids and Pigmented Glia;Wernicke Encephalopathy;Chronic Hepatic Encephalopathy;Osmotic Demyelination Syndrome;Vitamin B12 Deficiency;OthersInflammatory and Infectious Neuromyelitis Optica Spectrum Disorder;Neuro-Behçet;HTLV-1 Infection;OthersVascular Hypoxic Ischemic Brain Injury;OthersNeoplastic Tumor DisseminationMiscellaneousWallerian DegenerationPractical diagnostic approach

NREE-99   Beyond Anatomy: Looking To The Pixels - Radiomics And Radiogenomics In Neuro-oncology

Participants

Guilherme Chaves, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

In modern radiology, studies of radiomics and radiogenomics have grown exponentially because they analyze the image beyond its phenotypic aspects through the data that the image produces. In neuro-oncology, a broad and heterogeneous field in neuroradiology, such studies increase the accuracy of diagnosis and follow-up, besides being essential to radiologists in understanding this new field of study and its proven applications. Radiomics is defined as the conversion of images to higher dimensional data and the subsequent mining of these data for improved decision support, involving combining radiomic data with other patient characteristics. The radiomic data correlated with genomic patterns is known as radiogenomics. The combination of this subset of radiomic features with genomic data may increase diagnostic, prognostic, and predictive imaging power. In neuro-oncology, due to various tumor characteristics, researches involving radiomics and tumor molecular identification and mutations, prognostic assessment and to differentiate pseudo-progression from tumor progression are increasing and there are many recent publications in this field.

TABLE OF CONTENTS/OUTLINE

1. Radiomics and radiogenomics: definition, imaging acquisition, processing and analysis. 2. Review the new classification of the World Health Organization concerning Central Nervous System Tumors. 3. Application of radiomics and radiogenomics in neuro-oncology showing in a didactic way the consolidated aspects already published.

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GUEE

Genitourinary Education Exhibits

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Sub-Events

GUEE-1   Pathology Of The Scrotum: US Assessment and Pictorial Review

Participants
Pérez Perez Arroyuelos, Galdakao-Usansolo, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Sonography is the imaging modality of choice for examination of the scrotum. Objectives of this study: Review the normal US anatomy of testes and scrotum. Illustrate a wide variety of pathologic conditions afecting the scrotum. More in-depth assessment of the most representative diseases.

TABLE OF CONTENTS/OUTLINE

We reviewed all the scrotal sonographies made in our institution during a period of 10 years. Representative cases are illustrated in this exhibit (with other imaging techniques and radio-pathologic correlation when possible) grouped according the following headings:1 Infectious conditions: orchitis, epididimitis, pyocele, abscesses, chronic epididimitis. 2 Mechanical causes: testicular torsion, torsion of testicular appendages, segmental testicular infarction, scrotal trauma and hematoma. 3 Tumors. Testicular tumors: A) Germinal cell tumors (seminomatous and nonseminomatous) B) Sex cord-stromal tumors C) Others (lymphoma, epidermoid cyst). Extratesticular tumors: adenomatoid tumors, leiomyosarcoma, malignant fibrous histiocytoma. 4 Tumor-like lesions: nodose vasitis, adrenal rests, splenogonadal fusion, focal fibrosis. 5 Miscellaneous conditions: inguinoscrotal hernia, intratesticular and extratesticular varicocele, sperm granuloma, postvasectomy changes, spermatocele and epididymal cyst, microlithiasis, cyst of the tunica albugiínea, intratesticular cyst, hydrocele, tubular ectasia of the rete testis, scrotal calcifications, cystic testicular dysplasia.Take home points.

GUEE-10   Prostate MRI: Why Are We Missing Clinically Significant Cancer?

Participants
Joan C. Vilanova, MD, PhD, Girona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

a) Recognize different causes of missing clinically significant prostate cancer (csPCa) on mpMRI. b) Understand the radiobiopathology mechanisms supporting the m/bpMRI visibility and invisibility of csPCa. c) Identify other types of prostate cancer beyond the typical appearance of adenocarcinoma or other atypical prostatic disease. d) Recognize technical & protocol & biopsy issues related to false negative diagnose of prostate cancer. e) Show and review the ambiguities in image interpretation related to PI-RADS 2.1 that might develop false negative results

TABLE OF CONTENTS/OUTLINE

1.- Introduction to Prostate MRI 2.- Histopathology of prostate cancer 3.- Causes of missing and limitations for clinically significant prostate cancer on MRI: a) Pathological-Clinical/MRI features. b) Technical acquisition. c) Biopsy issues/under-sampling. d) Interpretation MRI. It will be illustrated different and multiple causes that can cause invisible clinically significant prostate cancer on m/bpMRI. It will be correlated MRI/ histopathological features that explain the invisible csPCa (Gleason grade, volume, cellular density, microvessel density, stromal tissue, cribriform pattern and intraductal carcinoma) with clinical data (PSA). It will be described technical & interpretation issues on MRI protocol, DWI-ADC, limitation on PI-RADS and biopsy under-sampling for false negative results on csPCa detection. It is important to know why csPCa is missed to reduce the false negative rates and improve PCa detection.

GUEE-100   An Insight Into The Revised Bosniak Classification For Renal Cysts: Version 2019

Participants
Suryansh Bajaj, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

Cystic lesions in the kidney are common occurrences and it is important to differentiate the benign cysts from the malignant lesions on the basis of radiological imaging. For this purpose, Dr. Morton A Bosniak proposed a classification system for different renal cystic lesions in 1986 on the basis of the imaging characteristics on CT. Reviewing the data showing the overdiagnosis and aggressive treatment of renal cell carcinoma and with a view of standardizing the classification to reduce the interreader variability, the Bosniak classification was revised in 2019 introducing major changes to the classification. The revised classification formally included the MRI imaging into the classification for the first time. This exhibit will review the revised 2019 version of the Bosniak classification for renal cysts, its clinical application, and the differences from the previous classification. We will also review images of different CT and MRI sequences for all Bosniak types.

TABLE OF CONTENTS/OUTLINE

Limitations of the previous classification The need for the revised Bosniak classification - 2019 version. Updated definitions and

Limitations of the previous classification. The need for the revised Bosniak classification - 2019 version. Updated definitions and descriptions of classes I-IV. MRI and CT features of each class. Standardized descriptions of terms used in the classification system. How to classify equivocal lesions. Limitations of the 2019 version.

GUEE-101 Multimodality Diagnosis Of Borderline Epithelial Ovarian Tumors: Radiologic-pathologic Correlation And Pitfalls In The Diagnosis.

Awards
Identified for RadioGraphics

Participants
Takahiro Tsuboyama, MD, Suita, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Borderline epithelial ovarian tumors (BEOT) are characterized by cellular proliferation with mild nuclear atypia, but without destructive stromal invasion. Preoperative diagnosis of BEOTs is important because treatment strategy is different from that for benign and malignant tumors. Although MR is the established method for characterization of ovarian masses, CT and PET can also provide useful information for the diagnosis of BEOTs. Learning objective of this presentation is to describe useful multimodality imaging findings correlated with pathological findings and pitfalls in the diagnosis of BEOTs, as well as to describe the revised points in the WHO 2020.

TABLE OF CONTENTS/OUTLINE

1, MR imaging findings of BEOTs and radiologic-pathologic correlation - Serous borderline tumor - Seromucinous borderline tumor - Mucinous borderline tumor - Clear cell borderline tumor - Endometrioid borderline tumor - Borderline Brenner tumor - Peritoneal implant 2, Multimodality diagnosis of BEOT - Role of CT - Role of PET 3, Pitfalls - Benign lesions mimicking BEOT - Malignant lesions mimicking BEOT

GUEE-102 Surgical And Interventional Management Of Renal Cell Carcinomas: A Primer For Radiologists

Participants
Aditi Chaurasia, MBBS, Bethesda, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

Invasive management of renal cell carcinoma (RCC) includes various surgical and interventional procedures. Surgical resection represents the standard of care for most RCCs. Surgical options include radical nephrectomy for larger renal masses, nephron-sparing surgery for smaller tumors, cytoreductive nephrectomy and metastasectomy/extirpation of local recurrence in advanced RCC. Moreover, interventional radiology has an increasingly popular role in the treatment of small renal masses, and options include cryoablation, microwave ablation, and radiofrequency ablation. Since adequate radiologic assessment and accurate staging is critical for planning any intervention, it is imperative for radiologists to be familiar with the imaging characteristics to determine and plan the appropriate procedure. This educational exhibit will review the existing guidelines and illustrate the key preoperative imaging findings & criteria necessary to plan the various surgical strategies and interventional procedures. It will also compare these features with the post-operative imaging characteristics.

TABLE OF CONTENTS/OUTLINE

1.Criteria and pre-and post-operative imaging characteristics for surgical strategies:?Radical nephrectomy ?Partial nephrectomy •Role of intraoperative ultrasound ?Cytoreductive nephrectomy ?Metastasectomy2.Criteria and pre- and post-procedural imaging characteristics for interventional radiological methods: 1.Cryoablation 2.Microwave ablation 3.Radiofrequency ablation 4.Embolization

GUEE-103 Improd and Multi-improd Server: Free Public Access To 499 Prostate MRI Scans, MRI Reports, Biopsy Findings, Scanned Whole Mount Prostatectomy Sections and Much More

Participants
Ivan Jambor, MD,PhD, New Haven, Connecticut (*Presenter*) Institutional Research Grant, Siemens AG

TEACHING POINTS

- to learn how to use IMPROD (http://petiv.utu.fi/improd/) MULTI-IMPROD servers (http://petiv.utu.fi/multiimprod/) for teaching purposes - to provide access to an optimized MRI acquisition protocol, including a scanned importable format - to learn how to detect prostate cancer using biparametric MRI (bpMRI) - to differentiate prostate cancer from common confounders such as benign prostatic hyperplasia using biparametric MRI (bpMRI)

TABLE OF CONTENTS/OUTLINE

IMPROD (Improved Prostate Cancer Diagnosis - Combination of Magnetic Resonance Imaging and Biomarkers) was a prospective registered clinical trial evaluating the role of a novel bpMRI and targeted biopsy in men with a clinical suspicion of prostate cancer. The validation 4 institutional trial using the same method was MULTI-IMPROD trial (ClinicalTrials.gov Identifier: NCT02241122). All anonymised bpMRI data sets and prospective bpMRI reports, biopsy and prostatectomy reports, follow up information, and results of additional analyses are freely available at the following address http://petiv.utu.fi/improd/ and http://petiv.utu.fi/multiimprod/ . Strength and limitation of bpMRI will be highlighted by provided direct link to all bpMRI data sets, biopsy and prostatectomy findings. Whole mount prostatectomy sections were digitalized and allow correlation of pre-biopsy bpMRI enhancing the learning experience.

GUEE-11 Urinary Diversions: Main Normal And Abnormal Findings With Special Focus On Hemorrhagic Complications

Participants
Amaia Perez, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

To describe the different surgical techniques used to create urinary diversion after radical cystectomy. To show the normal

radiological findings after radical cystectomy.To explain the main complications of urinary diversions.

TABLE OF CONTENTS/OUTLINE

Introduction: Main indications of radical cystectomy. Bladder cancer staging.The role of imaging in bladder cancer. Surgical techniques:Incontinent urinary diversions.Continent urinary diversions. CT-protocol.Normal radiological findings.Image-based review of main complications after radical cystectomy:Early complications:Alterations of bowel transit. Urinary leakage.Collections.Urinary fistula formation.Urinary obstruction.Vascular complications: arterio-ureteral fistula. Late complications: Urinary infection.Lithiasis.Parastomal herniation.Stenosis of the ureteral anastomosis.Granuloma of the anastomosis of the ureter and conduit or reservoirTumor recurrence.Special review of hemorrhagic complications through a case series. Take-home messages.

GUEE-12   Think Outside The Testicle: Extra-testicular Causes Of Acute Scrotal Pain And Swelling

Awards
Cum Laude

Participants
Adam Yen, MD, San Francisco, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Discuss causes of acute scrotal pain and swelling apart from testicular torsion and epididymitis-orchitis, with a focused discussion on often missed extra-testicular entities to prevent delay in diagnosis and patient morbidity.2. Review extra-testicular anatomy, particularly of the vas deferens and pampiniform plexus, to increase familiarity with these structures which may often be overlooked by technologists and radiologists.3. Develop a systematic anatomy-based approach to review extra-testicular structures as a framework for recognizing these entities.4. Analyze sonographic images of extra-testicular entities with discussion of pearls and pitfalls.

TABLE OF CONTENTS/OUTLINE

1. Overview- Review of anatomy- Anatomy-based framework for case review2. Skin- Acute idiopathic scrotal edema (AISE)- Cellulitis/abscess- Fournier's gangrene3. Tunica vaginalis- Hematocele- Pyocele4. Epididymis and vas deferens- Torsed appendage- Complicated epididymitis5. Spermatic Cord- Corditis/funiculitis- Spermatic vein thrombosis- Postoperative hematoma (vasectomy, hernia repair)6. Non-scrotal causes- Renal calculus- Inguinal hernia with strangulation7. Scrotal Pearls and Pitfalls- Diffuse scrotal wall edema, always check for subcutaneous gas.- Always evaluate testicular vascularity, even when the main finding is extratesticular, as it may be secondarily compromised.

GUEE-13   PI-RR And Beyond: A Practical Guide To Local Recurrence Of Prostate Cancer.

Awards
Magna Cum Laude

Participants
Paulo Antunes, MD, Niteroi, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To gain awareness of the clinical background of the main indications of radical prostatectomy and radiotherapy.To review the relevant anatomy of the male pelvis before and after radical prostatectomy.To discuss the main findings of prostate cancer local recurrence.To learn the new Prostate Magnetic Resonance Imaging for Local Recurrence Report (PI-RR) system.

TABLE OF CONTENTS/OUTLINE

Introduction From diagnosis to treatment - What the radiologists should know about the main guidelines recommendations? Basic concepts like PSA density, PSA doubling time, and biochemical recurrence.DiscussionFirst things first - Getting familiarized with the relevant male pelvis anatomy before and after radical prostatectomy.What to expect? What to look for? - A discussion of the normal and abnormal findings on multiparametric prostate magnetic resonance imaging after RP em radiotherapy.Fresh news - Learning how to apply the new PI-RR system.SummaryGrab and go - A brief review with take-home schematic drawings.

GUEE-15   Contrast Media In And Out The Urinary System - From Parenchymal Enhancement To MR Urography

Participants
Daniel Montel, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- How contrast media cruises through the urinary system and the normal nephrogram pattern in MR and CT. - When to use MR Urography with and without contrast media enhancement to diagnose different pathologies - The broad differential diagnosis of an altered nephrogram focusing on most frequent pathologies.

TABLE OF CONTENTS/OUTLINE

- Description of a normal nephrogram (unenhanced, corticomedullary, nephrographic, excretory phases). - Exemplify and illustrate CT and MR Urography technique - Altered nephograms (Absent nephrogram, delayed nephogram, striated nephrogram, spotted nephrogram, persistent nephrogram, reversed nephrogram).- Evaluation of urinary tract with MR Urography - Take-home messages

GUEE-16   Spectral CT In Renal Imaging: Cutting Edge Applications

Participants
Kevin Neville, DO, Andover, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Spectral CT (also referred to as Dual Energy or Multi Energy CT) is a technology that is steadily increasing in use, with many applications in renal imaging2. Spectral CT can reliably distinguish between enhancing and non-enhancing renal masses, with greater accuracy than traditional CT3. Advanced analysis with Spectral CT shows promise in differentiating between different renal tumor subtypes, possibly allowing patients to avoid biopsy4. Iodine selective imaging with Spectral CT can be used to assess

response of renal tumors to systemic therapy

GUEE-17 Imaging Characteristics Of Retroperitoneal Tumors: Differential Diagnosis And Histopathological Correlation - What A Radiologist Needs To Know

Participants
Martin Halicek, PhD, Augusta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To demonstrate diagnostic challenges including localization of the mass, extent of invasion and characterization of specific pathology such as liposarcoma, leiomyosarcoma, extragonadal germ cell, paragangliomas and sarcoma. 2. To illustrate patterns of spread, tumor components, tumor vascularity, helping narrow the differential diagnosis. 3. Added value of MR imaging.

GUEE-18 VIRADS In Bladder Cancer - A Practical Approach

Participants
Chooi Yan Anna Lois Lai, MD, Singapore, Singapore (*Presenter*) Nothing to Disclose

TEACHING POINTS

VIRADS IN BLADDER CANCER - A PRACTICAL APPROACHTEACHING POINTSA. To review aspects of bladder cancerB. To review radiological evaluation of bladder cancer on mpMRIC. To illustrate VIRADS scoring using case reviewD. To discuss practical challenges and pitfalls in mpMRI bladder analysis and in the use of VIRADS scoring

GUEE-19 Deep Infiltrative Pelvic Endometriosis: Image Based Review

Participants
Stuti Chandola, MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Define the various patterns of endometriosis.2. Review the common locations and imaging features of DIE on dynamic transvaginal USG (TVUS) and MRI through a multimodality image based review. 3. Highlight the importance of cross sectional imaging in surgical management of DIE. 4. Outline a step wise algorithm to approach a patient with endometriosis to avoid overlooking DIE lesions.

GUEE-2 Nuances Of Radiation In Prostate Cancer: Treat And Protect!

Participants
Rebekah Padilla, DO, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

Basics of radiation therapy for prostate cancerTypes of prostate cancer treatment including external beam radiation with fiducial markers and internal radiation utilizing brachytherapyUnderstand protection mechanisms for radiosensitive pelvic structuresImaging

characteristics of the pre- and post-radiated prostateSpecific placement of safety devices such as hydrogel spacersComplications of and contraindications for the use of safety devices

TABLE OF CONTENTS/OUTLINE

Male pelvic anatomy and anatomic variants on magnetic resonance imagingTypes of prostate cancer treatmentsThe role of MRI for evaluation of primary prostatic cancer, re-evaluation of disease and the post-radiotherapy prostateIndications and contraindications for prostate radiation therapy and hydrogel spacersCommon complications of prostate radiationThe role of spacer placement to reduce post-radiation complicationsDescription of spacer placement procedureCases of optimal versus suboptimal hydrogel spacer placement and spacer complications on MR images

GUEE-20   Pelvic Floor Ultrasound: A Primer For Radiologists

Participants
Anirudh Nair, MBBS, Doha, Qatar (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Pelvic floor disorders (PFD) affect about 50% of women in different stages of their lifetime. 2. These are either due to relaxed pelvic floor muscles that result in pelvic organ prolapse, urinary or fecal incontinence; or due to non-relaxing pelvic floor muscles that lead to pyriformis syndrome, puborectalis dyssynergia, etc. 3. Diagnosis of PFD is sometimes challenging when patients present with clinical symptoms attributable to sexual dysfunction, chronic pelvic pain, coital difficulties. 4. The radiologists should be aware of the utility of pelvic floor ultrasound as a useful tool in the diagnosis, classification, and quantification of pelvic floor disease.

TABLE OF CONTENTS/OUTLINE

1. Discuss the ultrasound anatomy of the female pelvic floor. 2. Literature review on utility of pelvic floor ultrasound (PFUS) in the imaging of PFD.3. Discuss indications, equipment, and techniques required to perform a PFUS.4. Classify PFD. 5. Demonstrate the common and challenging PFD involving anterior compartment (stress urinary incontinence, vaginal sling imaging, Fowler's syndrome, urethral stricture, cystocele with Green classification, etc); Central compartment (Congenital anomalies, vaginal inclusion cysts, Bartholin's cysts, levator ballooning/tears, pelvic congestion syndrome and varices, clitorial doppler for sexual dysfunction, genital mutilations, vulval lesions), and Posterior compartment diseases (rectocele, enterocele, anorectal dyssynergia). Other miscellaneous pathologies causing perineal symptoms.

GUEE-21   Imaging Of The Cowper's (Bulbourethral) Gland - Its Abnormalities And Differential Diagnosis

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Hiroaki Takahashi, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

Owing to increasing utilization of cross-sectional imaging, abnormalities of the Cowper's (Bulbourethral) gland and duct are more commonly depicted. While its function and anatomy are well-established, reports on imaging findings of the Cowper's gland are scarce. This exhibit will review the anatomy, physiology, and pathology of the Cowper's gland along with imaging assessment of the various abnormalities. In addition, common periurethral lesions that mimic Cowper's gland pathology on imaging will be discussed. Familiarity with these imaging findings will improve diagnostic confidence and accuracy when evaluating Cowper's gland, resulting in better patient outcomes. The purposes of this exhibit are to: 1. Review the anatomy, physiology and imaging findings of normal Cowper's gland. 2. Review the clinical and imaging findings of the abnormalities of the Cowper's gland with treatment options. 3. Discuss the differential diagnosis of the periurethral lesions about the bulbar and membranous urethra that could mimic the Cowper's gland abnormality.

TABLE OF CONTENTS/OUTLINE

1. Overview of Cowper's gland and its abnormality. 2. Fundamental anatomy, physiology and imaging of normal Cowper's gland. 3. Systematic review of clinical and imaging findings of the abnormalities of the Cowper's gland. 4. Differential diagnosis of periurethral lesions mimicking the Cowper's gland abnormality. 5. Summary

GUEE-22   Ovarian-adnexal Reporting Data System MRI (O-RADS MRI), Learning From Challenges In Our Clinical Practice.

Participants
Lledo Cabedo Esteve, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review how to perform the MR protocol for the O-RADS MRI score system . To recognize the imaging findings described in the O-RADS MRI score system, correctly stratify adnexal masses , depict differential diagnosis and pitfalls of these adnexal masses. Identify and know how to deal with the most common problems with the O-RADs MRI score system in the clinical practice.

TABLE OF CONTENTS/OUTLINE

O-RADS MRI protocol, mass characterization, differential diagnosis and pitfalls; O-RADS 1-No mass or non-adnexal mass: How to deal with serosal myomas mimicking ovarian fibromas and neighboring intestinal or urinary diseases considered ovarian masses by ultrasound; O-RADS 2 and 3-Benign adnexal masses: Hemorrhagic cysts and endometriosis disease. Not always ovarian cysts: other cyst-like findings. Rule out the solid component in hemorrhagic or proteinaceous multilocular cysts. Solid ovarian masses with type I enhancement curve. Dark-dark masses and other presentations of ovarian fibromas. Other benign tumors with typical radiological findings; O-RADS 4 and 5-Malignant adnexal masses: Definition and types of solid tissue. Non-enhancing ovarian masses torsion, clue findings. Non-solid ovarian cystic nodules that mimic solid tissue . DCE-MRI types of enhancement curves: meaning and pitfalls. Mucinous tumors, MRI findings and searching for another primary origin. Tips to avoid overlooking pelvic peritoneal implants. How to differentiate normal ovarian parenchyma from tumor solid tissue. Benign ovarian tumors with small areas of malignancy.

GUEE-23   Imaging Biomarkers Relevant For Prostate Cancer Management: Introduction

Participants
James Diss, PhD,FRCR, Epping, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Biomarkers (BM) are measured indicators of normal biological processes, pathogenic processes, or biological responses to interventions. BM are not assessments of how individuals feel or function; and are not survival surrogates or quality-of-life measures (but maybe correlated). (2) There are multiple classes of imaging BM of clinical relevance to the advancing prostate cancer state (Diagnostic, Prognostic, Predictive, Response). (3) Diagnostic imaging BM can become prognostic and/or predictive BM, serving different functions. (4) Prognostic BM are used to identify patients who do not need therapy intensifications and/or those with very poor outcomes (not benefiting from therapy intensifications). (5) Predictive BM are needed when outcomes are suboptimal to determine which therapy option provides the best benefit.

TABLE OF CONTENTS/OUTLINE

(1) Define and give examples of image-based diagnostic, prognostic, predictive and response BM used in the clinical management of prostate cancer. (2) Explain how BM are relevant to precision care using the advancing clinical states model of prostate cancer. (3) Describe how to distinguish between BM with prognostic or predictive properties using Kaplan Meier survival curves. (4) Show the clinical utility of prognostic and predictive BM to address the challenges contributing to diagnostic and therapy outcomes heterogeneity. The presentation will include a mini-quiz and take-home points.

GUEE-24   Pelvic Endometriosis: A Systematic Ultrassonographic Approach With MRI Correlation

Awards
Certificate of Merit

Participants
Merval Franklin Britto, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Discuss the role of transvaginal US compared to MR imaging in endometriosis diagnosis and managementBriefly review the US and MR technique and patient preparationDescribe systematic approach of US and MR imaging for endometriosis assessment, highlighting usual and unusual presentationsRecognize the importance of structured reports for endometriosis assessment

TABLE OF CONTENTS/OUTLINE

INTRODUCTIONOverview of endometriosisTransvaginal ultrasound accuracy, reliability and applicability, and comparison to MRIANATOMIC CONCEPTS Pelvic compartmentsUS AND MR IMAGING TECHNIQUEPatient preparation US and MR protocolsSYSTEMATIC US AND MR IMAGING APPROACH Comparison between the both methods (pros and cons)Compartment-based evaluationAssessment of usual and unusual sitesULTRASOUND FINDINGS WITH MRI CORRELATIONAnterior Compartment Uterus and AdnexaPosterior compartmentSliding signSoft markersUnusual presentationsPOST TREATMENT IMAGING Imaging role in post-treatment evaluationCritical spots that may be missed during surgeryHOW DO WE REPORT Sample cases to illustrate and solidify the conceptsStructured report

GUEE-25   Gas In The Genitourinary System: When To Worry,- A Cased-Based Review

Participants
Abhay Dhaliwal, Bloomfield Hills, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

To use an unknown case-based approach to highlight key imaging features of entities that can result in genitourinary system gas.To review the categories of inciting conditions that can lead to genitourinary gas.To emphasize the relevant clinical history and ancillary findings that may aid in making the correct diagnosis. To review the management of these entities, including the emergent conditions.

TABLE OF CONTENTS/OUTLINE

Gas in the genitourinary tract is a rare imaging finding and can vary in volume. However, its detection in even small amounts is crucial, as some causes of gas require emergent management. Determining the etiology of genitourinary system gas is as essential as its detection, and a category-based approach can aid in accurate diagnosis. Categories include infection, inflammation, ischemia, surgical, percutaneous, endourologic or endoscopic interventions, trauma, and neoplasm. The inciting process can originate in the genitourinary system or in an adjacent organ with secondary involvement of the genitourinary system. Multi-modality cases will be presented as unknowns with accompanying multiple-choice questions, as well as explanations that emphasize the relevant presentation, imaging findings, and management of each entity. The upper and lower urinary tract, and the male and female genital tracts will be included in this case-based review.

GUEE-26   Sonographic Assessment Of Penile Vascular Pathology: What The Urologist Needs To Know

Awards
Certificate of Merit

Participants
Christopher Fung, MD, Edmonton, Alberta (*Presenter*) Stockholder, Mikata Health

TEACHING POINTS

1. Normal sonographic anatomy of the penis. 2. Approach to color Doppler ultrasonography (CDUS) techniques in evaluating vascular pathology of the penis.3. Key imaging findings of erectile dysfunction, priapism, and Peyronie disease: what the urologist needs to know.4. Logistics of incorporation of penile CDUS in clinical practice 5. Future use of penile CDUS for detection of peripheral vascular disease (PAD) and coronary artery disease (CAD).

TABLE OF CONTENTS/OUTLINE

1. Introduction - Brief overview of penile imaging and the role of ultrasound in assessment of common and uncommon penile

vascular disease.2. Sonographic anatomy of the penis - Review vascular and non-vascular anatomy in standard imaging planes.3. Prostaglandin injection method and color Doppler ultrasonography techniques- Prostaglandin dosing, options, and risks of procedure- Protocol overview pre- and post-injection, with discussion of imaging timing and expected findings.4. Review of imaging characteristics in erectile dysfunction, arterial priapism, veno-occlusive priapism, Peyronie disease, and Mondor's disease. - Key findings the urologist needs to know for common and uncommon vascular pathology with discussion of treatment implications.5. Illustrative cases 6. Troubleshooting postoperative ED and non-responders to PDE5-I- Common issues during the examination and how to overcome them.7. Future use of penile CDUS for detection of PAD and CAD- Role of penile CDUS in patient lifestyle management and potential additional medical workup.8. Summary

GUEE-27　　Postoperative Complications In Urological Surgery: How Do We Face This Challenge?

Participants
Marina Herrero Huertas, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To learn the most frequent genitourinary types of surgery. - To understand the expected appearance of the normal postoperative image findings. - To become familiar with the different imaging modalities and protocols that can be used to diagnose postoperative complications. - To recognize potential postoperative complications and avoid common pitfalls.

TABLE OF CONTENTS/OUTLINE

1. A quick review of genitourinary normal anatomy and types of surgery. 2. Diagnostic imaging studies of choice for evaluation postoperative genitourinary tract: CT protocols (contrast material-enhanced CT with delayed imaging, CT cystography) and other types of urological imaging techniques (retrograde urethrography, antegrade or retrograde pyelography, nephrostomy studies).3. We illustrate the main urological postoperative complications through a case-based review, organized by its location and/or type of complication: vascular, infectious, urinary... - Renal Surgery: Partial and radical nephrectomy, renal transplant.- Cystectomy: urinary diversions.- Prostatectomy.- Others: as urinary derivations.4. Key points 5. Conclusions 6. Bibliography

GUEE-28　　Magnetic Resonance Hysterosalpingography: A Complete And Promising Imaging Method In The Work-up Of Female Infertility

Participants
Fernanda Goncalves, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Magnetic resonance hysterosalpingography (MR-HSG) is a promising imaging method that can provide important information in the assessment of female infertility, through the combination of an excellent anatomical characterization of the pelvis with tubal permeability evaluation.The use of contrast in the uterine cavity, may also have other indications, such as the investigation of uterine fistulas, post ectopic tubal conditions, and others. The purpose of this exhibit is to: 1. Explain the indications and utility of Magnetic Resonance Hysterosalpingography (MR-HSG). 2. Detail the MR-HSG imaging protocol. 3. Discuss the advantages and disadvantages of MR-HSG in comparison with the main and well-established imaging modalities, including conventional hysterosalpingography and laparoscopy with chromopertubation.

TABLE OF CONTENTS/OUTLINE

1. Brief review of the most common causes of female infertility. 2. Discussion of the most used imaging methods in the work-up of female infertility. 3. Indications and utility of MR-HSG, highlighting its advantages and disadvantages. 4. A detailed explanation of the MR-HSG protocol. 5. Selection of interesting cases using MR-HSG, some of them compared with conventional hysterosalpingography or laparoscopy with chromopertubation: normal tubes, endometriosis associated with hydrosalpinx, tubal obstruction, uterine fistula with Nabothian cyst, tubal entrapment by the endometrioma, and endometrial polyp.

GUEE-29　　Radiogenomics In Genitourinary Malignancies

Participants
Matthew Mason, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the genomic profiles of genitourinary (GU) malignancies; to describe the imaging features associated with various genetic mutations in GU malignancies; to display the clinical correlates of selected genetic mutations and imaging features

TABLE OF CONTENTS/OUTLINE

Renal cell carcinoma: Genomic characterization (TCGA); Imaging correlation: PBRM1, KDM5C-renal vein invasion;VHL-Well-defined margins, nodular tumor enhancement and intratumoral vascularization; BAP1-Ill-defined margins, calcifications and renal vein invasion; RUNX3 methylation-intratumoral vascularity, unclear margins and left-sided tumor; MUC4-exophytic growth; Clinical correlates: Associations with Radiogenomic Risk Score and BAP1, SETD2, KDM5C, MUC4 and TP53, RUNX3 methylation. Urothelial Carcinoma: Genomic characterization (TCGA); Imaging correlation: TP53-nodal and osseous metastases; RB1- peritoneal metastases; Clinical correlates: Associations with RB1, TP53, STAG2, ARID1A and High-risk Mutational Group. Ovarian Carcinoma: Genomic characterization (CLOVAR); Imaging correlation: CLOVAR mesenchymal subtype-Peritoneal involvement and mesenteric infiltration; Cyclin E1-Texture heterogeneity; BRCA 1/2-Gastrohepatic ligament metastases; BRAF-Bilateral ovarian masses; Clinical correlates: Associations with CLOVAR mesenchymal subtype, Cyclin E1, BRCA1/2, BRAF. Others: Endometrial Carcinoma, Cervical and Prostate Cancer, Testicular Germ Cell Tumors. For every cancer type, imaging examples will be provided.

GUEE-3　　Spectrum Of Testicular Lymphoma; Grey-scale And Color Flow Doppler Evaluation

Participants
Priyanka Garg, Rochester, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Testicular lymphoma is the most common tumor involving the testes above the age of 50 and familiarity with its sonographic features is important to differentiate it from other diseases that involve the testes diffusely. The attendee will be able to learn the

following from this exhibit:1. Various presentations of testicular lymphoma involving the testes 2. Color flow Doppler imaging of testicular lymphoma will be emphasized 3. Histopathological correlation as well as other modality correlation such as PET imaging will presented correlating the disease. 4. Other disease entities that mimic lymphoma will be presented as a differential diagnosis

TABLE OF CONTENTS/OUTLINE

1. Normal Grey-scale and Color Flow Doppler of the Testes 2. Images demonstrating spectrum of lymphomatous involvement of the testes with histopathological correlation and other imaging correlations 3. Color Flow Doppler features of testicular lymphoma 4. Images of diseases that mimic testicular lymphoma

GUEE-30   Treatment Strategies For Benign Prostatic Hyperplasia And Post-treatment MR Imaging Appearances

Awards
Identified for RadioGraphics

Participants
Elizabeth Han, MD, Royal Oak, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Patients suffering from lower urinary tract symptoms (LUTS) caused by benign prostatic hyperplasia (BPH) have minimally invasive, surgical, and endovascular treatment options in addition to standard medical options for symptom relief. 2) Non-medical treatment options cause significant changes to the MRI appearance of the prostate. This poses challenges to post-procedure lesion detection by multi-parametric MRI (mpMRI). 3) Familiarity with commonly encountered procedures and expected post-treatment changes will aid in lesion detection on mpMRI and management if clinically significant prostate cancer (csPCa) is detected.

TABLE OF CONTENTS/OUTLINE

1) Review of BPH classification on mpMRI (e.g. overall gland volume, histologic findings, and lobar distribution). 2) Review of treatment options and expected post-treatment appearances on prostate MRI: a) Surgical (simple vs radical prostatectomies) b) Minimally invasive surgery i) Transurethral approaches (ablations, vaporizations, laser enucleations) ii) Transrectal approaches (high intensity focused ultrasound) iii) Endovascular (prostate artery embolization) iv) Medical implants (e.g. urolift) c) Medical therapies (e.g. hormonal, alpha-adrenergic antagonists) and the effect on PSA density 3) Discussion on management after detection of csPCa. 4) Perspective: Role of pre-procedure mpMRI and MR predictors of BPH severity.

GUEE-32   A Didactical Radiologic Approach To Testicular And Paratesticular Lesions

Participants
Juliana Valdrighi, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Testicular and paratesticular masses mainly affect men 20 to 35 years of age and diagnostic workup begins with clinical history, physical examination, and followed by imaging. Along with this, imaging plays an increasingly important role in initial diagnosis, staging, and imaging surveillance of testicular malignancies. With that in mind, we aim to provide our colleagues with a complete guide to properly evaluate the anatomy, different image methods in the evaluation and identify the radiological findings of benign and malignant testicular and paratesticular pathologic conditions. The purpose of this exhibit is: (1) To review imaging appearances of the normal scrotum. (2) Discuss the role of the different imaging methods in the evaluation of testicular and paratesticular masses. (3) Identify and discuss the radiological findings of benign and malignant extratesticular and testicular pathologic conditions. (4) Propose an algorithm to narrow the diagnosis of testicular and paratesticular masses.

TABLE OF CONTENTS/OUTLINE

1. Anatomy and imaging appearance of the normal scrotum with didactic illustrations. 2. Epidemiology and imaging features of testicular and paratesticular lesions on ultrasound, computed tomography, magnetic resonance images. 3. A comprehensible guide to evaluating testicular and paratesticular masses: US, CT and MRI. 4. Case-based approach to discussing the radiological and histopathological findings of benign and malignant extratesticular and testicular pathologic conditions.

GUEE-33   Imaging Biomarkers Relevant For Prostate Cancer Management: Clinical Development

Participants
James Diss, PhD,FRCR, Epping, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) The clinical development of imaging biomarkers (IBM) for healthcare is a multistep process. The IBM type, context of use and clinical risk determines the level of evidence needed to support regulatory approvals (2) Higher levels of evidence are needed for more clinically impactful IBM in a risk-based approach (surrogate>predictive>prognostic>diagnostic) (3) Trials of diagnostic or prognostic IBM should assess changes in diagnostic/therapeutic management. Secondarily, IBM-driven management decisions may favorably impact on oncologic endpoints (4) Trials of predictive IBM should be evaluated as therapeutic studies against standard of care, focusing on the quality and quantity of life endpoints.

TABLE OF CONTENTS/OUTLINE

Outline the governing principles of the regulatory process regarding Context of Use and Levels of Evidence for IBM qualification that incorporates a patient risk based approach. Outline and show examples of the essential steps of IBM qualifications, including: (1) Defining use in settings where change in management is possible from IBM results (2) Ensuring that IBM are independently diagnostic/prognostic when incorporated into multivariable models (3) Ensuring that IBM improve the discrimination of clinically meaningful endpoints (4) Estimating both relative and absolute benefits for diagnostic & prognostic IBM (5) Demonstrating that IBM use increases diagnostic confidence and changes management via improved risk stratifications, and that quantity and/or quality of life is improved for predictive IBM.

GUEE-34   Utility Of Diffusion Weighted Sequence In Gynecological Imaging

Participants
Apurva Bonde, MBBS, MD, San Antonio, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Diffusion weighted imaging is functional imaging (DWI) technique with wide range of applications in malignant and non-malignant gynecological conditions. We describe basics of technique, pitfalls, major clinical applications and future trends in diffusion weighted imaging in gynecological entities.

TABLE OF CONTENTS/OUTLINE

Functional imaging with diffusion weighted imaging (DWI): complementary tool to conventional MRI sequences, wide range of clinical applications in malignant and non-malignant gynecological condition, describe the detailed technique and discuss problems encountered during DWI interpretation. The main implications in non-malignant conditions: differentiation of degenerated fibroids from uterine sarcomas, monitoring uterine fibroids after treatment, assisting diagnosis of adnexal torsion, tubo-ovarian abscess and endometrioma.The implications in malignant gynecological conditions: diagnosis and staging of endometrial, cervical, ovarian, and vulvar cancers, tumor response assessment, early detection of tumor recurrence/pelvic peritoneal disease, differentiation between tumor and post radiation fibrosis, quantitative assessment with ADC measurement with various tumor parameters.Pitfalls: T2 shine through, diffusion restriction in hemorrhage, melanin and in normal structures, lack of diffusion restriction in some malignant tumors.Newer techniques: DWIBS, DTI, and DSI, potential use in pelvic nerve mapping preoperative planning and fertility preserving surgeries.

GUEE-35   Reporting O-RADS MRI: How We Do It. Practical Application Of The ACR Reporting Template.

Awards
Cum Laude
Identified for RadioGraphics

Participants
Krista Suarez-Weiss, MD, Chestnut Hill, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Discuss the O-RADS MRI key descriptors and risk stratification Illustrate the use of O-RADS MRI through a standardized reporting template Discuss pitfalls and challenges in use of O-RADS MRI Provide various educational and clinical resources for use of O-RADS MRI in routine clinical practice

TABLE OF CONTENTS/OUTLINE

Outline: 1. MRI of Adnexal Lesions. 2. Introduction to O-RADS. 3. ACR Reporting Template for O-RADS MRI. 4. Case Examples. 5. Educational and Clinical Resources: O-RADS calculator, ACR E-Learning Module, RadAssist, RadiopaediaMRI of Adnexal Lesions 1. MRI can further characterize adnexal lesions deemed indeterminate on initial ultrasound. 2. Characterization by MRI can clarify the benignity of lesions that do not require further monitoring or surgical resection 3. Studies have shown that specific imaging characteristics, such as multilocularity of a cystic lesion or enhancing solid tissue, portend a higher risk of malignancy.ORADS MRI Reporting Components 1. Adnexal lesion A. Size B. Lesion type: Unilocular cyst without enhancing solid tissue; Multilocular cyst without enhancing solid tissue; Lesion with lipid content with/without large volume enhancing solid tissue; Lesion with enhancing solid tissue C. Cystic component characteristics: Wall enhancement; Fluid content D. Solid tissue component characteristics: T2 and DWI signal; Enhancement pattern 2. Extra-adnexal findings: Lymph nodes; Peritoneal, mesenteric or omental nodularity or thickening. 3. Impression: Adnexal lesion description with ORADS MRI score

GUEE-36   Get The Ball Rolling: A Pattern-based Approach For Imaging Diagnosis Of Testicular Lesions

Participants
Natália Cavalcante, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To exhibit general anatomic aspects of the testis and adjacent structures correlated with magnetic resonance imaging. To bring a diagnostic thought for testicular lesions with a step-by-step approach. To demonstrate focal and diffuse testicular lesions. To show inflammatory and neoplastic conditions that can occur at the testicle. To present the imaging appearance of usual and unusual cases.

TABLE OF CONTENTS/OUTLINE

•Pathological lesions of the testis are very frequently found. They consist of tumoral lesions, inflammatory lesions, and miscellanea. They can pose a diagnostic challenge for non-specialized radiologists.•Anatomical knowledge is essential for a good diagnostic reasoning and will be reviewed through educational illustrations and correlated with imaging exams.•A didactic approach of differential diagnoses is presented, based on imaging aspects, addressed as a focal, diffuse and miscellaneous pattern.•Most tumoral lesions have a focal presentation, including seminoma, rhabdomyosarcoma, mixed germ cell tumor, liposarcoma, and lymphoma, whose image presentations will be exposed, with clinical key information.•On the other hand, inflammatory lesions usually occur in a diffuse pattern, as well as in tuberculosis and epididymo-orchitis in general.•However, some lesions are not suitable in these two patterns, and the radiologist might be aware of atypical presentations and diagnostic challenges, such as infarction, microlithiasis, cryptorchidism, ectopic testis, vanishing testis, and burned-out tumor.

GUEE-37   ESRD: Evolving Guidelines, Sonographic Problem Solving, And Imaging Of The Patient With Renal Disease In 2021

Awards
Identified for RadioGraphics

Participants
Mary J. Clingan, MD, Ponte Vedra Beach, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Patients with Stage 4 or 5 chronic kidney disease have a very low risk of NSF with group II gadolinium- based contrast agents and the benefits may outweigh the risk for indicated examinations.-Contrast enhanced ultrasound is a useful problem- solving tool for indeterminate renal lesions detected in the native kidneys of patients undergoing pre-transplant evaluation. There is also a role for CEUS in patients with renal transplants.-Ultrasound mapping is useful for preoperative planning of dialysis access. Indications of

fistula maturity include a draining vein diameter of 4-6 mm, a depth under the skin of 5 mm or less, and a flow rate of at least 500-600cc/min.-Hemodialysis access stenosis is indicated by an Increased peak systolic velocity ratio of greater than 3:1 at the anastomosis or greater than 2:1 for the graft and draining vein.

TABLE OF CONTENTS/OUTLINE

1. Goals and Objectives2. Background3. Review of current iodinated and gadolinium-based contrast consensus recommendations as they relate to chronic kidney disease4. Multimodality case-based examples:-a. Pre-transplant evaluation imaging i. Ultrasound ii. NCCT-b. Contrast Enhanced Ultrasound Problem Solving i. Native Kidneys ii. Transplant kidney-c. Dialysis access work-up and surveillance i. Vein mapping ii. AV Fistula/Graft imaging/complications iii. Peritoneal Dialysis imaging/complications-d. Renal and Extrarenal findings specific to ESRD/Dialysis patients i. Acquired cystic kidney disease ii. Musculoskeletal findings iii. Cardiovascular findings

GUEE-38   The Prostate Cancer Clinical Trials Working Group 3 (pcwg3): What You Need To Know - An Overview Of Tumor Metrics Criteria

Participants
Halyna Pokhylevych, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Rapid development of novel therapeutics, recognition of new disease phenotypes, better understanding of disease biology and an evolving regulatory environment warranted the need to revise castration-resistant prostate cancer (CRPC) clinical trial recommendations in prior Prostate Cancer Clinical Trials Working Groups. Key new recommendations in Prostate Cancer Working Group 3 (PCWG3) include distinguishing histologic subtypes of the disease and considering the lines of therapy a patient has received as well as using blood-based assays of tumor material and imaging (or biopsy) to enable treatment selection based on disease biology. For trial outcome measures, new recommendations include the time to event end point of symptomatic skeletal events, as well as time to first metastasis and time to progression for trials in the non-metastatic CRPC state. PCWG3 focuses drug development on disease manifestations that are most likely to change prognosis unfavorably for new treatments in CRPC populations.

TABLE OF CONTENTS/OUTLINE

• A review of the PCWG3 and why it is essential in evaluating tumor response. • Image-based approach with educational points of tumor metrics criteria in prostate cancer. • Evaluation of the therapeutic response, recurrence, and complications. • Pitfalls: pseudoprogression. • Take-home messages.

GUEE-39   Cross-sectional Imaging Of Renal Masses: Potential Pitfalls And Possible Solutions

Participants
Adam Sierra, MD, San Antonio, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Describe the role of different imaging techniques in the evaluation of adult renal masses Review potential image acquisition-related pitfalls and suggest possible solutionsDiscuss potential image interpretation-related errors and provide possible solutions

TABLE OF CONTENTS/OUTLINE

IntroductionAppropriate imaging technique: Ultrasound, CT & MRIImage acquisition-related pitfalls Ultrasound (failure to detect a mass & operator dependency), CT (partial volume effects, pseudo-enhancement, pitfalls related to phase of CT data acquisition, image display format, and rendering technique) & MRI (respiratory misregistration artifacts).Image interpretation-related pitfalls Renal pseudotumors (Hypertrophied column of Bertin, focal acute pyelonephritis & abscess, renal infarct, localized cystic disease, vascular pathologies), Misinterpretation of fat containing solid renal masses (angiomyolipoma and mimics, perirenal liposarcoma, and RCC), and inappropriate assessment of contrast enhancement (papillary RCC, hemorrhagic cyst & calcified masses)ConclusionSummary and Clinical Implications: Recognizing and understanding various imaging-related pitfalls in the characterization of renal masses is necessary to avoid misdiagnosis and thus management. Improved knowledge regarding potential pitfalls along with their solutions will help radiologists to choose a different imaging modality or repeat the same study with technique modifications.

GUEE-4   A Must Know For Radiologists: A Pictorial Review Of Cystourethrography Imaging In The Diagnosis Of Genitourinary Pathology

Participants
Yumi Kimura Sandoval, BMBS, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Recognize the importance of cystourethrography in the diagnosis of genitourinary pathology.- Learn about the epidemiology, risk factors, and clinical presentation of genitourinary diseases.-Identify specific radiological signs of genitourinary pathology through cystourethrography.- Case-based review of the main radiologic features of genitourinary diseases observed in cystourethrography.

TABLE OF CONTENTS/OUTLINE

1. Normal genitourinary anatomy correlating with demonstrative cystourethrograms: A) Male urethral anatomy Portions of the urethra: anterior (penile and bulbar urethra) and posterior (membranous and prostatic urethra)B) Urethral glands: - Glands of Littré - Glands of Cowper C) Prostatic ducts2. Indications of cystourethrography3. Techniques - Retrograde urethrography - Voiding cystourethrography4. Urethral pathology - Strictures - Membranes - Diverticula - Calculi5. Bladder pathology - Bladder herniation - Colovesical fistula - Diverticula - Stress bladder - Cystocele6. Ureter pathology - Vesicoureteral reflux - Postsurgical changes

GUEE-40   Update In Comprehensive Imaging In ADPKD - What's New

Awards
Identified for RadioGraphics

Participants

Devang Odedra, MD, Burlington, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Role of radiologist in diagnosis & screening of ADPKD 2. Role of radiologist in detecting complications of ADPKD including RCC 3. Role of radiologist in predicting renal function decline 4. Imaging in ADPKD - what is the future?

TABLE OF CONTENTS/OUTLINE

1. Diagnostic criteria for ADPKD - Is it based on ultrasound or MRI? What is the Unified criteria? 2. What is the current imaging classification (Class 1-typical (A,B,C,D,E), Class 2- atypical (2A- unilateral, segmental, asymmetric, lopsided; 2B - bilateral with acquired unilateral or bilateral atrophy) 3. Can we differentiate PKD1 and PKD2 mutations on imaging? 4. What is hypomorphic ADPKD? Why is it important? 5. Screening - when to start, how often, what modality? 6. How to differentiate mimickers? 7. What does approval of Tolvaptan to treat rapidly progressive disease mean for the radiologist? How to risk stratify ADPKD on imaging for treatment? 8. Why is renal volume measurement important? What is height-adjusted TKV? 9. What is the best method of renal volume segmentation? 10. Can renal blood flow analysis with phase contrast/arterial spin labeling predict renal function decline? 11. Can texture analysis/radiomics predict renal function decline? Answer: Yes 12. Complications in ADPKD - infection/hemorrhage/fistulization 13. Treatment - what is the current role of sclerotherapy? 14. Does ADPKD have increased risk of RCC? Challenges in diagnosing RCC in ADPKD 15. ADPKD in pregnancy - considerations 16. Role of 3D printing? Intraoperative ultrasound? 17. Suggested reporting template

GUEE-41   Post Vasectomy Changes In Scrotum: Spectrum Of Ultrasound Findings

Participants
Pramod K. Gupta, MD, Plano, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Vasectomy is a popular method of male contraception where small portion of vas deferens is excised and ends are sealed with sutures or clip.2. Epididymal thickening, epididymal tubular ectasia, sperm granulomas, tubular ectasia of rete testis and mediastinal cysts occur more frequently in post vasectomy patients, believed to be due to increased intraluminal pressure in efferent ducts, epididymal duct and sperm stasis due to vas deferens interruption.3. Medial rotation of testis is occasionally seen in vasectomy patients which is likely due to iatrogenic changes in the structural support mechanism of the testis with resultant increased motility.4. Familiarity with post vasectomy changes makes interpretation of scrotal ultrasound easy and in some cases help in avoiding unnecessary follow up or work up.

TABLE OF CONTENTS/OUTLINE

-Introduction -Scrotal Anatomy -Various post vasectomy ultrasound findings with several illustrative examples and short discussion -Conclusion -References

GUEE-42   Renal Transplant Ultrasound: Primer On Vascular Evaluation And Complications

Participants
Sai Chennupati, BA, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Renal transplant is the treatment of choice for end stage renal disease. While nearly 23,000 transplants are done yearly in the US, demand still far outweighs availability and graft survival is of the utmost importance. Attentive surveillance with ultrasound plays an important role in the monitoring of these patients. Vascular complications are particularly important. While uncommon, several are potentially catastrophic and if caught early may result in the salvage of the transplant. In this exhibit, we will review normal post-transplant anatomy, normal sonographic appearance of the kidney, and review key vascular complications utilizing a case-based approach. Recognition of the imaging features of these complications, typical time-frames and differential diagnosis will help radiologists guide the appropriate management of these transplant patients.

TABLE OF CONTENTS/OUTLINE

A. Review normal post-transplant anatomy. B. Review normal sonographic appearance of the transplant kidney. C. Review key vascular complications via a case-based approach including renal artery thrombosis, renal vein thrombosis, renal artery stenosis, arteriovenous fistula, pseudoaneurysm, compartment syndrome and transplant torsion. D. Review potential mimics of these complications as well as treatment.

GUEE-43   Mesenchymal Neoplasms Of The Urinary Bladder:2021 Update And Comprehensive Review

Participants
Rashmi Balasubramanya, MD, Philadelphia,, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Mesenchymal neoplasms of the urinary bladder are rare, comprising 5% of tumors. A diverse spectrum of smooth muscle, neurogenic, fibrous, vascular and miscellaneous tumors with distinct histopathology and tumor genetics occur in the bladder. We present cross-sectional imaging findings of a wide spectrum of these tumors.To review taxonomy, epidemiology, clinical features, histopathology & biology of a wide spectrum of mesenchymal tumors of the urinary bladder.To describe multimodality, cross-sectional imaging findings of these tumors.To discuss biological behavior, management and prognosis of diverse mesenchymal tumors of the urinary bladder.

TABLE OF CONTENTS/OUTLINE

OrganizationIntroduction, classification, epidemiology, clinical manifestations, pathological features, CT, MRI, PET-CT findings, management, prognosis, conclusion.Entities discussedLeiomyoma, smooth muscle tumor of uncertain malignant potential, leiomyosarcoma, angiosarcoma, rhabdomyosarcoma, solitary fibrous tumor, inflammatory myofibroblastic tumor, undifferentiated sarcoma, pheochromocytoma.

The ABCDEs Of Fibroids

Awards
Certificate of Merit

Participants
Iris Chen, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Fibroids are benign neoplasms that represent the most common pelvic tumor in women with a lifetime risk of 70-80% and are classified using the FIGO system. While ultrasound (US) is often the first-line imaging for pelvic pathology including fibroids given its broad availability, cost-effectiveness, and real-time evaluation, MR provides the best assessment of fibroid size, number, and location. Fibroid variants include degenerated fibroids and lipoleiomyomas. Fibroids can often mimic the appearance of other pelvic pathologies on imaging. Distinguishing fibroids from these mimics can inform appropriate clinical management. Management should be tailored to the patient's age, symptoms, and desire to maintain fertility, along with consideration of the chances of success, limitations, and possible treatment complications. While management of symptomatic fibroids has largely been surgical, uterine artery embolization and MR-guided focused US are nonsurgical alternatives with comparable outcomes. Post-treatment complications include prolapse, devascularization, and post-surgical infection and hemorrhage.

TABLE OF CONTENTS/OUTLINE

This exhibit will include a comprehensive review of the FIGO classification for fibroids and fibroid variants, with examples of each type on US and MR and tips on how to classify them accurately. We will review common mimics of fibroids and recommendations for distinguishing the pathologies in real-time. We will also review the current literature on surgical and non-surgical treatment options.

GUEE-45 **Retroperitoneal Masses In Adults: A Pattern-based Imaging Approach On CT And MRI**

Awards
Certificate of Merit

Participants
Akira Yamamoto, MD, Kurashiki, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this study is1) To illustrate the anatomy of retroperitoneal space2) To indicate a pattern-based imaging approach on retroperitoneal lesion3) To demonstrate the CT and MR imaging appearances of various retroperitoneal mass.

TABLE OF CONTENTS/OUTLINE

1) Retroperitoneal space- Three compartments• Anterior pararenal (or paranephric) space• Perirenal (or perinephric) space• Posterior pararenal (or paranephric) space- Lymphatic system• Distribution of lymph node2) Pattern-based imaging approach on retroperitoneal lesion- Peritoneal lesions? or Retroperitoneal lesions?- Massive lesions? or Non-massive lesions?- Masses arising from retroperitoneal organ? or not organ?3) Image findings of cystic mass- Lymphangioma- Cystic mesothelioma- Bronchogenic cyst- Schwannoma, Neurofibroma4) Image findings of mass with fat- Lipoma, Liposarcoma- Teratoma- Extramedullary hematopoiesis5) Imaging findings of mass with calcification- Schwannoma- Ganglioneuroma- Teratoma- Sarcoma (dedifferentiated liposarcoma)- Bronchogenic cyst- Lymphangioma6) Imaging findings of hyper-vascular mass- Paraganglioma- Castleman disease- Hemangioma- Sarcoma (leiomyosarcoma)

GUEE-46 **What Radiologists Need To Know About Diagnosis Of Endometriosis**

Awards
Cum Laude

Participants
Hideyuki Fukui, Suita, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Endometriosis is defined as the presence of endometrial epithelium and stroma outside the uterine lumen and muscle layer. It is thought that repetitive bleeding and inflammation cause high fibrosis and adhesion. The accurate preoperative assessment of the spread of endometriosis is critical because surgery is the best treatment option for patients. MRI has the superiority for detecting blood components and plays an important role in detecting and diagnosing endometriosis due to repeated bleeding. In addition, it helps to plan a surgical approach. The purpose of this presentation is to become familiar with the image findings of endometriosis.

TABLE OF CONTENTS/OUTLINE

This article describes the clinical features and imaging findings on MR images of endometriosis and makes further reference to the hot topics concerning these diseases. 1. Endometriotic lesions of the anterior compartment - Bladder - Prevesical space - Vesicovaginal septum - Ureter 2. Endometriotic lesions of the middle compartment - Ovaries - Fallopian tubes - Uterus - Uterine ligaments 3. Endometriotic lesions of the posterior compartment - Pouch of Douglas (MR-Laparoscopic correlation) - Uterosacral ligaments - Rectovaginal septum - Rectum 4. Extrapelvic endometriosis - Subcutaneous endometriosis - Inguinal endometriosis - Thoracic endometriosis

GUEE-47 **Takes One To Know One: Imaging Features Of Non-syndromic Bilateral Renal Masses With Pathological Correlation**

Awards
Certificate of Merit

Participants
Amer Alaref, MD, Thunder Bay, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

[[Unsupported Character - Symbol Font &·]] Review common and uncommon adult non-syndromic bilateral renal

[[Unsupported Character - Symbol Font &;]] Review common and uncommon adult non-syndromic bilateral renal masses[[Unsupported Character - Symbol Font &;]] Describe clinical and radiological signs of bilateral non-syndromic renal masses[[Unsupported Character - Symbol Font &;]] Discuss histopathological features and their prognostic significance

TABLE OF CONTENTS/OUTLINE

Multifocal masses can involve the kidney bilaterally. A large number of non-syndromic conditions exist that can pose a diagnostic dilemma for radiologists leading to potentially unnecessary biopsies, redundant imaging follow-up and incorrect workup. In this presentation, clinical and imaging findings are reviewed with multiple case examples. Strategies for management are discussed. Disease categories include: Malignant: metastases, lymphoma, primary renal cell carcinomasBenign neoplasms: oncocytosis, angiomyolipomasInfectious: pyelonephritis, tuberculosis, abscessesVascular: infarcts, hematomasInfiltrative: IgG4 disease, amyloidosis, plasmacytomas, sarcoidosis, non-langerhans cell histiocytosis ConclusionThis educational exhibit provides a systematic approach to bilateral non-syndromic renal masses, a topic currently underrepresented in the literature. Upon completion of this exhibit, the participant will have an advanced level of knowledge of these lesions including an approach to workup and management.

GUEE-48   Ovarian Cancer Reporting: Pearls And Pitfalls

Participants
Krista Suarez-Weiss, MD, Chestnut Hill, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Understand FIGO 2018 staging of ovarian cancerDiscuss role of imaging in determining the initial managementUnderstand the easy to miss areas of spread on imaging and those predisposing to suboptimal cytoreductionDiscuss standardized CT/MRI report template that provides the referrers all the necessary information needed to make initial management decisions

TABLE OF CONTENTS/OUTLINE

OutlineBackground/epidemiology of ovarian cancerFIGO 2018 staging system and role of imagingEasy to miss areas of spread and sites predisposing to difficult or suboptimal cytoreductionElements of standardized reporting template for initial staging of ovarian cancerCase examplesFIGO 2018 Staging System- 2018 FIGO staging system is the most widely used staging system for ovarian cancer, classifying disease into one of four stages based on the primary tumor, nodal involvement, and presence and location of metastases based on surgical findings.-Imaging assists with lesion location (confirming ovarian origin), relative likelihood of benign versus malignant, and stage of the primary.-While US and MR play a key role in initial characterization of adnexal lesions, CT is the radiologic workhorse for staging and surveillance in ovarian cancer.-CT can also be used to assess the likelihood of a suboptimal surgical outcome in higher stage patients, with optimal cytoreduction defined as no residual tumor deposit measuring > 1 cm. - Accurate and thorough reporting of ovarian cancer at diagnosis is critical for optimal further management.

GUEE-49   MRI in Endometrial Carcinoma: An Illustrated Guide To 2018 Figo Staging

Participants
Juan Quintana Perez, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

The aims of this education exhibit are: (1) to review the indications of MRI in endometrial carcinoma and to propose an MRI protocol for daily practice; (2) to revise the 2018 FIGO staging through illustrations and real-life histologically-proven cases; (3) to point at potential problems and mistakes in MRI interpretation and to suggest useful tips for successful staging.

TABLE OF CONTENTS/OUTLINE

1. Indications of MRI in endometrial carcinoma 2. Technical aspects 3. MRI anatomy of the female pelvis 4. MRI staging: an illustrated stage-by-stage review 5. Pitfalls and pearls in MRI staging 6. Conclusions 7. References

GUEE-5   MRI-guided Transurethral Ultrasound Ablation (Tulsa) Of Prostate: From Basic Technology To Clinics

Participants
Roberto Luigi Cazzato, Strasbourg, France (*Presenter*) Proctor, Medtronic plc

TEACHING POINTS

- To present TULSA technology - To list current indications and contraindications to TULSA - To present TULSA devices and ablation procedure - To summarize the available TULSA literature

TABLE OF CONTENTS/OUTLINE

- TULSA technology - Indications and contraindications - TULSA devices and step-by-step procedure - Summary of TULSA literature

GUEE-50   Imaging In Uterine Fibroids With An Emphasis On The FIGO Classification Of Fibroids

Participants
Aishwarya Ghate, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To discuss the imaging features of fibroids with an emphasis on FIGO classification. 2. To review the important imaging features while reporting a case of uterine fibroid.3. Knowing the exact anatomical location and extent of fibroids is important. 4. FIGO class is important in deciding the management of fibroid disease.

TABLE OF CONTENTS/OUTLINE

1. Discussion regarding the FIGO classification of fibroids. 2. Description of MR imaging features of different FIGO classes with examples of each class. 3. Role of FIGO classification in management of disease. 4. Various complications of uterine fibroids with their imaging features.

GUEE-52   Easy Access: Radiology Primer For Dialysis Workup And Surveillance

Daniela Garcia, MBBS, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Diagnostic and interventional radiology play an important role during pre-procedural evaluation and monitoring of optimal peritoneal and vascular access. 2. Ultrasound, fluoroscopy and CT are modalities available for the assessment of peritoneal and vascular accesses. 3. Development of new ultrasound and fluoroscopy-guided endovascular techniques project promising outcomes focused in improvement quality of life and overall survival.

TABLE OF CONTENTS/OUTLINE

End stage kidney disease is a major cause of morbidity and mortality in the United States and dialysis is the most common method of renal replacement therapy in this population. Thus, the need to improved patient's outcomes requires integration of a multidisciplinary medical team. The role of the radiology department includes both diagnostic and interventional planning and regular assessment of peritoneal and vascular accesses, according to patient's needs. Radiologists must be able to recognize different types of access, as well as common complications utilizing different imaging modalities in order to guide appropriate clinical management. This exhibit will serve as a comprehensive imaging based review of a radiologist's role in dialysis work up and surveillance. We will provide pictorial examples of various access routes with their imaging correlates, an overview of the complications and their management, and a guide to pre- and post- procedural surveillance.

GUEE-53   Be Sceptical, Save A Testicle: Sonographic Features Of Benign Intratesticular Lesions That Can Mimic Malignancy

Participants
Elise Chua, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

As ultrasound has high sensitivity but poor specificity in the diagnosis of testicular tumours, a commonly accepted practice in the management of suspected testicular malignancy is radical orchidectomy and histological assessment. However, the increasing availability of ultrasound has led to detection of a greater proportion of benign lesions, prompting the need for a more conservative approach.The purpose of this exhibit is to:• Illustrate ultrasound appearances of common and rare benign testicular lesions• Identify features which enable confident differentiation of benign from malignant lesions, facilitating management and preventing unnecessary surgery• Discuss appropriate follow up and role of advanced techniques

TABLE OF CONTENTS/OUTLINE

1. Overview of testicular lesions2. Case presentations of benign lesions that can simulate malignancy with distinguishing features:• benign cystic lesions (intratesticular cyst, tubular ectasia of the rete testis)• trauma (haematoma) and vascular pathology (segmental infarction, necrosis) and evolution of appearances with time• infection (abscess, chronic orchitis)• granulomatous disease (tuberculous orchitis, sarcoidosis, cholesterol granuloma)• benign neoplasms (cystadenoma of the rete testis, Leydig cell hyperplasia, epidermoid cyst, lipomatosis)3. Management or follow-up options for testicular lesions identified on ultrasound and role of advanced imaging techniques (MRI, elastography, contrast-enhanced ultrasound)

GUEE-54   Etiology And Imaging Traits Of Bilateral Renal Cell Carcinoma And Mimics

Participants
Weibo Fu, BS, Augusta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) To review the epidemiology, etiology, imaging traits, and management of bilateral renal cell carcinoma + mimics 2) To highlight key distinctions between synchronous and metachronous bilateral renal cell carcinoma 3) To review the role of radiologists in diagnosing and guiding management of bilateral renal cell carcinoma and other bilateral renal tumors

TABLE OF CONTENTS/OUTLINE

Bilateral RCC is a rare manifestation of RCC, accounting for 3-4% of sporadic RCC. Synchronous tumors occur within 6 months of the primary cancer, whereas metachronous tumors occur after 6 months. Although most bilateral tumors present synchronously, a small number of cases present metachronously. Risk of metachronous RCC is significantly higher in younger patients presenting with RCC, suggesting a strong hereditary link. Inherited and familial causes of bilateral RCC include loss of chromosome 3 and diseases such as von-Hippel-Lindau and Birt-Hogg-Dube. Because treatment of bilateral RCC involves both kidneys, surgical management and planning may be challenging. Physicians must consider both preservation of cortex function and tumor eradication as similarly important goals. Thus, over time treatment has shifted from bilateral radical nephrectomy to nephron sparing partial nephrectomy. A clear understanding of bilateral RCC features and mimics is required for radiologists to inform appropriate management. 1) Epidemiology, etiology 2) Causes of bilateral RCC 3) Mimics 4) Imaging features 5) Diagnosis 6) Treatment considerations 7) Conclusion

GUEE-55   Mesenchymal Tumors In The 'Adult Diaper' Distribution: Genetics ; Imaging Update

Participants
Steven Chua, MD, PhD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review taxonomy, epidemiology, clinical features, histopathology & biology of a wide spectrum of mesenchymal tumors that occur in the inguino-genital-perineal regions.2. To describe multimodality, cross-sectional imaging findings of these tumors.3. To discuss biological behavior, management and prognosis of diverse mesenchymal tumors that occur in the 'adult diaper' distribution.

TABLE OF CONTENTS/OUTLINE

1. Introduction, epidemiology and clinical features.2. Histopathological features, immunocytochemistry & molecular pathology.3. CT, MR and PET-CT findings as well as tumor biology of the rich diversity of mesenchymal tumors of the inguino-genital-perineal region, which include:* Cellular angiofibroma* Angiomyofibroblastoma* Aggressive angiomyxoma* Myolipoma* Liposarcoma* Solitary fibrous

tumor* Fibrosarcoma* Angiosarcoma* Myxoid sarcoma* SMARCB1 sarcoma4. Prognosis.5. Conclusion.

GUEE-57   Fibrous Pseudotumors Of Scrotum

Participants
Seyed Mohammad Seyedsaadat, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

Fibrous pseudotumor of scrotum is a rare and benign condition encountered in young men, which might clinically mimic a testicular malignancy. Pre-operative diagnosis of these tumors can be challenging due to the lack of specific clinical and imaging characteristics. Understanding the differential diagnosis and determining the benign or malignant nature of the tumor will help guide clinical management and surgical options, thereby obviating radical orchiectomy and consider a testis-sparing intervention. After reviewing the educational exhibit, the learner will be able to: - Understand the different imaging characteristics of fibrous pseudotumors of the scrotum - Review the classification and types of fibrous pseudotumors of the scrotum based on their location and pathology - Recognize that the fibrous nature of the tumors as a preoperative diagnosis can guide management based on benignity

TABLE OF CONTENTS/OUTLINE

I. Objectives II. Background III. Classification of Fibrous pseudotumors of scrotum IV. Types a. Fibrous Pseudotumor of Epididymal Tail b. Fibrous Pseudotumor of Tunica vaginalis c. Multiple nodular Fibrous Pseudotumors of testis d. Bilateral Fibrous Periorchitis e. Calcified Fibrous Pseudotumor of Epididymal Tail f. Fibrous Pseudotumor of the Testicular parenchyma g. Tumor Mimics V. Conclusions

GUEE-58   Wunderlich Syndrome: Clinical And Imaging Review

Awards
Identified for RadioGraphics

Participants
Jignesh N. Shah, MD, Germantown, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the pathological spectrum of renal lesions leading to Wunderlich Syndrome 2. To discuss imaging approach and to review imaging features of these entities 3. To discuss implications of imaging on management

TABLE OF CONTENTS/OUTLINE

Review anatomy of retroperitoneal spaces; Introduction of Wunderlich Syndrome; Etiologies of Wunderlich Syndrome; Imaging approach; Imaging features of various pathologies leading to Wunderlich Syndrome including but not limited to Neoplasms such as angiomyolipoma, renal cell carcinoma, Vascular causes such as polyarteritis nodosa, renal artery aneurysm/pseudoaneurysm, renal arteriovenous malformation, renal arteriovenous fistula, renal vein thrombosis, Cystic renal diseases such as acquired cystic renal disease, renal hemorrhagic cyst, autosomal dominant polycystic kidney disease, Infectious causes such as acute pyelonephritis, emphysematous pyelonephritis, and Miscellaneous causes such as anticoagulation, reperfusion injury, end-stage renal disease, hemophilia, ureteric obstruction, nephritis; Discuss implications of imaging on management

GUEE-59   Unraveling Scrotal Pathology: Acute, Chronic, Congenital And Neoplastic Manifestations

Participants
Jennifer Hanak, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Scrotal and testicular pathology varies widely and often presents in a similar fashion: with pain, swelling or a mass. It is important to be able to distinguish the various etiologies based on imaging and clues in the patient history to assist clinicians in appropriate treatment. It is important to recognize benign, congenital and malignant causes of testicular mass to appropriately treat those with malignancy and prevent unnecessary procedures in those with benign masses.

TABLE OF CONTENTS/OUTLINE

Acute Torsion Torsion of appendage testes Infarct Epididymitis/epdidymorchitis Trauma Rupture/fracture Hematocele Abscess Emphysematous infection Chronic Chronic granulomatous epididymitis Epidermoid cyst Sarcoidosis Varicocele Inguinal hernia Calculi Congenital Undescended testes Polyorchidism Adrenal Rests Neoplastic Seminomas Nonseminomatous germ cell tumors Lymphoma Zebras - angiosarcoma, etc Metastasis

GUEE-6   Two Roads Diverged: Anomalies Of Mullerian And Wolffian Duct Development

Awards
Certificate of Merit

Participants
Neha Udayakumar, BS, Riverside, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to:1) Examine the normal embryological development of the Müllerian, Wolffian, and Metanephric ducts.2) Provide a case-based review of commonly encountered genitourinary development anomalies.3) Recognize the important MRI findings that guide the diagnosis and treatment of infertility related to development anomalies.

TABLE OF CONTENTS/OUTLINE

Embryological Development of Genitourinary Structures- Müllerian (Paramesonephric) ducts- Wolffian ducts- Metanephric ductsMüllerian Duct Anomalies - Uterine agenesis/hypoplasia (class I)- Unicornate uterus (class II)- Uterine didelphys (class III)- Herlyn-Werner-Wunderlich syndrome (OHVIRA)- Bicornuate uterus (class IV)- Septate uterus (class V)- Arcuate uterus (class VI)- T-shaped uterus (class VII)- Müllerian duct cystWolffian Duct Anomalies - Zinner syndrome- Gartner duct cystMetanephric Duct

Anomalies - Renal agenesis

Radiogenomics In Cancers Of The Genitourinary Tract

Participants
Aishah Azam, BSC,MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Radiogenomics is the combination of diagnostic imaging and genomic signatures to improve tumor phenotyping. (2) Radiogenomics extracts features from images including shape and texture, using mathematical modelling, as well as quantitative parameters from functional/molecular imaging e.g. apparent diffusion coefficient, perfusion, or standardized uptake value; and features from gene expression analysis requiring advanced statistical or deep learning approaches for data integration. (3) Radiogenomic signatures can be used to predict prognosis and response to treatment, and may allow more individualized patient care. (4) Standardization of study methodology and reporting is required for all radiogenomic studies, as described by the Image Biomarker Standardization Initiative.

TABLE OF CONTENTS/OUTLINE

(1) Introduction to radiomics and radiogenomics. (a) Using CT, MRI and PET. (b) Statistical and deep learning approaches to data handling. (2) Roles of radiogenomics. (a) Correlation/association between radiomic features and genomic signatures. (b) Combination of radiomic and genomic signatures to form predictive models (tumor phenotyping; response to chemo-/radio-/immuno-therapy; prognosis). (3) Radiogenomics in practice. (a) Renal cancer. (b) Prostate cancer. (c) Bladder cancer. (4) Challenges for implementation. (a) Segmentation. (b) Statistical overfitting. (c) Standardization of reporting for studies. (5) Potential areas for future use.

GUEE-61 **Cortical Renal Tumors: Correlation Of Radiologic And Histopathologic Features**

Awards
Certificate of Merit

Participants
Ruggeri Guimaraes, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1 - To show features of the most common renal tumors in adults. 2 - To correlate the radiologic features with histopathologic findings. 3 - To provide a guide using the imaging-histologic correlation to narrow diagnosis and support management of these renal tumors.

TABLE OF CONTENTS/OUTLINE

1 - Prevalence of cortical renal tumors in adults. 2 - Typical imaging characteristics of the most common renal tumors. 3 - Correlations between radiological and histopathological findings supported by the use of didactic illustrations as well as radiological and pathological images. 4 - Diagnostic tools, including computed tomography (CT) and magnetic resonance imaging (MRI). 5 - Imaging protocols. 6 - Description of atypical imaging features of these renal tumors, and how to avoid the misdiagnosis. 7 - Didactic diagnostic approach for solid cortical renal masses.

GUEE-62 **No Man Left Behind - MRI Diagnostic Workup of Male Infertility**

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Participants
Milton B. Muniz JR, DO, Teresina, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Anatomical review of the male reproductive system 2. Imaging evaluation of the anatomy of ejaculation process. 3. MRI n post-testicular cystic obstructive lesions: - cysts of the Wolffian duct, - ducts of the Cowper gland, - prostatic utricle, - Müller's duct cysts - seminal vesicle cysts. 4. Congenital genitourinary anomalies related to infertility: - Agenesis of the vas deferens - Zinner syndrome - Persistent Mullerian Ducto Syndrome - Testicular agenesis - Cryptorchidism

TABLE OF CONTENTS/OUTLINE

Among infertile couples, the cause of infertility is related to male partner in approximately 50% of cases and involves conditions related to production, function and distribution of sperm, in addition to anomalies of the reproductive system. The main role of imaging exams in diagnosis of male infertility factor is identification of congenital malformations and disorders that obstruct sperm transport and are potentially correctable. Magnetic resonance imaging (MRI) is useful for assessing the ductal system and male accessory sexual glands, being able to characterize the genito-urinary anatomy, identifying malformations and related injuries.

GUEE-63 **Vaginal Malignancies And MRI: What Radiologists Should Know**

Participants
Maria Clara Fernandes, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

* Primary malignant diseases of the vagina are rare, accounting for about 1-2% of all gynecological malignancies. The secondary involvement of the vagina is much more common, mainly due to direct extension cervical, endometrial, or rectal tumors. * MRI is the imaging method of choice for depicting and characterizing the lesion and locoregional staging. Therefore, the proper protocol is essential for the characterization. * Radiologists should be aware of the anatomic repairs, the pattern of spread, and possible differential diagnosis in order to correctly characterize these lesions. * This exhibit aims to review the literature and illustrate the imaging features of primary and secondary vaginal malignancies, the relevant pelvic anatomic structures for diagnosis and staging.

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GUEE-64   P.E.N.I.S. T.: A Mnemonic Approach To Imaging Evaluation Of The Penis

Awards
Cum Laude

Participants
Joao Manoel Santos, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:- To propose the mnemonic P.E.N.I.S. T. to imaging approach in the evaluation of the penis.- To review usual and unusual cases of penile conditions and its differential diagnoses.- To correlate important findings with the anatomy and pathophysiology.- To discuss image findings in order to enhance radiologists' skills.- To review MRI protocols in the evaluation of patients with acute and chronic penile conditions.- To highlight their characteristics in order to familiarize radiologists with these conditions, preventing unfavorable patient outcome.

TABLE OF CONTENTS/OUTLINE

- Applied anatomy of the penis.- MRI protocols in the evaluation of the penis.- The mnemonic P.E.N.I.S. T. (interactive touch-based panel).P: prosthesis, phimosis.E: external traumaN: neoplasm.I: infection, inflammation, induratio penis plastica (Peyronie's disease), impotence.S: sexuality, stenosis (urethra)T: thrombosis and vascular disorders.- Sample cases of pearls, pitfalls, diagnostic difficulties, and mimics.- Summary and take-home messages.

GUEE-65   The Role Of Ultrasound In Uterine Cervical Cancer

Participants
Paula Perroni, MD, Buenos Aires City, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

Abstract Examination of the cervix is often cursory during pelvic US, such that cervical disease may be overlooked or misdiagnosed Cervical cancer is a common gynecologic malignancy worldwide and the most frequent cause of cancer-related death in women younger than age 35, it is prevalent condition in poor contries .Ultrasound has gained increased attention in recent years; it is faster, cheaper, and more widely available than other imaging techniques, and is highly accurate in detecting tumour presence and evaluating local extension of disease. The familiarity with the imaging feature of uterine cervical lesions will facilitate prompt and accurate diagnosis and treatment Accurate staging is critical because risk stratification and treatment of clinically visible lesions varies depending on size of the tumor, presence and extent of local invasion, and presence of metastases This review describes the normal appearance of the cervix at US, the appearance of cervical cancer and FIGO 2018 staging system by ultrasound Teaching points Describe the normal appearance of the cervix at US Recognize us and color Doppler findings in uterine cervical cancer Review FIGO 2018 staging system for uterine cervical cancer by ultrasound

TABLE OF CONTENTS/OUTLINE

1. Normal US appearance of the cervix2. US findings in uterine cervical cancer3. Color Doppler findings in cervical cancer 4. Staging of cervical cancer

GUEE-66   Pathways Of Lymphatic Spread In Prostate Cancer: What The Radiologist Needs To Know

Participants
Camila Cifuentes, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Describe the anatomy of the pelvic nodal groups by using standard terminology. 2. Identify the different pathways of nodal metastasis in prostate cancer: lateral, posterior and anterior routes. 3. Learn the therapeutic implications of the involvement of different nodal groups

TABLE OF CONTENTS/OUTLINE

1. Pelvic lymphatic anatomy. 2. Imaging-based criteria for identifying nodal metastases with Ga-68 PSMA PET-CT: Lymph node size, nodal location, internal nodal architecture, tracer uptake and SUV max values. 3. Common pathways of nodal metastasis: Lateral route, for which the sentinel nodes are the obturator nodes, part of the external and internal iliac nodal group. The second most common pathway is the perirectal rout whose drainage is in to the inferior mesenteric nodes. 4. Uncommon pathways of nodal metastasis: Anterior rout, lymph nodes located anterior to the urinary bladder. From these nodes, metastases can spread to the internal iliac nodes. 5. Important staging system considerations (non-regional lymphadenopathy are considered M1). 6. Our local experience of staging patients with prostate cancer since the use of Ga-68 PSMA PET-CT in our institution. 7. Illustrative cases for each pathway of nodal metastasis. 8. Therapeutic considerations in prostate cancer (extended pelvic lymph node dissection)

GUEE-68   Big Ovaries? Big Deal: Non-mass Causes Of Ovarian Enlargement

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Participants
Rishabh Agarwal, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

TEACHING POINTS

In the setting of ovarian enlargement without an ovarian mass, radiologists often invoke the diagnosis of acute ovarian torsion, particularly in the setting of pelvic pain. However, there are many other causes of ovarian enlargement that the practicing radiologist should be aware of, some of which have imaging overlap with acute torsion. The purpose of this educational exhibit is to present a comprehensive differential diagnosis for non-mass causes of ovarian enlargement using multiple modalities, with a focus on the underlying pathophysiology and relevant clinical scenarios in which they arise.

GUEE-69   Renal Bleeding In Cancer Patient Cross Sectional Imaging And Role Of Intervention In Management

Participants
Khaled M. Elsayes, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Introduction to general causes of hemorrhage in cancer patients.2. Identify common benign lesions that bleed.3. Identify common malignant lesions that bleed.4. Recognize vascular causes of hemorrhage.5. Explain the role of intervention radiology in management of bleeding

TABLE OF CONTENTS/OUTLINE

1) Cross sectional and ultrasound appearance of blood. 2) Hemorrhage from malignant renal neoplasms. 3) Hemorrhage from benign renal lesions. 4) Bleeding from urothelial neoplasms: 5) Vascular causes of bleeding: Aneurysms, pseudo-aneurysms, AV fistulas and vascular outflow obstruction. 6) Traumatic causes of renal hemorrhage. 7) Procedure related bleeding: Percutaneous biopsies, nephrostomy, and nephron sparing surgeries. 8) Role of intervention in management of renal hemorrhage.

GUEE-7   A Pictorial Review Of Ultrasonography Of The Revised FIGO Classification For Uterine Leiomyomas.

Participants
Suryansh Bajaj, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

Uterine leiomyomas are the most common gynecological and pelvic neoplasm, occurring in up to 80 percent of women by age 50.Ultrasonography remains the first-line radiological investigation for the diagnosis of leiomyomas and is the most appropriate imaging modality for the initial assessment of AUB.To standardize nomenclature and identify causes of AUB, FIGO developed a classifications system - PALM-COEIN which was last revised in 2018.For the L category of leiomyoma, when present, a secondary and tertiary subclassification system is described distinguishing submucosal masses from others and categorizing the relationship of the mass to the endometrium and serosa. Pelvic USG usually consists of a combined approach to include both transabdominal (TAS) and transvaginal (TVUS) imaging. Complementary techniques include the use of color Doppler, 3D USG, USG elastography, contrast-enhanced ultrasound, and USG sonohysterography. A uniform characterization, mapping, and classification of leiomyomas are necessary to decide the optimal therapeutic approach. We present a pictorial review of USG images of all the FIGO categories of leiomyomas to provide a standard guide for radiology reporting.

TABLE OF CONTENTS/OUTLINE

Role of USG: TVUS vs TAS, use of color Doppler, 3-D USG, USG elastography, contrast-enhanced ultrasound, and USG sonohysterography.Comparative analysis of USG and MRIFIGO classification of AUB with 2018 revisions:USG of Submucosal leiomyomasUSG of Other LeiomyomasUSG of Hybrid leiomyomasLimitations of USG

GUEE-70   MRI/TRUS Fusion In Prostatic Cancer. What The Radiology Resident Needs To Know.

Participants
Piedad Acosta Mora, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To improve the knowledge of the normal anatomy of the prostate, the PIRADS 2.1 system, and indications for transrectal biopsy.-To describe the limitations offered by systematic biopsy TRUS-To know the advantages and disadvantages of TRUS biopsy by fusion of MRI/TRUS imaging.-To show the step-by-step MRI/TRUS fusion-guided biopsy

TABLE OF CONTENTS/OUTLINE

Introduction:-Normal anatomy-PI-RADS 2.1 system-Indications for biopsy Technique-Systematic transrectal biopsy -MRI/TRUS Fusion Advantages and benefits (case-based) Complications Conclusions

GUEE-71   A Colorful Matching Game Of Ovarian Tumors: From Easy Winning To Game Over

Participants
Jessica Marchi, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Primary ovarian neoplasms can be categorized on the basis of histopathologic features into epithelial surface cell tumors, germ cell tumors and sex cord-stromal tumors. • Imaging findings of ovarian neoplasms are often overlapping and nonspecific, although some subtypes have distinguishing imaging features and clinical data that approach to an accurate diagnosis.

TABLE OF CONTENTS/OUTLINE

To make a diagnostic approach of the most common ovarian tumors in a fun and different way• To make a diagnostic approach to the most common ovarian tumors through a flowchart drawn in a tetris and puzzle game model. • To illustrate the main features of the most common ovarian tumors• To highlight when the diagnostic hypothesis can be formulate based on the imaging features and clinical data and when the overlapping features can make it impossible. • To list the imaging tumor findings through specifics colors and then try to match it to the board of the game table that contain the most common ovarian tumors with it respective color combination (features combination). When the diagnostic hypothesis can be formulate, the "next" button will highlight, when it's not ,the "hold" button will highlight and the success must be tried with another ovarian tumor.

GUEE-72   Participants

MRI Imaging Findings Of Papillary Necrosis - The Utility Of Non-contrast MR Imaging Of The Pelvicalyceal System Including The Importance Of Papillary Diffusion Restriction.

Denver Pinto, MD, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

*To identify various calyceal findings of papillary necrosis*To recognize diffusion restriction of the calyx as an important precursor sign to the the occurrence of papillary necrosis and its pathophysiological basis.*To recognize that intravenous administration of contrast is not necessary to image papillary necrosis.

TABLE OF CONTENTS/OUTLINE

* Demographic data, epidemiology and disease burden of papillary necrosis* Etiology* Imaging modalities used for papillary necrosis and the role of intravenous contrast in imaging* Non-contrast MR Urogram findings of papillary necrosis, Calyceal findings seen in papillary necrosis. Special focus on diffusion restriction in the calyx as a sign of papillary necrosis, pathophysiologic basis of diffusion restriction as a cause for papillary necrosis.* Imaging of papillary necrosis (case discussions) due to various etiologies.* Comparison of static MR Urogram versus other modalities of imaging.

GUEE-73   Deep Infiltrating Endometriosis: A Structured Approach

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Participants
Jihyun Kang, Staten Island, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review and illustrate three distinct female pelvic compartments. 2. Discuss a structured approach to evaluating pelvic endometriosis within the framework of pelvic compartments. 3. Describe MR imaging characteristics of deep infiltrating endometriosis and discuss structured reporting system.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Anatomic illustrations: -Female pelvis -Pelvic compartments (anterior, middle, posterior)3. Diagnosis of endometriosis: -Clinical aspects -Subtypes of endometriosis (ovarian, deep infiltrating, superficial) -MR imaging characteristics of deep infiltrating endometriosis -Categorization of endometriosis within different pelvic compartments4. Discussion of structured reporting system with summary table5. Conclusion

GUEE-74   Imaging Of Urinary Bladder Masses And Mass-like Lesions

Awards
Identified for RadioGraphics

Participants
Mark Hoegger, MD, PhD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to:1. Illustrate the urinary bladder normal anatomy and appearance with multimodal imaging, including CT urography and MR urography, and describe techniques for image optimization.2. Highlight features of bladder malignancy including those described by current standardized reporting systems (i.e. VI-RADS).3. Provide a case-based review of various masses and mass-like lesions including intrinsic and extrinsic etiologies.

TABLE OF CONTENTS/OUTLINE

1. Anatomy:i. Urinary bladder layersii. Normal urinary appearance with CT and MR urographyiii. Urinary bladder inflow and outflow anatomyiv. Adjacent structures including comparative anatomy between males and females2. Techniquei. Compare CT modalities: cystography, urography, and standard CTii. Describe MR techniques for bladder imagingiii. Optimizing bladder imaging across modalities3. Urothelial malignancyi. Multimodal appearance of urothelial malignancyii. Description and application of VI-RADS4. Non-urothelial masses and mass-like lesions - malignant and benigni. Mesenchymal tumorsii. Metastatic lesionsiii. Benign extravesical masses and mass-like lesionsiv. Malignant extravesical and mass-like lesionsv. Hemorrhagic pathologiesvi. Inflammatory pathologies - Infectious and non-infectionsvii. Calcification and crystalline disease5. Pitfalls and special considerationsi. Suboptimal bladder distensionii. Optimal contrast usageiii. Age related changes and variant anatomyiv. Iatrogenic

GUEE-75   It's As Easy As 1,2,3: Three-step Approach To Cystic Renal Mass 2019 Bosniak Classification

Awards
Certificate of Merit

Participants
Dana Galvan, MD, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To familiarize radiologists and in-training radiologists on the use of a simple three-step approach to characterize all cystic renal masses to aid with consistent classification. 2. To demonstrate the "Magic 4" simplified rule for distinguishing nodularity, thickness, and septa. 3. To provide examples using the unique three-step approach to demonstrate classification of different Bosniak lesions such as 2F, 3, and 4.

TABLE OF CONTENTS/OUTLINE

Introduction and Importance of the 2019 Bosniak Classification. 2019 Bosniak Classification Summary. Overview of our Three Step Approach to the Bosniak Classification. Explanation with figures of the "Magic 4" simplified rule for distinguishing nodularity, thickness, and septa. Example Classifications of Bosniak Lesions using the Three-Step Approach: Bosniak 2F Lesion classification,

Bosniak 3 Lesion classification, Bosniak 4 Lesion classification. Summary Table of Three Step Approach to 2019 Bosniak Classification.

GUEE-76   Ovarian Torsion Revisited - Untwisting The Truth

Participants
Aman Kahlon, MBChB, Manchester, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Describe the appearances of ovarian torsion of a normal ovary. Differentiate between a torsion of a normal and pathological ovary. Describe the appearances of torsion in cystic pathologies including simple ovarian cyst, dermoid cyst and cystadenofibroma. Recognise commonly encountered complications, imaging pitfalls and mimics of ovarian torsion.

TABLE OF CONTENTS/OUTLINE

Torsion of a normal ovary although rare is often encountered in clinical practise. It occurs most often in adolescents and is an important differential in young patients presenting with acute pelvic pain. Conversely, torsion of ovaries with pre-existing pathologies is a well-recognised entity. Early recognition by the radiologist is vital to allow prompt intervention and preservation of ovarian function.We present a series of cases that highlight the imaging features of ovarian torsion in normal and pathological ovaries and the commonly encountered complications and pitfalls that radiologists should be aware of.

GUEE-77   Ultrasound Of Scrotal Masses: 10 Pearls And Pitfalls

Participants
Cindy Mai, MD, Leuven, Belgium (*Presenter*) Nothing to Disclose

TEACHING POINTS

Ultrasound is still the preferred imaging modality when it comes to scrotal pathology. It is widely available, inexpensive and non-invasive. Also, the extracorporeal and superficial position of the testicles make high resolution evaluation by ultrasound possible. It is widely performed among sonographers, radiologists and non-radiologists. However, as in other body areas ultrasound is very operator dependent.The purpose of this educational exhibit is:- To provide the most important concepts in scrotal ultrasound when evaluating intrascrotal masses (the pearls)- To familiarize the radiologist/ultrasonographer with common mistakes when an intratesticular lesion is seen (the pitfalls)

TABLE OF CONTENTS/OUTLINE

Pearl 1: Testicular microlithiasis, when to sound the alarm Pearl 2: First things first, is it extratesticular or intratesticular? Pearl 3: Second, is it cystic or solid? Pearl 4: Color doppler comes to the rescue Pearl 5: It is mostly germ cell tumor, but not always Pearl 6: It is mostly seminoma, but not always Pitfall 1: Anamnesis is important, but? never trust the patient Pitfall 2: Suboptimal doppler settings Pitfall 3: Conditions that can mimic tumor Pitfall 4: Underestimating experience in ultrasonography, it is not always a textbook case

GUEE-78   Endometriosis In The Chest And Upper Abdomen: Little-explored Territory

Participants
Cristiane Costa, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1 - Review the usual and unusual location of endometriosis of the chest and upper abdomen, imaging characteristics, theories of dissemination, and clinical manifestations. 2 - Provide the radiologist with the main information he must report and correlate the characteristics of MRI and US images with the findings of laparoscopy. 3 - Illustrate the cases of endometriosis in the chest and upper abdomen, demonstrating the therapeutic surgical options.

TABLE OF CONTENTS/OUTLINE

1 - Theories of dissemination of endometriotic implants. 2 - Location and imaging aspects of the lesions. 3 - Imaging protocols. Advantages and disadvantages of US and RM. 4 - More relevant information should the radiologist report to the surgeon. 5 - Correlation of imaging characteristics (US and MRI) with laparoscopy. 6 - Demonstrate surgical treatment options for lesions.

GUEE-79   A Radiological Advice: Tips About Gynecological Pelvic Devices

Participants
Flavia M. Starling, MD, Belo Horizonte, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

• The female pelvis is made up of a complex anatomy and understanding it can be challenging sometimes, especially if there are unknown devices inside the pelvic cavity, including the uterus or the vagina.• There are many contraceptive methods that have intravaginal and intrauterine delivery systems, such as the vaginal ring and intrauterine device (IUD) copper or hormones releasing. In addition, there are other devices that can be found in the female pelvis, for example the slings or vaginal pessaries, each one with their own function and purpose, or even foreign bodies.• Questionnaires are often vague when referring to these devices and most women forget to mention actively whether they have or are using them.• An understanding of the radiological appearance of some of these devices in the many imaging methods such as X-ray, ultrasound, CT and MRI is useful to avoid misinterpreting them, as well as knowing their correct positioning and possible complications, obtaining a diagnosis more quickly and accurately.

TABLE OF CONTENTS/OUTLINE

• Clinical and epidemiological aspects.• Case-based review illustrating the findings of different methods of women's vaginal and uterine devices, including normal and inappropriate positioning and complications.• Take-home messages.• References.

GUEE-8   A Panoply Of PEComas

Participants

Adam Kinzel, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Perivascular epithelioid cell tumors (PEComas) are a group of rare mesenchymal tumors composed of distinct perivascular epithelioid cells (PECs). First described in 1992 by Bonetti et al. due to distinct morphologic similarities between angiomyolipomas (AML) and clear cell "sugar" tumors of the lung (CCTL). These tumors were found to be immunoreactive to melanocyte markers, contain clear-acidophilic cytoplasm, have an unusual cell type, and were organized in a perivascular distribution. Bonetti et al. were also the first to suggest a connection between PEComas and Tuberous Sclerosis. Since that time, other tumors have been added to the PEComa family including lymphangiomyomatosis, abdominopelvic sarcoma of PECs, and other related tumors at various sites simply called PEComas. This educational exhibit will provide a comprehensive overview of PEComas by discussing the epidemiology, morphology, and radiographic appearance of the most common PEComas as well as describe therapeutic interventions in the treatment of these tumors. Finally, this exhibit will review the associated entities commonly seen with PEComas such as Tuberous Sclerosis and Lymphangioleiomyomatosis.

TABLE OF CONTENTS/OUTLINE

Background;General Pathology;Epidemiology, histology, imaging features, and treatment considerations for the most common PEComas (Angiomyolipomas, Lymphangiomyomatosis, Abdominopelvic sarcoma of PECs);Associated Entities (Tuberous Sclerosis, Lymphangioleiomyomatosis);Newer Treatments/Research;Summary and Conclusion

GUEE-80   MRI Of The Female Urethra

Awards
Certificate of Merit

TEACHING POINTS

The female urethra is well delineated on pelvic MRI due to the excellent soft tissue and spatial resolution of MRI. The utilization of pelvic MRI has rapidly increased over the last decade (eg. pre-operative imaging of patients with endometrial/cervical cancer). Therefore, incidental urethral pathology is more commonly detected and thus increases the need for accurate image interpretation and diagnosis. MRI also has an evolving role in the primary assessment of the female urethra for both benign and malignant pathology. Retrograde urethrography and voiding cystourethrography are typically the primary imaging modality of choice in the male urethra, but provide less information concerning the female urethra. MRI provides vital information regarding the anatomy and pathology of the female urethra which can guide clinical management and provide a road map for surgical procedures. Goals: 1. Describe the embryological development and anatomy of the female urethra 2. Highlight the female urethra imaging techniques with an emphasis on pelvic MRI 3. Exemplify the female urethra pathology: a.Benign - Congenital : malformations - Inflammatory/infective - urethritis, vasculitis - Post-surgical - urethral bulking agents - Tumour - leiomyoma - Other - diverticulum, Skene gland cyst, cecoureterocele b.Malignant - Rare primary urethral carcinoma - Secondary malignancy involving the urethra 4. Discussion of each category, including complementary imaging methods

TABLE OF CONTENTS/OUTLINE

1. Embryology and anatomy 2. MRI 3. Pathology 4. Summary

GUEE-81   Local Staging On Prostate MRI: What The Urologist And Radiation Oncologist Want To Know

Awards
Identified for RadioGraphics

Participants
Ravi Gottumukkala, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Prostate MRI findings regarding local tumor extent are increasingly incorporated into treatment planning. Surgical techniques have evolved to optimize continence and potency following radical prostatectomy, but rely on a detailed understanding of tumor extent and relationship to critical anatomic landmarks, in part derived from imaging assessment. Additionally, decisions regarding the logistics of radiation and androgen deprivation therapy rely on risk stratification that incorporates imaging-derived local staging features alongside other biomarkers. This clinically oriented exhibit aims to 1) Review key anatomic principles pertaining to local staging of prostate cancer, 2) Illustrate via case examples the spectrum of local staging features on prostate MRI, 3) Discuss inflection points where imaging findings may modify clinical management.

TABLE OF CONTENTS/OUTLINE

-Brief clinical overview of surgical and radiation therapy for localized prostate cancer-Anatomic principles and imaging assessment of extraprostatic extension (EPE)-Anatomic principles and imaging assessment of seminal vesicle invasion (SVI)-Discussion of how EPE and SVI modify the radiation oncologist's treatment approach-Discussion and imaging appearance of key anatomic/surgical landmarks where EPE may modify the urologist's technical approach

GUEE-82   Imaging Characteristics Of Post-partial Nephrectomy: Expectations And Complications

Awards
Certificate of Merit

Participants
Aditi Chaurasia, MBBS, Bethesda, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

Nephron-sparing surgery is the standard treatment in many patients with small renal tumors. Complication rates for such procedures are variable and can range from 4%-37% depending on factors such as patient's health status, tumor size and technique performed. Complications usually occur in the early post-op period, & include urinary leak/fistula, bleeding, acute renal failure, infection, fat necrosis, ischemic changes in the renal parenchyma and ureteral/ renal pedicle stricture. Most of these complications can be managed conservatively or with endoscopy or interventional radiology. As nephron-sparing surgery gains popularity, it is crucial for radiologists to be familiar with imaging characteristics of postoperative complications and distinguish them from normal

postoperative findings. This educational exhibit will illustrate the key imaging findings of complications after partial nephrectomy and describes the features that can help radiologists to distinguish them from expected postoperative changes and tumor recurrence. We will also discuss management strategies for postoperative complications.

TABLE OF CONTENTS/OUTLINE

1. Expected post-partial nephrectomy imaging characteristics • Enumeration of different normal imaging findings• US, CT and MRI findings2. Post-partial nephrectomy complications• Enumeration of different complications• US, CT and MRI findings3. Management of post-partial nephrectomy complications • Conservative options• Role of interventional radiology• Imaging of management strategies

GUEE-83   Ultrasound Of Pelvic Pain In A Fertile Woman: Characteristic Signs To Guide The Diagnosis

Participants
María Loyola, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Review the ultrasound diagnostic approach in patients with pelvic pain of childbearing age.-Classify the differential diagnosis in defined clinical settings.-Recognize the different ultrasound signs that we find in different clinical scenarios.

TABLE OF CONTENTS/OUTLINE

Introduction. - Epidemiology. - Possible clinical scenarios in ultrasound of pelvic pain in a fertile woman.Ultrasound signs present in the different scenarios (Description of B-mode signs and color Doppler signs): - Clinical Scenario 1: Unilateral ovarian volume enlargement. - Ovarian torsion: - Clinical Scenario 2: Normal size ovary + contralateral adnexal cyst-mass in patients without increased inflammatory parameters or bhcg levels. a)Hemorrhagic cyst. b)Ruptured hemorrhagic cyst. c)Endometrioma. d)Mature cystic teratoma. e)Torsion of the Fallopian Tube. - Clinical Scenario 3: Normal size ovary + contralateral adnexal cyst-mass in patients with elevated inflammatory parameters without increased bhcg levels. in a patient with elevated inflammatory parameters. a)Salpingitis-piolsalpinx. b)Tubo-ovarian abscess.- Clinical Scenario 4: Normal size ovary + contralateral adnexal cyst-mass in a patient with elevated BHCG. -Ectopic tubal pregnancy.Conclusions.

GUEE-85   Penis Fracture: Cowgirl, Decrease The Rhythm!

Participants
Evelyn Torres Gomez, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

Penile fracture is described as the rupture of the tunica albuginea and/or corpus spongiosum in the erect penis caused by rapid blunt force. The tunica albuginea covers the corpora cavernosa and sponge, has a normal thickness of 2 mm when the penis is flaccid, it stretches during erection and its thickness is reduced to 0.25 mm. Penile fracture generally occurs in the proximal or middle shaft and results in a transversal tear. The most common sexual position associated with penile fracture is the reverse cowgirl. US is an ideal technique for evaluating patients with penile trauma and can be routinely used in an emergency. It is a non-invasive method that gives results faster than cavernosography and MRI. Ideally, US of the penis is performed with a high-frequency (7-12.0 MHz) linear transducer, anatomic orientation, and ample gel to provide high-quality images. The examination should include different angles of insonation to identify hidden lesions due to edema of the penis.Tunica albuginea is easily represented as a hyperechoic linear line. It can show the integrity of the tunica albuginea as well as the extent and location of a tunical tear or to see any hematoma on either side of the tunica. The radiological report should include the location of the rupture, the major axis, hematoma diameters, and a description of findings that suggest a ruptured urethra.

TABLE OF CONTENTS/OUTLINE

Normal anatomy of the penis. Ultrasonographic findings of penile fracture. Frequency of sexual positions as a mechanism of injury. Ultrasound evaluation technique.

GUEE-86   Typical And Atypical Fibroids And Figo Classification: Old Disease And New Perspectives

Participants
Júlia Miranda, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Understand current concepts and management of uterine leiomyomas- Recognize uterus anatomy- Review the Magnetic Ressonance Imaging (MRI) technique- Comprehend FIGO classification- Recognize the most important imaging features to report and differential diagnosis

TABLE OF CONTENTS/OUTLINE

INTRODUCTION- Uterine leiomyoma prevalence, risk factors and clinical significance ANATOMIC CONCEPTS- Key anatomical landmarks demonstrated by illustrations with MRI correlation- MRI appearance of different subtypes of leiomyomas- MRI appearance of leiomyoma degenerationMRI TECHNIQUE- Preparation-MRI protocol-Difficulties and how to overcome themTYPES OF LEIOMYOMA DEGENERATION FIGO CLASSIFICATIONDIFFERENTIAL DIAGNOSIS- Adnexal lesions- Non-fibroid uterine lesions- Pitfalls TYPES OF TREATMENT- Briefly review the role of MRI on therapeutic planning SYSTEMATIC APPROACH- Systematic approach to evaluate uterine leiomyomas- Template reporting system INTERACTIVE CASE-BASED DIDACTICS- Sample cases to illustrate and solidify the concepts CONCLUSION

GUEE-87   Multidetector Computed Tomography (MDCT) With Tridimensional And Functional Reconstruction Modeling For Partial Nephrectomy: A Tool To Improve Surgery And Renal Function Outcomes

Participants
Giovanna Torre, Sao paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

I. Understand the concepts and applications of 3D kidney reconstruction for partial nephrectomyII. Comprehend the main

techniques used to outline the tumours as well as the kidney blood vesselsIII. Demonstrate through cases how 3D kidney reconstruction can improve post-treatment renal function, enhancing the the surgical planning and reducing the duration of renal ischemia IV. Discuss the future directions of 3D kidney reconstruction for partial nephrectomy

TABLE OF CONTENTS/OUTLINE

INTRODUCTION• Understand the benefits of 3D reconstructions in partial nephrectomyIMAGING TECHNIQUE• CT protocol and software management• Calculate the renal cortex volume and parenchymal volume with an imaging software program (Synapse 3D - FUJIFILM Corporation, Tokyo, Japan)• Assess the extrarenal and intrarenal vascular road map of renal artery tree• Characterize the tumor-specific vascularization• Estimate volumetry of the renal parenchyma and cortex volume of the anticipated remnant renal volumeIMAGING EVALUATION• What information the surgeon needs to know in a preoperative planning for partial nephrectomy• Illustrative cases of partial nephrectomies planned through 3D reconstructionFUTURE DIRECTIONS• What's on the horizon for 3D kidney reconstruction for partial nephrectomy

GUEE-88   Imaging Findings Of Succinate Dehydrogenase Subunit B (sdhb) Gene Mutation

Participants
Aditi Chaurasia, MBBS, Bethesda, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

Succinate Dehydrogenase Subunit B (SDHB) mutation-related cancer is a recently defined inherited syndrome characterized by increased risk of multiple paragangliomas, pheochromocytomas, and renal cell carcinoma. SDHB is associated with several subtypes of RCC, including clear cell, chromophobe carcinomas, and oncocytomas. These renal tumors present at an early age, and have a high tendency toward overtly malignant disease. Considering their early tendency to metastasize, SDHB tumors should be managed promptly with surgery.There is no clear consensus regarding the best time to initiate imaging surveillance, its frequency, and modalities of choice in these patients. This educational exhibit reviews the mechanism, clinical, and imaging findings as well as management and imaging surveillance in patients with SDHB mutation

TABLE OF CONTENTS/OUTLINE

This educational exhibit will illustrate the following features of patients affected with SDHB mutation:Genomics and underlying pathophysiology• Inheritance pattern• Gene involved• Gene function• Mechanism of tumorigenesis• Potential targeted therapyClinical presentation • Epidemiology• Onset, clinical signs, and symptoms• Natural course of the disease Imaging characteristics on CT, MRI, FDG-PET• Imaging findings of renal lesions • Imaging findings of extra-renal lesions Treatment options and potential management strategies • Role of surgery and/or interventional radiologyImaging surveillance- Current NCI guidelines regarding onset, frequency, and modality

GUEE-89   MRI Of Prostatitis: The Great Mimicker

Participants
Antonio Luna, MD,PhD, Jaen, Spain (*Presenter*) Speaker, General Electric Company

TEACHING POINTS

Review the classification of prostatitis Analyze their different presentations on MRI Provide tips and tricks to differentiate prostatitis and prostate cancer

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Classification of prostatitis -NIH classification -Radiological classification 3. Appearance on multiparametric MRI of prostatitis and its complications -Acute prostatitis +Complications: Abscess -Chronic prostatitis +Glandular atrophy +Postinflammatory scar -Granulomatous prostatitis 4. Prostatitis vs prostatic cancer on mpMRI using PIRADS v2.1 5. Conclusions

GUEE-9   Imaging Of Chronic Urinary Tract Infections

Participants
Mindy Horrow, MD, Philadelphia, Pennsylvania (*Presenter*) Spouse, Employee, Bristol-Myers Squibb Company

TEACHING POINTS

1. Appreciate the variety of underlying medical conditions that may predispose a patient to chronic urinary tract infections 2. Differentiate chronic pyelonephritic scarring and pseudotumors from fetal lobation and true renal masses 3. Demonstrate the typical findings of xanthogranulomatous pyelonephritis including renal enlargement, non-function, dilated calyces with constricted renal pelvis, staghorn calculus and discuss unusual manifestations and variations 4. Relate the pathophysiology of renal TB to the imaging findings of "autonephrectomy", ureteral strictures and bladder wall thickening with decreased capacity 5. Demonstrate ureteral and bladder findings of ureteritis and cystitis cystica and malakoplakia

TABLE OF CONTENTS/OUTLINE

1) Background 2) Chronic pyelonephritic scarring i) CT urography, US ii) Differentiate from fetal lobation iii) Appearance of pseudotumors iv) Association with papillary necrosis 3) Xanthogranulomatous pyelonephritis A) Pathophysiology B) Classic imaging findings 1) Contrast and non-contrast CT 2) Ultrasound 3) Retrograde urethrography C) Complications and variants 1) Extrarenal extension 2) Focal 3) Emphysematous 4) Replacement lipomatosis 4) Chronic inflammatory conditions of ureters and bladder A) Ureteritis cystica B) Cystitis cystica C) Malakoplakia 5) Tuberculosis of the urinary tract A) Renal 1) Granulomatous cavities and calcifications 2) Hydronephrosis 3) Auto nephrectomy- "putty kidney" B) Ureter and Bladder

GUEE-90   Gynecological Malignancy In Pregnancy: What Radiologists Should Know?

Participants
Arthur Uchoa Pacheco, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Malignancy during pregnancy is relatively rare. The overlap of the symptoms of pregnancy and malignant disease, delay the diagnosis, leading to higher stages of disease at diagnosis. Imaging of pregnant patients with cancer is challenging because conflict

between maternal benefit and fetal risk needs to be addressed. There are important considerations and challenges for the radiologist in this context. The purpose of this exhibit is to:1 - Review the general principles and approach to imaging the pregnant patient with suspected malignancy.2- Discuss the imaging strategies for staging, pitfalls and limitations.3- Discuss the effects of pregnancy on tumor biology and presentation of specific tumors.4- Illustrate the cases of gynecological malignancy in pregnancy.

TABLE OF CONTENTS/OUTLINE

- Brief review of the most common tumors in pregnancy with an emphasis on gynecological tumors.- Discussion about the imaging methods that should be used in pregnancy and the timing that it should be made, including follow-up. - Review the imaging protocols and its limitations in pregnancy.- Discuss the relevant information that the radiologist should report for staging.- Selection of interesting cases of gynecological malignancy in pregnancy with it's differential diagnosis.- Discuss safety and strategies of surgical and chemotherapy treatment planning in pregnant patients

GUEE-91   CT Subtraction For Renal Lesion Evaluation

Participants
Veronica Teixeira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:Describe the protocol and image manipulation to perform a single energy CT subtraction.Show how CT subtraction can aid radiologist detect subtle lesions, whether there is enhancement within a lesion and how it may add value to imaging surveillance after ablation therapy.

TABLE OF CONTENTS/OUTLINE

Introduction presenting literature review in diagnosis of incidental renal lesions.Review imaging-guided percutaneous ablation of renal cancer treatment.Present the challenges of post-ablation follow-up and diagnosis of residual lesions and recurrences after local treatment.CT subtraction protocol. Case-based examples on how CT subtraction can improve radiologist diagnosis of undetermined renal lesions in conventional CT, avoiding further imaging studies.Discuss the perspectives for CT subtraction in a routine.Conclusions and key points to consolidate the acquired knowledge.Bibliographical references.

GUEE-92   Imaging Of Female To Male Transexuals

Participants
Ajay K. Singh, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

There are multiple surgeries that transgender men can undergo, including hysterectomy, oophorectomy, vaginectomy, phalloplasty, metoidioplasty, and scrotoplasty.The surgical techniques are more complicated and therefore not always performed in transgender men. Limited use of surgery translates in to relatively less awareness of the imaging findings by the radiologist.Phalloplasty is a complex procedure with high complication rates, which often requires additional corrective surgery

TABLE OF CONTENTS/OUTLINE

Surgical techniques for transgender men:1. Phalloplasty.2. Metoidioplasty3. Scrotoplasty4. Hysterectomy and oophorectomy.Prevalence of surgery in male versus female transgenderPhalloplasty techniques: Forearm flap, abdominal flap, thigh flap and latissimus dorsi flap: Infection, hematoma and ischemiaSurgical complications

GUEE-93   Testicular Neoplasm: A Systematic Approach For Radiologist

Participants
Laise Silveira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Describe the epidemiology of the main histological subtypes of testicular tumor.- A brief review of guidelines treatment for testicular tumor.- Discuss the role of image in diagnostic, staging, and follow-up of patients with testicular tumor.

TABLE OF CONTENTS/OUTLINE

INTRODUCTION- Testicular cancer epidemiologyMANAGEMENT OF TESTICULAR CANCER- Management guidelines and algorithmMR AND CT IMAGING TECHNIQUE- MRI protocol- CT protocolIMAGING EVALUATION- Imaging modalities in diagnosis, staging and follow-up- Landing zones for lymphatic spread- What information should be reported in the primary staging and restaging- The role of PET imagingMIMICS- Epidermoid cyst- Testicular hematoma- Testicular Lymphoma- Infectious diseases

GUEE-94   High-Intensity Focused Ultrasound (HIFU) For Prostate Cancer: A Practical Guide To MR Imaging Evaluation

Participants
Laise Silveira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Describe the current indications of high-intensity focused ultrasound (HIFU).- Briefly review the HIFU procedure techniques- Discuss the expected and unexpected post-HIFU MR imaging findings.

TABLE OF CONTENTS/OUTLINE

INTRODUCTION- Brief overview of high-intensity focused ultrasound (HIFU)- Current clinical applicationsHIFU TECHNIQUE- Description of the procedure- Tissue effects post-HIFU- Limitations of HIFUIMAGING EVALUATION- MRI protocol- Systematic approach to evaluate prostate mpMR imaging- Describe post-HIFU MR imaging findings--- Discuss the importance of DCE--- Review the role of PET-PSMA- Didactic case-based learning

GUEE-95   Multimodality Imaging Review Of Fibroids With Emphasis On Work Up And FIGO Classification

Participants
Mohamed Badawy, BMBCh, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Discuss the epidemiology, risk factors, and clinical manifestations of uterine fibroids • Describe FIGO classification, typical and atypical imaging features of fibroids • Illustrate a recognition approach to reach diagnosis with emphasis on differentiation from its mimics and related pitfalls • Discuss the role of interventional radiology and magnetic resonance imaging in management and follow up of uterine fibroid

TABLE OF CONTENTS/OUTLINE

• Introduction • Risk factors: (race, endocrine factors, medication, obesity, special habits and genetics) • Clinical manifestations: heavy menstrual bleeding, compression symptoms, infertility, torsion) • FIGO classification • Imaging characteristics o X-ray o Ultrasound o CT o MRI: § Protocols (recent guidelines) § Typical features § Atypical features (edema, different types of degeneration, cellular, lipoleiomyoma variants) § Unusual locations: cervix, board ligament, pelvic organs, intravenous, metastasizing, peritoneal, retroperitoneal and parasitic § Role of MR diffusion and ADC images o Hystrosalpingiography • Differential diagnosis such as: leiomyosarcoma, endometrial carcinoma and pitfalls of imaging • Treatment options o Quality of life after various types of management o Magnetic resonance-guided ultrasound and uterine artery embolization (difference of materials used, indication, contraindication, side effects, relation with pregnancy) o Role of MRI after embolization • Conclusion

GUEE-96   Complications In The Pregnancy-puerperal Cycle: A Case Based Review

Participants
Roberto Freitas, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Complications during pregnancy, childbirth and the puerperium are associated with an increase in maternal and perinatal morbidity and mortality. Many of these changes require evaluation using imaging methods. Identifying and characterizing them correctly is essential for proper clinical management. The purpose of this exhibit is: 1. Review the pathophysiology of complications related to the pregnancy-puerperal period and its main risk factors. 2. Review, through cases and illustrations, the main imaging findings present in gestational and puerperal complications, such as hemorrhages, uterus-placental structural alterations and iatrogenic lesions related to the method of delivery. 3. Discuss practical challenges in the image evaluation of complications related to pregnancy and the puerperium.

TABLE OF CONTENTS/OUTLINE

1. General aspects of pregnancy and the puerperium. 2. Risk factors for the development of complications of the pregnancy-puerperal cycle. 3. Pathophysiology of complications related to the pregnancy-puerperal period. 4. Maternal complications in pregnancy and in the early and late puerperium: a case based review. 5. Challenges and limitations in the imaging evaluation of complications of the pregnancy-puerperal cycle. 6. Final considerations.

GUEE-97   Prostatic Cancer Radiopathological Diagnostic Pitfalls. What Are They And How To Approach Them?

Participants
Lidia Alcala, MD, Jaen, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Raise awareness of the potential radio-pathological diagnostic pitfalls in prostatic cancer (PCa).- Review different approaches to these potential errors with integrated PCa diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Pitfalls due to MRI technique. Are there any solutions?3. The PI-RADS v2.1 system: potential problems and how to avoid them.- Peripheral zone.- Transitional zone.- Anterior Fibromuscular Zone.- Central Zone.4. Biopsy sampling errors in PCa diagnosis:- Different biopsy types, their pros and cons: systematic biopsy, cognitive biopsy, target-biopsy (ultrasound-guided biopsy types, in-bore MRI Biopsy).- Approaching difficult locations such as the AFM zone. -Approaching difficult locations such as the AFM zone5. Pathology sample diagnosis: what can go wrong?- Is pathology ready to go digital?-Artificial Intelligence helps pathologists be more sensitive and specific.6. Integrated radiopathological diagnosis: here to help resolve errors in PCa diagnosis.7. Conclusion

GUEE-98   What Did I Epididy'miss'?: Extratesticular Scrotal Masses And Pseudomasses

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Mathew Smith, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

Imaging plays a crucial role in the work up of painful and painless scrotal masses. Ultrasound is the first-line imaging modality owing to its low cost, high spatial resolution, and wide availability. Magnetic resonance (MR) imaging provides a useful, noninvasive adjunct imaging option. Extratesticular masses lead to significant patient anxiety. Benign and malignant lesions exist in the extratesticular space and are sonographically and MR-apparent. It is important for radiologists to recognize the sonographic appearance of both common and rare extra-testicular masses/pseudo-masses and ascertain when MR may be warranted. It is helpful to organize extra-testicular scrotal masses and pseudo-masses according to their anatomic compartment, namely those that arise form the scrotal wall, the tunica vaginalis, spermatic cord, epididymis, and tunica albuginea.

TABLE OF CONTENTS/OUTLINE

Overview of scrotal anatomy. Overview of extratesticular masses/pseudomasses. Scrotal wall.Hemangioma. Subcutaneous inclusion

Overview of scrotal anatomy Overview of extratesticular masses/pseudomasses Scrotal wall Hemangioma Subcutaneous inclusion cyst Tunica vaginalis Cyst Scrotolith Hernia Hematocele Spermatic cord lipoma varicocele liposarcoma leiomyosarcoma Epididymis Head Leiomyoma Papillary cystadenoma Spermatocele Body Cyst Epididymitis (sarcoid/nodosa) Lymphoma Tail Adenomatoid tumor Tuberculoid epididymitis Tunica albuginea Fibrous pseudotumor Other Epidermoid Polyorchidism

GUEE-99   The Evaluation Of Obstructive Renal Disease By MRI- The Wonders Of A Static MR Urogram

Participants
Denver Pinto, MD, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

At the end of this exhibit the reader should be able to* Identify classic MR Urogram appearances of obstructive uropathy due to intraluminal obstruction, obstruction due to mural / ureteral wall involvement and extrinsic compression* Recognize that papillary necrosis can be imaged without administration of intravenous contrast* Be able to identify mimics like vascular impressions and air foci as a cause of diagnostic error

TABLE OF CONTENTS/OUTLINE

Utility of MR UrogramBenefits of MR URogram - using intrinsic contrast of the urine, no need for intravenous contrastCase discussion with imaging findings ofAnatomical variants like malrotated kidneys, ectopic location, duplex kidneys and ectopic ureteral insertionsIntraluminal obstruction: Papillary necrosis, Hematoma, Calculi, TuberculosisMural Obstruction Ureteral stricture, PUJ obstruction, Radiation fibrosis, Urethral obstruction, ureteric mass, Primary megaureter, Ureterocoele.Extrinsic compression: Mass lesions, Genitourinary prolapse, Retroperitoneal fibrosis, metastases, collections.Imaging in papillary necrosis and infections including TuberculosisConclusion statement regarding how MR Urogram is a superior modality that can be used safely in patients with renal dysfunction

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Abstract Archives of the RSNA, 2021

Sub-Events

ROEE-1   Role Of MRI In Work-up And Radiation Therapy Treatment Of Endometrial Cancer

Participants
Edina Wang, MD, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Discuss the role of obtaining a pelvic MRI in endometrial cancer 2. Discuss the use of pelvic MRI in radiation treatment planning for inoperable endometrial cancer 3. Discuss how MRI findings affect the treatment planning for radiation therapy 4. At the completion of this course, the participant will be able to: -Understand the role of pelvic MRI in endometrial cancer-Understand how findings on MRI may affect target delineation and radiation treatment for endometrial cancer

TABLE OF CONTENTS/OUTLINE

1. Evaluation of the role of pelvic MRI in endometrial cancer work-up based on evidence-based literature 2. Overview of treatment planning considerations when using primary CT simulation with secondary MRI for inoperable endometrial cancer 3. Segmentation considerations when using MRI in endometrial cancer radiation therapy planning 4. Summary

ROEE-10   The Application Of 3D Printing Personalized Surgical Guide Plate In Gynecologic Brachytherapy

Participants
Ya Li I, Zhengzhou, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

Step 1 The basic workflow of a 3D printing personalized surgical guide plate in gynecologic brachytherapy. Step 2 Segmentation imaging software to generate the target anatomic structures. 2.1 Image acquisition Transferring the CT images to the post-processing workstation. 2.2 Patient-specific Surgical guide plate design 2.2-4 Anatomy segmentation- skeleton, vascular, skin, and tumor structures using Region Growing technique and 3D software mimics. 2.5 Digital imaging modeling. Step 3 Learn how to print a 3D printing product, including the selection of 3D printer, material, parameters etc. 3.1 Equipment of Medical 3D Printing 3.2 3D printing Products 3.3Clinical application of 3D printing

TABLE OF CONTENTS/OUTLINE

Learning objective Step 1 Step2 Step 3

ROEE-2   Collateral Damage: Radiation Therapy-related Changes And Complications In Neuroradiology

Participants
Jeet Patel, MD, St. Augustine, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Radiation therapy is an important modality of the multidisciplinary approach to treatment of neoplasms of the CNS and head and neck. Different forms encountered in neuroimaging include stereotactic radiosurgery, intensity-modulated radiation therapy, whole brain radiation therapy, and proton therapy. 2) Radiation-induced changes range from expected commonplace pathology (e.g. oral mucositis) to severe complications that might require surgical management (e.g. osteoradionecrosis). 3) The radiologist plays an important role in monitoring for and diagnosing complications of radiation therapy on surveillance imaging.

TABLE OF CONTENTS/OUTLINE

1) Mechanism of radiation-induced injury. 2) Overview of radiation therapy modalities. 3) Radiation necrosis: Brain; spinal cord. 4) Radiation-induced vasculopathy: Capillary telangiectasia / cavernous malformation; Moya-Moya syndrome; Mineralizing microangiopathy; Accelerated large vessel atherosclerosis. 5) Radiation-induced optic neuropathy. 6) Leukoencephalopathy. 7) Radiation-induced mucositis. 8) Osteoradionecrosis. 9) Radiation-induced tumors: Meningioma; Sarcoma

ROEE-3   Radiomics And Artificial Intelligence To Predict Response To Chemotherapy In Primary Brain Tumors

Participants
Edward Florez, PhD, Jackson, Mississippi (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To understand the principles and different MRI pulse sequences used in the diagnosis of primary brain tumors. • To discuss the role of radiomics as quantitative biomarkers in the process of identification and characterization of brain tumors, as well as in the evaluation of the response to chemotherapy. • To review the best applications of the use of radiomics features together with artificial intelligence (AI) models in the evaluation and prediction of tumor response to chemotherapy, particularly anti-angiogenic

therapies. • To review response criteria in oncologic neuroimaging.

Glioblastoma multiforme (GBM) is the most frequent and aggressive primary tumor of the central nervous system with a dismal prognosis (median progression-free survival [PFS] = 6.9 months and median overall survival [OS] = 14.2 months) with limited treatment options. Currently, the gold standard therapy is the Stupp protocol consisting of surgical resection (but only possible in 40% to 45% of patients) and chemotherapy with temozolomide. In addition, MRI is the standard of care to monitor brain tumors. We will discuss the role of radiomics and AI as crucial factors to quantify initial changes in multiparametric MRI of primary brain tumor to predict PFS as well as response in recurrent GBM patients eligible for second-line chemotherapy.

ROEE-4   Abbreviated MRI Protocol For Brachytherapy Of The Cervical Cancer: Case-based Review With Serial Follow-up

Participants
Jigarkumar Rangunwala, MD, Flowood, Mississippi (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To describe an optimized abbreviated magnetic resonance imaging (MRI) protocol for brachytherapy cervical cancer planning and follow up • To review the latest updates on cervical cancer staging according to the FIGO classification • To comprehend the brachytherapy procedure technique, appropriate applicator positioning and dosing selection • To recognize the role of MRI and PET-CT in cervical cancer staging, brachytherapy planning, applicator positioning, complication assessment and surveillance

TABLE OF CONTENTS/OUTLINE

MRI has an established role in diagnosis, characterization, staging, treatment guidance and surveillance of cervical cancer. Moreover, given its excellent soft tissue contrast resolution, MRI is indispensable in brachytherapy planning, post implantation assessment, and dose estimation. In this presentation we will review the imaging features of cervical cancer staging and corresponding treatment selection. We will describe the essential components of MRI assessment in brachytherapy planning and monitoring including a structured report template. We will provide a case-based review covering a wide range of presentations on MRI and PET-CT including post radiotherapy complications.

ROEE-5   Expect The Best, Prepare For The Worst: Unusual Complications Of Immunotherapy In Oncological Patients.

Participants
Ines Podadera, Pilar, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the interaction between the immune system and cancer development. To assess the different immunological therapies available to avoid cancer progression and its mechanism of action. To evaluate unusual immune-related adverse effects and its most relevant radiological findings. To emphasize the radiologist role in the treatment of oncological patients with immunotherapy and the importance of interdisciplinary work.

TABLE OF CONTENTS/OUTLINE

Introduction Immunoediting Cancer immunotherapy Adverse effects and its radiological findings Differential diagnosis Conclusion

ROEE-6   Is It Treatment Related Change Or Disease Progression? - Looking Beyond Size With Diffusion And Perfusion Imaging

Awards
Cum Laude

Participants
Shivaprakash Hiremath, DMRD,FRCR, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

The teaching points include: • Review the basic concepts of radiotherapy planning and treatment • Describe the early and delayed imaging changes based on the duration post radiotherapy • Illustrate the role of diffusion and perfusion imaging in differentiating treatment-related changes and disease progression in monitoring a glioma and metastatic tumor. • Depict the common presentations post-therapy including pseudoresponse, pseudoprogression, radiation necrosis, and tumor recurrence along with uncommon manifestations such as peri-ictal pseudoprogression (PIPG), stroke-like migraine attacks after radiation therapy (SMART) and post-radiation vasculopathy

TABLE OF CONTENTS/OUTLINE

Ø Importance of the initial radiation planning treatment map for the interpretation of the subsequent imaging Ø Radiation associated changes mimicking tumor progression Limitations of RANO criteria in the assessment of small lesions (<1cm) and non-enhancing lesion Imaging pattern on conventional and advanced MR imaging of: o Lesions seen in the acute to subacute period following radation § Pseudoprogression § Pseudoresponse § Radiation necrosis § Tumor recurrence o Lesions seen in the delayed period following radiation § Benign punctate enhancement § Peri-ictal pseudoprogression § Stroke-like migraine attacks after radiation therapy (SMART) Ø Flow chart for assessment of a new lesion seen following radiation treatment using a combined approach of conventional and advanced MR imaging

ROEE-7   Imaging Features In The Liver Post Stereotactic Body Radiation Therapy (SBRT)

Awards
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Certificate of Merit

Participants
Patrick Navin, MBBCh,MRCPI, Rochester, Minnesota (*Presenter*) Nothing to Disclose

Learn the technique of SBRT delivery to the liver and indications for treatment. Understand post SBRT changes in the tumor and surround liver parenchyma. How to evaluate tumor response post SBRT delivery and avoid pitfalls in assessment Understand common complications following SBRT.

TABLE OF CONTENTS/OUTLINE

1. SBRT technique Discuss evolution of SBRT as a viable treatment option for liver masses. Discuss indications and fundamentals of radiation delivery Patient selection Simulation, motion management and target delineation Dose prescription and fractionation Treatment planning, delivery Types X-ray Photon beam 2. Post SBRT changes in liver tumors and Assessment of tumor response Response of liver tumors to SBRT- how is it different from other treatments Typical features on imaging (CT/MRI/PET) which predict tumor response Response assessment tools and their limitations (mRECIST, EASL, LIRADS) 3. Parenchymal changes post SBRT Evolution of typical post SBRT changes on imaging - acute, subacute and chronic Discuss potential complications and related imaging features o Radiation Induced Liver Disease (RILD) o Prediction of RILD i. Child-Pugh score, MELD score ii. Imaging 1. Hepatocellular contrast 2. MR Elastography Injury to surrounding structures (radiation enteritis, radiation pneumonitis)

ROEE-8   Endometrial Cancer Revisited: What Radiologists Should Know

Participants
Giovanna Torre, Sao paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

I. Review of endometrial cancer histopathological subtypes and integrated genomic characterizationII. Understand current concepts of the prognosis of endometrial cancer and its clinical impactIII. Describe our institutional protocol of MR imaging acquisition for endometrial cancerIV. Discuss the most important imaging features to report in preoperative staging of endometrial cancerV. Review the role of functional imaging in follow-up and detection of recurrent disease

TABLE OF CONTENTS/OUTLINE

INTRODUCTION- Brief discussion of epidemiologyMR IMAGING TECHNIQUE- Preparation- MRI protocol and how to optimize itMANAGEMENT OF ENDOMETRIAL CANCER- Histological type- Integrated genomic characterization- FIGO classification- Treatment guidelines and algorithm- Discuss fertility-sparing in low-grade tumorsIMAGING EVALUATION- Systematic approach to evaluate MR imaging for endometrial cancer (pre- and post-treatment)- Didactic case-based approach for FIGO classification- Pitfalls, challenges, and how to overcome theseFUTURE DIRECTIONS- PET imaging- Radiomics

ROEE-9-HC   What Information Can We Derive From In-vivo Rectum Dose Measurement During RALS Irradiation?

Participants
Hiroaki Hayashi, PhD, Kanazawa, Japan (*Presenter*) Research collaboration, Meditec Japan Co., Ltd;Research collaboration, JOB Corporation

TEACHING POINTS

1. In radiation therapy, it is unlikely that the patient will stay in their original position during finalization of their treatment planning. Therefore, we should evaluate the effects of movement.2. During RALS irradiation for the cervical cancer treatment, we measured the rectum dose which is known as OAR using our novel OSL dosimeter.3. When performing in-vivo measurement of 64 patients, 21 cases (33%) of planned dose were not in agreement with the experimental data with the differences of approx. 10%. The cause of the difference was evaluated as due to incomplete medical imaging such as (a) patient movement, (b) presence of intestinal gas, and (c) artifacts.4. For general cases of the other 43 patients, the measured values were in good agreement with the planned values.5. Medically dangerous levels of exposure are not performed, therefore the traditional RALS irradiation method can be achieved at low-cost and simple systems that can be said to be robust.

TABLE OF CONTENTS/OUTLINE

Although dose control is very important in radiotherapy, most evaluations are static phantom studies, and there are only a few cases of actual dose measurement. Recently, we made a novel rectum dosimeter using OSL dosimeter and established the manufacturing method and dose calibration method. In this presentation, we will demonstrate in-vivo measurement of rectum dose, and analyze the robustness of the traditional irradiation method without using a dynamic tracking function.

Abstract Archives of the RSNA, 2021

Sub-Events

MSEE-1   Deep Gluteal Syndrome: Dark Corner

Participants
Rodrigo Loto, MD, Rosario, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

Learning objectives - To describe the anatomy and CT/MRI appearance of the subgluteal space (SS). - To review known etiologies of deep gluteal syndrome and introduce new ones. - To describe the management of pathologic conditions of the SS and the role of the radiologist in the diagnosis, treatment and postoperative evaluation.

TABLE OF CONTENTS/OUTLINE

By 1947 the terminology and clinical description of piriformis syndrome was established in the medical literatura.Research in hip kinematics has identified a number of areas within the deep gluteal space where the sciatic nerve may be susceptible to entrapment. Although the designation piriformis syndrome is still used, these observations lead to the introduction of the term deep gluteal syndrome (DGS) which better distinguishes the pathophysiology and clinical symptoms of hip and buttocks pain as well as radicular pain caused by non-discogenic and extrapelvic entrapment of the sciatic nerve.A broad spectrum of known pathologies may be located nonspecifically in the subgluteal space and can therefore also trigger DGS. these can be classified as traumatic, iatrogenic, inflammatory/infectious, vascular and tumor pseudotumors.The present communication is interesting given the low frequency of cases.

MSEE-10   Multimodality Imaging In Paraneoplastic Syndromes And Related Neoplasms

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Certificate of Merit

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the spectrum of paraneoplastic syndromes (PNS)2. To review tumors associated with common PNS3. To discuss an approach for the imaging of PNS4. To illustrate the imaging appearances of PNS and the associated tumors

TABLE OF CONTENTS/OUTLINE

Paraneoplastic syndromes- DefinitionImaging- Radiograph, ultrasound, fluoroscopy, whole body CT, MRI, PET/CT, bone scan, angiographyDiscussion and illustration of the following PNS. The most common tumor associated with these syndromes is listed in parenthesis.A. Endocrine-SIADH (lung)-Ectopic ACTH (lung)-Cushing's (lung)-Hypercalcemia (Epithelial tumors)-Hypoglycemia (Mesothelioma)-Gonadotrophin excess- (Germ cell)-Oncogenic osteomalacia (Fibroma)B. Musculoskeletal-Hypertrophic osteoarthropathy (Lung)-Dermatomyostiis (Lung)C. Hematological-Venous thromboembolism (Pancreas)-Trosseau's syndrome (Lung)-Autoimmune hemolytic anemia (lymphoma)-Migratory thrombophlebitis (pancreas)-Idiopathic thrombocytopenic purpura (Lung)- Erythrocytosis (RCC)-Marantic endocarditis (Mucinous adenocarcinoma)-Giant cell myocarditis (germ cell)D. Neurological-Limbic encephalitis (Lung)-Myasthenia gravis (Thymoma)-Cerebellar degeneration (Lung)-Brainstem encephalitis-Lambert-Eaton syndrome (Squamous)-Myelopathy/neuropathyE. Dermatological-Necrolytic migratory erythema (Glucagonoma)-Seborrheic keratoses(Lymphoma)- Poyphyria cutanea tarda (HCC)Diagnostic algorithm and approach

MSEE-100   Vascular Injuries In Blunt Torso Trauma. Image-based Classification

Participants
Gorka Arenaza Choperena, San Sebastian, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To review the traumatic vascular injury classification with emphasis on imaging findings -To present these injuries in different organs that are part of the torso. showing some specific characteristics for each organ-To convey the importance of detecting them to avoid complications -To show several cases of vascular injuries involving the torso and discuss some teach key points to achieve the most accurate diagnosis

TABLE OF CONTENTS/OUTLINE

Patients with multiple trauma can present a wide spectrum of injuries. Most of them can be treated conservatively. Therefore, it is key to identify those injuries that require intervention, such as vascular injuries, which are associated with hypotensive shock and higher mortality rates. We propose an image-based classification for vascular injuries in which different injuries can appear with the same imaging features and, also, the same condition can appear with different image findings. We present several vascular injuries

in great vessels, solid viscera, mesentery and pelvis: -Active bleeding -Pseudoaneurysm -Occlusion-Intimal tear/dissection -AV fistula -Intramural hematoaAlso, indirect signs that can help to identify vascular injuries are presented:-Hematoma -Perivascular stranding -Distal non-enhancement-Vasospasm

MSEE-101   Modifiers In Spine Trauma Reporting

Participants
Meena Nedunchelian, MBBS, Coimbatore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To describe the various imaging findings in spine trauma, newly categorized as modifying factors in the AO spine trauma classification system.2. Discuss the clinical and surgical relevance of these modifiers in patient management using multimodality imaging in a case-based approach.

TABLE OF CONTENTS/OUTLINE

Multimodality imaging plays a crucial role in the management decision for spine trauma. AO Spine classification system is widely accepted and is based on CT scan, although MRI is performed in patients with neurological deficits. In the current AO Spine Classification system, spinal injuries in each segment are classified mainly as axial compression, distraction and translation injuries. It also includes clinical and imaging modifiers for each segment, denoted by the letter M followed by a number. The presence of modifiers changes management. Examples of specific modifiers in the upper cervical segment include mid substance transverse ligament tear and type 2 odontoid fractures; however vertebral artery injury, critical disc herniation with bilateral locked facets in the sub axial spine. Rigid spine and metabolic diseases are thoracolumbar modifiers whereas SI joint disruption and pelvic-ring injuries are modifiers in the sacral segment. Summary:Radiologists should be aware of these modifiers to guide optimal management. We describe the various modifying factors in a case based approach with a checklist for each segment.

MSEE-102   To Err Is Human: Comprehending And Learning From My Mistakes-The Viewpoint Of A Resident Trainee In Radiology

Participants
Ankit Arora, MBBS, Jodhpur, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To be aware of the difference between error and bias.• To know about the various errors and bias in radiology , and the commonly followed Kim-Mansfield classification of radiological errors.• To understand the workflow of radiology reporting , the final communication of report with the clinician and its impact on patient management.• To understand the human cognition behind reporting and the concept of Type 1 and Type 2 thinking• Comprehending each error with the help of real-life case examples.• How to avoid errors

TABLE OF CONTENTS/OUTLINE

• Introduction and Brief History• Error and Bias• Kim Mansfield radiology error classificationo Type 1 Error: Complacencyo Type 2 Error: Faulty Reasoningo Type 3 Error: Lack of Knowledgeo Type 4 Error: Under-readingo Type 5 Error: Poor Communicationo Type 6 Error: Techniqueo Type 7 Error: Prior Examinationo Type 8 Error: Historyo Type 9 Error: Locationo Type 10 Error: Satisfaction of searcho Type 11 Error: Complicationo Type 12 Error: Satisfaction of Report• Workflow of Radiology Reporting • Human cognition in reporting• Case examples of each error and the learning points from the same.• How to avoid mistakeso Structured reportingo Computer aided detection

MSEE-103   MSK Imaging Manifestations Of Recreational Drug Use

Awards
Certificate of Merit

Participants
Joshua Gu, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Recreational drug use is an increasing problem worldwide, contributing to significant morbidity and mortality, as well as economic impact. 2. Recreational drug use may lead to numerous acute and chronic health consequences, including infections of the musculoskeletal system. 3. Clinical presentations are challenging. Imaging provides depth and severity of the infection to allow for appropriate diagnosis and treatment of musculoskeletal infections related to recreational drug use. 4. Early diagnosis of pathologies such as necrotizing fasciitis and septic arthritis impacts morbidity and mortality. 5. Knowledge of advanced MR imaging techniques (DWI) is key in solving complex cases.

TABLE OF CONTENTS/OUTLINE

1. Status of worldwide recreational drug and recent trends. Explore infections directly and indirectly related to drug use. 2. Description of various imaging modalities available to the radiologist, and their advantages and disadvantages. 3. Discussion of MRI protocols for evaluating disease process and their respective advantages. Utility of diffusion weighted imaging.4. Multimodal demonstration of disease processes, including: Cellulitis, Abscess, Pyomyositis, Necrotizing fasciitis, Osteomyelitis Tenosynovitis, Septic arthritis, Discitis, Mycotic aneurysm, Chondritis, Granuloma5. Image guided management of drug related disease processes.6. Pitfalls. 7. Summary

MSEE-104   Imaging Of Acute Mesenteric Pathologies

Participants
Borna Dabiri, MD, PhD, Milton, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

• - Review of the anatomy of the mesentery and its relationship to other abdominopelvic structures. • - Briefly discuss the MDCT protocols used in the emergency setting and highlight the role of Dual Energy CT (DECT). • - Review the imaging findings of acute mesenteric pathologies classified as primary and secondary entities with case examples. • - Underscore mesenteric pathologies and

their pattern of involvement of the adjacent abdominopelvic structures.

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• - Brief overview of the anatomy of the mesentery and its relationship to adjacent structures as well as its role in the inflammatory and immune response. • - Discuss the most common imaging protocols used to diagnose mesentery pathologies in the acute setting, with emphasis on the role of DECT. • - Highlight examples of primary mesenteric pathologies o Acute mesenteric ischemia o Internal hernia o Volvulus o Traumatic mesenteric injury o Epiploic appendagitis o Omental infarct o Idiopathic sclerosing mesenteritis o Primary mesenteric tumors • - Highlight examples of secondary mesenteric pathologies o Infection (complication from acute appendicitis) o Inflammation (Crohn's disease) o Neoplasms (carcinomatosis; ruptured mucocele) o Endometriosis o Hepatic congestion o Secondary sclerosing mesenteritis

MSEE-105   Imaging Of The Multi-organ Diabetic Complications

Participants
Madiha Aslam, MBBS, Darby, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Diabetes mellitus is a commonest endocrine disorder with multiple devastating end organ complications. Radiologists play decisive role by making an early diagnosis and guiding further management of acute diabetic complications with increased morbidity and mortality like acute limb ischemia associated with PAD and especially due to increased risk of infection like emphysematous cholecystitis, emphysematous pyelonephritis, and Fournier's gangrene. We will provide a pictorial review of the usual and unusual, acute and chronic multi-organ diabetic complications.

TABLE OF CONTENTS/OUTLINE

Diabetes mellitus is a chronic epidemic disease and its prevalence is expected to increase by 54% by 2030. It results in a variety of multi-organ, clinically important complications, which account for major morbidity and mortality associated with this disease. Radiological manifestations of diabetic complication are proportional to the duration of the disease e.g. micorangiopathy and macroangiopathy complications, however increased risk of infection in diabetics result in some acute complications with increased mortality like emphysematous cholecystitis, emphysematous pyelonephritis/pyelitis/cystitis, acute osteomyelitis, Fournier gangrene. Sound knowledge of the imaging characteristics of multi-organ acute and chronic diabetic complications is of paramount importance for accurate management of diabetic patients. Using several imaging examples we will present wide variety of head to toe diabetic complications.

MSEE-106   Iron Man's Face: MDCT Evaluation In Post-operative Traumatic Facial Bone Injuries: Imaging Features Of Satisfactory Repair And Related Complications

Participants
Gaurav Chauhan, MD, Coimbatore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To describe most common facial bone fractures which warrant surgical intervention. • To illustrate the imaging findings indicating the satisfactory placement of post-operative stabilizing hardware and various mesh used in facial bone injuries. • To familiarize the reader about immediate and delayed post-operative complications and their clinical and imaging features.

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Facial bone fracture repair is one of the commonest facial surgeries. There is a spectrum of orthopedic hardware and various types of mesh used in facial bone fracture repair, both for functional and cosmetic purposes. Although clinical findings and radiographs are adequate in a post-operative follow-up, there are certain complications for which MDCT plays a crucial role owing to its superior resolution of the intricate details. The radiologist should be aware of the imaging features indicating the satisfactory facial bone repair using the hardware or the mesh. Knowledge of the clinical features and chronology of the occurrence of various complications helps in accurate diagnosis. Based on the facial buttress system and surgical intervention in each of the station, contributing imaging features will be described along with complications.SUMMARY This pictorial review provides comprehensive knowledge on acceptable outcome and complications following facial bone fracture repair by clinical and radiological findings.

MSEE-107   Non-traumatic Gastrointestinal Emergency Conditions That A Radiology Resident Must Identify - A Hot Seat Presentation!

Participants
Denver Pinto, MD, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

After completion of this exhibit you should be able:*To identify life threatening gastro-intestinal conditions in the ER reading room and discuss the imaging findings*To understand the epidemiology, evaluation and management of these patients.*To recognize indirect imaging signs of life threatening conditions

TABLE OF CONTENTS/OUTLINE

ObjectivesEpidemiology of life threatening gastro-intestinal conditions seen in the ER reading room.The cases will be presented in a quiz format. Key imaging findings, pearls and differential diagnostic points will be highlighted in each case discussion. The list of cases and key findings include* Aortic aneurysm with rupture into the lower esophagus causing massive gastrointestinal hemorrhage - no pleural effusion, exact site of hemorrhage could not be demonstrated.* Focal intraluminal bleeding branch of gastroduodenal artery - extremely subtle and hard to pick finding that was prospectively picked up.* Bleeding gastroduodenal artery pseudo-aneursym - secondary to pancreatitis* Peptic ulceration with bleed - hard to pick focus of bleed that was prospectively picked up.* High grade portal vein stenosis with variceal bleed - one of the causes of elevated portal venous pressure* Boerhaave syndrome* Oesophageal neoplasm, Gastric neoplasm with bleed - important and common cause of bleed* Diffuse esophageal spasm* Midgut and gastric volvulusImpending life threatening hemorrhage* Duodenal ulcer almost eroding into the gastroduodenal artery - impending massive gastrointestinal hemorrhage

MSEE-108   Next Generation Imaging For Evaluating Advanced Prostate Cancer: WBMRI/PSMA PET

Complementarity

Participants
Andra Curcean, MD, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Next generation imaging (NGI) including whole-body MRI (WBMRI) and PSMA PET/CT has superior accuracy for advanced prostate cancer (APC) compared with standard imaging (CT and bone scan) and is increasingly used in clinical practice. MET-RADS-P for WBMRI and PSMA PET progression (PPP) reporting criteria have been recently published. In parallel, there is emerging evidence of complementarity between NGI techniques that is addressing: a. technique-specific limitations b. tumour heterogeneity c. disease response challenges and d. early detection of complications.

TABLE OF CONTENTS/OUTLINE

1. Introduction a. Definition of APC disease states b. Use of next generation imaging (WBMRI and PSMA PET-CT) in APC 2. Limitations of PSMA PET-CT a. Tracer urinary excretion masking disease b. False positive uptake benign bone marrow lesions c. False positive uptake benign soft tissue lesions (nodes/hemangiomas) d. PSMA expression heterogeneity e. FLARE phenomenon f. Malignant spinal cord compression 3. Potential limitations of WBMRI a. Poor specificity in nodal disease b. Low sensitivity in setting of early biochemical relapse c. Subcentimetre lung metastases d. Subcentimetre rib lesions e. Suboptimal image quality due to artefacts 4. How to optimally combine NGI for evaluating patients with advanced prostate cancer according to disease states

MSEE-109   The Role Of Radiologists In Reporting Non Accidental Injuries In Elderly

Awards
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Participants
Mohamed Badawy, BMBCh, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

- The unrecognized detection of elder abuse despite its wide prevalence in the US - What radiologist should report - Illustrating the red flags for elder abuse from patients' history and imaging - Future directions for the radiologist training and imaging correlations with elder abuse

TABLE OF CONTENTS/OUTLINE

- Introduction - Prevalence of elder abuse - Radiologist role in non-accidental injuries - Challenges in diagnosis compared to the pediatrics population - Common site of injuries o upper extremity as axilla lateral aspect of the arm (most common) o face or neck (2nd most common) o skull/ brain o Torso o Lower extremity - Red flags in patient history o Injury occurred > 24 hour prior to the presentation o Dementia o Multiple ED visit for the same complaint - Factors increase suspicion from imaging review o Site and type of fractures § Multiple fractures with or without head trauma § Ribs (upper, posterior) § Distal Ulna § Maxillofacial area § Spiral fracture o Different healing stages of patent's injury o Hematomas § Small bowel hematomas § Multiple subdural hematomas o Unusual findings for the mechanism of injuries narrated in the history (e.g fall) o Brain volume loss due to malnutrition o Decubitus ulcer - How Radiologist- ED communication - What radiologist should know about their elder patient o Functional capability o Social circumstances o Mechanism of injury - Future directions o for radiologist training o Large studies that identify the imaging correlates for elder abuse - Conclusion

MSEE-11   Body MRI Lessons Learned: Pearls And Pitfalls From Training To Remember As An Attending

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Participants
Anup Shetty, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit is targeted towards resident and fellows, as a solicited topic of interest from the RadioGraphics Editorial Board, with the following goals:1. Discuss nuances and subtleties in body MRI sequences, physics, protocols, search patterns, interpretive pitfalls, and problem solving from the perspective of the trainee2. Show the key teaching points for these concepts through a series of illustrative cases

TABLE OF CONTENTS/OUTLINE

1. Protocols and Contrast: Liver contrast timing, algorithm and considerations; contrast timing; Eovist nuances2. Artifacts as Problems: Misregistration between free-breathing sequences and breath-hold sequences; parallel imaging artifact; Subtraction misregistration; "bouncy" images on interleaved versus respiratory-navigated; susceptibility mimicking pathology3. Artifacts as Solutions: THID as a clue; chemical shift sequences for hemosiderin; the value of India ink4. Fat as friend and foe: Background liver steatosis and lesion assessment; DIXON for bone evaluation; intrapancreatic fat as an IPMN fooler; fat-containing adrenal nodules; infiltrative steatohepatitis5. Moving patient techniques: Compressed sensing; radial acquisition; CAIPIRINHA; respiratory gating6. Search Pattern/Interpretive Tips: How to use clinical history; value of reviewing prior imaging; minimizing errors of detection and interpretation; optimal use of DWI7. Blind spots/pain points: Body wall; peritoneum; bones; lower thorax; liver left lateral section

MSEE-110   Imaging Of Immune Related Adverse Effects Emergencies From Head To Toe.

Participants
Felipe Amorim SR, MD, Salvador, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the most common immune-related adverse effects of immune checkpoint inhibitors for different types of cancer at the emergency department, classified by their system of origin. To propose a diagnostic workflow based on initial clinical presentation. To discuss the role of imaging evaluation in the initial approach of patients with suspected toxicity syndromes. To describe and illustrate the main imaging features of each immune-related adverse effect by organ. To discuss the essential information of the

radiologic report in the emergency setting.

TABLE OF CONTENTS/OUTLINE

1. Major toxicity syndromes related to immune checkpoint inhibitors by organic system: Central nervous system: encephalitis, meningitis and transverse myelitis. Head and neck: uveitis. Endocrine system: hypophysitis. Cardiovascular system: myocarditis, vasculitis and acute coronary syndrome. Pulmonary system: pneumonitis. Musculoskeletal system: inflammatory arthritis and myositis. Gastrointestinal system: colitis, pancreatitis and hepatitis. 2. The role of different imaging techniques (US/CT/MRI/PET-CT) in evaluating immuno-related urgencies and main radiologic findings of: Ultrasound/ echocardiogram Computed tomography (CT) Magnetic Resonance Imaging (MRI) PET/CT 3. Radiology report structure in the emergency department. Oncologic background: tumor type, immune checkpoint inhibitor type and dates "Red flag" imaging findings ComparisonFollow-up

MSEE-111   What Else Can Go Wrong? Multisystemic Complications In Patients With Covid-19

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Participants
Marcus Vinicius Silva Ferreira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

? Review the pathophysiology of SARS-CoV-2 infection and its impact on different systems ? Recognize multisystemic complications related to Covid-19 disease ? Understand the role of different imaging modalities in the diagnostic approach ? Recognize complications due to invasive and noninvasive treatment modalities ? Be familiar with possible sequelae related to severe disease or prolonged hospital stay

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INTRODUCTION- Epidemiology- Mechanisms of disease / pathologic pathwaysPULMONARY COMPLICATIONS- Exacerbated inflammatory response- Thrombotic and embolic complications- Treatment-related complications CARDIAC COMPLICATIONS-Exacerbated inflammatory response- Thrombotic complicationsABDOMINAL COMPLICATIONS- Exacerbated inflammatory response on parenchymatous viscera- Hypoxic-ischemic complicationsNEUROLOGIC COMPLICATIONS- Cerebrovascular events- Diffuse leukoencephalopathy and microhemorrhages- Treatment-related complications MUSCULOSKELETAL COMPLICATIONS- Peripheral neuropathies- Hemorrhagic complicationsSEQUELAE POST SEVERE INFECTION- Late post-inflammatory findings on lung parenchyma-Persistent symptoms after infection resolution- Chronic sequelae due to prolonged hospitalization

MSEE-112   What Is This? - Imaging Of Unusual Complications In An Oncologic Hospital

Participants
Andre De Freitas Secaf, MD, Barretos, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Oncological patients can present several clinical and surgical complications that may or may not be associated with the underlying disease, as well as complications due to invasive procedures. These may result in a myriad of imaging findings which, if misinterpreted, can significantly affect clinical outcome. Therefore, imaging plays a crucial role both in the initial diagnosis and in the therapeutic management of these acute conditions. The objectives of this Educational Exhibition are to describe and discuss the radiological findings of patients with complications related to treatment of cancer, whether invasive or not; to make radiologists aware of these findings, deemed uncommon even in large cancer centers; and to perform a literature review related to each reported complication, through a series of cases. Radiologists must be familiar with these diagnoses, as it may prove helpful when interpreting challenging imaging findings in the acute setting at cancer treatment centers.

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1. Introduction; 2. Case reports of unusual oncology complications such as intestinal pneumatosis due to esophageal mucositis; infected liver metastases; gas in the portomesenteric system after rectal endoprosthesis; fistula between the colon and L5-S1 disc space; migrated esophageal stent evolving with discitis; jejunogastric intussusception after abdominal surgery; radiation-induced large-vessel arteritis; fracture and migration of a venous catheter; 3. Discussion.

MSEE-113   Photon Counting Detector CT A New Powerful Addon Tool To Forensic Autopsy.

Participants
Anders Persson, MD, PhD, Linkoping, Sweden (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of these lecture is to present the potential superiority of new high resolution photon counting detector prototype CT (PCD-CT) in comparison with a standard CT (EID-CT) for postmortem imaging.The lecture will present the new technology and image examples from several forensic cases were PCD-CT may contribute important new information in cases such as identifications, battered children, gunshot wounds, traffic accidents, and air embolisms.

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Photon Counting Detector CT has many advantages such as significantly higher resolution and reduced blooming artifacts from metal. K-edge imaging provides potential for tissue quantification and accurate volume determinations of foreign bodies such as bullets and other non-body materials. The technology is currently only available for research.We have used a prototype PCD-CT system from Siemens (PCD-CT; SOMATOM CounT Plus; Siemens Healthineers, Forchheim, Germany) since more that a year for postmortem imaging. The PCD-CT has been used in comparison with an energy integrating detector CT (EID-CT; SOMATOM Force; Siemens Healthineers, Forchheim, Germany) for forensic examinations.The PCD-CT allows visualisation of implant-bone interface and non-body material with higher resolution. It also provides superior delineation of trabecular bone compared to conventional CT due to smaller detector elements allowing for thinner slice thickness and a large image matrix of 2048 x 2048 pixels and 9 microns resolution.

MSEE-114   Interpreting Whole Body MRI In Oncological Imaging: A How-to Guide For The Novice

Participants
Naami McAddy, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

There are recognised roles for whole-body diffusion-weighted MRI (WB-DWI-MRI) in staging and response assessment, especially in tumours where bone disease predominates.The combination of DWI and Dixon derived T1W relative fat fraction sequences allows differentiation between normal bone marrow, active disease and post treatment scarring. By combining DWI with anatomical sequences, WB-DWI-MRI has increased accuracy in detection of liver, peritoneal and serosal bowel disease. It allows prompt detection of complications such as metastatic spinal cord compression (MRI gold standard), fractures, hydronephrosis (does not require contrast) and local tumour complications.The radiologist should be aware of limitations and pitfalls of WB- DWI- MRI such as low accuracy for subcentimetre nodes and lung metastases. Familiarisation with well know MRI artefact such as those due to prostheses is also essential. A systematic approach facilitated by template reporting can highlight review areas e.g. skull base and hypophysis, reducing the risk of overlooking disease or complications.

TABLE OF CONTENTS/OUTLINE

1) Imaging protocol and optimisation 2) Detecting disease a) Bone marrow i) Identifying normal bone marrow & variants ii) Identifying active disease b) Viscera c) Peritoneal & Nodal disease d). Local disease 3). Assessing response a) Bone marrow specific response patterns b) Systemic response 4) Pitfalls and Limitations 5) Template reporting

MSEE-116   Paraneoplastic Syndromes From Head To Toe; Pathophysiology, Imaging Features And Workup

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Mohamed Badawy, BMBCh, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

• • List most common paraneoplastic syndromes associated with various neoplasms • Discuss the clinical and multimodality imaging features of the various paraneoplastic syndromes • Illustrate an algorithmic approach for the most common paraneoplastic syndromes by anatomical body systems • Describe pitfalls in imaging diagnosis

TABLE OF CONTENTS/OUTLINE

• Introduction: definition, epidemiology, pathogenesis • Clinical significance of paraneoplastic syndromes • Incidence and onset of paraneoplastic syndromes related to pertinent malignancy • Paraneoplastic syndromes: Ø Target patient population Ø Clinical manifestations Ø Radiological features Ø Most common neoplasms associated with; o Nervous system: § Cerebellar degeneration § Limbic encephalitis § Cranial and peripheral neuropathy § Spinal myelopathy § Lambert Eaton Myasthenic Syndrome, Myasthenia Gravis o Endocrinal § ACTH dependent and independent Cushing syndrome § Parathyroid hormone-related peptide and its effect on bones o Polymyositis/Dermatomyositis o Musculoskeletal § Oncogenic osteomalacia § Hypertrophic osteoarthropathy, § palmar fasciitis, arthritis o Autoimmune like manifestations (e.g. panniculitis, scleroderma, rheumatoid arthritis) o Summary o Conclusion

MSEE-117   Autoimmune Diseases Of The Gastrointestinal Luminal Tract; Pathophysiology, Imaging Findings And Workup

Participants
Mohamed Badawy, BMBCh, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Discuss multi-modality imaging features of autoimmune diseases affecting the gastointestinal luminal tract Algorithmic approach to the differential diagnosis of findings in each affected organ Potential imaging pitfalls

TABLE OF CONTENTS/OUTLINE

• Introduction • Anatomical background • Pathophysiology of Immune-mediated gut disorders• Epidemiology, risk factors and types of immune response • Common clinical presentation of bowel involvement in autoimmune disease • Role of diagnostic imaging in the evaluation of bowel disease.o Fluoroscopyo Computed tomography (CT) o Utility of dual-energy CT maps in evaluation of bowel diseaseo MRI/CT enterography techniques• Anatomical-based approach to immune-mediated bowel diseases.(Foregut, Midgut, Hindgut)• Primary intestinal autoimmune diseases (Clinical manifestations and imaging findings)o Celiac disease o chronic intestinal pseudo-obstructiono Crohn's diseaseo Ulcerative colitis• Secondary intestinal involvement in autoimmune conditions (Diagnostic approach, Common imaging features) o Esophagus (scleroderma; achalasia, Chagas disease)o Stomach (autoimmune gastritis)o Small bowel (celiac disease, inflammatory bowel disease)• Large bowel (inflammatory bowel disease, Hirschsprung's disease)• The immunocompromised patiento Graft versus host disease • Conclusion

MSEE-12   End-stage Kidney Disease: Renal And Extrarenal Imaging Features

Participants
Dyan V. Flores, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

End-stage kidney disease occurs when GFR is permanently lower than 15 ml/min/1.73 m2. Imaging features of end-stage renal disease include both renal and extrarenal findings. Renal findings include chronic kidney failure, polycystic kidney disease, acquired cystic renal disease and transplant-related complications. Extrarenal findings involve a wide spectrum of abnormalities from the more common musculoskeletal manifestations (i.e. renal osteodystrophy, brown tumors, osteosclerosis) to the much rarer encapsulating peritoneal sclerosis. Thrombosis and pseudoaneurysms are potential vascular access complications.

TABLE OF CONTENTS/OUTLINE

Renal • Polycystic kidney disease • Chronic renal failure • Acquired cystic renal disease • Renal neoplasms • Transplant-related

Renal • Polycystic kidney disease • Chronic renal failure • Acquired cystic renal disease • Renal neoplasms • Transplant-related complications Extrarenal Musculoskeletal Secondary hyperparathyroidism Osteosclerosis, osteoporosis Osteomyelitis Avascular necrosis Thoracic Interstitial and alveolar edema Pleural effusion Lung atelectasis Calcifications of the bronchial walls, pleura and chest wall vessels Ground-glass opacity Bronchiectasis Cardiovascular CHF, left ventricular afterload Neurologic Focal white matter lesions Hypertensive encephalopathy, PRES Cerebral infarction Intracerebral hemorrhage Gastrointestinal Spontaneous hemorrhage Encapsulating peritoneal sclerosis Vascular and soft tissues Metastatic calcifications Dialysis access complications Thrombosis, pseudoaneurysms

MSEE-120   Imaging Of Systemic Vasculitis: A Multimultimodality Review

Participants
Mariano Volpacchio, MD, Buenos Aires, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching points 1. To review current nomenclature and classification of systemic vasculitis 2. To review imaging modalities and discuss strenghs and limitations thereof in diagnosis and follow-up 3. To discuss imaging findings of various systemic vasculitides with clinical information relevant to diagnosis 4. To offer diagnostic clues to proper interpretation with a pattern-based approach considering underlying pathophysiologic basis

TABLE OF CONTENTS/OUTLINE

Table of Contents • An Introduction to systemic vasculitis • Role of Different Imaging Modalities • Large Vessels Vasculitides • Medium-sized Vessels Vasculitides • Small Vessels Vasculitides • Conclusion Outline Systemic vasculitides represent an heterogeneous group of entities affecting different organ systems with varied clinical presentation thus, posing a diagnostic dilemma for clinicians. Further compounding this limitation, imaging findings, particularly in small vessel vasculitides, are often nonspecific. Nevertheless, a systematic, pattern-based imaging approach integrated with active interdisciplinary discussion is key to hone in on the right direction regarding diagnosis and management. The role of the radiologist has become of utmost importance provided that He or She is familar with the array of clinical and imaging presentations. Our goal is to review nomenclature and current classification scheme of systemic vasculitis, to describe imaging findings in various organs systems with a systematic, pattern-based approach on different modalities.

MSEE-121   Imaging Histiocytosis Cell´s Diseases. From Head To Toe.

Participants
Daniel Sebastian Chaves Burbano, MD, , Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Recognize the different types of dendritic cells, their origin and some pathologies that can be diagnosed and followed by imaging findings. - Identify the different imaging modalities that can be used in the histiocytosis cells disease.- Describe the findings of the post infiltrative and proliferative changes caused by the dendritic cells, especially the Langerhans cells. - The dendritic cells disease approach is not easy, but with anatomy distribution identified in images the approach can be improved.

TABLE OF CONTENTS/OUTLINE

- Introduction. - Pathophysiology of the dendritic cells disease. - Imaging modalities. - X-ray.- Nuclear medicine.- PET-CT.- CT.-
MRI.Anatomy distribution of the disease.- Brain.- Lung.- Gastrointestinal.- Genitourinary.- Musculoskeletal.- Spine.-
Others.Conclusions.Bibliography.

MSEE-123-HC   Looks Can Be Deceiving: Imaging Findings Of Cosmetic Procedures For Gluteal Augmentation

Participants
Maria Lucia Brun, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To outline the normal anatomy and surgical pockets of the gluteal region on different imaging modalities, essential for gluteal augmentation.• To explain the usefulness of the different imaging modalities in the assessment of gluteal augmentation.• To review the role of the radiologist in the diagnosis and recognition of complications derived from gluteal augmentation procedures.• To exemplify, through representatives cases, the normal appearance of different gluteal augmentation techniques and its postprocedural complications.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Essential anatomy3. Types of gluteal augmentation procedures and techniques4. Role of the radiologist. 5. Imaging modalities in assessment of gluteal augmentation procedures (US, CT, MR, PET-CT)6. Normal appearance of different gluteal implants and fillers7. Imaging evaluation of the most common complications8. Summary and conclusions9. References

MSEE-13   Multisystemic Imaging Manifestations Of Connective Tissue Diseases

Participants
Dyan V. Flores, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

The connective tissue diseases or disorders (CTDs), also known as collagen vascular diseases, form a heterogeneous group of conditions that are linked by a disease process that mainly affects the connective soft tissues and vasculature of the body. These abnormalities may share not only derangements of structural proteins such as collagen and elastin, but multisystemic imaging findings. The objectives of this educational exhibit are: • To briefly review basic pathologic concepts of classic and hereditary CTDs • To discuss multisystemic imaging findings common to CTDs • To highlight imaging findings characteristic or unique to each disease

TABLE OF CONTENTS/OUTLINE

Review of basic pathologic concepts: • Systemic lupus erythematosus (SLE) • Systemic sclerosis (SSC) • Sjogren syndrome (SS) • Mixed connective tissue disease (MCTD) • Polymyositis • Dermatomyositis • Marfan syndrome • Ankylosing spondylitis Multisystemic

imaging findings: Neurologic Cerebrovascular disease Intracranial hemorrhage Neuritis, myelitis Dural ectasia Pulmonary Interstitial lung disease Pneumonias Cardiac Pulmonary arterial hypertension Myocardial fibrosis GIT Esophageal dilatation Bowel derangement (dilatation and inflammation) Vascular Aneurysms, ectasias Thrombosis Vasculitis Extremities and soft tissues Arthropathy Myositis and fasciitis Osteomyelitis and septic arthritis Calcifications

MSEE-14   Emergencies In Congenital Heart Disease

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the common and uncommon emergency presentations in congenital heart disease (CHD)2. To understand the role of multimodality imaging, especially CT and MRI in the management of these patients3. To illustrate the CT and MRI appearances of emergent CHD presentations4. To provide a diagnostic algorithm in the management of these patients

TABLE OF CONTENTS/OUTLINE

IntroductionCauses of emergent presentation in CHDImaging approach- Chest radiograph, echocardiography, CT, MRICT and MRI protocols for the emergent presentation of CHDDiscussion and illustration of the following emergencies in congenital heart disease, focusing on imaging findings and scan techniquesA. Acute chest pain- Prevalence of CAD same as in general population- ACS in anomalous coronary origins, repaired coronary arteries including TGA, Bentall procedureB. Arrhythmias- Identifying substrateC. Heart Failure- Cardiac cirrhosisD. Infective endocarditis in conduits/prosthetic valvesE. Thromboembolic complications-- Fontan shunt, prosthetic valves, stents, grafts, chronic cyanosis (Eisenmenger syndrome)- Fontan circuit thrombus vs contrast mixing-----CT scanning techniques- Foot and upper extremity injection; Delayed scan-----MRI scanning technique- Feraheme- Pulmonary embolism- Paradoxical embolism- Air embolismF. Constrictive pericarditisG. Baffle complications- Stenosis-- LeakH. RuptureI. Aortic dissection, rupture in Bicuspid/quadricuspid valvesJ. Pulmonary AVMsK. MAPCAsL. Pulmonary or mediastinal abnormaliteis

MSEE-15   Astronomy And The Classical Elements Signs In Radiology

Participants
Raquelle El Alam, MD, Beirut, Lebanon (*Presenter*) Nothing to Disclose

TEACHING POINTS

When interpreting findings on imaging, radiologists rely on their sense of pattern recognition to establish either a pathognomonic diagnosis or a comprehensive differential diagnosis. These patterns can come together to resemble objects or phenomena encountered in everyday life. We present in this pictorial review a group of radiological disease manifestations resembling cosmic and celestial bodies, as well as ones seen in nature around us, providing a broad collection of classic signs aiming to assist training radiologists in the recognition and diagnosis of a multitude of pathologies. In this review we discuss several signs seen on different imaging modalities, spanning all fields of radiology. For every sign, we included an image from the database of our institution with a description of the pathology, coupled with an illustration of the corresponding sign seen in nature to highlight the resemblance between the two.

TABLE OF CONTENTS/OUTLINE

I. Introduction/background II. Cosmic signs 1. Celestial bodies in motion (comet tail, twinkling) 2. Our galaxy and beyond (galaxy, milky way) 3. The night sky (loss of halfmoon overlap, crescent, pie in the sky) 4. Among the stars (star field, starry sky, sunburst, halo) III. Terrestrial signs 1. Earth (the earth heart, no man's land, matterhorn, mount fuji, rolling stone) 2. Ice (tip of the iceberg, snowstorm, snowman, snowcap) 3. Water (chain of lakes, whirlpool, whirl, fluid fluid, air fluid, geyser) 4. Fire (flame shape, ring on fire, brain on fire) IV. Conclusion

MSEE-16   Adverse Effects In The Brain, Head ; Neck, And Spine Associated With Immune-checkpoint Inhibitors And Molecularly Targeted Drugs

Awards
Certificate of Merit

Participants
Ryo Kurokawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

We summarize the variety of clinical and radiological findings of the adverse effects associated with immune checkpoint inhibitors (ICIs) and molecularly targeted drugs (MTDs) in the brain, head & neck, and spine.

TABLE OF CONTENTS/OUTLINE

I. What are ICIs and MTDs? The concept of ICIs and MTDs; Types of ICIs and MTDs; Types of adverse effects associated with ICIs and MTDs II. ICI-associated adverse effects Brain: Encephalitis; Cerebellitis; Aseptic meningitis; Guillain-Barre syndrome; PRES; Vasculitis; Demyelination; Hypophysitis; Ataxia; Polyneuropathy; Infection Head & Neck: Optic neuritis; Thyroiditis; Scleritis; Vogt-Koyanagi-Harada disease-like uveitis; Sjogren syndrome Spine: Myelitis; Aseptic meningitis; Demyelination III. MTD-associated adverse effects Brain: Tumor pseudoprogression/pseudoresponse; Leukoencephalopathy; PRES; Cerebral hemorrhage; ANCA-associated vasculopathy; Demyelination; RPLS; PML Head & Neck: DRONJ; Nasal septal perforation; Cervical artery dissection; Brachial neuritis; Guillain- Barre syndrome; Optic neuritis; Hypothyroidism Spine: Meningitis; Demyelination; CIDP Summary 1. Patients receiving ICIs or MTDs can develop various types of adverse effects in the brain, head & neck, and spine. Summary 2. Knowledge of clinical and radiological findings can help differentiate adverse effects from tumor metastasis or dissemination. Summary 3. The development of ICIs and MTDs is rapidly advancing, so we should keep up with the relevant clinical and radiological findings.

MSEE-17   One Space, Many Pathologies: A Pictorial Case Based Review Of The Presacral Space.

Awards
Cum Laude

Participants
Sean Mendonca, MD, Morristown, New Jersey (*Presenter*) Nothing to Disclose

TEACHING POINTS

The presacral space is an important pelvic extraperitoneal space posterior to the rectum and anterior to the sacrococcygeal spine. A wide variety of pathological processes can occur given its unique location and internal contents. These range from developmental/congenital masses to a variety of benign and malignant tumors as well as pseudotumors and infectious/inflammatory processes. Post-surgical alterations and complications can also frequently be seen. This exhibit aims to:Review anatomic relations of the presacral space.Review common and uncommon presacral pathologic processes utilizing a case-based approach.Review common surgical procedures and complications involving the presacral space.

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-Anatomy of the presacral space.-Case based approach review the following common and uncommon pathologies:Congenital/Developmental: Tailgut cyst, Sacrococcygeal teratoma.Benign Tumors: Neurogenic Tumors, Extra-Adrenal myolipoma, giant cell tumor.Malignant Tumors: Chordoma, lymphoma, neuroendocrine tumor, metastasis.Miscellaneous: Fibrosis, Ulcerative Colitis, Extra-medullary hematopoiesis.-Infectious/Inflammatory: Abscesses, fistulas.-Post surgical alterations and complications.

MSEE-18   Keys To The Zoo: Body Imaging Manifestations Of Zoonotic Infections

Awards
Identified for RadioGraphics

Participants
David Kraft, MD, Carrollton, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Objective: To review the clinical pearls and key radiologic findings that can aid the body imager in the evaluation of zoonotic infections. Each infection is presented as an unknown case with an exposure history and key radiology images, followed by the diagnosis and discussion slides with additional cases and teaching points.

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1. Bacterial infections: Case-based review of Pasteurella multocida, Bartonella henselae (Cat-scratch disease), Coxiella burnetii (Q fever), Brucella spp., Francisella tularensis (tularemia), and Leptospira spp. infections in humans highlighting helpful clinical clues (including exposure histories) and key radiology findings on cross-sectional imaging studies (including ultrasound, computed tomography, and magnetic resonance imaging) with a focus on thoracic, cardiovascular, abdominal, and musculoskeletal findings2. Parasitic infections: Case-based review of Echinococcus spp., Paragonimus spp., Toxocara spp. (visceral larva migrans), and Dirofilaria immitis infections in humans highlighting helpful clinical clues (including exposure histories) and key radiology findings on cross-sectional imaging studies (including ultrasound, computed tomography, and magnetic resonance imaging) with a focus on thoracic, cardiovascular, abdominal, and musculoskeletal findings

MSEE-19   Forensic Post-mortem CT To Investigate The Cause Of Death: Pictorial Essay

Participants
Wataru Fukumoto, Hiroshima, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Post-mortem computed tomography (PMCT) is valuable for forensic investigations. We present some forensic cases in which PMCT was useful for investigating the cause of death. In dead burn victims, PMCT permits individual identification by revealing the shape of vascular prostheses and dental fillings. The detection of intratracheal soot helps to determine whether death occurred before or during the fire. Heat hematomas, a kind of epidural hematoma, are a specific burn-related finding. In case of strangulation, volume-rendering images facilitate the identification of ligature marks. Laryngohyoid fractures are more easily detected by PMCT than by classic autopsy. Fluid and froth in the airway are usually observed in drowning cases. Swallowed water distends the stomach and the inflow of water fills the paranasal sinuses. Differences between fresh- and salt water affect lung findings and the density of the sinus fluid. In cases with multiple injuries from traffic accidents and falls, PMCT facilitates the detection of organ damage and multiple bone fractures.

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TABLE OF CONTENTS/OUTLINE 1. Burned bodies •Identification of severely burned bodies •Intratracheal soot •Heat hematoma •Chicken fat clots 2. Strangulations •Ligature marks •Laryngohyoid fractures 3. Drownings •Fluid and froth in the airway, stomach and paranasal sinuses •Difference between fresh- and salt water drownings 4. Multiple injuries in traffic accidents and fall injuries •Organ damage and multiple bone fractures •Vanishing aorta

MSEE-2   Standardized Reporting In Lymphoma Radiology (CT, PET-CT, MRI): SIHMIR, A Paradigm Shift

Participants
Sara Zafar, MBChB, MRCP, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

•Review the need for standardized reporting in lymphoma radiology. •Introduce the original 'Specialist Integrated Hematological Malignancy Imaging Reporting' (SIHMIR) framework to radiologists; highlight clinical and research utility.

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•Lymphoma encompasses a wide, complex spectrum of disorders with over 40 non-Hodgkin's and 5 Hodgkin's lymphoma categories currently recognized by the revised WHO classification. •Highlight need for accurate diagnosis of precise histological subtype, as this is vital in ensuring appropriate patient management and optimizing outcome. •Standardized reporting templates already mandated in UK pathology laboratories as per NICE Guidelines and Quality Standards, in an attempt to improve accuracy of histopathological lymphoma diagnosis. •Recognize analogous issues in imaging, with the need for better integration and specialist

interpretation of complex multi-parametric anato-functional imaging (CT, PET-CT, MRI); providing key data-items at staging, interim and 'end-of-treatment' response assessment. •Highlight key prognostic indicators during the patient pathway, including secondary CNS lymphoma risk factors; a high degree of inter-observer variability being a current issue with regards to reporting these items. •Present the original SIHMIR framework, designed as a comprehensive yet practical reporting tool for radiology departments globally, for use in daily clinical practice and research studies together with artificial intelligence applications.

MSEE-20   Lymph Node Anatomy With A Case Review Perspective: A Trip From Neck To Inguinal Region

Participants
Luis Frias Mendez SR, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

The human body is composed of approximately 800 lymph nodes. Knowing the nodal anatomy is essential in identifying the pattern distribution in neoplastic lymph node metastases, systemic disease and local inflammatory process which helps to narrow the final diagnosis.Various attempts have come to a consensus on the evaluation of the regional metastasic disease such as the IASLC node map and the pathways of dissemination of gastric cancer according to the Japanese Gastric Cancer Association and others like RECIST that gives a reproducible way to measure the treatment response during the follow-up of these patients.Systemic diseases like tuberculosis are capable of affecting from neck to the gastrointestinal tract, especially in immunocompromised patients with necrotic centre adenopathies as a hallmark feature.In benign settings, the presence of inflammatory lymph node in specific locations helps in the diagnosis such as appendicitis and now with vaccinated patients in the COVID-19 era.

TABLE OF CONTENTS/OUTLINE

Introduction to lymph node, Inflammatory lymph node vs Adenopathy, Lymph node levels of the neck, Thoracic IASLC lymph node map, Extrathoracic lymph nodes, Abdomen lymph node anatomy, pelvic lymph node anatomy

MSEE-21   Emergence Of AI In Emergency Radiology: Applications, Approaches, Benefits ; Challenges

Participants
John Zhu, BSC, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

By viewing this exhibit, participants will be able to: 1) Recognize that radiological artificial intelligence (AI) has the potential of becoming a powerful tool to increase efficiency and accuracy in patient care in the age of mounting radiologist burden. 2) Describe how AI can potentially be integrated into the emergency radiology workflow. 3) List acute conditions to which machine learning (ML) techniques have been applied, in terms of detection, segmentation & classification of neurovascular, thoracic, orthopedic & abdominal pathologies. 4) Recognize that while a wide variety of AI algorithms exists, the same goal can be accomplished by vastly different approaches. 5) Describe challenges faced by current AI technologies related to development, ethics & adoption. 6) Recognize that while radiological AI is rapidly developing, it is not expected to replace all roles of radiologists in the foreseeable future. 7) Describe the roles radiologists play in the uptake of AI technologies, and how to get involved.

TABLE OF CONTENTS/OUTLINE

1) Overview & definitions of common AI terms 2) Potential benefits of AI in emergency radiology 3) Stages of workflow benefitted by AI 4) AI approaches being explored 5) Applications in acute conditions - neurovascular, thoracic, orthopedic, abdominal 6) Current & future challenges 7) Outlook of AI

MSEE-22   Expect The Unexpected When They're Expecting: Imaging Of Acute Non-Traumatic Abdominal Pain In Pregnancy

Participants
Koween Vencatasawmy I, MBChB, Leicester, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Imaging is vital to elucidate the cause of non-traumatic abdominal pain in pregnancy as accurate clinical diagnosis is hampered by anatomic and physiologic factors. Delayed diagnosis can confer worse neonatal and maternal outcomes.Ultrasound is often used as the first line modality, with MRI suitable at all gestational ages as a second line tool - gadolinium is relatively contraindicated.Diffusion-weighted imaging and fat-saturated SSFSE sequences allow detection of inflammation and fluid, gradient echo for appendix patency and T1 sequences for haemorrhage.Diagnoses involving multiple organ systems may be made, enabling prompt treatment.Dilatation of the ovarian vein and proximal ureter are physiologic but may be mistaken for appendicitis.

TABLE OF CONTENTS/OUTLINE

Outline of imaging modalities available and their strengths and weaknesses.Description of MRI protocol with rationale for sequence choice.Examples of normal studies with focus on identifying key structures and an approach to a non-visualised appendix.Appearances of uncomplicated and complicated acute appendicitis.Multimodality review of other diagnoses involving different systems: (a) Gastrointestinal: bowel obstruction, intestinal ischaemia, epiploic appendagitis (b) Gynaecologic: degenerating fibroids, ectopic/heterotopic pregnancy, ovarian mass and torsion (c) Hepatobiliary: cholecystitis, acute pancreatitis (d)Urologic: pyelonephritisExpected normal findings such as ovarian vein distension and physiologic hydronephrosis.

MSEE-23   Periarticular Calcifications

Participants
Mayuran Saththianathan, MBChB,MS, Westmead, Australia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Differentiating between calcifications and ossification followed by systemically reviewing different etiologies is a method of generating a list of differential diagnoses when assessing peri-articular mineralization.2. A list of conditions leading to peri-articular calcifications can be further subdivided into multi-regional and single region involvement to assist in diagnosing.3. Ossifications tend to be post-traumatic whereas calcifications although having variable etiologies, are associated with crystalline causes. 4. Mineralization can be broadly categorised into dystrophic and metabolic causes.

Periarticular calcification and ossification is a frequent finding on imaging and may sometimes pose a diagnostic challenge. The differential diagnoses for this radiological finding can be classified into broad groups such as idiopathic, developmental (accessory ossicles/sesamoids), trauma (myositis ossificans & avulsion fracture), burns, infection, tumor (synovial sarcoma, soft tissue chondroma & intracapsular chondroma), connective tissue disease (scleroderma), crystalline (gout, CPPD & HADD), metabolic (end stage renal disease, vascular (atherosclerotic plaques, Monckeberg media sclerosis & vascular malformation) and foreign bodies. This presentation aims to review the clinical-radiologic findings of periarticular calcified or ossified lesions as well as mimickers of periarticular mineralisation with relevant imaging illustrations.

MSEE-24   Globe Injuries In Emergency Radiology

Awards
Certificate of Merit

Participants
Matthew Lee, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review normal ocular anatomy on CT.To review different types of globe injuries.

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Normal Globe Anatomy on CTAnterior Chamber InjuriesCorneal lacerationHyphemaLens InjuriesPartial lens dislocationComplete lens dislocationPosterior Segment InjuriesVitreous hemorrhageRetinal detachmentChoroidal detachmentGlobe RuptureDirect signs of open-globe injuries: altered globe contour/volume, scleral discontinuityIndirect signs of open-globe injuries: altered anterior chamber depth, foreign body/air

MSEE-25   Revisiting Hyper Dense Lesions On Unenhanced Head CT- Correlation With Brain MRI And Contrast Enhanced CT Imaging

Participants
Alka Gupta, MBBS, Syracuse, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Unenhanced head CT is a commonly utilized study in varied clinical settings. In emergency settings, it acts as a sensitive tool for detecting lesions that require immediate neurosurgical intervention with added value as a screening tool for triage. Hyper attenuation on CT is a commonly encountered and often non specific finding with broad differentials ,that needs to be interpreted in appropriate clinical context for efficient confident diagnosis. Substantial overlap in imaging appearances of these lesions can often confound diagnosis. Further evaluation with advanced imaging including contrast enhanced CT, CT angiography, dual energy CT and brain MRI is important for narrowing down the differential diagnoses, thus enabling timely intervention.

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Hyperattenuation on unenhanced head CT is a commonly encountered and often non specific finding with broad differentials. A comprehensive list of acute and chronic brain diseases and conditions, that can present as hyper attenuation on unenhanced CT will be presented. The imaging findings of these lesions on head CT will be systematically evaluated based on their pattern of distribution, multiplicity, location and anatomic relationship to formulate a differential diagnosis. The lesion characteristics will be further illustrated utilizing contrast enhanced CT, CT angiography, dual energy CT or Brain MRI for problem solving thus classifying them into broad categories such as traumatic, infectious, vascular, neoplastic, metabolic and congenital disorders.

MSEE-26   Treatment Response Assessment In Lymphoma Radiology: Utility Of PET-CT, Deauville Classification, The New RECIL And LyRIC Criteria.

Participants
Sara Zafar, MBChB, MRCP, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

•Identify clinical indications for CT and FDG-PET CT imaging in interim and end-of-treatment (EOT) response assessment in non-Hodgkin's lymphoma (NHL).•Review currently utilized tools in assessing disease response, including the Deauville classification (DC) and newer criterion, such as the Response Evaluation Criteria in Lymphoma (RECIL) and Lymphoma Response Criteria in Immunomodulatory Therapy (LyRIC).•Understand concepts of disease tempo and potential low-high transformation.

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•Accurate response assessment is essential for optimizing patient management. •Highlight specific utilities of FDG-PET CT in interim and EOT response assessment, for example being advocated at EOT response in high-grade NHL subtypes including diffuse large B-cell and Burkitt's lymphoma, whilst not routinely recommended in low-grade NHL or at interim response in DLBCL due to false-positive activity, particularly observed with rituximab-based regimens; CT imaging instead advised. •Utility of DC in allocating overall response category at EOT response assessment, based on FDG-avidity of lesions.•Importance of stating Deauville score (DS) in all PET-CT reports. •Limitations and nuances of DS, specifically the DS 'X' score. •Simplified new RECIL response assessment methodologies, including new response category of 'minor response,' with case-based examples of its utility. •Review new LyRIC modification, with 3 'indeterminate response' categories, in the context of novel immunomodulatory therapy in the lymphomas.

MSEE-27   An Outsider In The Emergency Room: An Overview Of The Abdominal Foreign Bodies In The Acute Setting, Differentiating Expected Findings From Complications

Participants
Daniel Montel, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Recognize the importance of active search for foreign bodies, mainly after positive history.• Identify and characterize the

different kinds of foreign bodies, looking for the optimum window, to avoid missing non-radiopaque objects.• Demonstrate the main imaging findings in emergencies related to foreign body complications such as perforation, occlusion and infection.• Demonstrate how to recognize normal findings in therapeutic materials in the gastrointestinal and genitourinary tracts, not classified as incidental foreign bodies.

TABLE OF CONTENTS/OUTLINE

1. Introduction.2. Expected attenuation of the different foreign body materials (metal, plastic, wood, glass, bones, etc).3. Foreign bodies in the gastrointestinal and genitourinary tract arising from ingestion or introduction through natural orifices, such as anus, vagina, and, less frequently, the urethra.4. Foreign body complications such as perforation, gastrointestinal occlusion, and infection.5. Iatrogenic post-surgical foreign bodies.6. Demonstration of normal aspects of foreign bodies after therapy and eventual ectopia.7. Take home messages.

MSEE-28   **How To Get Through The Night-Diagnostic Approach To Acute Intracranial Hemorrhage**

Participants
Nicolas Murray, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Differential diagnosis of acute intracranial hemorrhage (AIH) is broad. A compartmental/distribution approach is key in narrowing the differential diagnosis. In the trauma setting, AIH is commonly the result of the traumatic injury, but may also represent or may point towards a causative factor precipitating a trauma. Vascular studies are key in identifying a vascular lesion (aneurysm, vasospasm, extravasation, AVM, venous thrombosis) as a cause of AIH. Potential complications related to AIH must be assess on every study with AIH.

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This poster will present the various types of traumatic and spontaneous AIH, including hemorrhage related to trauma (epidural, subdural, subarachnoid, intraventricular, diffuse axonal injury, Kernoan notch, Duret hemorrhage), vascular lesions (aneurysm, arterio-venous malformation), venous thrombosis, vascular dysregulation (hypertensive hemorrhage, PRES, RCVS), vasculitis, benign perimesencephalic hemorrhage. Examples will be provided as well as summary decisional trees in order to help the radiologists navigate through the potential causes of AIH, and determine when a vascular study (CT/MR angiogram +/- venogram) is needed. Complication of acute intracranial hemorrhages will also be discussed (intracranial herniation syndromes, secondary ischemic changes, extension of hemorrhage into the adjacents spaces, active extravasation and delayed expansion, vasoconstriction), as well as utility of dual-energy CT in detection and characterization.

MSEE-29   **Chondrosarcoma From Head To Tail : A Pictorial Review Of Chondrosarcomas Outside The Appendicular Skeleton**

Participants
Margaret Adejolu, FRCR,MRCP, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Overview of 2020 WHO pathological classification of chondrosarcomas 2. Recognizing the Imaging appearances of chondrosarcomas presenting at uncommon sites and their differential diagnosis 3. Understanding the clinical course and patterns of metastases.

TABLE OF CONTENTS/OUTLINE

1. 2020 WHO pathological classification of chondrosarcomas. 2. Secondary Chondrosarcomas. 3. Typical imaging appearances of chondrosarcomas and correlation between tumor grade and MRI appearances 4. Chondrosarcoma of the skull base 5. Chondrosarcoma of the Nasal septum 6. Chondrosarcoma of the maxillary antrum 7. Laryngeal and tracheal chondrosarcoma 8. Chondrosarcoma of the costal cartilages 9. Chondrosarcoma of the sternum 10. Chondrosarcomas involving thoracic and abdominal viscera 11. Chondrosarcomas involving the pelvis and perineum.

MSEE-3   **A Walk To Not Remember: A Detailed Review Of Pedestrian Versus Motor-vehicle Injuries At A Level 1 Trauma Center**

Participants
Andrew Mitchell, MD, Memphis, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review most common injuries associated with automobile vs pedestrian trauma. Data will be from over 150 cases reviewed at our trauma center and from previously published data. 2. Show examples of common resident "misses" and what subtle radiographic injuries to evaluate for. Common misses include vascular injury, bowel/mesenteric injury, and relevant additional fracture findings. 3. Examples of cases that needed advanced imaging (MRI/DSA) to confirm results or identify associated injuries. 4. Show examples of initially normal scans that later demonstrated traumatic findings.

TABLE OF CONTENTS/OUTLINE

1) Background: Epidemiology and general overview of auto vs pedestrian traumatic findings, which often include pelvic, extremity, bowel, and intracranial injuries. 2) Case based review of common auto vs pedestrian/blunt trauma injuries and a review of recent research on the topic. 3) Case based presentations of common resident/community misses and pitfalls, including pearls to improve detection. Cases include secondary findings that require advanced imaging or delayed findings found on follow-up imaging. 4) Summary: Conclusions/References

MSEE-30   **Imaging Foreign Bodies In Trauma**

Participants
Ivica Bratanovic, MSc, Port Moody, British Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Foreign body (FB) deposition can result from various types of penetrating trauma?. Traumatic FB diversity and their common

1. Foreign body (FB) deposition can result from various types of penetrating trauma2. Traumatic FB diversity and their common clinical and imaging presentations are important to recognize3. Understand the importance of the traumatic mechanism and its anatomical location is key in establishing a plan to evaluate FBs with imaging4. Recognition of the imaging signs of common complications of traumatic FBs is essential

TABLE OF CONTENTS/OUTLINE

- Introduction to foreign body (FB) imaging, modality selection, and utility- Overview of trauma mechanisms that can lead to deposition of FBs- FB diversity and the impact of composition on imaging modality selection- Evaluating patients with suspected traumatic FB based on clinical signs and mechanism of trauma- Imaging traumatic FBs based on anatomical location- Imaging characteristics of common complications of traumatic FBs based on mechanism- Utility and safety of MRI in evaluating patients with FBs in an emergency trauma setting- Clinical Cases- Summary and key points moving forward

MSEE-31   Who Are You Calling Fat? A Review Of Fat-containing Lesions In The Abdomen And Pelvis

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Certificate of Merit

Participants
Anthony Larder, DO, Milford, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Review multimodality imaging findings of fat-containing lesions in the abdomen and pelvis including pearls and pitfalls to aid in diagnosis-Discuss pathophysiology and clinical implications of various fat-containing lesions-Review imaging findings of syndromes associated with fat-containing lesions

TABLE OF CONTENTS/OUTLINE

General Concepts:-Identifying macroscopic vs. microscopic fatDiscussion of imaging findings and clinical implications of fat-containing lesions. Modalities include CT, MRI, US, fluoroscopy, angiography, and PET-CT. Case examples include:-Adenomas-Angiomyolipoma of the kidney, liver, and spleen-Fat-containing hepatocellular carcinoma-Fat-containing renal tumors-Fatty infiltration/replacement -Fibrofatty proliferation-GI tract lipomas including associated intussusception -Lipoleiomyoma-Liposarcoma including retroperitoneal and scrotal-Myelolipoma, adrenal and extra-adrenal-Omental infarct-Solid organ lipomas-Steatosis-Teratomas-Testicular lipomatosisReview of syndromes associated with fat-containing lesionsCase examples include:-Tuberous Sclerosis-Lymphangioleiomyomatosis-Cowden syndromeSummary and Clinical Implications-Fat-containing lesions are commonly encountered in the abdomen and pelvis-Knowledge of imaging findings of various fat-containing lesions and associated syndromes to is essential to guide diagnosis and management

MSEE-32   Imaging Trauma During Pregnancy

Awards
Cum Laude

Participants
Asir Chishti, Lexington, Kentucky (*Presenter*) Nothing to Disclose

TEACHING POINTS

I. Radiography, Sonography and CT play a crucial role in evaluating the traumatically injured pregnant patient. II. The risk of radiation to the pregnancy is small compared with the risks of missed or delayed diagnosis. III. Placenta abruption is characterized by a large, contiguous retroplacental and/or full-thickness area of hypo enhancement that forms an acute angle with the myometrium. IV. Fetal Injuries are generally uncommon due to afforded protection by maternal body; however, fetal skull injuries are possible in the 3rd trimester with cephalic presentation, often in the setting of maternal pelvic fractures.

TABLE OF CONTENTS/OUTLINE

I. Background (Epidemiology, special considerations in maternal physiology, review of normal pregnancy imaging anatomy) II. Imaging Algorithm (Radiography, sonography (maternal/fetal), computed tomography, fetal dose concerns) III. CT and US imaging examples (Traumatic placental findings, traumatic uterine findings, fetal trauma, maternal trauma) IV. Conclusion (Radiologist should be comfortable evaluating traumatically injured pregnant patients. Knowledge of normal anatomy, injury patterns, imaging limitations and pitfalls can help radiologist avoid diagnostic error.)

MSEE-33   The Leading Role Of The Radiologist In The Assessment Of Retroperitoneal Haematoma: From Diagnosis To Endovascular Treatment

Participants
Dario Herran de la Gala, MD, Santander, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit will: 1) Review the retroperitoneal anatomy and its appearance on CT. 2) Describe CT protocol for evaluating retroperitoneal haematomas. 3) Review the different etiologies of retroperitoneal haematoma. 4) Describe the role interventional radiology has in the treatment of retroperitoneal haematomas.

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Retroperitoneal hemorrhage can be the source of significant but clinically occult blood loss. There are different conditions that can lead to retroperitoneal haematoma (RH) and it is recommended to evaluate RH in multi-phase CT scan, where non-enhanced acquisitions are key. Trauma is the leading cause of RH. In the absence of trauma history, underlying conditions must be scrutinized in order to justify the haematoma: iatrogenic, abdominal aorta aneurysms, inferior vena cava rupture, renal or suprarenal lesions, hemorrhagic pancreatitis or, lastly, spontaneous retroperitoneal bleeding. Evaluating the presence of active bleeding is imperative to discuss whether the patient might benefit from endovascular treatment or not.

MSEE-34   The Manifold Manifestations Of Pheochromocytomas And Paragangliomas, From Head To Pelvis

Participants
Karen Man, BS,MD, Morristown, New Jersey (*Presenter*) Nothing to Disclose

TEACHING POINTS

After viewing this exhibit, the learner will be familiar with:1. The pathophysiology of pheochromocytomas and paragangliomas, as well as major sympathetic and parasympathetic nervous system anatomy.2. Imaging characteristics of adrenal pheochromocytomas across multiple modalities.3. Imaging characteristics and signs of extra-adrenal pheochromocytomas and paragangliomas across a variety of locations in the body, from head to pelvis.4. Multi-system syndromes in which pheochromocytomas and paragangliomas may manifest.5. Pre-treatment optimization and therapeutic options for patients, which may vary according to location or other characteristics of tumors seen on imaging.

TABLE OF CONTENTS/OUTLINE

I. Pheochromocytoma and Paraganglioma Anatomy & PathophysiologyII. Adrenal Pheochromocytomas A. Classic Imaging Characteristics on CT, MRI, and ultrasoundB. Exceptions to the Rule: Cystic PheochromocytomaC. Imaging with Radiotracers Specific to Neuroendocrine TumorsIII. Extra-adrenal Pheochromocytomas and Paragangliomas A. Carotid Body TumorB. Glomus JugulareC. Glomus TympanicumD. Organ of Zuckerkandl TumorE. Miscellaneous Extra-adrenal TumorsIV. Multi-System Syndromes A. Von Hippel-LindauB. Multiple Endocrine Neoplasia SyndromesV. Management and Therapeutic Options

MSEE-35   A Comprehensive Imaging Review Of Elbow Injuries In The Emergency Department

Awards
Identified for RadioGraphics

Participants
Jean Sebastien Rowe, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand the functional anatomy of the normal elbow joint, its intrinsic stability, and the biomechanical forces required to result in a fracture or dislocation.2. Identify the major types of elbow fractures and dislocations, with complications and appropriate recommendations for additional imaging.3. Recognize common injury classification systems used by orthopedic surgeons and what clinically relevant material to add to the radiology report.

TABLE OF CONTENTS/OUTLINE

Elbow injuries are common, representing 15% of upper extremity injuries in the Emergency Department (ED). The elbow joint is a complex hinge-type synovial joint, with several types of common injury patterns. Radial head and neck fractures are the most common elbow fractures in adults; however, distal humeral fractures, ulnar fractures, and complex fracture-dislocations occur with elbow trauma. Radiologists should be aware of the clinically relevant injury classification systems used by orthopedic surgeons, such that they can include relevant information in their reports. This exhibit will review the functional anatomy of the elbow using multimodality imaging. A brief discussion of the common biomechanical forces required to cause a fracture or dislocation will follow. Subsequently, multiple common elbow injuries seen in the ED will be presented on multi-modality imaging. Clinically relevant injury classification schemes and terminology will be discussed, and imaging complications will be reviewed.

MSEE-36   MR Imaging Of Non-obstetric Acute Abdominal Presentations In Pregnancy.

Participants
Elizabeth Robinson, MD, Bristol, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Have a low threshold for performing MRI in acute abdominal presentations in pregnancy. At our institution, the cause of pain was identified >50% of patients.- Scan from diaphragm to pubic symphysis as symptoms may be difficult to localize.-Consider both black blood and white blood sequences - these help to differentiate appendix from parametrial veins, ureters from vessels, and for detecting thrombosed vessels.

TABLE OF CONTENTS/OUTLINE

We present our experience of using MRI to investigate non-obstetric causes of acute abdominal presentations in pregnancy. We illustrate our learning points with cases from our institution.1) Introduction and Objectives-Our experience- findings from a 5 year cohort of 35 pregnant women with acute abdominal presentations-Safety and consent-MRI techniques- key sequences and implementation.2) Appendicitis-Acute appendicitis-Pitfalls of identifying the appendix in pregnant patients.3) Gastrointestinal-Inflammatory bowel disease-Bowel obstruction4) Hepatobiliary-Cholecystitis-Choledocholithiasis5) Genitourinary-Pregnancy-related hydronephrosis-Obstructive hydronephrosis-Acute pyelonephritis6) Vascular-Gonadal vein thrombosis7) Gynaecological-Ovarian torsion-Cervical cancer-Mature cystic ovarian teratoma8) Endocrine-Bilateral adrenal hemorrhage9) Summary of learning points

MSEE-37   Uncovering The Dark Side Of Melanin: Pictorial Depiction Of Head To Toe Imaging Spectrum In Malignant Melanoma

Participants
Ankush Jajodia, DMRD,MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Melanoma accounts for 50% of deaths related to skin cancer and can spread by direct extension, lymphatic, or hematogenous routes and can involve virtually every organ system. The prognosis is dismayed with a median survival of 6-10 months in metastatic disease. 2. T1 hyperintensity on MR imaging gives us clue to the melanotic pattern which is the dominant variety. The amelanotic variety appears as iso or hypointense on MRI. 3. We have largely incorporated the rarer amelanotic type in our pictorial depiction of this entity. This is done to make readers keep in mind this ghastly entity while encountering such cases. 4. Multiple masses with similar signal intensity are characteristic of this entity. However, in few cases, we have presented multiple lesions exhibiting different signal intensities in metastatic uterine cervix cancer. 5. This review serves to present an embodiment of the typical and

atypical multi-modality imaging manifestations of malignant melanomas from head to toe. 6. We have incorporated 18- FDG PET-CT imaging and MR imaging which hasn't been undertaken in previous studies.

TABLE OF CONTENTS/OUTLINE

Aims I. Head A. Scalp B. Brain C. Duramater II. Neck A. Nasal cavity B. Sinus C. Orbit D. Nasopharyngeal E. Cervical spinal canal F. Skull base III. Chest A. Pre-sternal region B. Lungs and pleura C. Breast IV. Abdomen A. Liver B. Spleen C. Gall bladder D. Pancreas E. Peritoneum F. Mesentery V. Pelvis A. Rectum B. Cervix C. Vagina D. Vulva and Clitoris VI. Extremity A. Forearm B. Femur C. Toe

MSEE-38   Imaging IVDU Complications: A Review Of The Most Common Abdominopelvic Imaging Findings.

Participants
Abbas Charlie, DO, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Recognize the increasing incidence of recreational intravenous drug use (IVDU) in the United States and its clinical presentations. Using a multi-modality imaging approach, review some of the most common abdominopelvic imaging findings attributable to IVDU from a busy inner-city hospital that the radiologist may encounter in the emergency setting. Discuss practical imaging tips for aiding and narrowing the differential diagnosis as well as strategies to avoid diagnostic pitfalls.

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Incidence of intravenous drug use in the United States. Review case examples of soft tissue/musculoskeletal infections including cellulitis, abscess, necrotizing fasciitis, discitis/osteomyelitis, and retained foreign body; vascular complications including arterial aneurysm, arteriovenous fistula, thrombophlebitis, and septic emboli; gastrointestinal complications including stercoral colitis/perforation.

MSEE-39   Imaging Features Of The Ectopic Tissues With Embryologic Approach For Correct Diagnosis.

Awards
Identified for RadioGraphics
Cum Laude

Participants
Mariko Kurokawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Understand normal and abnormal human development causing the ectopic tissues or organs.• Recognize clinical and radiological features of these ectopic tissues focusing on the anatomical correlations and genetic factors.• Identify the complications, the differential diagnoses and key findings of the ectopic tissues for the correct diagnosis.

TABLE OF CONTENTS/OUTLINE

I. Introduction to fetal developmentFetal development from zygote to each organ.How does the ectopic tissue develop? - Embryonic rests, Impaired migration, Dissemination, Metaplasia, Iatrogenesis Signaling pathway and gene mutations which cause malformations or affect the development of organ systems.II. Normal and abnormal fetal development Divided into five areas. Brain, Head and neck, Chest, Abdomen, Bone and soft tissue. What is an important point with the aspect of diagnostic radiology?III. Case based review1. Brain: Periventricular nodular heterotopia, Focal cortical dysplasia, Ectopic posterior pituitary, Ectopic pituitary adenoma, Ectopic brain tissue, Nasal glioma2. Head and neck: Ectopic thyroid tissue, Ectopic parathyroid gland, Ectopic thymic tissue, Branchial cleft cyst3. Chest: Ectopic tissues in the lung, Ectopic mammary gland, Ectopic thymus4. Abdomen: Ectopic pancreatic tissue, Annular pancreas, Wandering spleen, Intrahepatic accessory spleen, Adrenal rest tumors, Ectopic kidney, Heterotopic endometriosis, Ectopic tissue in Meckel's diverticulum, Ectopic ureters5. Bone and soft tissue: Ectopic bone formationIV. Summary

MSEE-4   Lymph Node Evaluation In Imaging Response Assessment Criteria: Similarities And Differences

Participants
Tagwa Idris, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

• -To describe lymph node assessment across imaging response criteria • -To compare the criteria to determine nodal assessment similarities and differences • -To recognize the challenges of applying these criteria

TABLE OF CONTENTS/OUTLINE

• -Timeline of imaging criteria using lymph node for treatment response assessment • -Terminology and rules for nodal response assessment • -Similarities and differences across various response assessment criteria • -Case-based scenarios to demonstrate nodal assessment variations in response criteria/categories • -Challenges in image metrics assessment using these different criteria • -Summary and future directions • -References

MSEE-40   Primary Tumors And Tumor-like Lesions Of The Mesothelium And Their Mimics: Cross-sectional Imaging Spectrum

Awards
Identified for RadioGraphics

Participants
Apurva Bonde, MBBS, MD, San Antonio, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Discuss anatomy, embryology & functions of mesothelium covering pleura, pericardium, abdominal organs & testiclesReview imaging spectrum of primary benign and malignant tumors and tumor-like lesions of mesothelium & role of imaging in managementDescribe

the spectrum of non-mesothelial mimics & role of imaging in appropriate diagnosis

TABLE OF CONTENTS/OUTLINE

IntroductionAnatomy, Embryology & Physiology of MesotheliumMesothelium to mesenchymal transition: What is the role in cancer developmentRole of ImagingPericardium: Malignant Pericardial Mesothelioma, benign pericardial proliferations & pericardial cyst; Mimics:Sarcoma, metastases, pericardial lymphoma & tuberculous pericarditisPleura: Malignant pleural mesothelioma; Solitary fibrous tumor, pleural fibrosis secondary to tuberculosis & actinomycetes. Mimics: Metastases, lung cancer & Extrapleural hematoma.Peritoneum including serosal covering of Uterus & Ovaries: Malignant peritoneal mesothelioma & Well-differentiated papillary mesothelioma, solitary fibrous tumor, adenomatoid tumor & benign multicystic mesotheliomaMimics: omental infarction, epiploic appendagitis, primary peritoneal serous carcinoma, peritoneal carcinomatosis, tuberculous peritonitis, peritoneal inclusion cyst pseudomyxoma peritonei, cystic lymphangioma, neurofibromatosis & lymphangiomatosis Tunica vaginalis: Mesothelioma & adenomatoid tumors; Mimics: Hematocele, metastases, lipoma, sarcoma, epididymitis & supernumery testesConclusion

MSEE-41 Tonight I'll Be Eating And Reading: A Review Of Radiology Food Signs

Participants
Jonathan Revels, DO, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Familiarize radiologists with the multimodality imaging appearance and diagnoses associated with "food signs" in radiology. 2. Provide multimodality images of food signs and illustrations to improve their recognition by using pareidolia (ability to perceive random images or patterns as an object or pattern known to the observer).

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Introduction to pareidolia and patternicity and its radiological application Thoracic radiology food signs with case examples and illustrations: Honeycomb-Head Cheese-Mitral Annular Caseous Calcifications-Cheerios Abdominal radiology food signs with case examples and illustrations: Cottage Loaf sign-Nutmeg Liver sign-Lollipop sign-Honeycomb sign-Liver Scalloping sign-Sausage sign-Bean sign-Pancake sign (kidney, adrenal)-Apple core sign- Coffee bean sign-Donut sign-Mushroom sign-Pear shape bladder sign Female pelvis radiology food signs with case examples and illustrations: Swiss Cheese sign-Boba sign-Bagel sign Male pelvis radiology food signs with case examples and illustrations: Onion Skin sign-Eggplant sign-Pie sign Fetal radiology signs with case examples and illustrations: Lemon sign, Strawberry sign, Banana sign Other radiology signs with case examples and illustrations: Omental caking-Lymph node eggshells-Rice Bodies Musculoskeletal and Neuroradiology food signs with case examples and illustrations: Celery stalk metaphysis -- Sausage digits- Onion skin periosteal reaction - Hamburger sign - Carrot stick fracture Summary Table

MSEE-42 Behcet's Disease From Head To Toe

Awards
Certificate of Merit

Participants
Furkan Ufuk, MD, Denizli, Turkey (*Presenter*) Nothing to Disclose

TEACHING POINTS

? To review the entire spectrum of clinical and imaging findings of Behçet's disease. ? To review the Behçet's disease-associated complications and imaging findings.

TABLE OF CONTENTS/OUTLINE

Vascular Involvement: Venous occlusion (most common), arterial occlusion, and arterial aneurysm can be seen in patients with Behçet's disease (BD). Vascular involvement is the most important cause of morbidity and mortality in BD patients.Thoracic Involvement: In patients with BD, both systemic and pulmonary vessels (arteries and veins) can be involved. Moreover, lung parenchyma, mediastinum, and pleura can be involved.Neurologic Involvement: Neurological involvement in BD is rare, and both parenchymal (brain stem, spinal cord) and non-parenchymal (cerebrovascular disorders, aseptic meningitis, and intracranial hypertension) involvement can be seen.Gastrointestinal involvement: Behçet's disease can involve the intestinal venules and cause mucosal ulceration, and mostly involve the ileocecal region. Bowel ischemia can be seen due to mesenteric vein or artery thrombosis.Cardiac Involvement: Cardiac involvement of BD is rare, and myocarditis, pericarditis, and intracardiac thrombosis are the most common presentations.Musculoskeletal Involvement: BD may cause sacroiliitis, avascular necrosis, enthesopathy, and myositis. Hepatobiliary Involvement: BD may cause Budd-Chiari syndrome, portal vein thrombosis, portal hypertension, and sclerosing cholangitis.

MSEE-43 Optimising 3D Printed Physical Models From Imaging: Learning Points, Tips ; Tricks

Participants
Mark Tan, MBBS,FRCR, Singapore, Singapore (*Presenter*) Nothing to Disclose

TEACHING POINTS

This educational exhibit describes various pointers in optimising 3D printed models from CT/MRI imaging. Applications of high resolution physical anatomical models created using additive manufacturing techniques from medical imaging include the rehearsal of complex patient-specific surgeries, the pre-sizing and pre-shaping of surgical plates and screws, the employment of custom made targeting guides, as well as the reconstruction of osseous defects post tumour resection, craniotomy, or joint surgery. Various domains of this process are covered in this exhibit, including image acquisition, image segmentation, image transformation, print protocolling. This exhibit may be of interest to the teams involved in such tasks i.e. radiologists, radiographers, surgeons and biomedical engineers.

TABLE OF CONTENTS/OUTLINE

Optimising 3D models from imaging:The following are non-exhaustive and include:Image acquisitionMetal artefact reduction techniquesDual energy CTMetal Artefact Reduction AlgorithmImage segmentationUtilising multiplanar reconstructions to improve segmentationMultimodal lesion analysisImage transformation (i.e. 3D model manipulation)Closing of large mesh defectsCreating structures to model non critical regions of anatomy to increase print efficiencyModelling tubular structuresPrint protocollingPrinter

technique choice for different applicationsMaterial choice for different applicationsPrint bed sizingOptimising model orientations for print efficiency

MSEE-44   MR Imaging In Ob/Gyn Emergencies: A Practical Guide

Participants
Bernardo Oliveira, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Understand the role of MR imaging in the evaluation of gynecologic emergencies. Proficiently recognize pelvic gynecologic emergencies by MR imaging. Be able to evaluate acute abdominal pain during pregnancy by MR imaging. Be aware of safety issues regarding MR imaging contrast media during pregnancy and lactation.

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Gynecological emergencies and pregnancy-related complications are frequent causes of hospital care among women of reproductive age. Although ultrasonography remains the first-line imaging modality in this setting, when a definite diagnosis is not obtained, Magnetic resonance (MR) imaging plays a role by increasing diagnostic accuracy. Therefore, the emergency radiologist may be aware of MR imaging presentation in gynecologic emergencies, such as adnexal disorders (torsion, hemorrhagic cyst, ectopic pregnancy); complication of uterine fibroids; inflammatory pelvic disease; as well as nonobstetric causes of acute abdominal pain during pregnancy, such as appendicitis and urinary disorders. Eventually, it is also important to address considerations related to safety of contrast media during pregnancy and lactation.

MSEE-45   Imaging In Histiocytic Disorders In Adults: Hard Work But, Let's Make Some "imaging Teamwork".

Participants
Ana Santos Angel, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Histiocytic disorders can rarely affect adults and present nonspecific image findings. The role of the radiologists in the diagnosis is relatively limited but, familiarity with typical radiographic features and putting together with histological findings may promote accurate and timely diagnosis.

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Histiocytic disorders are defined as non-malignant disorders that include some rare multisystem diseases with a wide and heterogeneous clinical radiological spectrum. Langerhans cell histiocytosis is the most common disease and its imaging features are better known. But there are other uncommon diseases in this category such as Erdheim-Chester disease, Rosai-Dorfman disease, juvenile xanthogranuloma, and hemophagocytic lymphohistiocytosis, that should be included in the differential diagnosis. Focusing on CT images and correlating with microscopic histologic images, we present some cases of our hospital including adult patients with histiocytic disorders. We review image findings including locations of involvement and some key radiographic features as "hairy" margins of the kidneys in Erdheim-Chester disease or locations of massive lymphadenopathy in Rosai-Dorfman disease, among others. We also review microscopic histologic images with some clues for the histopathological diagnosis. These findings are nonspecific, but on the whole, its knowledge is important for radiologists and pathologist to get them into account in the differential diagnosis.

MSEE-46   "Why-RADS", A 2021 Update On The Standardized Reporting And Data Systems

Awards
Certificate of Merit

Participants
Kyle Unsdorfer, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

• The American College of Radiology (ACR) Reporting and Data Systems (RADS) are a set of dynamic documents created to address a specific need, but all aim to unify standardized imaging assessment, classification, terminology and reporting • Formal processes are underway to determine the extent and ways in which RADS should be collectively standardized

TABLE OF CONTENTS/OUTLINE

Review• Explore "why" each RADS exist and the historical context behind each RADS creation and adoption • Compare and contrast RADS systems regarding prior biopsy, role of interval change, multiple lesions, and lexiconLearning and Tools• Provide an update on guidelines and reporting systems since prior RadioGraphics Fundamentals article 39:1435-1436 (2019).• Review of ACR RADS: BI-RADS, C-RADS, CAD-RADS, GI-RADS, LI-RADS, Lung-RADS, NI-RADS, *PI-RADS, *O-RADS, and TI-RADS, and Non-ACR/International "RADS": *BT-RADS, CO-RADS, MY-RADS,*VI-RADS, and *PSMA-RADS (*new/updated since 2019) • Provide educational resources and web-based calculator appsFuture• Discuss future directions and potential synergy among current and future RADS • Discuss pros and cons of ACR affiliation-resources, processes, degree of organization involvement, adoption and legitimizing • Discuss aims for consistent scales, terminology, description of lesion biopsy status between systems • Discuss collaboration with clinicians to further improve standardized language and patient management across multiple disciplines

MSEE-47   Lymphoepithelial Carcinoma And Lymphoepithelioma-like Carcinoma: Imaging And Clinicopathological Features Within And Beyond The Head And Neck

Participants
Koji Takumi, MD,PhD, Kagoshima, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Lymphoepithelial carcinoma and lymphoepithelioma-like carcinoma (LEC/LELC) are rare histologic types of solid tumors that arise most frequently in the head and neck and also occur in other anatomic sites such as the lung, thymus, stomach, uterine cervix, bladder, etc. LEC/LELC is characterized by undifferentiated malignant epithelial cells with a prominent lymphocytic infiltration. LEC/LELCs have been reported to be associated with viral infection such as EB virus and HPV. In spite of a high incidence of

regional and distant metastasis when diagnosed, the prognoses for LEC/LELCs are generally better than those of other malignancies in each organ because of high sensitivity to irradiation and antitumor drugs. It is important for radiologists to understand the clinicopathological and radiological features of LEC/LELCs to avoid misdiagnosis and improper patient management as they may be mistaken for metastatic nasopharyngeal carcinoma or lymphoma on biopsy histopathologic specimens. Therefore, we should review and clarify the clinical and imaging features of LEC/LELC of nasopharyngeal and non-nasopharyngeal region. The purpose of this exhibit are: 1. To illustrate the etiology and epidemiology of LEC/LELCs 2. To review the histopathological and radiological imaging features of clinical cases of LEC/LELCs 3. To discuss the differential diagnosis of LEC/LELCs in each organ

TABLE OF CONTENTS/OUTLINE

1. Overview of LEC/LELCs 2. Clinicopathological and imaging features of LEC/LELCs in each organs 3. Limitations of imaging in LEC/LELCs

MSEE-48   Lower Back Pain: Not So Innocuous After All - A Guide For ER Radiologist

Participants
Baran Vardar, MD, Worcester, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Lower back pain (LBP) is a symptom, not a disease, and is one of the most common causes of emergency room (ER) visits in the United States. It is estimated that at least 80 percent of adults have one episode of low back pain during their lifetime. Although most LBP results from a lumbar strain and does not warrant further workup, more emergent or serious underlying conditions, including cancer, infection, fracture, cauda equina syndrome, and ruptured abdominal aortic aneurysm, may present to the ER with LBP. High level of clinical suspicion with imaging study done in a timely fashion significantly impacts patient management and prognosis. This educational exhibit reviews the imaging manifestations of possible serious LBP causes with ER presentation.

TABLE OF CONTENTS/OUTLINE

1) Overview of normal imaging anatomy of the lumbar spine 2) Red flags in the management of LBP and possible imaging indications per American College of Radiology Appropriateness Criteria 3) Multimodality imaging examples of LBP with complicated underlying conditions: a) Infection: Osteomyelitis/discitis, paraspinal abscess, epidural abscess, arachnoiditis b) Neoplasia: Metastatic carcinoma, multiple myeloma, lymphoma, myxopapillary ependymoma, schwannoma c) Fractures: Vertebral compression fracture, burst fracture, sacral insufficiency fracture d) Cauda equina syndrome: Degenerative herniated disc, spinal canal stenosis, epidural hematoma, facet joint cyst e) Visceral disease: Nephrolithiasis, pyelonephritis, ruptured aortic aneurysm, pancreatitis.

MSEE-49   Imaging Challenges And Considerations Of The Obese Trauma Patient

Participants
Julia Saltalamacchia, MD, Portland, Oregon (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Imaging obese patients present specific challenges in trauma/emergency settings.2. Body habitus plays a role in traumatic injury pattern, injury severity, morbidity, and mortality.3. Implement strategies to mitigate the effect of obesity on image quality to ensure the best possible trauma care for all patients, regardless of body habitus.

TABLE OF CONTENTS/OUTLINE

1. Review obesity demographics 2. General trauma imaging challenges are more complex in obese patients, including: a. Spine precautions b. Patient stability c. Unknown past medical history 3. Challenges of imaging an obese patient a. CT: Technical/scanner characteristics, positioning and risk of airway compromise, and obesity related artifacts b. Ultrasound c. Radiograph 4. Obese trauma patient imaging: special considerations during hospital stay a. Mechanism and injury pattern: increased likelihood of MVC, increased risk of chest, extremity, and pelvis fracturesb. Increased risk of infection, VTE, and post-operative complication 5. Optimizing imaging modalities: strategies and solutionsa. Modality specific i. CT: increase tube current, increase peak voltage, increase reconstruction section thickness, and bundling ii. US: Tissue harmonic imaging, patient positioning iii. Radiography - Antiscatter grid, tight collimationb. Technologist education and compassionate care c. Reporting language and clinician communication

MSEE-5   Dixon Technique In Musculoskeletal And Spine MRI - Beyond The Bone Marrow

Participants
Robert W. Morris, MD, Jackson, Mississippi (*Presenter*) Nothing to Disclose

TEACHING POINTS

Much has been written about utilizing the Dixon technique to evaluate the bone marrow, but this imaging method has applications in musculoskeletal and spine MRI outside of the bone marrow. These applications include: 1. Improved fat suppression on fluid-sensitive and contrast-enhanced sequences. 2. Enhanced lesion detection in the soft tissues. 3. Fat fraction quantification. 4. Characterization of soft tissue lesions. 5. Evaluation and quantification of muscle atrophy.

TABLE OF CONTENTS/OUTLINE

Table of Contents: 1. Review of the Dixon method. 2. Use in fat suppression: fluid-sensitive sequences. 3. Use in fat suppression: contrast-enhanced sequences. 4. Enhanced lesion detection. 5. Quantification of fat fraction using the Dixon method. 6. Lesion characterization: lipid-containing lesions. 7. Lesion characterization: lesions with little to no lipid content. 8. Evaluation and quantification of muscle atrophy. 9. Conclusion.

MSEE-50   Don't Forget To Look Up: Clues To Abdominal Diagnoses In The Lower Thorax

Participants
Matthew McCann, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. A careful search of the lower thorax at abdominal CT may reveal important clues for a unifying diagnosis of abdominal findings 2.

Abdominal pathologies may manifest with predictable patterns of lower thoracic involvement 3. Abdominal findings may be attributable to a primary thoracic disease process, such as congestive hepatopathy related to cardiac dysfunction 4. Various disease processes may involve both the thorax and abdomen; for example, Lymphangioleiomyomatosis (LAM) and Birt-Hogg-Dubé are both cystic lung diseases associated with renal lesions and cutaneous findings

TABLE OF CONTENTS/OUTLINE

Formatted as Interactive unknown cases first showing abdominal findings, then click to MCQ, then click for lower thorax findings that seal the unifying diagnosis + teaching points.Pulmonary: a. LAM b. Birt-Hogg-Dubé c. Alpha-1 antitrypsin deficiency d. Metastases from abdominopelvic tumors (metastasizing leiomyoma, choriocarcinoma, gestational trophoblastic disease)Pleura: a. Ovarian hyperstimulation b. Meigs syndrome (Triad: pleural effusion, ascites, ovarian tumor) c. Thoracic endometriosis d. SplenosisCardiovascular: a. CHF & constrictive pericarditis hepatopathy "nutmeg liver", cardiac cirrhosis b. Tumor thrombus c. Hepatopulmonary syndrome d. Erdheim-Chester disease e. Carcinoid heart from liver mets f. Abdominal infarcts with cardiac thrombus

MSEE-51   Imaging Ingested And Aspirated Foreign Bodies

Participants
Ivica Bratanovic, MSc, Port Moody, British Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Ingested and aspirated foreign bodies (FBs) are commonly encountered in the Emergency Radiology setting and understanding the epidemiology and patient's risk factors is essential2. A thorough clinical history is important to determine the best imaging modality to evaluate aspirated and ingested FBs3. FB composition and anatomical location will influence the selection of the appropriate imaging modality to investigate ingested and aspirated FB4. Ingested and aspirated FB can be associated with complications and recognizing their imaging characteristics is key for the radiologist

TABLE OF CONTENTS/OUTLINE

- Brief introduction to FB imaging and imaging modality utility- Overview of ingested and aspirated FBs and their epidemiology- Key anatomical locations to evaluate with imaging for ingested and aspirated FBs- Patient profile and history on determining imaging modality selection- Imaging characteristics of common ingested or aspirated FBs- Review of common complications associated with ingested and aspirated FBs and imaging considerations- Clinical Cases- Summary and key points moving forward

MSEE-52   Beyond The Lungs: Abdominal Involvement By Tuberculosis

Awards
Certificate of Merit

Participants
Bianca Coimbra, BMedSc, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Tuberculosis remains the leading cause of death from infectious diseases among adults worldwide, especially in developing countries.The abdomen is the most common site of extrapulmonary tuberculosis, being a diagnostic challenge, due to several presentations of the disease, we may have delays in the diagnosis and development of complications. Early diagnosis, initiation of anti-tuberculosis therapy and surgical treatment, in some cases, are essential to prevent morbidity and mortality. It is important that the Radiologist recognizes the imaging findings, allows the establishment of a more effective strategy to confirm the diagnosis and institute the appropriate treatment as soon as possible.

TABLE OF CONTENTS/OUTLINE

Clinical and epidemiological aspects. To review presentations of abdominal tuberculosis in computed tomography (CT) and magnetic resonance (MRI), especially in immunocompromised patients, based on our service's digital archive: pulmonary, lymph node, renal, splenic, adrenal, peritoneal and testicular involvement. Take-home messages. References.

MSEE-53   Sonography Made Simple: A Case-based Review

Participants
Brian Tsui, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Ultrasound technology and tools constantly evolves, giving radiologists new methods to make more accurate diagnoses on ultrasound alone. Understanding these ultrasound modes and tools can help trainees, fellows, and general radiologists recognize when to use them and how to troubleshoot in order to confidently make a diagnosis. 1. 1. Case-based review with multiple choice questions of common ultrasound tools and modes 2. 2. Demonstrate through cases how these tools and modes work, including physics 3. 3. Discuss common scenarios when to use these tools and common pitfalls

TABLE OF CONTENTS/OUTLINE

1. 1. Introduction2. 2. Transducer and Grey scale optimization 3. 3. Doppler and Microvascular Imaging4. 4. Harmonic imaging5. 5. Contrast-enhanced ultrasound6. 6. 3-D ultrasound7. 7. Chroma maps 8. 8. Panoramic imaging9. 9. Elastography10. 10. M-mode imaging11. Summary and conclusion

MSEE-54   The Radiologist'S Role In Thread Lifts Evaluation With High Frequency Ultrasound:how To Detect, Recognize And Access Complications

Participants
Luciana Zattar, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Facial aesthetic procedures are increasingly being performed, and minimal invasive types are preferable. In this context, the

radiologist has been requested to recognize their usual aspects as well as to assess possible complications.To achieve accurate and timely detection and appropriate approach of each case, High frequency ultrasound (HFUS/24-33MHz) is the most effective method since it provides optimal anatomical information of the skin and allows identification of thread lifts and its complications.This study aims to discuss and illustrate the radiologist's role in the evaluation of thread lifts with HFUS.The purpose of this exhibit is:-To describe the pre procedure evaluation-To illustrate the anatomy of the skin and facial layers-To show the main image patterns of thread lifts that allows its identification-To list, classify and describe the procedure complications-To highlight the importance of HFUS guidance in thread lifts procedures/removal-To keep in mind a practical chart that may help reaching the correct patient's approach

TABLE OF CONTENTS/OUTLINE

1.PREPROCEDURE EVALUATIONAnatomical variantMaterials2.LOCALIZATIONSkin/facial layers3.THREAD LIFT IDENTIFICATION4.COMPLICATIONS5.PROCEDURE GUIDANCE

MSEE-55   An Emergency Radiologist's Guide To The Acute Breast

Participants
Douglas Katz, MD, Mineola, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the spectrum of potential breast emergencies and the settings where they can occur To recognize the clinical and imaging features of breast emergencies and their differential diagnosis, based on various imaging modalities, including radiography, ultrasound, and CT To discuss the current literature on the imaging and management of breast emergencies

TABLE OF CONTENTS/OUTLINE

Although breast emergencies are infrequently encountered, these acute situations require urgent management, and may be encountered by both the general and the emergency radiologist, in addition to the breast imager, whom is much more familiar with these entities. It is important to recognize the clinical signs and imaging appearances for timely diagnosis and treatment. We will review the multi-modality imaging appearances of breast emergencies, and will show multiple examples including trauma, infection, malignancy, and iatrogenic etiologies, and their potential mimics and pitfalls. We will also discuss the treatment and follow-up of acute breast disease, to ensure continuity of care and facilitate timely disease management. Entities to be demonstrated and discuss will include complications from percutaneous biopsy or trauma, as well surgery (hematoma, fat necrosis, pseudoaneurysm and/or AV fistula); infection (mastitis, abscess, Mondor disease); malignancy (inflammatory carcinoma, emergency presentations of locally advanced/metastatic breast cancer); and other breast lumps presenting emergently (Phylloides tumor and gynecomastia).

MSEE-56   Facial Fat Compartments Evaluation With High Frequency Ultrasound

Participants
Luciana Zattar, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Facial aging is a multifactorial process. Physiological and morphological changes occur in both skeletal and soft tissue composites. Most available therapeutic options are aimed at restoring the redistributed volume of superficial and deep facial fat layers. The correct evaluation and measurement of these fat compartments is essential to determine which structure is the key player in the presenting clinical scenario of ageing and wrinkles formation, since a wrong manipulation might yield an aesthetically undesirable result. In this context, the radiologists may be requested to recognize and evaluate the layers, compartments and their contents, crucial for safe and effective minimally invasive rejuvenation procedures. To achieve accurate and timely detection and appropriate approach of each case, High frequency ultrasound (HFUS/24-33MHz) is the most effective method since it provides optimal anatomical information of the skin and allows skin layers differentiation and changes monitoring. This study aims to discuss and illustrate the radiologist's role in the evaluation of fat-pads with HFUS.The purpose of this exhibit is:- To illustrate the anatomy of the skin and facial layers- To describe the most important facial aging changes- To highlight the importance of HFUS in fat-pads characterization- To show the dynamic fat-pads evaluation and measurements with HFUS

TABLE OF CONTENTS/OUTLINE

1.ANATOMY:Skin/facial layers2.FACIAL AGEING PROCESS3. FAT-PADS EVALUATIONBICHATEYELIDROOFSOOF4.CONCLUSION

MSEE-57   Abdominal Tuberculosis: Untangling The Great Mimicker

Participants
Wider Landim Filho, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The incidence of tuberculosis has increased mainly as a consequence of HIV infection and use of immunosuppressive drugs. The abdomen is the most common site of extrapulmonary tuberculosis. Owing to the multiplicity of abdominal organs, there are many forms and patterns of occurrence, representing a diagnostic challenge for radiologists. Abdominal presentation may involve structures such as gastrointestinal tract, genitourinary tract, liver, spleen, pancreas, gallbladder, aorta, peritoneum and lymph nodes, frequently with simultaneous involvement of those organs.Abdominal tuberculosis may be mistaken as several different conditions, such as inflammatory bowel disease, cancer and other infectious diseases. A delay in the correct diagnosis may result in significantly increased morbidity, and an early recognition is essential for proper management.

TABLE OF CONTENTS/OUTLINE

• Discussion of the different forms of presentation of abdominal tuberculosis, describing the most typical radiological findings in each type. • Discussion on the performance of each imaging modality in tracking and detecting the disease. • Presentation of rare imaging features found in unusual cases. • Take-home messages and provision of a didactic approach of differential diagnoses, based on imaging features, addressed to each abdominal system/ organ.

MSEE-58   **Arterial Injuries Associated With Superior Pubic Rami Fractures: Variants, Cross-talk, Collaterals, And Conventional Anatomy**

Participants
Ethan Speir, MD, San Francisco, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Superior pubic rami fractures can result in hemorrhage from multiple arterial vascular territories.2) The corona mortise is a common anatomic variant to consider during pelvic angiography.3) Limited pelvic angiography in the traumatic setting can result in failure to recognize life-threatening hemorrhage.

TABLE OF CONTENTS/OUTLINE

Pubic rami are the most frequently fractured pelvic ring elements in the setting of blunt force trauma and are the most common osteoporotic pelvic fracture. Superior pubic rami fractures are of particular importance as they can result in hemorrhage from multiple arterial vascular territories including the obturator artery, medial circumflex femoral artery, and corona mortise, a common anatomic variant present in nearly half hemi-pelvises. Furthermore, heavy atherosclerotic burden can result in extensive collateralization. Clinically, this poses a challenge to the interventionalist as life-threatening hemorrhage can arise from internal and/or external iliac branches originating from the ipsilateral and/or contralateral side.In this exhibit, we will review cases from our institution, a Level I Trauma Center, which highlight these anatomic implications. We will also review data from our cohort and compare incidence of culprit vessels and patient outcomes to those reported in the literature

MSEE-6   **Bowel And Mesenteric Injuries In Trauma - Correlation With Intraoperative Findings/ Follow-up Imaging: Where An Early Diagnosis Can Save Lives.**

Participants
Denver Pinto, MD, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit aims to help the ER radiologist or resident to:* Identify subtle signs of bowel injury.* Identify signs of mesenteric injury necessitating operative repair.* Demonstrate bowel related remote complications of trauma.* Evaluate the imaging findings of bowel and mesenteric injury caused by varying mechanisms

TABLE OF CONTENTS/OUTLINE

Objectives.Epidemiology of bowel and mesenteric trauma.Importance of prospectively picking up subtle findings.Evaluation and Imaging findings (cases and discussion)Blunt trauma: Peri colonic hematoma with interval development of hemoperitoneum, Ascending colon hematoma (sub serosal tear) with mesenteric injury, Mesenteric injuries with and without active extravasation, Pseudoaneurysm in the mesocolon inferior to the liver.Stab injury: Peritoneal violation without bowel injury, Perforated bowel, Perforated stomach, Psoas and mesenteric hematoma, Omental hematoma, Retroperitoneal hematoma.Gun-shot wound: Colon hematoma with full thickness perforation, Jejunal and sigmoid colon perforation - be wary of satisfaction of search. Air may act as a negative contrast.Importance of analysis of trajectory of a projectileSpecial cases: Non-viscus/ non-renal retroperitoneal injury, Foreign body perforating the rectum.Complications: Diaphragmatic hernia and closed loop obstruction following a remote stab injury to the diaphragm, Adhesions causing bowel obstruction S/p colonic repair.Teaching points. References

MSEE-60   **Contrast-enhanced Ultrasound As A Problem-solving Tool: A Guide To A Successful Integration Into Clinical Routine**

Participants
Lucas Roberto Lelis Oliveira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Discuss how contrast-enhanced ultrasound (CEUS) is performed, focusing on setup and workflow issues.• Summarize dosing and safety questions related to the microbubble contrast administration in adults and pediatric patients.• Present different clinical scenarios in which CEUS can be used as a problem-solving tool, including "off-label" indications.• Improve the knowledge of current and potential applications of CEUS among radiologists, aiming to facilitate the integration of this technique into their clinical routine.

TABLE OF CONTENTS/OUTLINE

Introduction - General concepts of CEUS• How microbubble contrast works.• Advantages of CEUS over other imaging modalities• Indications and contraindications.CEUS Technique• A step-by-step explanation of how to perform CEUS.• Common CEUS artifacts and pitfalls.• Tips and tricks for beginners and veterans.Case-Based Review• Sample cases demonstrating how CEUS can be used as a problem-solving tool in clinical practice.This section will present illustrative cases of:o Hepatic and renal focal lesions o Gynecological diseaseso Organ Transplantationo Vascular pathologieso Pediatric imagingo Abdominal Traumao CEUS in Interventional RadiologyFuture Directions: What is on the horizon for CEUS?Conclusion and key takeaways.

MSEE-61   **Eye Got It: Orbital Trauma**

Participants
Jason A. Pietryga, MD, Warren, Rhode Island (*Presenter*) Consultant, Radiostics LLC

TEACHING POINTS

Review normal orbital and globe anatomyReview common traumatic pathologies of the globe. Review common mimics of acute globe trauma.Review orbital traumatic pathologies.

TABLE OF CONTENTS/OUTLINE

Introduction: Present statistics regarding orbital/globe traumaNormal globe & orbit anatomyTraumatic pathologies of the globe: corneal laceration, traumatic cataract, vitreous hemorrhage, lens dislocation, and globe ruptureMimics of globe trauma: staphyloma, silicone injection, trochlear apparatus calcification, post operative changes (e.g. pseudophakia, scleral buckle)Traumatic orbital pathologies: orbital fractures, extra-ocular muscle entrapment, retrobulbar hemorrhage, orbital compartment syndrome, orbital foreign body.

MSEE-62   Polycystic Neotropical Echinococcosis: Imaging Review Of A Rare Variant Of Hydatid Disease

Awards
Certificate of Merit

Participants
Jose Wilson Trindade, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To describe the epidemiology and pathophysiology of neotropical polycystic echinococcosis, a rare variant of hydatid disease • To discuss differential diagnosis of hepatic cystic lesions and calcification, emphasizing key points to consider Echinococcus infection in patients from endemic regions • To illustrate different imaging features of polycystic echinococcosis on CT • To present a proposed CT staging system for echinococcosis after initial treatment, to provide further adequate therapeutic decisions and improve outcomes

TABLE OF CONTENTS/OUTLINE

1) Introduction and overview of polycystic neotropical echinococcosis, including epidemiology, imaging features and differential diagnosis 2) Discussion of various confirmed cases, emphasizing the most common hepatic and extra-hepatic imaging findings on CT and their correlation with patients' prognosis and outcomes 3) Proposed CT staging system for polycystic echinococcosis

MSEE-63   CT Of Sacral Fractures: Classification Systems, Management, And Complications

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Elana Smith, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

After reviewing this exhibit, readers will be able to: i. Describe common classification systems for sacral fractures. ii. Explain how injury grade affects surgical decision-making iii. Discuss post-traumatic or post-surgical complications by fracture type.

TABLE OF CONTENTS/OUTLINE

I. CT-based classification1. Isler and Denis• based on violation of neural foramina/spinal canal• zone 3 subclassification- considers orientation, angulation, translation, and comminution2. AO spine for sacral fractures• Need for universal system identified through worldwide survey of 474 spine surgeons.i. Type A: lower sacrococcygeal- no instabilityii. Type B: posterior pelvic instabilityiii. Type C: spinopelvic instability3. Insufficiency fractures:• No trauma/low impact trauma (esp women > 55 yrs)• typically non-ambulatory• Bone scintigraphy/MRI complementary (H-sign)II. Management considerationsi. Indications/types of stabilization/instrumented fusionii. Indications/types of neural decompressioniii. Sacroplasty/kyphoplasty for insufficiency fracturesiv. Conservative mgmtIII. Complications:i. neural compression symptomsii. neural compression: CT findingsiii. post-operative complications:o screw malpositiono wound complications/infectiono loosening requiring revision surgery

MSEE-64   Ankylosing Spondylitis: A Review From Head To Toe

Awards
Certificate of Merit

Participants
Vamsi Meka, MD, Charlottesville, Virginia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Ankylosing spondylitis (AS) is a prototype of HLA B27+ve axial spondyloarthritis. It is a chronic, potentially debilitating, inflammatory disorder with multisystem involvement. Musculoskeletal manifestation is characterized by 'enthesitis' (inflammation at the ligament or tendon insertion site on to the bone) or synovitis. Bilateral sacroiliitis, spondylitis, spinal fusion and ankyloses are characteristic musculoskeletal imaging findings. The purpose of this exhibit is to review the multimodality imaging appearance of typical and atypical imaging findings of AS with focus on different organ system involvement. It is important to differentiate AS from other inflammatory spondyloarthropathies on imaging to aid in early diagnosis. We briefly discuss the diagnostic criteria for AS, current role of imaging in the diagnosis and follow up, and management.

TABLE OF CONTENTS/OUTLINE

Introduction Epidemiology and Pathophysiology of AS Imaging and clinical manifestations of AS - a) Musculoskeletal: Sacroiliitis, Spondylitis, Peripheral arthritis. b) Cardiovascular: Aortitis, aortic regurgitation c) Pulmonary: Parenchymal abnormalities, Apical fibrosis. d) Gastrointestinal: Inflammatory bowel disease. e) Miscellaneous: Anterior uveitis, Psoriasis.Diagnostic criteria Differential diagnosis Disease related complications Summary References

MSEE-65   High Energy Lower Extremity Trauma: Beyond Fracture Lines

Participants
Ane Ugarte Nuno, MD, San Sebastian, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To explain how to acquire CT images in high energy trauma patients including lower limbs. - To describe pathologic findings related to vascular system, musculotendinous structures and soft tissue. - To convey the importance of detecting these findings to improve pacient management

TABLE OF CONTENTS/OUTLINE

Patients that undergo high energy trauma usually present to the ER with multiple injuries affecting the head, thorax and abdomen. These lesions can be life-threatening. Associated injuries to lower extremities often take second place. However, it is crucial to

evaluate them because high energy fractures promote a systemic inflammatory response that makes even more difficult management of these patients. Stabilization of fractures is mandatory. Moreover, beyond the fracture lines, it is essential to evaluate sorrounding soft tissues, neurovascular system and musculotendinous structures. This presentation will emphasize evaluation of these forgotten structures following these index: - Introduction - CT protocol - Vascular injuries associated to high energy fractures - Injuries to musculotendinous structures - Subcutaneus tissue and skin injuries in high energy fractures - Few fracture classifications of use in high energy fractures

MSEE-66   Teratoma: From Head To Toe.

Participants
Samyra Medeiros, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teratomas are a common form of GCT. They are defined histologically as containing tissues derived from all 3 germ cell layers: ectoderm, mesoderm (most teratomas contain fat, an imaging hallmark, which is a mesodermal derivative), and endoderm. Teratomas are also classified as mature or immature, depending on the degree of differentiation of its components. Teratoma is an uncommon neoplasm with an incidence of 0.9/100,000 population. Common sites for teratomas in infancy and children are extra-gonadal like mediastinal, sacro-coccygeal and pineal regions. In adults, they are mainly gonadal. Retroperitoneal teratoma is rare and comprises of about 1% of all teratomas. In more than 50% of cases, mature teratomas have no symptoms at initial diagnosis and are detected by chance. Teratomas have already been reported in different locations, ranging from intracranial, thoracic, abdominal compartments, to ostiomuscular and spinal compartments.

TABLE OF CONTENTS/OUTLINE

Present a brief review of teratoma and its possible locations. Demonstrate, through imaging, some common and rare sites of teratomas, available in our digital archive.

MSEE-67   Musculoskeletal Involvement In Marfan Syndrome: An Imaging Overview

Participants
Mariana Batista Rosa Pinto, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: 1. Briefly approach the pathophysiology and epidemiology of Marfan Syndrome. 2.Remember the diagnosis criteria and point the importance of musculoskeletal radiologist. 3.Review and didactically illustrate the most frequent musculoskeletal manifestations of Marfan Syndrome with imaging findings in a multimodality approach (radiographs, computed tomography scans and magnetic resonance imaging).

TABLE OF CONTENTS/OUTLINE

Introduction: General presentation of the pathophysiology, epidemiology, clinical findings and diagnostic criteria of Marfan Syndrome. Present a schematic table with the main musculoskeletal imaging findings in Marfan Syndrome, as well as didactically divide them to facilitate the approach. Provide didactic and illustrative cases of each site of musculoskeletal involvement (spine, pelvis, chest wall, hands and feet). Conclusions. Bibliographical references.

MSEE-68   Imaging Of Pregnant Patients In The Trauma Setting: A Case-based Review

Participants
Helena Bentley, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Trauma is the leading cause of non-obstetric mortality of pregnant patients. Timely, high-quality imaging evaluation of pregnant patients who sustain trauma is essential for patient & fetal outcomes.Using illustrative cases from our tertiary, high-volume level 1 trauma center upon review of this educational exhibit the reader will be better able: (1) to recall the epidemiology of trauma sustained by pregnant patients; (2) to understand the general principles of imaging evaluation of pregnant patients in the trauma setting; (3) to recognize the unique pattern of traumatic injury sustained by pregnant patients; & (4) to discuss notable imaging findings of obstetrical complications arising from trauma sustained by pregnant patients & associated do not miss diagnoses.

TABLE OF CONTENTS/OUTLINE

While non-pregnancy related injuries may arise, we will emphasize potential obstetrical complications & injuries. General principles of imaging evaluation of pregnant patients in the trauma setting will be described, with a particular focus on study selection as well as radiation dose and contrast concerns. The increased incidence of abdominal injury will be outlined as well as the physiologic rationale for same. Obstetrical complications associated with trauma, including internal hemorrhage, placental abruption, & uterine rupture, shall be reviewed.

MSEE-69   "Non Vascular Uses Of Ultrasound Contrast" - Unexplored Territories And Unfamiliar Utilities

Participants
Pooja Vyas, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Use of ultrasound contrast agents in diagnosis of various non vascular gastrointestinal or genitourinary pathologies is a relatively unfamiliar territory. Local instillation of ultrasound contrast via oral/urinary catheter/ drainage catheter into intraluminal or intracavitatory spaces further augments the utility of ultrasound with microbubble agents and opens a new spectrum of real time visualization of various pathologies that can be diagnosed, in addition to the routine intravascular ultrasound contrast studies.

TABLE OF CONTENTS/OUTLINE

1. Introduction to USG Contrast 2. Case series -Gastrointestinal(GI) applications:Oesophageal strictures, Hiatus hernia, Gastric malignancy, Pyloric mass, upper GI Perforation4. Case series -Genitourinary applications- Vesicoureteric reflux,Urethrogram,5. Case series-applications in Fistulae/ sinuses-Vesicovaginal fistula,Vesicocolonic fistula, Perianal abscess and fistula,Sinogram6.Sentinel

lymph node detection post intraductal contrast instillation in breast malignancy

MSEE-7   **Imaging Of Non-traumatic Renal Hemorrhage In The Emergency Department - Where The Radiologist Saves Lives!**

Participants
Denver Pinto, MD, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit aims to help the ER radiologist or resident to:* Identify subtle findings related to the type and etiology of renal hemorrhage.* Identify high risk conditions predisposing to renal hemorrhage.* Identify the different imaging findings in non-traumatic renal hemorrhage

TABLE OF CONTENTS/OUTLINE

Objectives.Epidemiology and pathophysiology of renal hemorrhage.Importance of prospectively picking up subtle findings on Plain CT and Ultrasound.Evaluation and Imaging findings (cases and discussion)Intrinsic renal hemorrhage: Spontaneous subcapsular hematoma with an active bleeding vessel, Renal neoplasm with hemorrhage, Renal AML with pseudoaneurysm and hemorrhage, ADPKD with hemorrhage, Transplant kidney with pelvicalyceal hemorrhage.Vascular causes: Renal aneurysm and pseudoaneurysm, Renal vein thrombosis/ infarct.Extrinsic causes of hemorrhage: Retroperitoneal lipomatosis causing renal compression and hemorrhage, Post-operative Page kidney.Iatrogenic cause (non-biopsy): Renal stone causing deviation of nephrostomy tube causing hemorrhage.Special cases:Complication: Renal hemorrhage with urinoma and communication with the subhepatic space.Endograft leak.Conditions that are high risk for life threatening hemorrhage1. Renal AV shunting in a vascular tumor.2. Renal vascular malformation.3. Renal mass with an IVC thrombus.Teaching points.References.

MSEE-71   **Trauma: Ao Classification Pocket Guide For Residents**

Participants
Camila Justino, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To simplify by schematic drawings and clinical cases the different types of fractures in the Ao classification as terminal segment fractures, diaphyseal, spine and special cases.To emphasize which important aspects of fractures should be included in the radiologist's report to assist the orthopedic surgeon's decision.

TABLE OF CONTENTS/OUTLINE

Throughout history there have been numerous classifications of bone lesions proposed to create a common language among the members of the healthcare team.The lack of consensus can limit communication between doctors and hinder the complete understanding of the lesion, making it difficult to plan and develop treatment algorithms.A study group was created in 1958 in Switzerland, entitled Ao, which means in english Association for the Study of Internal Fixation. For a better understanding of each fracture, this group initiated several lines of research associated with innovations in surgical techniques that have allowed a change in the treatment of fractures. It is essential that the radiologist understands the Ao classification, since the definition of the treatment of these fractures will be based on their report, impacting the recovery of function and the patient's morbimortality. The clinical application of this classification will be illustrated later in schematic drawings and a case-based approach.

MSEE-72   **Standardizing Whole Body MRI In Myeloma: Myeloma Response Assessment And Diagnosis System (MY-RADS)**

Participants
Khalil ElGendy, PhD,MBBCh, Brentford, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Purpose of the exhibit: • To be aware of the international guidelines for Whole-body diffusion weighted MRI (WB-DW-MRI) for imaging patients with myeloma. • To review the Myeloma Response Assessment and Diagnosis System (MY-RADS) guidance into standardization of acquisition and reporting of WB-DW-MRI in multiple myeloma patients. • To recognize the five Response assessment categories (RAC) according to the response to the intervention based on objective parameters (including lesion size, number, ADC measurements and bone marrow signal). • To review a series of RAC case examples

TABLE OF CONTENTS/OUTLINE

• Role of WB-DW-MRI in multiple myeloma with a focus on response assessment • MY-RADS: • Overview • Standardized acquisition • Structured reporting • RAC descriptions: objective criteria for assessment. • Case examples for RAC descriptions (RAC1 to RAC5)

MSEE-73   **Atypical Chest Pain: Role Of Cardiac MRI Beyond Myocardial Infarct**

Awards
Certificate of Merit

Participants
Juliana Sitta, MD, Jackson, Mississippi (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To review the differential diagnosis and classification of atypical chest pain• To describe MRI findings and useful sequences to narrow the differential diagnosis• To review interesting common and uncommon cardiothoracic pathologies in which MRI is useful to guide clinical management

TABLE OF CONTENTS/OUTLINE

Acute chest pain is one of the most common presentations in the Emergency Department. Cardiac magnetic resonance imaging (CMRI) has an established role in the risk stratification of patients with acute coronary syndrome (ACS). However, when initial clinical workup excludes ACS, MRI aids in assessing differential diagnoses and mimickers. In this presentation, we will discuss the

role of CMRI in the assessment of atypical chest pain. We will discuss the advantages of different MRI protocols compared to other imaging modalities by describing sequence specific findings and their role in each pathology. We will provide case samples covering cardiac, vessels, lung, chest wall, and miscellaneous topics, including various etiologies such as cardiomyopathies, inflammation, infection, congenital malformations, malignancy, trauma, and incidental findings.

MSEE-74 Beyond The Aorta: Mimics Of Aortic Dissection On CT

Participants
Richard D. White, MBChB, FRCR, Cardiff, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Demonstrate alternative explanations in cases of suspected aortic dissection on CT across a range of body systems 2) Highlight pearls and pitfalls from imaging of suspect aortic dissection, including key artefacts which can masquerade as aortic dissection

TABLE OF CONTENTS/OUTLINE

1) Clinical presentation2) Pathologiesa. Cardiacb. Vascularc. MSKd. Pulmonarye. Miscellaneous3) Pearls, pitfalls and artefacts

MSEE-75 Vascular Causes Of Abdominal Emergencies: What The Radiologist Needs To Know

Participants
Richard D. White, MBChB, FRCR, Cardiff, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Appreciate pearls and pitfalls when evaluating the abdominal vasculature system on portovenous phase CT2) Be aware of key vascular review areas3) Highlight a spectrum of vascular causes of abdominal emergency of different mechanisms, with clinical correlation and management strategies, drawn from cases from two tertiary vascular centres

TABLE OF CONTENTS/OUTLINE

1) Pearls and pitfalls2) Key vascular review areas3) Vascular causes of abdominal emergencya. ischemiai. arterial vs venousii. atheroscleroticiii. thromboemboliciv. dissectionv. miscellaneousb. rupturec. hemorrhaged. AV fistulae. inflammatoryf. extrinsic compressiong. miscellaneous

MSEE-76 Cryptococcosis Not Hidden Anymore: Growing And Showing Up In Immunocompetent And Imunosuppressed Patients

Participants
Jessica Marchi, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the general image aspects of cryptococcosis in multiple systems, address the main organs affected by it and recognize their most common involvement patters; To present cryptococcal infeccions image findings, both in immunocompetent and immunosuppressed patients

TABLE OF CONTENTS/OUTLINE

A review of cryptococcosi's epidemiology, pathophysiology and systemic manifestations; An assessment of the main imaging findings of cryptococcosis in multiple systems, both in immunocompetent and immunosuppressed patients, focusing on the possible differences and similarities between them;Case based review with illustrative cryptococcal infections represented by image methods.

MSEE-77 Neurofibromatosis From Head To Toe: What The Radiologist Needs To Know

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Mindy Wang, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Describe and distinguish the clinical presentations of neurofibromatosis types 1 and 2.2) Identify the imaging features of neurofibromatosis types 1 and 2 in various modalities.3) Discuss the impact of imaging features on management.

TABLE OF CONTENTS/OUTLINE

1) Neurofibromatosis type 1a) Pathophysiology and diagnosisb) Clinical presentations and imaging featuresi) Cutaneous manifestations(1) Neurofibromas and plexiform neurofibromasii) Central nervous system manifestations(1) Focal areas of signal intensity(2) Optic pathway gliomas and astrocytomas(3) Malignant peripheral nerve sheath tumor(4) Sphenoid wing dysplasia(5) Plexiform neurofibromas(6) Meningocelesiii) Thoracic manifestations(1) Interstitial lung disease(2) Bullae formationiv) Abdominopelvic manifestations(1) Neurofibromatosis(2) Various neoplasms such as gastrointestinal tumors and pheochromocytomav) Musculoskeletal manifestations(1) Kyphoscoliosis(2) Posterior vertebral scalloping(3) Dural ectasia(4) Rib abnormalities(5) Bony dysplasias(6) Non-ossifying fibromasvi) Vascular manifestations(1) Vascular dysplasias such as moya-moya arteriopathy and renal artery stenosis(2) Aneurysms/arteriovenous malformationsc) Management2) Neurofibromatosis type 2a) Pathophysiology and diagnosisb) Clinical presentations and imaging featuresi) Schwannomaii) Meningiomaiii) Ependymomac) Management

MSEE-78 Technical And Methodological Issues Which Influencty Ceus Examination

Participants
Irene Campo, Conegliano, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

Knowledge of the basic physical and technical principles of ultrasound is needed to understand sonographic images and findings and to be able to evaluate the possibilities and limitations of the method. Like the B-mode ultrasound, the quality of the Contrast Enhancement Ultrasound (CEUS) is also subject not only to the well-known manual skills of the operator but also to a deep knowledge of the technique, to improve image quality and avoid misleading artifacts. CEUS technique, technical errors and possible solutions are described.

TABLE OF CONTENTS/OUTLINE

Although CEUS is a widespread and easily manageable technique, image interpretation errors are often due to the operator's inexperience and / or lack of knowledge of the pitfalls it can offer, causing uncertain diagnosis and misdiagnosis. The pitfalls can be simplified as follows: pitfalls of acoustic windows; pitfalls arising from the methodological approach of US equipment; pitfalls of inadequate visualization of the depth and location of the structure; Pitfalls arising from equipment malfunction. Content organization: 1. Introduction 2. CEUS technical parameters 3. Pitfalls resulting from acoustic windows 4. Pitfalls resulting from metodological setting of us equipment 5. Pitfalls resulting from inadequate visualization of the deep and seat of structure 6. Pitfalls resulting from malfunction of the equipment 7. Conclusion 8. Reference

MSEE-79   Doppler Ultrasound Of Peripheral Vascular Emergencies: A Beginner's Guide To Riding Waves

Participants
Francesca Iacobellis, MD, Naples, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

To provide a practical learning guide of color Doppler ultrasound applications to recognize acute vascular emergencies, including technical and interpretative approaches. To review color-Doppler parameters regulation techniques to avoid artifacts and pitfalls, in order to optimize the quality of Doppler waveform for a correct data interpretation. To examine the role of innovative vascular ultrasound technologies useful in the emergency setting. To identify the spectral waveform alterations of the commonly-encountered vascular peripheral conditions in the emergency department. To learn a standardized nomenclature to be used in describing peripheral arterial and venous waveforms, according to recent expert consensus statements.

TABLE OF CONTENTS/OUTLINE

Technical and interpretative principles of Doppler: Technical parameters. Artifacts. Innovative techniques in Vascular Ultrasound. Normal arterial and venous spectrograms. Reporting of Doppler waveform alterations. Peripheral vascular emergencies· Acute ischemic conditions. Trauma-related conditions. Iatrogenic injuries. Deep Vein Thrombosis.

MSEE-8   When Anatomical Variants Mimic Trauma Or Pathology In The Upper Extremity - How To Differentiate Them: A Radiographic Review For The Emergency Radiologist!

Participants
Denver Pinto, MD, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

To help the ER Radiologist or resident identify anatomical variants mistaken for pathology or fractures

TABLE OF CONTENTS/OUTLINE

Objectives.Imaging of fractures and fracture mimics.Importance of identifying the variant anatomy.Evaluation and Imaging findings (cases and discussion)Shoulder: Suprascapular foramen, Irregular ossification centre of the acromion, unfused coracoid process vs fractures in this region, prominent bicipital aponeurosis, infra scapular bone.Arm and elbow: Delayed fusion of ossification centers vs fractures (Ex: Triceps avulsion fracture), supracondylar process.Forearm: Delayed fusion of ossification centers vs fractures (Ex: Radial head and neck fractures), notch of radial neck.Wrist and hand: Unfused ossification centers vs avulsion fracture, variant ossification centers Ex: Pisiform bone, carpal coalition, dense metaphyseal bands.Special cases* Focus on hard to pick Salter-Harris fractures (cases and discussion)* Don't touch me lesions: Melorheostosis, Enchondroma, Fibrous dysplasia, Non-ossifying fibroma, Simple bone cyst.Teaching points.References

MSEE-80   Mesenteric And Intestinal Lesions In Blunt Abdominal Trauma, A Common Cause Of Underdiagnosis

Participants
Javier Cuetos, MD, Donostia-San Sebastian, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To understand the anatomy and pathophysiological mechanisms.- To know what findings require urgent surgery.- To know how to identify the specific and less specific findings of intestinal and mesenteric traumatic injuries.

TABLE OF CONTENTS/OUTLINE

Bowel and mesenteric injuries in blunt abdominal trauma continue to constitute one of the most frequently underdiagnosed pathologies by radiodiagnosis services.The underdiagnosis or delay in diagnosis has vital implications since a delay of only eight hours has been associated with increased morbidity and mortality mainly related to bleeding, peritonitis, and sepsis.Computed tomographic scan is considered as the most reliable method for diagnosis of bowel or mesenteric injuries and has become the preferred diagnostic test for the evaluation of blunt abdominal trauma in hemodynamically stable patients.There are certain imaging findings that require urgent surgical exploration and others that are very specific for a traumatic mesenteric or abdominal injury. The objective of this presentation is to emphasize imaging findings that may be useful in identifying mesenteric and intestinal lesions as well as in correctly describing and classifying lesions given the differences that may exist in therapeutic implications.

MSEE-81   Anastomosing Hemangioma: A New Kid On The Block?

Awards
Certificate of Merit

Participants
Krishna Prasad Shanbhogue, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

--To review epidemiology, clinical features, & histopathology of anastomosing hemangiomas, newly described benign vascular neoplasms with distinct histopathology.--To describe multimodality, cross-sectional imaging findings of these tumors.--To discuss tumor biology and management of anastomosing hemangiomas

TABLE OF CONTENTS/OUTLINE

Introduction Clinical features Pathology: Gross pathology, Histopathology and Immunohistochemistry Imaging features: Ultrasound, CT and MRI of anastomosing hemangiomas from head-to-toe. Differential diagnosis: Imaging features of other vascular lesions that can mimic anastomosing hemangiomas such as angiosarcoma, Kaposi sarcoma, Angiomyolipoma, and hypovascular lesions such as hepatocellular carcinoma and renal cell carcinoma will be discussed. Implications on Diagnosis and Management

MSEE-82   Neuro And Head And Neck Imaging: What The Musculoskeletal Radiologist Should Know

Participants
Tatiane Moriwaki, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: Highlight the main points to look for in the neuro and head and neck imaging for a musculoskeletal radiologist; Provide a systematic way not to miss important and critical findings; Illustrate and show didactically challenging cases, classified according to pathophysiology (vascular, trauma, neoplasm, congenital/malformations and inflammatory/infectious conditions).

TABLE OF CONTENTS/OUTLINE

Introduction: illustration of the main practical points for the musculoskeletal radiologist to be aware about neuro and head and neck imaging; Present a schematic illustration with didactic cases of different pathologies, classified according to pathophysiology (vascular, trauma, neoplasm, congenital/malformations and inflammatory/infectious conditions); Summary with tips of how to look beyond musculoskeletal findings not to miss and/or forget to report a critical finding; Bibliographical references.

MSEE-83   Beyond Blood And Bone: Rare Cerebrovascular Complications At A Level I Trauma Center

Participants
Ashanth Thomas, MD, MEng, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. An in-depth understanding of cerebrovascular anatomy is essential to identify potentially life-threatening injuries in penetrating head trauma. 2. Unique mechanisms of injury and unusual complications of trauma are important to become familiar with outside of Level I Trauma centers. 3. Dural venous sinus thrombosis, pseudoaneurysm, carotid-cavernous fistulae, and cerebrovascular dissections are difficult to identify in the presence of confounding findings that are often present in trauma cases. Radiologists must be aware of the imaging pitfalls of penetrating trauma, to avoid missed diagnoses that may benefit from additional imaging.

TABLE OF CONTENTS/OUTLINE

The primary goals of this exhibit are to provide a review of cerebrovascular anatomy and provide guidance on recognizing unusual cases of cerebrovascular complications after penetrating injury. Cases will include unusual mechanisms of injury as well as less common complications, focusing on dural venous sinus thrombosis, psuedoaneurysm, carotid-cavernous fistulae, and multiple cerebral arterial dissections. CT findings for these cases will highlight difficult and subtle abnormalities in the presence of larger confounding findings, such as intracranial hematomas and calvarial fractures. Finally, the pitfalls and numerous mimics of these cases will be explored, to educate radiologists on the limitations of post-traumatic imaging, and to increase sensitivity for these rare findings.

MSEE-84   Immune-related Adverse Events Associated With Cancer Immunotherapy: A Review For Radiologists

Participants
George Veloso Filho, DDS, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Advances in the use of immune response modulation in cancer treatment have led to exceptional responses in patients with advanced-stage tumours. However, the non-specific activation of the immune system can cause significant adverse effects in multiple organ systems. The purpose of this exhibit is to review the radiological features of immune-related adverse events (IrAE), highlighting Immune checkpoint inhibitors (ICIs), in a multisystemic approach, including musculoskeletal, pulmonary, cardiac, neurological and gastrointestinal disorders. In a didactic and illustrative way, we will discuss the multimodality imaging findings of such adverse events and differential diagnosis.

TABLE OF CONTENTS/OUTLINE

IntroductionImmune-related adverse events concept and epidemiology Pathophysiology Concepts: Main immunotherapy drugsImmune system and tissue damage consequencesClinical presentationToxicities phenotypes and their mais complaintsCase-based review CT, MRI and PET/CT imaging findingsMusculoskeletal (inflammatory arthritis, adhesive capsulitis, myositis, eosinophilic fasciitis) Pulmonary (pneumonitis, sarcoid-like granulomatosis, pleural effusion)Cardiac (myocarditis)Neurological (meningitis, hyphophysitis)Gastrointestinal (hepatitis, colitis, pancreatitis)OthersSummary and conclusionIrAE can cause serious complications during immunotherapy. Radiologists should be aware of imaging features and help to recognize and properly treat these patients

MSEE-85   Don't Step In The Puddle: Challenges And Mimics Of Mucin-containing Lesions In Abdomen And Pelvis

Awards
Certificate of Merit

Participants
Ekta Maheshwari, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Mucin-containing neoplastic intrabdominal lesions broadly include mucinous adenocarcinoma, signet ring cell carcinoma, post treatment change in a non-mucinous carcinoma and premalignant and malignant mucinous neoplasms of pancreas and biliary tree. Mucinous malignancies arising from or secondarily involving multiple intraabdominal and pelvic organs and spaces demonstrate characteristic imaging findings on US, CT, MRI/MRCP and FDG-PET scan. Mucinous neoplastic lesions can mimic and may be mistaken for several benign entities resulting in delayed diagnosis, complications and adverse outcomes.

TABLE OF CONTENTS/OUTLINE

Review the histology and functional and clinical significance of mucin. Review imaging appearance of mucin content on ultrasound, CT, MR and PET scans. Describe the typical imaging findings of mucin-containing neoplasms in abdomen and pelvis. Present the spectrum of imaging appearances of mucin-containing neoplasms mimicking benign entities such as cysts, abscesses, fistulae, hydrosalpinx, lymphangioma etc., and alternate cystic and necrotic malignancies.

MSEE-86   Fluid In The Belly: A Patterned Approach To Encountering Unexpected Abdominopelvic Ascites

Participants
Kira Melamud, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Discuss an approach to evaluating unexpected (nontraumatic) large volume abdominopelvic fluid on CT. 2. Review potential causes of free simple and complex fluid in the abdomen. 3. Discuss potential pitfalls which may lead to misdiagnosis of sources of fluid and tips for avoiding such mistakes.

TABLE OF CONTENTS/OUTLINE

Patterned Approach to Encountering Unexpected Abdominopelvic Fluid:1. Measure the Attenuation of Fluid and Narrow Windows 2. Evaluate for Ancillary Findings 3. Evaluate Location/Distribution of Fluid 4. Evaluate for Presence of Hemoperitoneum (i.e. look at the most dependent portions of the abdomen and pelvis; search for a sentinel clot) 5. Use dual energy CT to your advantage to problem solve to differentiate blood from soft tissue 6. Look for free air and extraluminal oral contrast in the setting of bowel perforation with large volume ascites, but be aware of pitfalls (i.e. RYGB). 7. Assess pattern of peritoneal abnormality (i.e. smooth and uniform, irregular, or nodular)

MSEE-87   Diabetes-related Complications In The Abdomen And Pelvis: Spectrum Of Imaging Findings

Participants
Ayman H. Gaballah, MD, FRCR, Columbia, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

Overview of the pathophysiology of diabetes mellitus (DM) Multi-modality imaging features of DM involving multiple organs in the abdomen/pelvis and potential related complications Algorithmic approach to the differential diagnosis of findings in each affected organ Diabetes and organ transplant Potential pitfalls in imaging diagnosis

TABLE OF CONTENTS/OUTLINE

Pathophysiology of DM (I and II), and how it affects organs in the abdomen and pelvis Discussion of multi-modality imaging evaluation of abdominal/pelvic organs that can be affected by DM GI tract (reflux, dysmotility, ulcer disease), hepatobiliary (fat infiltration, non-alcoholic steatohepatitis, acute liver failure, cirrhosis, and hepatocellular carcinoma, gallstones and various type of cholecystitis, sphincter dysfunction), pancreas (pancreatitis, fat infiltration, insufficiency, atrophy), adrenals (insufficiency, hemorrhage, hyperplasia), kidneys (chronic/end-stage renal disease, papillary necrosis, various stages of infection, calculi), vasculature (atherosclerosis and stenosis), and reproductive organs (vas deferens calcification, erectile dysfunction, ovarian failure, polycystic ovaries) Potential complications (various types of infections, organ failure, transplantation) Relation of diabetes to organ transplantation and subsequent complications Potential pitfalls in imaging diagnosis (use of IV contrast and options, use of alternate imaging modalities) Management options

MSEE-88   Imaging Of Sequelae Of Eating Disorders

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Nadia Solomon, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

Eating disorders are common and linked with high morbidity and mortality, yet they tend to be underdiagnosed and undertreated due to societal stigma and associated poor patent compliance. Imaging findings may suggest the diagnosis and identify complications. We aim to provide a review of imaging findings seen in patients with eating disorders as well as findings associated with their complications. Teaching points: • Familiarize the radiologist with the spectrum of eating disorders • Discuss the clinical presentation of eating disorders and their medical complications/sequelae • Describe the imaging features associated with common and uncommon sequelae • Provide a brief overview of management and treatment of eating disorders

TABLE OF CONTENTS/OUTLINE

• Diagnostic criteria of spectrum of eating disorders including epidemiology • Life-long potential complications of eating disorders • Role of imaging and imaging features associated with sequelae of eating disorders • Neurologic (e.g., volume loss, osmotic myelinolysis) • Head and Neck (e.g., dental caries, patulous eustachian tube) • Pulmonary (e.g., aspiration/infection/abscess, lipoid pneumonia) • Cardiac (e.g., right ventricular dilatation, pericardial effusion) • Gastrointestinal (e.g., patulous GE junction, bezoar) • Urogenital (e.g., female genital tract immaturity) • Musculoskeletal: (e.g., osteopenia, delayed skeletal growth) • Brief overview of management of eating disorders and their sequelae

MSEE-89   High-value Radiologic Diagnosis In Acute Post-partum Pathologies In The Abdomen And Pelvis

Participants
Kheng L. Lim, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Present pearls in diagnosing common acute abdomen in females of reproductive age regardless of whether the patient is pregnant or not such as appendicitis, pyelonephritis, obstructive uropathy from stone disease, acute cholecystitis, and diverticulitis. Differentiate bladder flap hematoma from normal post-operative findings Pearls in diagnosing endometritis at ultrasound by incorporating clinical and laboratory findings from normal recent cesarean appearance of the uterus, and correlation to CT. Pearls in diagnosing ovarian thrombosis (filling-defect within an enlarged ovarian vein with peripheral rim-enhancement).

TABLE OF CONTENTS/OUTLINE

Various pathologies categorized by clinical signs and symptoms. Postpartum hemorrhage: Pelvic hematoma after vaginal delivery. Bladder flap hematoma after c-section. Pain/fever: Endometritis. Retained product of conception. Ovarian vein thrombosis. Pyelonephritis. Appendicitis. Iatrogenic complications from C-section. Rupture of a large myoma. Bladder injury. Normal appearance of recent C-section changes (ascites, hemoperitoneum, echogenic sutures at ultrasound mimicking gas). Normal appearance of recent post-partum uterus (e.g. engorgement of vessels and heterogenous myometrium).

MSEE-90 Cardiac Pacemaker Safety And Imaging Features Of Complications

Awards
Identified for RadioGraphics
Cum Laude

Participants
Rishabh Agarwal, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. An estimated one million adults in the United States are equipped with a pacemaker. Pacemakers are commonly encountered by a radiologist on imaging studies. 2. This exhibit will review the imaging basics of pacemakers and some of their immediate and long-term complications. 3. This exhibit will also discuss MRI safety of pacemaker devices, appropriateness criteria and approach.

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1) Types of cardiac pacemakers and their radiographic appearance a. Defibrillating vs non-defibrillating devices b. Intra-vascular leads, extra-vascular leads, unusual lead positioning (ex: "His" lead), leadless 2) Basics of cardiac pacemaker components, specifically defibrillating capacitor and lead function 3) Discuss common and identifiable pacemaker complications on multimodality imaging a. lead fracture, lead displacement, lead perforation, Twiddler's syndrome, infection 4) Discuss MRI safety of pacemaker devices and develop an approach for determining appropriateness of performing MRI on patients with pacemakers

MSEE-91 All We Need To Know About Gaucher Disease

Participants
Juliana Duarte, Porto Alegre, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are: • Review the main imaging findings of Gaucher disease. • Describe the main imaging patterns of Gaucher Disease type 1, 2 and 3, highlighting the role of MRI imaging since the diagnosis, follow-up and monitoring the response of the enzyme therapy.

TABLE OF CONTENTS/OUTLINE

Imaging patterns of Gaucher Disease: - VISCERAL MANIFESTATIONS: - Massive splenomegaly - Splenic nodules - Hepatomegaly - Hepatic ischemia - Iron deposition - Brain atrophy - Pulmonary involvement: - Ground glass pattern - Reticulonodular infiltration - Air retention -SKELETAL MANIFESTATIONS: -Osteopenia -Osteonecrosis -Metaphyseal notching of humerus -Pathological fracures - Erlenmeyer flask deformity -Involved bone marrow shows reduced T1 and T2 signals due to infiltration of Gaucher cells - Salt and pepper pattern in MRI due to scattered involvement -H-shaped vertebra -Bone marrow burden score in MRI (semi-quantitative MRI scoring system for assessing the extent of bone marrow involvement). Treatment results in improvement of marrow infiltration however it takes much longer than the visceral and hematologic manifestations. Imaging plays a key role in both initial diagnosis and treatment monitoring. MRI of the abdomen is used to monitor liver and spleen volumes. MRI of the femoral and lumbar spine is used for evaluation of bone marrow infiltration burden. Final remarks.

MSEE-92 Hit A Nerve? Perineural Invasion In The Abdomen And Pelvis

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Wendy Tu, MD, Edmonton, Alberta (*Presenter*) Nothing to Disclose

TEACHING POINTS

Perineural invasion (PNI), while commonly discussed in head and neck cancers, is less appreciated as a mechanism of disease spread in the abdomen and pelvis despite multiple common abdominopelvic cancers exhibiting a proclivity for it. Though much more frequently a histopathologic finding, PNI can be evident radiologically and, when identified, has the potential to indicate more aggressive tumor biology, modify oncologic management, and suggest a possible cause for patient-reported pain disproportionate to tumor extent. This exhibit aims to 1) Review the anatomic and pathologic principles pertaining to abdominopelvic PNI, 2) Illustrate appearances of PNI on cross-sectional imaging for specific cancers, and 3) Discuss how PNI may impact clinical management.

TABLE OF CONTENTS/OUTLINE

Review pathologic principles of PNI. Overview of anatomic principles of PNI, including illustration of nerve plexuses in the upper

abdomen and posterior pelvis most susceptible to PNI. Identify abdominopelvic cancers with propensity for PNI, with case examples and suggested cancer-specific search patterns, and brief discussion of perineural involvement in endometriosis. Discuss how PNI identified on imaging may potentially modify oncologic management including surgery, radiation therapy, and pain management.

MSEE-93   Acute Ankle Tendon Tears, Dislocations And Associated Lesions

Awards
Magna Cum Laude

Participants
Ricardo De Carli SR, BMBS, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review the normal anatomy of the ankle tendons and retinaculum using ultrasound and MRI Explain how dynamic maneuvers can be done on ultrasound to improve accuracy for ankle tendon lesions and dislocations Elucidate the most important imaging findings and report goals

TABLE OF CONTENTS/OUTLINE

Ankle acute trauma is one of the most common injuries presenting to emergency rooms. Most of the orthopedic and radiology literature about ankle trauma is focused on ligaments and osseous abnormalities due to its high prevalence and morbidity. Although less prevalent, acute ankle tendon injuries can be present in the setting of acute trauma, and its early diagnosis can prevent tendon dysfunction and foot deformity. The ankle clinical exam is limited in the setting of acute trauma by the presence of edema and local pain, impairing physical examination. Ultrasound and MRI are the imaging methods of choice to identify tendon lesions. Ultrasound has the advantage for its accessibility, low cost, and the possibility to dynamic evaluate using maneuvers such dorsiflexion, plantar flexion, calf compression and ankle eversion. MRI can identify ligamentous and intra-articular lesions. Tendon injuries vary from subtle tenosynovitis to a tendon complete tear and can be associated with retinaculum injuries and tendon dislocations. It is important to the radiologist to be familiar with these injuries, their appearance on MRI and ultrasound, and the report goals.

MSEE-94   Imaging Approach To Ballistic Injury In Pediatric Patients

Participants
Mohammed Abdeen, FRCR, MSc, Memphis, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Background:Ballistic injuries account for the majority of penetrating trauma in pediatric patients and lead to high mortality. We will be discussing key imaging findings in various body areas and their role in imaging protocols/workups related to gunshot injuries, with emphasis on findings consistent with injuries requiring immediate surgical intervention.Teaching points:1. Knowledge of imaging findings for various modalities and protocols can improve diagnosis for ballistic injuries.2. Demonstrate the spectrum of imaging features for various types of gunshot injuries.3. Understand the imaging findings that require surgical intervention.

TABLE OF CONTENTS/OUTLINE

1. Mechanisms and statistics on U.S.A. gunshot injuries in children2. Intracranial gunshot injuries and imaging analysis3. Head and neck gunshots4. Thoracic gunshots5. Abdominopelvic gunshots6. Musculoskeletal gunshots including spine

MSEE-95   Crash Course On Calcifications: Classifying The Common, Concerning, And Critical

Participants
Lyndon Luk, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Abdominopelvic calcifications are commonly encountered and can result from a variety of disease processes. 2. Morphology, location, and mobility of calcifications can be used to narrow the differential 3. Incidentally discovered calcifications on different imaging modalities can lead to diagnosis of malignant and potentially life-threatening conditions 4. Radiologists should be aware of the variety of calcifications in the abdomen and pelvis and use them to help guide management when appropriate

TABLE OF CONTENTS/OUTLINE

1. Review of calcification types and mechanisms 2. Review abdominopelvic calcifications on radiographs, ultrasound, CT, and MRI 3. Identify calcification patterns and locations that require further workup for potentially malignant or life-threatening etiology 4. Discuss different methods of classifying abdominopelvic calcifications

MSEE-96   Vascular Anomaly Syndromes: Current Update Of I.S.S.V.A. Classification Of Imaging Findings And Role Of Intervention

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Mindy Wang, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Describe the ISSVA classification of vascular anomalies and its relation with various syndromes.2) Identify the imaging features of vascular anomaly syndromes in various modalities.3) Discuss the management and role of interventional radiology in treatment.

TABLE OF CONTENTS/OUTLINE

1) Updated ISSVA classification2) Multimodality imaging features of specific vascular anomaly syndromesa) Hereditary hemorrhagic telangiectasiab) Blue rubber bleb nevus syndromec) Gorham-Stout syndromed) Primary lymphedemae) Klippel-Trenaunay syndromef)

Parkes Weber syndromeg) Servelle-Martorell syndromeh) Sturge-Weber syndromei) Maffucci syndromej) Macrocephaly-capillary malformationk) CLOVES syndromel) Proteus syndromem) Bannayan-Riley-Ruvalcaba syndromen) CLAPO syndromeo) Kasabach-Merritt phenomenonp) PHACE syndrome3) Management and role of interventional radiology

MSEE-99   Artificial Intelligence (AI) In The Emergency Department: Incorporating Into The Work Flow And Clinical Applications

Participants
Babina Gosangi, MD,MPH, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Artificial intelligence (AI) reads through the studies and identifies cases with acute findings such as intracranial hemorrhage, pulmonary embolism, rib or cervical spine fractures. It marks the cases as important and moves them higher up in the worklist so that the radiologists can read these cases immediately and improves patient care. 2. Post processed images from the AI highlight the abnormal findings and color code them so that the radiologists can review these images. 3. AI can overcall findings or miss findings and radiologists need to closely review the findings and dispose the case according to their acumen.

TABLE OF CONTENTS/OUTLINE

1. Introduction to Artificial intelligence (AI)- How is AI applied to radiology- How are images obtained- How are the images post processed and color coded2. How is AI incorporated into the workflow in the emergency department (ED)- Review cases- Identify abnormal cases- Prioritize the cases in the worklist by coding them or moving them to the top of worklist3- Various applications of AI in the ED- Intracranial hemorrhage- Pulmonary embolism- Rib fracture- Cervical spine fracture4. Pitfalls- Missed diagnosis - Overcalls

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Abstract Archives of the RSNA, 2021

Sub-Events

PDEE-1   Evolution And Long Term Sequelae Of Chronic Non-bacterial Osteomyelitis

Participants
T. Shawn Sato, MD, Iowa City, Iowa (*Presenter*) Research Grant, Bracco Group

TEACHING POINTS

- Chronic non-bacterial osteomyelitis (CNO) is a rare auto-inflammatory condition characterized by multifocal bone pain with a waxing and waning course.- Untreated or incompletely treated disease can result in complications including pathologic fractures, vertebral body collapse, hyperostosis and physeal bars.- Despite development of these complications, with adequate treatment in some cases these damages resolve.

TABLE OF CONTENTS/OUTLINE

- Clinical features of CNO- Imaging appearances of CNO on plain film, CT and MRI- Typical disease course of CNO- Importance of whole body MRI for diagnosing and monitoring CNO- Review cases of patients that develop pathological fractures of the axial and appendicular skeleton, hyperostosis and physeal bars and demonstrate follow up to demonstrate how adequate treatment can in some cases resolve these complications

PDEE-10   Inflammatory Myopathies In Children: Tips And Tricks

Participants
Maria Navallas, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

After reviewing this exhibit, the learner should be able to:1. Discuss the main inflammatory myopathies that occur in children2. Describe the most common imaging findings of inflammatory myopathies in children, with special emphasis on MRI3. Discuss the differential diagnosis of inflammatory myopathies in children

TABLE OF CONTENTS/OUTLINE

1. Background2. Clinical and demographics of inflammatory myopathies in children3. Imaging techniques for the diagnosis and follow-up of inflammatory myopathies, with special emphasis on the use of whole-body MRI3.1. Whole-Body MRI: abbreviated and fast protocol to avoid anesthesia4. Myopathies in children:4.1. Idiopathic inflammatory myopathies: Juvenile dermatomyositis, Juvenile polymyositis, Overlap myositis, Immune-mediated necrotizing myopathies4.2. Myositis associated with other connective tissue diseases such as scleroderma, systemic lupus erythematosus, systemic juvenile idiopathic arthritis, and mixed connective tissue disease4.3. Infectious inflammatory myopathies: viral, bacterial and parasitic4.4. Neoplastic related inflammatory myopathies4.5. Trauma4.6. Drug-induced myopathies4.7. Rhabdomyolysis4.8. Neuromuscular diseases: Muscular dystrophies, Congenital myopathies, Metabolic myopathies5. Management of the most common inflammatory myopathies in children6. Summary

PDEE-11   Current And Emerging Applications Of Computer-assisted Reporting And Decision Support (CAR/DS) Tools In Pediatric Radiology

Awards
Cum Laude

Participants
Eric Tung, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Computer-assisted reporting and decision support (CAR/DS) tools are a developing technology in radiology reporting that provide real-time assistance to improve accuracy, efficiency, reproducibility, and clinical utility of radiology reports. Many CAR/DS modules have either been developed or are being developed that have clinical applications in pediatric radiology. This exhibit aims to highlight the value of CAR/DS tools in the practice of pediatric radiology, including a) their value to pediatric radiologists through improved adherence to evidence-/consensus-based guidelines, promotion of clinically useful categorization, rapid access to educational materials, and performance of laborious calculations and b) their value to pediatric referring providers and deep learning tool developers through incorporation of standardized report language.

TABLE OF CONTENTS/OUTLINE

CAR/DS benefits pediatric radiologists: 1. Guideline adherence (i.e. AAST solid organ injury grading, SAR/SPR/AGA Crohn's disease reporting, perinatal UTD grading); 2. Clinically useful categorization (i.e. Papile germinal matrix hemorrhage classification, AO-ASIF distal humeral fracture classification, acute pancreatitis Balthazar Score); 3. Educational material access (i.e. ossification center graphic, foot alignment measurements, Mullerian duct anomaly spectrum); 4. Calculations (i.e. bone age evaluation, measurement

comparison to reference standards). Standardized language benefits referring providers and AI tool developers.

PDEE-12   Complications Of Cancer Therapy In Children: A Comprehensive Review

Awards
Cum Laude

Participants
Elizabeth Snyder, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Although progress has been made in reducing toxicity associated with cancer treatment in children, many complications may be unavoidable. Moreover, children are living longer after therapy as cancer survival rates have improved. Treatment-related complications may occur acutely after initiation of therapy or years following remission and can affect any organ system. Pediatric radiologists often play an important role in the diagnosis and evaluation of these complications, and thus, awareness of their imaging findings is essential to guide management and avoid misdiagnosis. The aim of this educational exhibit is to provide a comprehensive review of potential complications of cancer therapies, both short-term and long-term, from head to toe.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Brain, Head & Necka. Short-term: e.g. Methotrexate toxicity, pseudoprogressionb. Long-term: e.g. Secondary neoplasm, moyamoya vasculopathy, microsomia3. Chesta. Short-term: e.g. Infection, pulmonary edemab. Long-term: e.g. Pulmonary fibrosis, bronchiolitis obliterans, GVHD4. Abdominopelvic:a. Short term: e.g. enteritis, pancreatitis, veno-occlusive diseaseb. Long term: e.g. Focal nodular hyperplasia, hepatic fibrosis, GVHD5. Musculoskeletala. Short term: e.g. myositisb. Long-term: e.g. Avascular necrosis, secondary osteochondroma6. Conclusion

PDEE-13   RASopathies: The Imaging Spectrum

Participants
Yuko Tsujioka, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

RAS genes are common oncogenes that encode signaling molecules regulating cell proliferation, differentiation, and survival. Recent investigations have shown that abnormal activation of RAS signaling due to germinal mutations of RAS and RAS-related genes causes a group of congenital disorders, collectively termed RASopathies. The group of disorders is divided into two subgroups. The first subgroup includes Noonan syndrome and allied syndromes (cardio-facio-cutaneous syndrome and Costello syndrome) caused by overactivation of RAS activators, RAS proteins, and downstream molecules. The second comprises capillary malformation-arteriovenous malformation (CM-AVM) and neurofibromatosis type 1 (NF1) caused by inactivation of RAS inhibitors. It may be odd to most clinicians to address the Noonan group and NF1 together; however, there are a number of patients who show characteristics of both disorders. It is noteworthy that somatic mutations of RAS and RAS-related genes may manifest as atypical RASopathies. Clinical trials of RAS-signal inhibitors for affected individuals have provided promising results. The advances in therapeutic intervention may increase an opportunity for imaging examinations of RASopathies. We present here on the imaging spectrum of RASopathies.

TABLE OF CONTENTS/OUTLINE

- Concept of RASopathies - Noonan group/CM-AVM/NF1 - disorders bridging a gap between NF1 and Noonan syndrome (Jaffe-Campanacci syndrome, Noonan-like multiple giant cell lesion syndrome, etc.) - disorders due to somatic mutations

PDEE-14   Strategies To Help Optimize Fetal MRI Image Quality

Participants
Gregory A. Vorona, MD, Henrico, Virginia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Appropriate sequence selection and optimization is essential to perform quality fetal MRI. The "three-point tool" can be used to create in-plane images from oblique images in a moving fetus. Optimizing the shim mode can minimize delays between running sequences, mitigating the chance of the fetus repositioning itself. Adjusting the settings of parallel imaging can impact image quality factors including image sharpness and noise. Adjusting the number of concatenations can help to improve image quality by mitigating artifacts such as cross-talk.3.0 Tesla MRI imaging of the fetus presents technical challenges, which in part can be mitigated by hardware and software optimization.

TABLE OF CONTENTS/OUTLINE

Fetal MRI studies can be some of the most challenging MRI examinations to perform. The purpose of this educational exhibit is to share and discuss some of the technical factors that we identified as being useful to modify at our institution using a single vendor MR platform (Siemens). The exhibit will begin with a brief discussion of sequence selection, particularly focused on fetal brain MR evaluation. We will then discuss potential strategies that can be employed to optimize obtaining diagnostically acceptable multiplanar sequence acquisitions when the fetus is moving. We will then discuss other strategies that can be attempted to optimize image quality, including the use of parallel imaging and adjusting the number of concatenations. Finally, we will briefly discuss our experience performing fetal MR at 3.0T.

PDEE-15   Evaluation Of Extracardiac Complications Of Fontan Circulation Using Non-invasive Imaging

Awards
Certificate of Merit

Participants
Sowmya Balasubramanian, MD,MSc, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Fontan circulation can result in long term cardiac and extracardiac complications- Radiological studies play an important role in

the evaluation of end-organ dysfunction- Emerging techniques play a critical role in the detection and interventions of extracardiac complications

TABLE OF CONTENTS/OUTLINE

Background: Fontan circulation carries long term burden of cardiac, pulmonary and visceral organ dysfunction and aberration in lymphatic drainage due to increased central venous pressure and low cardiac output warranting routine, detailed diagnostic imaging. Diagnostic Imaging Options: Ultrasonography, magnetic resonance (MR) and computed tomography (CT) with advanced techniques can detect early and late sequelae. Extracardiac Complications: Lungs - Presence of veno-venous collaterals and arteriovenous malformations can be shown by CT or MR. Veno-lymphatic complications - Lymphatic congestion and abnormal lymphatic channels may contribute to plastic bronchitis and protein losing enteropathy. T2 weighted MR angiography with and without contrast can delineate flow dynamics and guide interventions to improve lymphatic function. Fontan associated liver disease - Findings include passive congestion, fibrosis, regenerative nodules, cirrhosis, hepatocellular carcinoma and intra- and extrahepatic veno-venous collaterals. Hepatocyte-specific contrast can differentiate regenerative nodules from hepatocellular carcinoma, while elastography allows for quantification of fibrosis.

PDEE-16   Pigmented Villonodular Synovitis In Children: A Comprehensive Review Of Entities And Differential Diagnosis

Awards
Certificate of Merit

Participants
Emilio Inarejos Clemente, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.Describe the use of ultrasound, radiography, CT and MRI for diagnosis and follow-up in children with pigmented villonodular synovitis (PVNS).2.Explain the different entities that are included in the term PVNS.3.Discuss the most common imaging findings of pigmented villonodular synovitis in children and compare with corresponding surgical and gross pathology.4.Describe the most frequent differential diagnosis depending on patient's age and disease location.

TABLE OF CONTENTS/OUTLINE

1. Background.2. Clinical findings and demographics of PVNS in children.3. PVNS includes the following entities: diffuse intraarticular form, localized intraarticular form, diffuse extraarticular form and localized extraarticular form (also known as giant cell tumor of the tendon sheath).4. Conventional and advanced imaging techniques in the study of PVNS in children, emphasizing on the role of US and MRI (diffusion-weighted imaging and perfusion) for diagnosis and follow-up.5. Ultrasound, radiography, CT, and MRI findings of PVNS in children, including illustrative examples with clinical, surgical and histopathological correlation.6. Novel targeted treatment options for non-surgical forms and recurrent PVNS: Imatinib.7. Use of contrast-enhanced MRI in treatment response assessment with illustrative examples.8. Summary.

PDEE-17   Cranial Sutures: Methods, Analysis And How Far Ultrasound Can Go. A Review.

Participants
Alessandra Chiovatto, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The objectives of this study is to analyse the main cranial sutures, with the aim of differentiation from craniosynostosis and positional skull deformities, emphasizing the role of ultrasound in the frontline. This manuscript intends to outline the normal anatomy of the newborn skull, technique of the sonographic exam to evaluate cranial sutures and to demonstrate the major types of craniosynostosis as well as the sonographic differential diagnosis from positional skull deformities.

TABLE OF CONTENTS/OUTLINE

1. Exam technique2. Sonographic anatomy a. by age group b. which age that close the sutures3. Epidemiology;4. Common presentation;5. Positional deformity X Craniosynostosis;6. Ultrasound, X-Ray and CT imaging limitations.

PDEE-18   Imaging The Cerebral Veins In Pediatric Patients: Beyond The Dural Venous Sinuses

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Asha Sarma, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Pediatric cerebral venous pathologies are a diverse group of entities with numerous underlying causes. This educational exhibit will prepare the radiologist to: a) compare and consider pros and cons of various cross-sectional imaging techniques used for evaluating pediatric patients with cerebral venous pathologies; and b) recognize and understand a broad variety of superficial and deep venous pathologies in children. Less-frequently discussed topics such as pathologies involving the cortical/bridging veins and the deep veins will be emphasized.

TABLE OF CONTENTS/OUTLINE

1. Anatomy, embryology, and normal variants 2. Cross-sectional imaging and post-processing techniques: CTV, MRI, MRV 3. Pathologic entities: A. Primarily superficial venous pathology: 1. Dural venous sinus pathologies (e.g., thrombosis, stenosis) 2. Traumatic bridging vein injury (acute, chronic with collateralization, subdural hemorrhage complicating arachnoid cyst) 3. Anomalous tortuous superficial cerebral veins 4. Cephalocele with anomalous drainage 5. Sinus pericranii (e.g., isolated and associated with other anomalies) 6. Isolated cortical vein thrombosisB. Primarily deep venous pathology: 1. Deep medullary vein thrombosis and white matter injury in infants 2. Complicated developmental venous anomalies 3. Sturge-Weber (spectrum of venous abnormalities) 4. "Vein of Galen" malformation 5. Cerebral venous metameric syndrome

PDEE-19   **Temporal Bone Tumors In Pediatric Age Group: A Pictorial Review.**

Participants
Mohammad Alwatban, MBBS, Khobar, Saudi Arabia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review the anatomy of the temporal bone.Discuss the clinical presentations associated with temporal bone lesions.Describe imaging features of some of these lesions and how to distinguish based on imaging findings.

TABLE OF CONTENTS/OUTLINE

The temporal bones comprise the lateral skull base, forming portions of the middle and posterior fossa. They are composed of five osseous parts and contain important structures such as the ossicular chain, osseous labyrinth, nerves, vessels, between others.The clinical manifestation of lesions of the temporal bones can be very variable, depending on the involvement of the adjacent intra- and extracranial structures, can present as a visible/palpable mass, or even be an incidental finding. The specific diagnosis by imaging can be challenging. CT and MRI are complementary in providing an appropriate differential diagnosis, the relation with important structures and in aiding surgical planning.There are numerous conditions that can affect the temporal bone region, including inflammatory and neoplastic. The tumors can originate from the diverse different structures that are seen in this region.We will briefly review the anatomic architecture of the temporal bone and present a pictorial review of 8 cases of temporal bone tumors, with discussion and illustration of the imaging features.

PDEE-2   **The Ductus Arteriosus: A Review Of Embryology, Fetal Imaging, Pathophysiology, And The Role Of Advanced Imaging In PDA Management And Intervention In Children And Adults**

Participants
Lauren May, MD, Wilmington, Delaware (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The ductus arteriosus (DA) is a key structure in fetal circulation that shunts blood from the pulmonary artery to the aorta to bypass the lungs. The fetal DA is highly amenable to assessment by ultrasound. 2. The DA typically closes after birth but can remain patent (PDA) causing pathophysiology as a result of shunting from the aorta to the pulmonary artery. 3. Depending on symptomatology and patient age a PDA can be closed with medication, occlusive devices, or surgical ligation. 4. Ductal-dependent congenital heart disease may require non-invasive and minimally-invasive interventions to maintain DA patency prior to palliative or definitive treatment. 5. An understanding of DA anatomy and function is crucial in the assessment and management of vascular rings and aortic malformations. 6. The DA can develop complications like aneurysm or thrombus for which advanced imaging techniques like CT and MRI are helpful in management and surgical planning.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Embryology and Maturation of the DA 3. DA Prenatal Imaging 4. PDA Clinical Presentation and Pathophysiology 5. PDA Imaging and Management 6. DA in Vascular Rings, Aortic Coarctation and Interrupted Arch 7. Ductal-Dependent Congenital Heart Disease 8. Conclusion

PDEE-20   **CT Report: Understanding The Staging System For Hodgkin's Lymphoma**

Participants
Warda Limaye, MD, Halifax, Nova Scotia (*Presenter*) Nothing to Disclose

TEACHING POINTS

By the end of this exhibit, the reader should be able to : 1- Understand the staging system of lymphoma. 2- The definition of bulk disease, measurable disease, and non-measurable disease. 3- Calculate the perpendicular product PPD and SPPD (sum of perpendicular products). 4- Be confident in assessing response to treatment (complete response versus very good partial response, versus partial response versus no response)

TABLE OF CONTENTS/OUTLINE

- Staging of HD.- Definitions: bulk disease, measurable, non-measurable disease.- Treatment response.

PDEE-21   **Contrast-enhanced Ultrasound In Pediatric Radiology: Why, How And When.**

Participants
Luca Basso, MD, Genova, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To explain the safety of intravenous application of UCAs - To mention current indications of UCAs in child - To discuss indications and limits of intravenous application of UCAs in different radiological settings in pediatric population (i.e. characterization of focal organ lesion, blunt abdominal trauma, pyelonephritis, vasculitis, etc.) - To make Radiologists aware of advantages of CEUS in diagnosis and follow-up in different radiological settings in children being a radiation-free and repeatable imaging technique

TABLE OF CONTENTS/OUTLINE

a) Physical Principles of Contrast-enhanced Ultrasound (CEUS) - b) Safety-profile of Ultrasound Contrast Agents (UCAs) - c) Acquisition technique of CEUS - d) Indications and off-label application of CEUS in pediatric population - e) Case series in pediatric population: I. Contrast-enhanced Voiding Urosonography (CEVUS) for Vesicoureteral Reflux (VUR) through endocavitary administration - II. Intravenous administration for: a. Characterization of focal organs lesions b. Blunt abdominal trauma c. Pyelonephritis d. Vascular pathologies (i.e. vasculitis) e. Inflammatory Bowel Disease (IBD) assessment f. Testicular lesions

PDEE-22   **Establishing A Non-sedate Pediatric MRI Program: Awake Or Asleep...Both Options Are On The MRI Table**

Awards
Certificate of Merit

Participants
Samantha Harrington, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Building blocks Ensure correct processes, people and workflows are in place. 2. Options Tailor non-sedate strategies to patients and their MRI scans. 3. Optimization Optimize MRI protocol for targeted, faster, quieter imaging with sequence order prioritized.

TABLE OF CONTENTS/OUTLINE

1. Departmental Processesi) referrals - who and how, ii) scheduling - when, where and with whom, iii) bookings - if it works AND if it doesn't. 2. Non-sedate Practices - General Considerations: i) environment, ii) education, iii) patient preparation.3. Non-sedate Practices - Specific Options: (including process, inclusions and exclusions) i) feed and swaddle, ii) natural sleep, iii) animal assisted therapy, iv) MRI simulation - real and virtual, v) Child Life Specialists - alone or in combination with other options, vi) non-sedating medications e.g. antianxiolytic agents, melatonin, vii) distracters e.g. music, movies. 4. MRI scanning - General Considerations: i) faster sequence strategies, ii) shorter protocols, iii) quiet MRI technology, iv) motion compensation strategies, v) advanced sequences. 5. MRI Scanning - Specific Considerations: i) indication-specific protocols, ii) protocols in prioritized order, iii) minimize use of intravenous gadolinium, iv) complementary modalities e.g. contrast enhanced ultrasound for cystic vs. solid lesions.

PDEE-23   CT In Tetralogy Of Fallot: Pre- And Postoperative Evaluation

Participants
Evan Zucker, MD, Palo Alto, California (*Presenter*) Research Consultant, F. Hoffmann-La Roche Ltd

TEACHING POINTS

1. To review the current and evolving indications for CT in tetralogy of Fallot (TOF). 2. To illustrate the broad spectrum of CT applications in pre- and postoperative TOF. 3. To emphasize the expanding role of CT for diagnosis, monitoring, and management of TOF, including emerging techniques.

TABLE OF CONTENTS/OUTLINE

TOF is the most common cause of cyanotic congenital heart disease, characterized by a subaortic ventricular septal defect (VSD), overriding aorta, right ventricular hypertrophy, and pulmonary stenosis. Yet, the anatomy and clinical course are in fact greatly heterogeneous. Echocardiography, supplemented by MRI, remains the primary imaging modality in TOF. Yet, in recent years, CT has become increasingly important. The growing indications for CT in TOF are reviewed, highlighting newer techniques (e.g., dual-energy, 3D printing, augmented reality). The broad spectrum of CT applications in TOF is illustrated through preop examples of conventional TOF, TOF with absent pulmonary valve, and TOF with pulmonary atresia / major aortopulmonary collaterals and postop examples of volumetry surveillance, right ventricular outflow tract aneurysm and recurrent obstruction, VSD patch leak, recurrent pulmonary arterial and conduit stenosis, aortic dilation, stent and implanted device-related complications, and repeat intervention planning (e.g., redo sternotomy, transcatheter pulmonary valve). In summary, CT has emerged as an essential tool in TOF evaluation, helping to facilitate precise diagnosis and tailored management.

PDEE-24   Hope For The Best, Prepare For The Worst - Pediatric Arthralgia: A Practical And Complete Guide For Rheumatic Pediatric Conditions

Participants
Andre Y. Aihara, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Joint pain in children is a common complaint. Although there are more frequent causes of joint pain, rheumatic causes should always be considered due to their high morbidity. In according to this,this exhibit aims to:Review every rheumatic disease in pediatric population, including clinical presentation, diagnostic criteria, image findings, complications, and differential diagnosis for these conditions in a multimodality approach;Illustrate with didactic cases the presentations of rheumatological diseases in children;Highlight and discuss specific findings that could help to determine the correct diagnosis/narrow down the differential diagnosis.

TABLE OF CONTENTS/OUTLINE

Overview about pediatric arthralgia,including clinical assessment. Propose a structured report with essential information that must be included in the report to help rheumatologists to approach the correct diagnosis.Demonstrate didactically the CR,CT,US and MRI findings of each rheumatic disease in children,including:Juvenile Idiopathic arthritis,Chronic nonbacterial osteomyelitis,Systemic lupus erythematosus,Scleroderma,Dermatomyositis/Polymyositis,Reactive arthritis,Inflammatory bowel disease.Differential diagnosis: infection, neoplasms, transitory synovitis. Propose a diagnostic algorithm for articular pain in children, which exams to be requested and according to the findings and clinical-laboratory correlation, narrow down the differential diagnosis and determine the correct diagnosis.

PDEE-25   The New Age Of Medulloblastomas: Imaging Features Of The Molecular Subgroups Of Medulloblastomas

Awards
Certificate of Merit

Participants
T. Shawn Sato, MD, Iowa City, Iowa (*Presenter*) Research Grant, Bracco Group

TEACHING POINTS

Medulloblastomas are the most common pediatric brain tumors. While historically considered a single entity, distinct molecular subgroups of medulloblastomas have emerged with implications for prognosis and optimal therapy. Although these tumor subgroups are often definitively characterized by molecular features, they can often be distinguished by distinct imaging features in conjunction with patient demographics, and the radiologist can play a larger role in diagnosis when tissue sampling is inconclusive due to sample variance. It is therefore important for radiologists to be familiar with these ongoing developments in medulloblastoma classification, specifically the most recent WHO classification, and typical imaging findings to provide intelligent consultation for our

oncology colleagues and provide the best care for our patients with medulloblastomas.

TABLE OF CONTENTS/OUTLINE

1. Overview of medulloblastomas 2. Review of embryological development of the hindbrain 3. Discussion of proposed embryological origins of medulloblastoma subtypes 4. Overview of each medulloblastoma subgroup (WNT, SSH, Group 3, and Group 4) 5. Review of multiple cases within each subgroup of medulloblastoma with emphasis on imaging characteristics unique to each subgroup

PDEE-26   Pediatric Right Lower Quadrant Ultrasound: Appendicitis And Beyond

Participants
Chris O'Sullivan, Temple, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand indications for right lower quadrant ultrasound 2. Perform appropriate scan technique 3. Identify normal appendix on ultrasound 4. Identify abnormal appendix on ultrasound 5. Identify complications of appendicitis 6. Recognize alternative diagnoses 7. Incorporate a standardized radiology report into practice

TABLE OF CONTENTS/OUTLINE

I. Indications for RLQ US a. ACR Criteria II. Scan Technique a. Preparation b. Technique c. Positioning d. Documentation III. Normal Appendix a. Measurements b. Morphology c. Compressibility IV. Abnormal appendix a. Measurements b. Morphology c. Noncompressible d. Vascularity e. Appendicolith V. Complications a. Abscess b. Perforation VI. Alternative diagnoses a. Ileitis b. Mesenteric adenitis c. Omental infarct d. Urachal remnant e. Meckel's diverticulum VII. Standard report

PDEE-27   Ectopic Thymic Tissue Masquerading As A Mass In Children - Tips And Tricks For The Radiologist.

Participants
Maura E. Ryan, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

The thymus is normal lymphoid tissue, typically prominent in childhood and classically located in the anterior mediastinum.However, thymic tissue can be encountered in other locations along the path of the thymopharyngeal ducts from which the thymic tissue arises.Ectopic or accessory thymic tissue, frequently encountered in the cervical soft tissues can be mistaken for pediatric malignancies such as neuroblastoma.Thymic tissue in ectopic regions retains imaging characteristics of lymphoid tissue on MR, CT and US imaging.Recognizing the typical imaging features, morphology and locations of ectopic thymic tissue to avoid unnecessary workup or surgery.

TABLE OF CONTENTS/OUTLINE

Embryology, anatomy and natural history of thymic tissue.Imaging appearance of normal thymic tissue on US, CT and MR.Case based pictorial review of children with ectopic thymic tissue, including superior extension of thymic tissue, ectopic thymic tissue in the thyroid gland, central neck and carotid space and in the posterior mediastinal space.Examples and discussion of ectopic thymic tissue associated with DiGeorge Syndrome (22q11.2 deletion).Discussion rare instances of symptomatic ectopic thymic tissue, management and follow-up

PDEE-28   A Radiologist's Lexicon For Reporting In Child Abuse

Awards
Magna Cum Laude
Identified for RadioGraphics

Participants
Asha Sarma, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Child abuse is a common and critical problem that may be encountered by radiologists in multiple disciplines. Optimal radiological terminology for suspected abuse-associated injuries in young children may differ from that used in other scenarios, including reporting in older patients and in cases of accidental trauma. Variable terminology for the same finding in the literature may also lead to confusion. Child abuse pediatricians' expert evaluation of injury-mechanism correlation relies on precise, appropriately detailed, and consistent use of radiological terminology for clinical, forensic, and medicolegal applications. This exhibit aims to catalog child-abuse related injuries from head to toe, with emphasis placed on preferred terminology from the child abuse pediatrics literature. More recently described entities (e.g., bridging vein injury), potential terminological pitfalls (e.g., inadequate description of fracture morphology), and mimics (e.g., coagulopathy, benign extra-axial fluid collections) will be highlighted.

TABLE OF CONTENTS/OUTLINE

1. Abusive CNS Trauma: a. Scalp injury b. Skull fractures and sutural widening c. Extra-axial collections (e.g., bridging vein injury, dating considerations) d. Parenchymal injury e. Retinal hemorrhage f. Spinal cord injury 2. Skeletal injuries: a. Fracture morphology (appropriate terminology, biomechanics) b. Fracture by site of injury c. Fracture dating d. Potential mimics of child abuse 3. Thoracoabdominal injuries

PDEE-29   Pediatric Airway Obstructions That Will Take Your Breath Away

Participants
Bruno Peres, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To display and discuss several teaching cases of congenital and acquired upper airway obstructive conditions from our hospital's 15-year database, mostly through computed tomography (CT) and magnetic resonance (MR) scans.

TABLE OF CONTENTS/OUTLINE

1. Brief introduction of pediatric upper airway anatomy and obstructive conditions. 2. Cases: unilateral and bilateral choanal atresia - unilateral and bilateral congenital dacryocystocele - pyriform aperture stenosis - arhinia (Bosnam syndrome) - retropharyngeal lymphadenitis - retropharyngeal suppurative lymphadenitis - congenital cervical teratoma - epiglottitis - juvenile nasopharyngeal angiofibroma - nasal cavity foreign body - oral cavity foreign body - infantile hemangioma - tracheobronchitis - aberrant left pulmonary artery (pulmonary sling) - tracheobronchial papillomatosis - tracheal stenosis tracheomalacia - tracheoesophageal fistula. 3. Conclusion.

PDEE-3   Lung Ultrasound For The Pediatric Radiologist

Participants
Thomas Marini, MD, Rochester, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Understand the basic physics of lung ultrasound and image acquisition. 2) Understand the broad spectrum of applications for lung ultrasound in pediatric radiology. 3) Identify basic imaging features of common and uncommon pediatric pulmonary conditions on lung ultrasound. 4) Discuss the use of lung ultrasound in the context of the larger health system.

TABLE OF CONTENTS/OUTLINE

1) Introduction to lung ultrasound: a) Basic physics to contextualize clinical findings including discussion of "A-Lines" and "B-Lines" b) Lung ultrasound image acquisition in pediatric patients c) Indications for lung ultrasound and its sensitivity and specificity for conditions d) Discussion of current use of lung ultrasound including point of care ultrasound and future directions 2) Lung ultrasound imaging findings in pediatrics: a) Asthma b) Viral illness including bronchiolitis and COVID-19 c) Bacterial pneumonia d) Pleural fluid (effusion/empyema) e) Pulmonary edema f) Abscess g) Miscellaneous cases including vaping and bronchopulmonary dysplasia 3) Future uses and directions in pediatric lung ultrasound a) Alternative to chest x-ray utilization b) Point of care versus diagnostic lung ultrasound c) Lung ultrasound health policy and global outreach

PDEE-31   Neurological Findings In Down Syndrome: What Every Radiologist Should Look For

Participants
Juliana Benez, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibition is to: • Demonstrate the most frequent neuroradiological findings in Down syndrome. • Illustrate through didactic cases and different imaging modalities the main manifestations according to brain/spine/vascular/head and neck. • Help young radiologists to perform an active search of these changes.

TABLE OF CONTENTS/OUTLINE

• Introduction • Main imaging findings in DS, according to - Brain: overall reduced brain volume, progressive brain atrophy, basal ganglia calcifications, malformations of the corpus callosum, syndrome) - Spine: craniocervical instability, flattened surface of the occipital condyles, bifid C1 arches, atlantooccipital assimilation, "Os Odontoideum" and, "Mickey Mouse" pelvis.- Vascular: aberrant subclavian artery and Moyamoya syndrome. - Head and neck: microcephaly/microcrania, brachycephaly without craniosynostosis, platybasia, macroglossia, stenotic external auditory canal, ossicular chain abnormalities, and hypoplasia/aplasia of the bony island of the lateral semicircular canal. • Objectively delineate what findings radiologists should look for. • Provide didactic and illustrative cases in a challenging format to test and consolidate the knowledge acquired. • Conclusions. • References.

PDEE-32   Ultrasonography As A Diagnostic Tool In The Evaluation Of Congenital And Acquired Duodenal Obstruction: Anatomy, Usual And Unusual Cases

Participants
Natalia Lima, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:1. To review the normal duodenal anatomy by ultrasound;2. To show the importance and effectiveness of ultrasound as a method of choice for the diagnosis of obstructive pathologies of the duodenum in neonates and children;3. To show usual and unusual cases of congenital and acquired duodenal obstruction from our pediatric radiology group;4. To show the main sonographic findings, classic signs and tips in the assessment and diagnosis of duodenal obstruction in neonates and children.

TABLE OF CONTENTS/OUTLINE

1. Sonographic technique in duodenal evaluation;2. Sonographic duodenum anatomy and adjacent structures;3. Illustrated teaching cases from our pediatric radiology group showing sonographic images of usual and unusual causes of congenital and acquired duodenal obstruction:- Duodenal web;- Annular pancreas;- Intestinal malrotation;- Duodenal hematoma after upper digestive endoscopy.

PDEE-33   Optimizing Imaging Of Pediatric Liver Tumors: Guidelines From The Pediatric LI-RADS Workgroup

Awards
Identified for RadioGraphics

Participants
Govind Chavhan, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

Differential diagnosis of pediatric focal liver lesions should be based on age, underlying history, and AFP level. Children vary significantly in age, size, ability to stay still, and ability to breath-hold. Choosing and tailoring imaging techniques for each indication and age group is important. The need for sedation can be obviated using techniques like feed and bundle, contrast-enhanced ultrasound, and motion-insensitive sequences for MRI. Hepatobiliary contrast media enables detection of satellite lesions and helps radiologists to refine their differential diagnosis.

PDEE-34 Abnormalities Of Placental Blood Flow: What The Radiologist Needs To Know

Awards
Certificate of Merit

Participants
Morgan McLuckey, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

TEACHING POINTS

There is a growing body of literature which suggests that placental hemodynamics are related to common gestational problems such as maternal hypertension, intrauterine growth restriction, and preterm delivery. The increasing availability of prenatal MR allows radiologists to assess in vivo placental vasculature more clearly than ever before. There is a need for radiologists to have a more thorough understanding of placental imaging to better predict which vascular anomalies are problematic and which are incidental findings.

TABLE OF CONTENTS/OUTLINE

1. Review placental vascular anatomy and embryology // 2. Highlight examples of placental extravascular blood // a. Intraplacental // b. Retroplacental // c. Subchorionic // d. Subamniotic/Intra-amniotic // e. Aging hematoma // f. Comparison of hematoma and ongoing hemorrhage // g. Comparison of hematoma and transient myometrial contraction // 3. Illustrate examples of placental ischemic lesions // a. Placental infarction // b. Generalized ischemia // c. Intervillous thrombi (with comparison to placental lakes) // 4. Address imaging findings of the placenta in intrauterine growth restriction in the setting of perfusion abnormality // 5. Assess the clinical significance of these findings and how they relate to systemic gestational disease processes // 6. Summarize the diagnostic value of placental MRI and how findings are related to perinatal outcome.

PDEE-35 Ultrasound: A Noble Technique For The Diagnosis Of Gastroesophageal Reflux In Children

Participants
Evelyn Torres Gomez, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

Gastroesophageal reflux is a physiological condition in patients under one year, however, when the quantity or intensity of these episodes increases, it conditions a gastroesophageal reflux disease. A good history and physical examination are usually sufficient for the clinical diagnosis of gastroesophageal reflux.However, in the presence of complications or suspected GERD, some of these patients will require additional diagnostic studies, among which are phmetry, endoscopy with or without biopsy, esophageal manometry, barium fluoroscopic studies, scintigraphy abdominal and abdominal ultrasound.Abdominal ultrasound is a safe, non-invasive, ionizing radiation-free and reliable procedure, with a sensitivity that exceeds 68%; which can be used in the assessment of GERD patients.Ultrasound allows evaluation of morphological characteristics of the esophagogastric junction, diagnose gastroesophageal reflux and classify the severity of the reflux according to the number of episodes in a given time.Abdominal ultrasonographic evaluation also makes it possible to identify differential diagnoses with pathologies that may have a similar clinical presentation, among which is pyloric hypertrophy and hiatal hernia.

TABLE OF CONTENTS/OUTLINE

Normal anatomy of the esophagogastric junction.Ultrasound technique for the evaluation of the distal esophagus.Main imaging findings in patients with gastroesophageal reflux.Ultrasonographic classification of the severity of gastroesophageal reflux.

PDEE-36 Diffusion MRI (DW-MRI) In Pediatric Soft Tissue Tumors And Pseudotumors: Technical Considerations, Pitfalls, Current And Evolving Applications

Participants
Maria Clara Lorca, MD, Pittsford, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Diffusion weighted imaging MRI (DW-MRI) role in evaluation of pediatric soft tissue masses, both as complement and alternative to traditional MR pulse sequences 2. Artifacts associated with DW related to hardware, pulse sequence or the composition of the assessed soft tissue mass; radiologists must recognize and when possible, mitigate these artifacts 3. DW-MRI role in characterization and post-therapy assessment of pediatric soft tissue masses 4. 4. Intravoxel incoherent motion (IVIM), an advance in DW-MRI separates microcirculation/perfusion-related effects from pure tissue diffusion, thereby allowing for derivation of pure diffusion coefficients and improving accuracy of characterization of pediatric soft tissue masses

TABLE OF CONTENTS/OUTLINE

1. Physics, technique, pitfalls of pediatric musculoskeletal DW-MRI exams 2. Whole body MRI: tool to examine multifocal soft tissue tumors 3. WHO classification of soft tissue tumors 4. Institutional acquisition protocols of single body part / whole body MR imaging 5. Scanner considerations and pulse sequences used for DW acquisition with relative merits and demerits of each; strategies to optimize single-shot echoplanar imaging (SS-EPI) 6. Current and evolving applications of DWI-MRI for assessment of pediatric soft tissue tumors/pseudotumors on an image-based template, with histologic correlation where applicable

PDEE-37 Pediatric Hepatic Cystic Lesions: Differential Diagnosis And Multimodality Imaging Approach

Awards
Identified for RadioGraphics

Participants
Erica Riedesel, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

The differential diagnosis of cystic hepatic lesions seen in the pediatric population can be divided into developmental, infectious, post-traumatic/iatrogenic, and malignant lesions. Familiarity with key radiologic findings and understanding of specific clinical associations can assist the practicing radiologist in definitive diagnosis. In this educational exhibit, we will present a comprehensive differential diagnosis for pediatric hepatic cystic lesions with an emphasis on imaging findings on multiple modalities.

TABLE OF CONTENTS/OUTLINE

• Introduction • Developmental o Simple cystso Biliary cysts § Choledochal cysts § Caroli's disease o Foregut cysts • Infectious o Pyogenic abscess o Hydatid cyst • Post-Traumatic/Iatrogenic o Hematoma o Seroma o Biloma o UVC-related extravasation o Post-ablation changes • Malignant o Mesenchymal hamartoma o Undifferentiated embryonal carcinoma • Mimics o Fungal microabscess o Vascular tumor (infantile or congenital hepatic hemangioma) o Diaphragmatic mesothelial cyst

PDEE-38 Diagnostic And Therapeutic Utility Of Contrast Enema In Pediatric Patients: What Does The Radiologist Need To Know?

Participants
Khem R. Uprety, MD, Memphis, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Educational Goals1. To review the appropriate indications and contraindications of contrast enema in the pediatric patients.2. To become familiar with the technique and appropriate choice of contrast while performing contrast enema.3. To review imaging features of various conditions causing distal intestinal obstruction in neonates. 4. To review therapeutic utility of contrast/air enema in various emergent conditions such as Volvulus, Ileo-Colic Intussusception and Meconium Ileus.

TABLE OF CONTENTS/OUTLINE

Indications and contraindications of contrast enema; Appropriate technique and choice of contrast while performing contrast enema; Normal anatomy, anatomic variants as well as expected post-surgical appearances of the colon; Review typical contrast enema findings in different colonic pathologies including but not limited to Hirschsprung's disease, microcolon, meconium ileus, functional immaturity of the left colon, colonic stricture secondary to necrotizing enterocolitis, and colonic atresia; Review therapeutic utility of contrast enema in meconium ileus and colonic volvulus; Review air reduction enema in ileocolic intussusception.

PDEE-39 MRS Signatures Of Inborn Metabolic Errors In Children With Normal Or Near-normal Appearing Brains

Participants
Matt Whitehead, MD, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. 1H MRS detects neurometabolic disturbances directly in normal appearing brains early in disease and in milder IEM phenotypes2. MRS often outperforms blood and CSF analyses3. Creatine deficiency syndromes, galactosemia, urea cycle, mitochondrial, and long-chain fatty acid oxidation disorders can manifest specific spectroscopic signatures and normal brain MR imaging4. Consider MRS in pediatric patients with unexplained seizures, altered mentation, stupor, developmental delay/intellectual disability, movement disorders, weakness, and/or hypoglycemia notwithstanding the appearance of the brain MR

TABLE OF CONTENTS/OUTLINE

1. Introduction/Background2. Technical considerations/recommendations3. Case examples: creatine deficiency, galactosemia, urea cycle, mitochondrial, and long-chain fatty acid oxidation disorders4. Take-home points

PDEE-4 Pediatric Facial Trauma: What The Surgeon Needs To Know.

Awards
Identified for RadioGraphics

Participants
Naoya Shatani, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Pediatric facial fractures follow patterns similar to those in adults, however the relative incidence of fracture patterns and associated complications change as skeletal development progresses from infant to adolescent.2. The concept of facial buttresses, well-described in adult literature, also applies to the pediatric population, providing an approach to description of injury patterns involving different facial subunits.3. When a facial fracture is clinically suspected, low dose CT from the forehead to chin, with 3D rendering, should be performed early, to provide the surgeon with optimal information for treatment planning.4. Surgeons make decisions based on aesthetics and function. It is crucial to identify and describe facial fractures according to clinically relevant facial subunit injuries. Associated features that the surgeon must be aware of are extent of displacement and alignment, and involvement of adjacent structures including the brain and dura, orbital contents, dentition, and neurovascular structures.

TABLE OF CONTENTS/OUTLINE

1. Description of relevant facial anatomy, using three dimensional illustrations, and patterns of facial fractures using concept of subunits and buttresses.2. Unique aspects of facial fractures in children and important radiologic "pearls".3. What the surgeon

wants to know for each pattern of injury: orbital, zygomaticomaxillary complex (ZMC), nasoorbitoethmoidal (NOE), Le Fort, mandibular, nasoseptal, and dentoalveolar.

PDEE-40   When Sugar Looks Like Salt: Pitfalls That Could Lead To The Incorrect Diagnosis Of Child Abuse

Participants
Nadia Solomon, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

Identifying victims of child abuse is vital to protect them, yet false accusations are also damaging. We aim to provide a review of imaging findings that may suggest the incorrect diagnosis of child abuse and how to distinguish these from true cases. 1. Introduction to child abuse emphasizing importance of accurate identification 2. Clinical and imaging approaches, including best practices for imaging 3. Various processes potentially mistaken for child abuse, including presentation, pathophysiology, and imaging features to aid in differentiation

TABLE OF CONTENTS/OUTLINE

1. Common non-accidental trauma, with mechanisms and imaging findings 2. Clinical and imaging approaches for investigating child abuse 3. Processes potentially mistaken for child abuse on imaging and distinguishing features a. Accidental injury b. Congenital/developmental variants (e.g., Wormian bones) c. Birth trauma (e.g., molding) d. Infections, postinfectious conditions (e.g., syphilis) e. Primary bone diseases (e.g., bone cysts) f. Vitamin deficiencies, toxins g. Connective tissue disorders, skeletal dysplasias (e.g., Ehlers Danlos) h. Metabolic disorders (e.g., homocystinuria) i. Hematologic diseases, coagulation disorders (e.g., hemophilia) j. Hypoxic and ischemic disorders k. Other neurological conditions (e.g., hydrocephalus) l. Other genetic disorders (e.g., Prader-Willi) 4. Review of confusing imaging findings and differential diagnoses 5. Update on research/best practices for imaging suspected abuse cases

PDEE-41   Utility Of Various Measurements In Diagnosis And Management Of Lower Extremity Alignment Disorders In Pediatric Patients.

Participants
Jignesh N. Shah, MD, Germantown, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review etiopathogenesis and imaging features of various lower extremity alignment disorders in pediatric population 2. To review utility of measurements in diagnosis and management

TABLE OF CONTENTS/OUTLINE

Enumerate alignment disorders of lower extremities in pediatric patients; Discuss embryological basis and etiopathogenesis; Imaging features of alignment disorders involving lower extremities in pediatric patients including but not limited to developmental dysplasia of hip, coxa vara, coxa valga, femoral anteversion, tibial torsion, genu varum, blount disease, genu valgum, leg length discrepancy, club foot, congenital vertical talus, rocker-bottom foot, metatarsus adductus, skewfoot, flatfoot, calcaneovalgus, pes cavus, hallux valgus, cerebral palsy; Utility of various measurements such as hip alpha angle, acetabular index, reimers migration percentage index, femoral neck-shaft angle, angle of femoral anteversion, angle of tibial torsion, metaphyseal-diaphyseal angle of Drennan, lateral talocalcaneal angle, meary's angle, calcaneal inclination angle etc. to diagnose and guide management of above mentioned entities

PDEE-42   Congenital Hand Anomalies: What Does The Radiologist Need To Know?

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Participants
Ankita Chauhan, MD,MBBS, Memphis, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Background Information Congenital hand anomalies are often isolated phenomena but can be associated with other congenital anomalies and maybe the only external manifestation of a syndrome. Knowledge of radiographic features is the mainstay to characterize the hand anomalies and guide treatment for better functional prognosis. Objectives / Teaching Points 1. To become familiar with the classification of congenital hand anomalies and the syndromes associated with them. 2. To acquire a basic understanding of the embryological and genetic basis of congenital hand anomalies. 3. To review the salient imaging features of the congenital hand anomalies and treatment options.

TABLE OF CONTENTS/OUTLINE

-Embryologic and genetic basis of hand development -Classification of congenital hand anomalies -Typical imaging features of hand anomalies (including but not limited to synostoses, clinodactyly, camptodactyly, syndactylies, delta phalanx, Kirner's deformity, symphalangism, constriction band syndromes, arthrogryposis multiplex congenita) -Syndromes associated with hand anomalies (such as Holt-Oram syndrome, Thrombocytopenia Absent Radius (TAR) syndrome, VACTRL, Fanconi anemia, Apert syndrome, Poland syndrome -Treatment options -Summary

PDEE-43   The Importance Of Nuchal Access In Cranial Ultrasound: What Are We Missing?

Participants
Natalia Lima, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:1. To review the main indications of cranial ultrasound in neonates;2. To show the importance and the technique of the nuchal access in the routine neonatal cranial ultrasound;3. To show based on cases from our pediatric radiology group important structures that must be evaluated by this nuchal access;4. To review based on cases from our pediatric radiology group the main congenital and acquired abnormalities of the neonatal posterior fossa only detected by the nuchal access and not identified by a routine cranial ultrasound through the anterior fontanelle.

PDEE-44   Fetal MRI At 3T: Principles To Optimize Success

Awards
Identified for RadioGraphics
Cum Laude

Participants
Fedel Machado, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

The MRI technologist plays a crucial role in patient preparation and success of examHigher SNR can be leveraged to optimize sequences and improve spatial and temporal resolution. Individual sequences play different roles in fetal MRI: showcase of frequently used sequences in clinical examplesFetal MRI at 3 T is safe: review of evidenceAdvantages and disadvantages of 3T vs 1.5 T

PDEE-45   Pediatric COVID-19 Infection From Head To Toe

Participants
Christine Nwoke, MS, Cordova, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Children infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) may present with acute respiratory symptoms, acute systemic symptoms, or a post infectious inflammatory syndrome known as Multisystem Inflammatory Syndrome in Children (MIS-C). Symptoms of acute COVID-19 infection and MIS-C in children are often nonspecific and overlap with common pediatric pathologies such as acute appendicitis. While routine imaging is usually not indicated in pediatric COVID-19 infection, imaging can facilitate care in severe and complex cases as well as exclude alternative diagnoses. The purpose of this exhibit is to review imaging features, clinical presentation, and clinical follow up of 582 patients that presented to our institution with laboratory evidence of COVID-19 and 47 patients with clinical diagnosis of MIS-C. Cases will be reviewed in context of our current understanding of pediatric COVID-19 infection based on a literature review.

PDEE-46   MRI In Neonates: Practical Approach To Improve Image Quality And Diagnostic Yield

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Participants
Limin Xu, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To review principles of image optimization for neonatal MRI -To learn appropriate patient preparation and strategies to enable non-sedated MRI -To understand safety considerations -To demonstrate examples of common indications -To showcase emerging technologies that improve MR image quality and access in sick newborns

PDEE-47   A Pictorial Review Of Neurosonographic Vascular Anatomy As Depicted With Microflow Imaging

Participants
Shawn Lyo, MD, Brooklyn, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Neurosonography is an indispensable imaging examination in the evaluation of the infant brain. Grayscale sonography allows assessment of the parenchyma and extra-axial spaces and Doppler-based imaging may evaluate the intracranial vasculature. Microflow imaging (MFI) is one of multiple recently developed Doppler sonographic techniques which utilize advanced background tissue suppression algorithms to allow non-contrast visualization of low-flow microscopic vessels which were not well visualized previously. In this pictorial review, we demonstrate the intracranial microvascular anatomy which is frequently visualized with MFI with correlation to conventional and MR angiography.

TABLE OF CONTENTS/OUTLINE

I. Neonatal neurosonography a. Grayscale b. Doppler i. Color Doppler, spectral Doppler, Power doppler ii. Advanced Doppler techniques such as MFI c. Comparison of overlayed grayscale and Doppler techniques II. Neurosonographic examination a. Standard views via anterior fontanelle i. Coronal ii. Sagittal III. Vascular anatomy a. Arteries i. Anterior circulation 1. Intracranial segments of the internal cerebral artery 2. Anterior cerebral artery 3. Middle cerebral artery 4. Lenticulostriate and thalamostriate arteries ii. Posterior circulation 1. Basilar Artery b. Veins i. Superficial venous system including sinus and cortical veins ii. Deep venous system c. Additional i. Choroid plexus/arachnoid granulations IV. Conclusion

PDEE-49   Pediatric Renal Cysts: Is It Really That Simple?

Participants
Marcelo Takahashi, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Pediatric renal cysts differential diagnosis and associated syndromes.- Key imaging features that must be evaluated in cases of pediatric renal cysts.- Imaging rationale and technique tips/recommendations

TABLE OF CONTENTS/OUTLINE

1- Introduction:Epidemiology of renal cysts in childrenNormal renal development.2- Imaging Rationale in pediatric renal cyst evaluation:Pre-natal US and MRIUSCTMRVCUG.3 - Urinary tract abnormality related cysts:Multicystic Dysplastic KidneyCystic Dysplasia4 - Genetic disorders associated with cysts:Autosomal dominant polycystic diseaseAutosomal recessive polycystic diseaseOthers (Von Hipel-Lindau, Tuberous sclerosis, Hajdu-Chenye).5 - OthersCystic partially differentiated nephroblastomaCystic nephromaAbscess6 - Pitfalls:Focal calyceal dilationNormal neonatal pyramids7 - Take Home Message

PDEE-5   Skeletal Dysplasia Families: A Comprehensive Review

Participants
Atsuhiko Handa, MD, Iowa City, Iowa (*Presenter*) Nothing to Disclose

TEACHING POINTS

Skeletal dysplasias encompass a heterogeneous group of over 400 disorders. They are individually rare, but collectively common with an approximate incidence of 1/5000; thus, radiologists occasionally encounter skeletal dysplasias in daily practice. Most skeletal dysplasias have their characteristic pattern of skeletal changes, and the diagnosis rests on pattern recognition. A group of skeletal dysplasias that share a distinctive radiological pattern can be grouped into a "skeletal dysplasia family" that generally shares a common pathogenesis. Since major skeletal dysplasia families are limited in number, the radiologists can become readily familiar with their diagnostic patterns. The purpose of this exhibit is to 1) demonstrate the radiological characteristics of major skeletal dysplasia families and 2) review their clinical and genetic features that help radiologists to participate in multidisciplinary care. After completion of this presentation, the learners will have an overall picture of the entire world of skeletal dysplasias.

TABLE OF CONTENTS/OUTLINE

- Introduction - Approach to skeletal dysplasias - FGFR3 (achondroplasia) family - COMP family - Type II collagenopathies - Dysostosis multiplex family (mucopolysaccharidoses and mucolipidoses) - TRPV4 (metatropic dysplasia) family - Skeletal ribosomopathies (eg. Schwachman Diamond) - DTDST (diastrophic dysplasia) family - Filaminopathies - Punctata group - Skeletal ciliopathies - Osteogenesis imperfecta group - Osteopetrosis group

PDEE-50   Pediatric Macrocephaly: A Systematic Approach And Review Of Etiologies And Neuroimaging Characteristics

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Jennifer Huang, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Macrocephaly, defined as head circumference > 2 standard deviations above the mean.• Distinguishing which of the four components of the cranium is increased (cerebrospinal fluid, blood, brain parenchyma, calvarium), patient age, and symptoms are key.• Benign enlargement of subarachnoid spaces (benign macrocephaly) is the most commonly imaged entity. However, there are also many pathologic etiologies (see below).• Multiple imaging modalities are complementary in the evaluation of macrocephaly.

TABLE OF CONTENTS/OUTLINE

• In-depth review of differentiating clinical and imaging features of various causes of macrocephaly, organized by each of 4 involved compartmentsso Cerebrospinal fluid spaces§ Benign enlargement of subarachnoid spaces (BESS)§ Hydrocephalus§ Hydranencephaly§ Choroid plexus neoplasmso Blood§ Hemorrhage (e.g., subdural)§ Arteriovenous malformation (e.g., Vein of Galen)o Brain parenchyma§ Anatomic megalencephaly (e.g., PTEN, PIK3/AKT/mTOR mutations)§ Metabolic megalencephaly• Glutaric aciduria type 1• Leukodystrophy (Alexander disease, Canavan disease, megalencephalic leukoencephalopathy)• Lysosomal storage disorders (e.g., mucolipidosis)§ Intracranial mass (e.g., cyst, tumor, abscess)§ Neurocutaneous disorders§ Cerebral gigantismo Calvarium§ Skeletal dysplasia (e.g., achondroplasia)§ Thalassemia major

PDEE-51   A Systematic Approach And Neuroimaging Review Of Pediatric Cerebellar Ataxia

Participants
Jennifer Huang, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Structural abnormalities and diseases causing cerebellar ataxia in children are relatively common and warrant further evaluation with imaging.• The often-nonspecific clinical presentation can present challenges in definitive diagnosis, however a combination of neuroimaging modalities and genetic testing are useful adjuncts.• A systematic approach of pediatric cerebellar ataxias categorized by imaging finding will be proposed.• Overlapping findings may be seen between categories of disease listed below.

TABLE OF CONTENTS/OUTLINE

• Detailed review of clinical and imaging features of selected causes of pediatric cerebellar ataxia, categorized into groups by salient imaging finding (additional entities may be included in final presentation)o Cerebellar mass§ Medulloblastoma§ Pilocytic astrocytoma§ Ependymoma§ Lhermitte-Duclos disease (dysplastic cerebellar gangliocytoma)o Cerebellar atrophy§ Spinocerebellar ataxia§ Friedreich's ataxia§ Ataxia-telangiectasia§ Vanishing white matter diseaseo Cerebellar malformation/underdevelopment§ Dandy-Walker syndrome§ Molar Tooth Malformation§ Rhombencephalosynapsiso Abnormal cerebellar enhancement§ Cerebellitis§ Herpesviruso Abnormal cerebellar signal§ Cerebellitis§ Paraneoplastic degeneration§ Metabolic disorders (e.g., mitochondrial, neuronal ceroid lipofuscinosis, GM2 gangliosidosis, phospholipase A2 associated neurodegeneration (PLAN))§ Hemorrhage§ Multiple sclerosis§ Infarct

PDEE-52 **Gadolinium In Pediatric Magnetic Resonance: Indications, Risks And Alternatives**

Participants
Ana Paiva Cavalcante, PhD, MD, Sao Paulo, Brazil (*Presenter*) Research Advisor, Bayer AG

TEACHING POINTS

There is great concern on Gadolinium use in children. Some strategies can be used to reduce the use of GBCA in the pediatric group.

TABLE OF CONTENTS/OUTLINE

The macrocyclic gadolinium-based contrast agents (GBCA) were recently approved for use in children under 2 years of age. These contrast agents demonstrated improved lesion detection and delineation, and were well-tolerated for use in children. However, recent observations of gadolinium (GD) tissue retention have raised additional concerns about the use of GBCA in the pediatric population. Although studies to date have not shown clinical consequences of GD tissue retention, the jury is still out on whether such consequences may arise during the lifetime of children submitted to multiple doses of GBCA. We reviewed the literature on the risks of adverse events and GD tissue retention in the pediatric population and highlighted several clinical indications in which the benefits of enhanced MRI and PET-MR outweigh potential risks. We outlined alternative strategies to reduce the use of GBCA in the pediatric group including unenhanced MRI protocols, use of Contrast Enhanced Ultrasound (CEUS), and the recent applications of liquid biopsy in pediatric tumors. Finally, we discussed the use of reduced dose of a 1.0 M GBCA, the recent applications of Deep Learning for synthetic enhanced MRI, as well as possible indications for alternative MRI contrast agents such as superparamagnetic iron-oxide nanoparticles (SPIONs).

PDEE-53 **A Radiology Resident's Guide To Imaging The Sick Neonate: A Head-to-toe Primer**

Participants
Jennifer Lindsey, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Acutely ill neonates often require imaging for common and uncommon critical diagnoses and identification of complications of therapeutic intervention. Bedside modalities (e.g., ultrasound, portable radiography, and increasingly, portable CT and MRI) are of vital importance. Effective communication with the clinical team is also essential.This educational exhibit aims to prepare radiology trainees to:1. Identify key clinical and imaging findings on head-to-toe imaging of the sick neonate.2. Understand best practices in communication, clinical intervention, and follow-up imaging.

TABLE OF CONTENTS/OUTLINE

1. Craniala. Ischemic injury (e.g., HIE, neonatal stroke, mimics),b. Hemorrhage (e.g., germinal matrix hemorrhage, subgaleal hematoma)c. Infectiond. Hydrocephalus2. Chesta. Neonatal lung diseasesb. Congenital diaphragmatic herniac. Complications of critical care (e.g., barotrauma)d. Support device complications (e.g., hepatic abscess/TPNoma, thrombosis)3. Abdominopelvica. Necrotizing enterocolitis and complications i. Radiography vs. USb. Malrotation with midgut volvulus i. Fluoroscopy vs. USc. Renal vein thrombosisd. Biliary atresia4. MSK/Spinala. Post-LP hematoma5. Non-cardiac causes of cardiac failurea. Pathologic shunts (e.g., hepatic, vein of Galen malformation)b. Congenital hemangioma

PDEE-54 **Precocious Puberty: What Radiologist Needs To Know**

Participants
Diego Guerrero Gomez SR, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Precocious puberty (PP) is the name given to the pubertal development more than 2-2.5 standard deviations earlier than population norms (less than 8 years in girls and 9 years in boys). - Reminding the endocrinological Hypothalamus-pituitary-gonadal (HPG) axis, could be understood the main PP etiologies. - Main central (Brain) causes of PP include tumoral etiologies such as hypothalamic hamartoma, optic pathway or hypothalamic glioma, and germinomas, and non-tumoral causes like traumatic brain injury, and toxoplasmosis sequalae.- Peripheral PP could be attributed to pathology located in adrenal gland (adrenal neoplasm or congenital adrenal hyperplasia), ovaries (simple cyst, Juvenile granulosa cell tumor), testes (Juvenile granulosa cell tumor) or from Syndromic origin (McCune-Albright Syndrome).- According to the physical exam and lab-tests should be made the radiological approach as described in the proposed algorithm.

PDEE-55   Acute Imaging Manifestations Of Meckel's Diverticulum In Children

Participants
Guillermo Alfonso, DO, Tucson, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

Meckel diverticulum (MD) is a congenital intestinal diverticulum due to degeneration of the umbilical end of the omphalomesenteric duct in relation to the distal ileum. Although most cases are asymptomatic, some children could present with acute abdominal pain due to complications arising from MD. The clinical presentation is similar to acute appendicitis with ultrasound being the initial imaging modality of choice. Ultra-fast MRI can offer a quick and accurate alternative to established imaging modalities including contrast enhanced CT and radionuclear imaging. We propose to present an non enhanced ultrafast MRI protocol that perform robustly in the setting of both acute appendicitis and acute complications of MD

TABLE OF CONTENTS/OUTLINE

1. Anatomy and Embryology of omphalomesenteric duct2. Clinical presentation of MD3. Ultrafast MRI protocol4. Case presentations: Incidental MD, Acute Meckel Diverticulitis, Perforation, bowel obstruciton, Internal hernia5. Differential Diagnosis with illustrative examples.

PDEE-56   Imaging Of Pediatric Neuro Emergencies: Paradigm Shift

Participants
Neetika Gupta, MBBS,MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To illustrate the diverse etiology of acute neurological emergencies in pediatric patients. • To discuss the role of various imaging modalities and interventions in the evaluation of acute pediatric neuro emergencies.• To highlight the role of Rapid MRI in pediatric neuro emergencies, reducing the scan duration and needs for anesthesia. • To emphasize the diagnostic and prognostic role of neuroimaging in the evaluation of pediatric neuro emergencies.

TABLE OF CONTENTS/OUTLINE

• Identify the frequent traumatic and nontraumatic acute neurological emergencies in the pediatric population.• Review the key imaging findings of common pediatric neuro emergencies and their life-threatening complications.• Describe the specific role of various imaging modalities and neuro interventions in the emergency management of acute neurological emergencies of childhood. • Recognise the common imaging pitfalls in the evaluation of pediatric neuro emergencies and tips & tricks to avoid them.• Emphasize the role of Rapid MRI in pediatric neuro emergencies, reviewing the Rapid MRI protocols (vs Conventional protocol) and its clinical case-based application.• At last, compare the strengths and limitations of Rapid MRI in acute pediatric neuro emergencies.

PDEE-57   Imaging Of Non-neoplastic Mediastinal Masses In Children

Participants
Hiral Banker, MD, Memphis, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Non-neoplastic mediastinal masses are uncommon in children. These lesions can be related to congenital conditions, trauma, infection, post-surgical complications, benign enlargement of mediastinal structures, etc. The objective of this presentation is to describe various non-neoplastic pathologies seen in the pediatric age group which can present or mimic a mediastinal mass. To describe and illustrate their appearance on various imaging modalities and describe the differentiating radiological features. 3-D reformations often help in the diagnosis. Early and accurate diagnosis is helpful in reducing patient morbidity or mortality, especially in life-threatening conditions. Correct diagnosis of these entities can also help in reducing unnecessary interventions.

TABLE OF CONTENTS/OUTLINE

• Overview of mediastinal anatomy. • Describe various non-neoplastic entities that can present as mediastinal mass in children. • Describe and elucidate imaging algorithm for workup of possible mediastinal mass in children. • Describe the radiological appearance with a 3-D reformation of nonneoplastic mediastinal masses and other mimickers in children with an emphasis on life-threatening conditions e.g., aortic aneurysm.

PDEE-58   The Pathology And Radiology Of Connective Tissue Disease (CTD)-associated Lung Disease In Children And Young Adults

Participants
Andrew Schapiro, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Lung disease can occur in association with connective tissue disease (CTD) in children and young adults, with certain lung disease patterns tending to occur in association with certain CTDs2) The primary role of the radiologist is to identify the pattern of lung disease and note any change over time in the setting of known CTD, and to suggest the possibility of CTD in the setting of diffuse lung disease without known etiology3) The typical pathology and radiology findings of lung diseases in children and young adults with the following CTDs will be reviewed: Sjogren syndrome, systemic sclerosis and mixed connective tissue disease (MCTD), polymyositis (PM) and dermatomyositis (DM), systemic lupus erythematosus (SLE), and systemic juvenile idiopathic arthritis (sJIA)

TABLE OF CONTENTS/OUTLINE

1) Overview of CTD-associated lung disease, including the role of the radiologist2) Sjogren syndrome-lymphoid interstitial pneumonia (LIP) (emphasized)-nonspecific interstitial pneumonia (NSIP)3) Systemic sclerosis and MCTD-NSIP4) PM and DM-

organizing pneumonia (OP) (emphasized)-NSIP5) SLE-diffuse alveolar damage-hemorrhage-serositis-rarely NSIP6) sJIA-endogenous lipoid pneumonia (ELP)/pulmonary alveolar proteinosis (PAP) spectrum7) Summary of characteristic features of each condition

PDEE-59   Orbital Lesions In Pediatrics- A Radiologist'S Primer

Participants
Hiral Banker, MD, Memphis, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Orbit is comprised of many structures including the optic nerve, globe, muscles, and retro-orbital fat. A wide range of pathologies can be seen affecting the orbit. The spectrum of orbital lesions in children differs from that of adults. Certain tumors such as rhabdomyosarcoma and vascular anomalies are more common in pediatrics and have characteristic imaging appearances. Recognition of key features of various pathologies helps make the correct diagnosis and facilitates appropriate management.

TABLE OF CONTENTS/OUTLINE

• Overview of US, CT & MRI anatomy of orbit. • Describe clinical presentation and imaging appearance of various orbital lesions on different modalities such as USG, CT scan & MRI. • Explain key radiological differentiating features of pediatric orbital lesions including congenital conditions, infection, neoplasm, trauma, and vascular anomalies. • Review uncommon orbital lesions with case illustration, e.g. orbital toxocariasis.

PDEE-6   Soft Tissue Masses In The Young Infant And Neonate: When Is Sonography Not Enough?

Participants
Alex El-Ali, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Given that infantile hemangioma is the most common tumor of infancy, the primary role of the radiologist is differentiating infantile hemangioma from other masses which may have an overlapping clinical presentation- Role of ultrasound is to maintain high specificity for the diagnosis infantile hemangioma- Ultrasound diagnosis of infantile hemangioma may still necessitate additional imaging if specific patterns of involvement are recognized- Clinical context serves as the bedrock of appropriate diagnosis and management

TABLE OF CONTENTS/OUTLINE

- Clinical presentation of soft tissue masses in young Infant and neonate- Sonography of soft tissue masses in in young Infant and neonate- Specific ultrasound imaging features of infantile hemangioma- Ultrasound imaging features that are inconsistent with infantile hemangioma ('Red Flags')- Location/pattern approach to infantile hemangiomas requiring additional imaging- Location specific differential considerations for vascular masses in young infants and neonates- Role of MRI and tissue sampling in neonatal soft tissue masses

PDEE-60   Don't Be Out Of The Loop: Ultrassonographic Approach Of Gastrointestinal Pediatric Emergency

Participants
Eduardo Chiovatto, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

After this presentation you will be able to identify the ultrasound anatomy of the intestinal loops in children and understand what the normal anatomy of an intestinal loop is like. In addition, the main childhood's pathologies of the intestinal loops will be presented and illustrated each of them on ultrasound. Finally, we present the challenges and pitfalls that the doctor may find when making this assessment.

TABLE OF CONTENTS/OUTLINE

Historical context of ultrasound Ultrasound anatomy Appropriate techniqueGastroesophageal reflux: Normal esophageal; Hiss angle measurement; extension of the intrathoracic and intra abdominal esophagus and esophageal caliber Hypertrophic pyloric stenosis: Normal pylorus; Pylorus thickness and length Pylorospasm Inflammatory bowel disease: Crohn's disease; Ulcerative colitis; Findings of acute inflammatory disease; chronic inflammatory disease and contrast evaluation Intussusception: ileoileal; simple and complicated ileocecale; small intestinal invagination and hydrostatic reductionNecrotizing enterocolitis: image findings and the method limitations Colitis: infectious; inflammatory: immunosuppressed and not immunosuppressed Appendicitis: Normal appendix; Classical appendicitis; Perforated appendicitis and Abscess Difficulties and Pitfalls in those exams.

PDEE-61   Ultrafast MRI For Acute Pelvic Pain In Girls: Lessons Learned

Participants
Guillermo Alfonso, DO, Tucson, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

Acute lower abdominal/pelvic pain is one of the common presentations to the pediatric emergency department, especially in adolescent girls. Differentiating acute gynecologic pathologies from GI conditions including acute appendicitis is often clinically challenging. Imaging plays a key role in diagnosis and ultrasound is often the initial imaging modality of choice. An Ultra-fast, un-enhanced MRI can offer a quick, safe and reliable alternative in evaluation of both lower abdominal and pelvic conditions. We will discuss the ultra-fast MRI protocol along with imaging findings of both common and uncommon pelvic conditions.

TABLE OF CONTENTS/OUTLINE

1. Clinical conditions associated with acute lower abdominal pain2. Describe an ultra-fast un-enhanced MRI protocol3. Case Presentation: Adnexal/ovarian torsion, ovarian cyst, ruptured follicles, hemorrhage into an ovarian cyst, tubal pathologies, ovarian neoplasms, pelvic inflammatory disease, hematocolpos, and ectopic pregnancy4. Differential diagnosis: Acute appendicitis, obstructive uropathy, enteritis and musculoskeletal conditions5. Pearls and pitfalls in pelvic imaging

PDEE-62   Babies Aren't Mini-Me: Lung Ultrasound In Newborn Intensive Care Unit

Participants
Sasha Gordon, BS, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Neonates receive 1-4 chest x-rays during hospitalization. Replacing chest x-ray (CXR) with lung ultrasound (LUS) reduces radiation exposure. 2. Neonatal anatomy and pathophysiology differ from adults which affects LUS interpretation.3. B-lines on LUS are commonly seen in preterm neonates with respiratory distress syndrome, yet can be normal in neonates with transient retention of fetal lung fluid.4. Neonates non-calcified ribs do not produce an acoustic shadow on LUS so pleural lines appear continuous and can be mistaken for pleural effusion, pneumothorax or subcutaneous emphysema.5. A prominent neonatal thymus mimics lung consolidation or a mass.6. High-frequency oscillatory ventilation used in neonates blunts lung sliding, which resembles pneumothorax.

TABLE OF CONTENTS/OUTLINE

LUS technique considerations: Probe selection, machine settings, scan technique, and high frequency oscillatory ventilation can impact interpretation.Neonatal vs. adult differences: Neonates have normal LUS features including B-lines, non-calcified ribs, and prominent thymus not seen in adults.Unique neonatal lung pathology: Neonates have specific lung diseases such as respiratory distress syndrome, transient tachypnea of the newborn, meconium aspiration, congenital diaphragmatic hernia, and congenital pulmonary lesions.Is LUS better? LUS is safer, less costly and more sensitive than CXR, but does have limitations.

PDEE-64   **The Many Faces Of Eosinophil-associated Diseases From Head To Toe**

Participants
H. Nursun Ozcan, MD, Ankara, Turkey (*Presenter*) Nothing to Disclose

TEACHING POINTS

Eosinophil-associated diseases (EADs) are a wide spectrum of disorders characterized by an increase in circulating or tissue eosinophils. This condition can affect several organ systems which includes; heart, lungs, liver, spleen, gastrointestinal system and central nervous system. In patients with eosinophilia and unexplained clinical findings of different organs, eosinophil associated diseases should be kept in mind. Diagnosis is often challenging and needs a combination of clinical and imaging findings along with laboratory findings. Imaging findings are crucial not only for diagnosis, but also for identifying the extent of the disease and determining the probable biopsy site. There is a lack of comprehensive review about eosinophil associated diseases that cover various systems in radiology literature. In this exhibit; we review the imaging features of various eosinophilic disorders of heart, lungs, liver, spleen, gastrointestinal system and central nervous system both in pediatric and adult patients.

TABLE OF CONTENTS/OUTLINE

1. General information and diagnostic criteria of EADs. 2. The role of radiology in the diagnosis of visceral involvement. 3. Imaging patterns of cardiopulmonary, gastrointestinal and central nervous system involvement of EADs with different radiologic modalities and follow up images. 4. Differential diagnosis of EADs and review of literature.

PDEE-65   **Tips For Imaging Pediatric Stroke: From Cradle To School**

Participants
Stephanie Nagano, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1- To briefly describe pediatric risk factors, etiology and anatomical findings that can lead to stroke in chilhood and its difference from adults. 2- To describe imaging findings of acute and chronic stroke in pediatric patients and its peculiarities, as well as what is important to be reported. 3- To describe a diagnostic algorithm and the importance of each imaging method.

TABLE OF CONTENTS/OUTLINE

1- Neonatal stroke: incidence, imaging findings and anatomical peculiarities. 2- Pediatric stroke etiology, imaging findings and risk factors. 3- Imaging patterns of acute and chronic stroke. 4- Diagnostic algorithm to pediatric stroke and imaging methods. 5- Brief description of treatment and its particularity.

PDEE-66   **Imaging Features And Complications Of Paediatric Osteomyelitis: A Pictorial Assay**

Participants
Ankit Arora, MBBS, Jodhpur, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand the pathogenesis of hematogenous osteomyelitis in children and relevant anatomy.2. Review the radiographic, CT and MRI imaging features of osteomyelitis.3. Acquaintance of the immediate and late complications of osteomyelitis and recognise them on imaging.

TABLE OF CONTENTS/OUTLINE

• Definition and Pathophysiology• Anatomical Considerationso Blood supply of metaphysis in childhoodo Metaphyseal equivalents• Role of Imaging and Imaging approach• Imaging features:o Radiographo Ultrasoundo MRIo CT• Complications of paediatric osteomyelitis: Early and late• Cases• ConclusionBackground:The dynamic nature of the microvasculature of the epimetaphyseal region in pediatric population makes it imperative for the radiologist to study the normal physiology and subsequent course of hematogenous osteomyelitis in diagnosing its crippling compliations. Being a fairly common entity, knowledge and thereby early diagnosis with clinicoradiological correlation will aid in preventing complications. Early complications include septic arthritis, cellulitis, myositis and deep venous thrombosis in the affected limb. Delayed complications include avascular necrosis, growth arrest, fracture and chronic osteomyelitis with sinus tract formation. With this exhibit we try to illustrate the imaging findings of osteomyelitis with special emphasis on its complications.

PDEE-67   **Approach To Pediatric Renal Masses: It's Not Always Wilms!**

Participants
Vasundhara Smriti, MD, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Describe various renal masses in paediatric population• Provide an imaging approach to diagnose paediatric renal masses • Depict the typical & atypical imaging features of Wilms tumors• Recognise the most common non-Wilms primary renal neoplasm & its imaging features.• Describe the benign renal masses that mimic Wilms • Discuss secondary involvement of kidney by malignant tumours

TABLE OF CONTENTS/OUTLINE

• Classification of pediatric renal masses• Pathophysiology & clinical presentation of Wilms tumor • Typical & atypical imaging features of Wilms tumor • Discuss what the surgeon wants to know • Pathophysiology & clinical presentation of the common non-Wilms tumors • Highlight points to differentiate Wilms from non-Wilms tumors & the resultant impact on clinical management • Flowchart of approach to pediatric renal masses

PDEE-68   Role Of Child Life Services In Pediatric Radiology

Participants
Gloria Mendez, MS, Orlando, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

Overview of child life services in Pediatric Radiology. Different interventions to improve cost savings and reduce radiation exposure. Reducing trauma in the medical setting. Simple methods to reduce the need for sedation.

TABLE OF CONTENTS/OUTLINE

Introduction. The fundamentals of Child Life and how a Child Life Specialist is an integral part of the multidisciplinary team within the Radiology department. We will discuss the value and benefits that a Child Life Specialist has to offer to pediatric radiology imaging and how this can improve patient and family satisfaction within a hospital or an imaging center. We will also discuss the different interventions used to help increase pediatric cooperation, reduce sedation rates, and help provide higher quality images. Simple tools and resources will be shared on how an imaging center or hospital can start implementing simple and effective ways to help improve a pediatric patient's cooperation during imaging. Using different methods, together with radiology staff, to obtain successful studies within each modality of a radiology department. This presentation will focus on the value and benefits of having a Child Life Specialist and how this member of the interdisciplinary team can be a cost savings tool. Cost saving measures can include less staff needed for each procedure to help hold down patients, reduce the time a procedure room in occupied, and reduce additional medications needed such as sedatives. Conclusion.

PDEE-69   Not So Acute: Imaging Of Thoracic Manifestations Of Sickle Cell Disease In Children

Participants
Dominique Gardner, Charleston, South Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the pathophysiology of sickle cell disease and associated disorders.2. Discuss the clinical presentations and management of acute and chronic sickle cell manifestations within the chest in pediatric patients.3. Showcase imaging findings of sickle cell disease chest manifestations and complications in pediatric patients via radiographs, US, CT, and MRI and provide guidance on how to differentiate between similar entities.

TABLE OF CONTENTS/OUTLINE

1. Lungsa. Infarct/acute chest syndromeb. Pneumonia (including COVID-19 viral pneumonia)c. Fibrosis/interstitial lung disease2. Cardiovasculara. Cardiomyopathyb. Increased cardiac extracellular volume (ECV)/fibrosisc. Thrombosis/pulmonary embolismd. Pulmonary hypertension3. Bones/marrowa. Bone infarct/osteonecrosisb. Osteomyelitisc. Anemia/extramedullary hematopoiesisd. Iron deposition

PDEE-7   Primary Osseous Tumors Of The Pediatric Spine: Tips For Diagnosis

Awards
Certificate of Merit

Participants
Emilio Inarejos Clemente, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Describe the use of conventional techniques (radiography and CT) and multiparametric MRI for diagnosis and follow-up in children with primary spinal tumors.2. Describe the most common benign and malignant primary osseous spinal tumors in children.3. Discuss the most common imaging findings of primary osseous spinal tumors in children and compare with corresponding surgical and gross pathology findings.4. Interpret multiparametric MR imaging in patients with malignant unresectable tumors (Ewing sarcoma and osteosarcoma).

TABLE OF CONTENTS/OUTLINE

1. Background.2. Clinical findings and demographics of benign and malignant primary spinal tumors in children.3. Benign tumors: Hemangioma, osteochondroma, osteoblastoma, osteoid osteoma, unicameral bone cyst, aneurysmal bone cyst. Malignant tumors: Ewing sarcoma, osteosarcoma, chondrosarcoma, hemangioendothelioma, Langerhans cell histiocytosis.4. Conventional and advanced imaging techniques in the study of benign and malignant primary spinal tumors, emphasizing on the role of multiparametric MRI and PET-MR for diagnosis and follow-up (diffusion-weighted imaging, perfusion, dynamic contrast studies, 3D printing models).5. Radiography, CT, PET-CT, PET-MR and advanced MRI findings of benign and malignant primary spinal tumors, with illustrative examples with clinical, surgical and histopathological correlation.6. Illustrative examples of functional MRI and nuclear medicine in treatment response assessment.7. Imaging follow-up after surgery.8. Summary.

PDEE-70   How To Optimize Neuroimaging In Children With Less Sedation, Less CT And Faster MRI Protocols: Experience In A Quarternery Academic Children's Center

Participants
Aylin Tekes-Brady, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Sedation can be used to support children hold still during MRI, however negative impact of anesthesia in brain development poses concerns. 2. CT can be an alternative to MRI with sedation, given its fast image acquisition, with the caveats of radiation exposure and poor parenchymal resolution. 3. Indication specific fast MRI protocols may mitigate use of CT and sedation. 4. Age specific developmental stages can be helpful to avoid sedation: neonatal brain MRI can be performed during natural sleep. 5. Fast MRI is not a quick peek for all neuroimaging indications. 6. Reduced gradient time can be achieved by utilizing limited sequences for specific indications OR reducing spatial resolution of sequences in return for temporal resolution. 6. Child life specialists can help ease anxiety and concerns of children and families, therefore eliminate use of sedation/anesthesia.

TABLE OF CONTENTS/OUTLINE

1. define clinical indications for fast brain MRI and fast spine MRI: T2 bright lesions are best for fast MRI such as hydrocephalus and shunt evaluation, arachnoid cyst, subdural effusion/hygroma, headache, follow-up head trauma, syrinx evaluation to name a few 2. define sequences and parameters for indication specific fast brain spine MRI protocols; fast brain MRI, modified fast trauma brain MRI, fast spine MRI. 3. Indications not suitable for fast MRI: developmental delay, seizure, tumor initial diagnosis and enhancing tumor follow-up to name a few. 4. define neonatal brain MRI protocol with natural sleep.

PDEE-71   Beyond The Usual: Use Of Ultrasound For The Diagnosis Of Less Common Small Bowel Obstructions In Children

Participants
Desi Schiess, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Key features of bowel obstructions on ultrasound include free fluid, differential dilation of bowel loops, bowel wall thickening, and lead points 2. Especially in younger children, consider congenital etiologies in addition to midgut volvulus such as segmental volvulus associated congenital cysts and small bowel atresias 3. When identified sonographically, patients can be triaged directly to surgical intervention especially when danger signs such as bowel hypoperfusion are identified

TABLE OF CONTENTS/OUTLINE

a. Introduction: Epidemiology b. Ultrasound a. Pros and cons compared to radiographs, CT, MRI, and fluoroscopy b. Ultrasound technique c. Identifying and interpreting the imaging findings a. Normal sonographic appearance of bowel b. Illustrative cases on ultrasound with correlation to other modalities, including XR, CT, and fluoroscopy with surgical and pathologic correlation i. Examples of classic and subtle cases of less common bowel obstructions including: 1. Omphalomesenteric duct spectrum (Meckel's, cyst, and fibrous remnant) with associated segmental volvulus or perforation with obstruction 2. Duplication & mesenteric cysts 3. Congenital mesenteric band 4. Small bowel atresias 5. Foreign bodies, including toys and bezoars 6. Intussusceptions with pathologic lead points d. "Don't miss" sonographic findings a. Signs of bowel wall ischemia b. Pneumoperitoneum c. Midgut volvulus e. Conclusion: Teaching points reemphasized

PDEE-72   Soft Tissue Calcifications And Ossifications In The Pediatric Population: A Pattern-based Imaging Approach With A Review Of Common Etiologies

Participants
Eugen Lungu, MD,MSc, Montreal, Quebec (*Presenter*) Nothing to Disclose

TEACHING POINTS

Soft tissue densities due to calcifications or ossifications in children are less common than in adults. Their causes are more commonly due to systemic, congenital or hereditary conditions as opposed to degenerative and age-related conditions in adults. - Pathologies presenting with calcifications or ossifications in children involve mainly the cutaneous and subcutaneous soft tissues, as opposed to perivascular and periarticular locations in adults. - Imaging by radiographs, US, CT or MRI may help diagnosis; however, it may have a greater role in evaluating disease progression and treatment planning.

TABLE OF CONTENTS/OUTLINE

- Comparison of epidemiology and etiology of soft tissue calcifications and ossifications in children vs adults- Overview of the calcinosis cutis and osteoma cutis patterns at imaging- Pathophysiology, epidemiology, clinical presentation, treatment and imaging findings: Calcinosis cutis: dermatomyositis, juvenile systemic sclerosis, interferonopathies, Ehlers-Danlos syndrome, chronic kidney failure, Albright hereditary dystrophy, calcinosis cutis universalis, tumoral calcinosis, subepidermal calcified nodules; Osteoma cutis: isolated skin osteoma, plate-like osteomatosis cutis, fibrodysplasia ossificans progressiva, progressive osseous heteroplasia, benign milliary osteoma cutis.- Imaging caveats of soft tissue densities in children

PDEE-75   Imaging Of Complications After Palliative Procedures For Congenital Heart Disease

Awards
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Participants
Harold Goerne, MD, Guadalajara, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the complications of palliative procedures performed for congenital heart disease (CHD) 2. To discuss the role of different imaging modalities in assessment of these complications 3. To illustrate the imaging features of these complications

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Role of imaging modalities- CT, MRI, echocardiography, cardiac catheterization 3. Complications based on type of palliative procedures A. Increasing pulmonary artery flow: Blalock-Taussig shunt- Stenosis, occlusion ,thrombosis, pseudoaneurysm. Bidirectional Glenn shunt- Stenosis / occlusion, thrombosis, pseudoaneurysm, infection. Shunt infection / dehiscence. Fontan-Ventricular failure, systemic venous hypertension B. Decreasing pulmonary artery flow Pulmonary banding- Failure, obstruction. Norwood procedure complications- Pulmonary hypertension, systemic or pulmonary vein obstruction C. D-TGA atrial switch: Baffle stenosis, obstruction. Baffle leak. Systemic ventricular D. Aortic palliation: Recoarctation Pseudoaneurysms Dissection Stent fracture Infection 4. Conclusion

PDEE-76   Not Just Nodes And Bones: Langerhans Cell Histiocytosis In Children. From X-ray To PET-MRI

Participants
Mary Arevalo Molina, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Describe pathophysiology and current classification of Langerhans Cell Histiocytosis.- Recognize common radiological findings of LCH in X-ray, CT, and MR with a histological and immuno-histochemical confirmed.- Increase the knowledge about extra-osseous affectations of LCH and their differential diagnosis.- Provide an illustrative tutorial highlighting the utility of 18F-FDG PET to detect the spectrum of manifestations and its role for early diagnosis.- Introduce the promising PET/MR role in the assessment of LCH. Advantages and disadvantages.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Objectives3. A brief update of the newer Histiocytosis classification. Advances in pathophysiology4. Review of the current literature on Imaging methods for diagnosis, response assessment and follow-up in pediatric patients.a. Recognize the characteristic x-ray, CT, and MRI imaging findings of LCH.b. Describe the role of 18F-FDG PET-CT in the early diagnosis. Pictorial review.c. It is PET-MR time? Discuss the value in the evaluation of active lesion. Compare with PET-CT: Advantages and drawbacks.5. Not Just nodes and bones: Recognizing extra-osseous affections and their differential diagnoses.6. Summary7. References

PDEE-77   Pediatric Skeletal Deformities Analyzed By 3d Stereoradiography: Three-dimensional Analysis And Low Dose Radiation

Participants
Pedro Arruda, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The spine and lower limbs disorders in the pediatric population have a complex three-dimensional (3D) nature. A deformity seen in the coronal plane may often be accompanied by deformities in the sagittal and axial planes. Understanding the global view of the skeletal system in an orthostatic position can aid therapeutic planning. A standard radiographic study (projection in a plane) has important limitations in axial measurements, which can be overcome by computerized tomography (CT). However, CT delivers a higher radiation dose, and is not a weight-bearing study, bringing incorrect data. Stereoradiography with 3D capabilities is a low-dose, weight-bearing equipment, which takes full-body, frontal and lateral images of the skeletal system in a standing position. It provides 3D images of the spine, pelvis, and lower limbs in all spatial planes, improving visualization of the pediatric deformities. The equipment exposes much less radiation than traditional imaging technologies. When necessary frequent medical imaging, it can reduce even more the radiation exposure (MicroDose), which corresponds to 20 to 45 times less radiation than an X-ray exam.

TABLE OF CONTENTS/OUTLINE

1. Basic principles of the 3D Stereoradiography 2. Spine deformities a. Spinopelvic measurements b. 3D scoliosis and kyphosis analysis 3. Lower limbs deformities a. Lower limbs length discrepancy b. Coronal and sagittal alignment deformities c. Torsional deformities 4. Pre and postoperative analysis 5. Clinical application and compensatory mechanisms

PDEE-78   Basis, Diagnosis And Treatment Of Craniosynostosis: What The Radiologists Needs To Know

Participants
Satoru Takahashi, MD, PhD, Suita, Japan (*Presenter*) Research Grant, Siemens AG;Research Grant, LPixel Inc

TEACHING POINTS

Craniosynostoses are the premature fusion of one or more cranial sutures and cause various deformity of the skull by affected sutures. As craniosynostoses might be syndromic and related to intracranial abnormality, knowledge of the basis and treatment is essential for appropriate management. The purpose of this exhibit are;1. To review normal development and anatomy of the skull2. To show different types of craniosynostoses and their characteristics 3. To demonstrate the imaging techniques for diagnosis, preoperative assessment, and post-treatment follow-up4. To summarize surgical approaches: indication, technique, complication and outcomes

TABLE OF CONTENTS/OUTLINE

1. Embryology & Anatomy2. Classification of craniosynostosis-primary vs. secondary-nonsyndromic vs. syndromic-monosutural vs. multisutural-related cranial deformity, genetic and clinical abnormality3. Types of surgery-application and techniques-sutureectomy, cranial spring surgery, fronto-orbital advancement, cranial vault reconstruction4. Imaging -ultrasound, Xray, low-dose CT, MRI-application and combination of modalities5. Imaging key findings- sutures, deformity- venous anomaly, dilatation of emissary veins-increased intracranial pressure- cerebellar herniation, ventriculomegaly- surgical complication

PDEE-79   Congenital Intrahepatic Portosystemic Shunts With Anorectal Malformation And Cardiac Anomaly

Participants
Armaandeep Aulakh, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Introduction Congenital portosystemic venous shunts (CPSS) are rare vascular anomalies that occur secondary to abnormal involution of fetal vitelline and umbilical veins. Splanchnic blood directly into systemic circulation bypassing the first pass metabolism of liver. Depending on the site of anastomosis they can be - extrahepatic or intrahepatic. CPSS may be isolated or in

combination with multiple congenital anomalies like cardiac defects, biliary atresia, polysplenia syndrome, anorectal malformations and renal agenesis etc. Untreated CPSS may lead to hepatic encephalopathy, pulmonary hypertension and liver nodules. Hence, early diagnosis with accurate delineation of the anatomy of shunts has clinical and therapeutic implications. Teaching points After going through the presentation, the reader will be able to Understand the embryological basis of development of CPSS. Identify and differentiate various types of congenital extrahepatic and intrahepatic portosystemic shunts. Understand the findings in a rare case with multisystem involvement. Understand planning for therapeutic endovascular interventions or surgery

TABLE OF CONTENTS/OUTLINE

Table of Contents Overview of relevant anatomy and embryological basis of development of congenital portosystemic shunts Imaging the hepatic vasculature- Ultrasound/ CECT abdomen Classsification of CPSS- a. Intrahepatic b. Extrahepatic Case discussion Points to note while planning endovascular intervention or shunt surgery

PDEE-8   US Of The Spine In Neonates And Infants: A Practical Guide Of Normal Findings, Normal Variants And Pathologic Conditions

Awards
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Certificate of Merit

Participants
Emilio Inarejos Clemente, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.Discuss the US technique, transducers and positions for evaluation of the spine in neonates.2.Describe the US appearance of the most common normal variants in neonates and children.3.Correlate the US appearance of the most common congenital and pathological entities in the spine with prenatal and postnatal MRI and the added value of color Doppler US.

TABLE OF CONTENTS/OUTLINE

1.Sonographic technique and anatomic positions.2.Normal anatomy of the spine on US with tips for anatomic references.3.Normal variants in children: Transient dilatation of the ependymal canal, filar cyst, ventriculus terminalis, prominent epidural fat, prominent filum terminale, "pseudomass" due to positional nerve root clumping, pseudosinus tract, dysmorphic coccyx.4. Checklist of anatomic structures to be assessed in the examination: spinal cord, conus medullaris, ependymal canal, pulsatility of nerve roots and filum terminale, thecal sac, intraspinal masses, sinus.5. Sonographic appearance with prenatal and postnatal MRI correlation in the following conditions:- Congenital: lipomyelocele, lipomyelomeningocele, intraspinal lipoma, tethered cord, sinus tract.- Infectious: meningitis, subdural abscess.6. Clinical indications for spinal US:- Low risk: typical sacral dimple, mild hypertrichosis, capillary malformation, hemangioma, nevus.- Intermediate risk: Atypical sacral dimple, deviation of the gluteal cleft, severe hypertrichosis.- High risk: dermal sinus, subcutaneous lipoma, and cutaneous appendage.7. Conclusion

PDEE-80   Dual Energy Abdomen CT In Pediatric Clinical Practice: A Jack Of All Trades

Participants
Woo Rim Seo, MD, Hwaseong, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Describe the principles of dual energy CT (DECT)- Describe the advantages of DECT by various post-processing techniques and the potential of reducing radiation dose of abdominal DECT in pediatric patients- Recognize the application of abdominal DECT in pediatric clinical practice which increases the confidence in diagnosis: experience from a single center

TABLE OF CONTENTS/OUTLINE

1. Dual energy CT (DECT)1) The principles2) The advantages of abdominal DECT: post-processing techniques and radiation dose- Water map/ Iodine map/ Virtual monochromatic images2. Application of abdominal DECT in pediatric clinical practice 1) Tumor/Oncology- Extragonadal mixed germ cell tumor- Primary lymphoma of liver- Leukemia 2) Bowel disorder- Inflammation: Crohn's disease, gangrenous appendicitis with appendicolith, diverticulitis- Ischemia: Ischemic enteritis in Henoich-Schonlein purpura 3) Trauma- Post traumatic ischemia and perforation of bowel- Renal laceration and urinary leakage 4) Metal artifact reduction- Recognize ingested foreign body and bowel complication 5) Stone evaluation- Ureteric stone evaluation using material specific urolithiasis application 6) Genitourinary - Emergency: Testis torsion, ovarian torsion, ruptured hemorrhagic ovarian cyst- Acute pyelonephritis 7) Biliary system- Acute cholecystitis

PDEE-81-HC Susceptibility Weighted Imaging (SWI): Beyond The Bleed

Participants
muhamad serhal, Beirut, Lebanon (*Presenter*) Nothing to Disclose

TEACHING POINTS

Susceptibility weighted imaging (SWI) is traditionally used to detect intracranial hemorrhage with enhanced sensitivity to microbleeds. This exhibit highlights the added value of SWI in a variety of clinical conditions encountered in childhood that may go unrecognized. SWI can reveal perfusion changes not appreciated on routine imaging and help guide the correct diagnosis. SWI is a fundamental sequence that must be part of routine brain MRI protocol.

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SWI is a 3D high resolution gradient echo sequence that offers increased sensitivity to magnetic susceptibility. It is generally used to detect intracranial hemorrhage and mineralization. However, SWI lends tremendous diagnostic value to neuroimaging evaluation in a variety of pediatric pathologies. Acute arterial ischemic stroke: SWI can reveal the location of intraarterial thrombus and delineate the ischemic penumbra by demonstrating prominent veins in areas of impaired perfusion. Migraine: the neurovascular pathophysiology of migraine can result in increased or decreased venous conspicuity throughout the affected cerebral hemisphere on SWI as a result of vasoconstriction or vasodilatation. Status epilepticus: altered oxygenation can be detected by SWI as diminished cortical veins during the ictal phase or accentuated veins in the post-ictal period paralleling perfusion changes. Vascular malformations: SWI can detect and monitor high flow vascular malformations with arteriovenous shunting by demonstrating increased signal in arterialized veins.

PDEE-82-CS Causes And Variations Of The Sonographic (US) Whirlpool Sign Of The Intestine In Neonates

Participants
Alan Daneman, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

In neonates, the US whirlpool sign may be seen with volvulus due to midgut malrotation or with segmental volvulus of the intestine unrelated to midgut malrotation. In neonates with symptoms of acute abdomen or intestinal obstruction, a conscious search of the entire abdomen and pelvis with US for a whirlpool sign is essential, especially in the absence of other US signs of malrotation. Segmental volvulus most commonly effects a short segment of the small intestine, rarely a long segment and rarely the colon. Segmental volvulus may occur antenatally (when it may be associated with an intestinal atresia) or postnatally (when it may be secondary to previous intra-abdominal adhesions or inflammation). A whirlpool sign may also be seen with Type 3B atresia of the small intestine when the distal apple-peel anomaly may appear as a whirlpool on US. A pseudo-whirlpool sign may be seen in neonates with obstruction due to kinking of the intestine due to adhesions. Recognizing the whirlpool sign on preoperative US facilitates an extremely rapid diagnosis and obviates the necessity for contrast examinations of the gastrointestinal tract.

TABLE OF CONTENTS/OUTLINE

1 Introduction Background of midgut malrotation and segmental volvulus as well as Type 3B intestinal atresia. 2 Purpose To illustrate the value of sonography in documenting the presence of a whirlpool sign in neonates with acute abdomen or intestinal obstruction. 3 Discussion Illustrations of various whirlpool signs on US and importance of meticulous US technique.

PDEE-9   Diagnostic Value Of High Resolution US, Color Doppler US And Superb Microvascular Imaging (SMI) In The Evaluation Of The Sick Neonate.

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Emilio Inarejos Clemente, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Describe the current applications of bedside US in the sick neonate.2. Discuss the US technique (technical aspects, transducers) for the evaluation of the sick neonate.2. Describe the added value of Doppler US and Superb Microvascular Imaging (SMI) for the evaluation of necrotizing enterocolitis.3. Recognize US appearance of common acute pathologies in the sick neonate with radiographic and fluoroscopic correlation.

TABLE OF CONTENTS/OUTLINE

1. Current indications and applications of bedside ultrasound in neonates.2. Technical details of the sonographic procedure: High Resolution US, Color Doppler US and SMI.3. Tips to obtain optimal images.4. Use of high resolution US in the evaluation of:- Pneumothorax, distress respiratory syndrome- Necrotizing enterocolitis: severity grading with clinical and radiographic correlation- Complications of necrotizing enterocolitis: detection of pneumoperitoneum, fluid collections and portal venous gas- Malrotation with midgut volvulus: typical sonographic signs- Meconium peritonitis- Incarcerated inguinal hernia- Check placement of lines and tubes5. The use of Color Doppler US and SMI in the evaluation of:- Necrotizing enterocolitis- Malrotation with midgut volvulus- Incarcerated hernia6. Clinical management of the most frequent entities described in this exhibit.7. Conclusion.

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Abstract Archives of the RSNA, 2021

Sub-Events

RIEE-1   O-RADS: Case Based Learning

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Phyllis Glanc, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

O-RADS for ultrasound is a lexicon combined with a risk stratification and management system which can be applied to lesions involving the ovary and adnexa. This is the only risk stratification system which is paired with a management system allowing for consistent care in women with adnexal lesions.The use of a lexicon aims to improve the quality of communication between interpreting radiologists and referring clinicians.The consistent use of O-RADS is intended to decrease number of interventions for ovarian and adnexal lesions which are destined to resolve or remain stable whilst increasing appropriate referrals to a gynecologic oncologist for those with high risk of malignancy. Appropriate referral to a gynecologic oncologist has been demonstrated to decrease morbidity and improve survival in women with high grade ovarian malignancy.The use of an experiential case approach, based on O-RADS ,following a simple algorithm will familiarize users with the practical aspects of the system, enable avoidance of pitfalls and emphasize key knowledge points. This practical exercise will help the imager to make the best use of the system in daily practice.

TABLE OF CONTENTS/OUTLINE

1, Introduction to the ORADS for US Risk Stratification and Management System.2. Case Examples Beginner Level.3. Case Examples Intermediate Level.4. Case Examples Expert Level.5. Summary

RIEE-10   Amniotic Fluid Volume Assessment In Pregnancy

Awards
Identified for RadioGraphics

Participants
Rubal Penna, DO, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

Amniotic Fluid (AF) disturbances are associated with fetal, placental and maternal conditions.AIUM & SMFM: DVP preferred for oligohydramniosOligohydramnios: Bimodal distribution of gestational age at time of diagnosis has significant implications for etiologySpecial considerations for AF assessment in multigestation versus singleton pregnanciesRole of interventions

TABLE OF CONTENTS/OUTLINE

IntroductionAmniotic Fluid physiology and circulation pathwaysMethods (AFI, DVP, subjective) and recommendations Why & when to performOligohydramniosDiagnosis & incidenceEtiology & casesCommonPreterm premature rupture of membranes (PPROM)Fetal growth restrictionLess commonGU AnomaliesBilateral renal agenesisBilateral multicystic dysplastic kidneysBilateral UPJ obstructionLower urinary tract obstruction (e.g. Posterior urethral valves)Acquired renal cystic dysplasiaComplicationsPulmonary hypoplasiaPotter's sequencePolyhydramniosDiagnosis & incidenceEtiology & casesCommonIdiopathicMaternal diabetesMacrosomiaLess commonRelated to swallowingGI anomaliesCNS anomaliesExtrinsic compression from chest massesRelated to movementMSK anomaliesRelated to circulationHigh cardiac output states (anemia, vascular masses, hydrops)ComplicationsPlacental abruptionPPROMCord prolapsePreterm laborRole of interventions Amnioreduction, amnioinfusion and more

RIEE-11   Translabial Ultrasound Technique - A Case Based Review

Participants
Kathryn McGillen, MD, Hershey, Pennsylvania (*Presenter*) Speaker, MRI Online

TEACHING POINTS

Translabial ultrasound is a useful adjunct to evaluate anatomy that may be challenging by other modalities.Best use is to answer specific clinical questions.Extra training of sonographer and radiologists may be necessary for some applications, such as urethral imaging or pelvic floor abnormalities.

TABLE OF CONTENTS/OUTLINE

Review common uses and techniques for translabial ultrasound scanning.Review anatomy.Review classic cases.Review challenging

cases.

RIEE-12   Front And 'Centa: The Latest On MRI Imaging Of Placenta Accreta Spectrum Disorders

Awards
Certificate of Merit

Participants
Preethi Raghu, MD, San Francisco, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand the background, pathophysiology, and imaging appearance of placenta accreta spectrum disorders (PASD).2. Correlate image-rich ultrasound examples with MRI features, implications for management and surgical planning, and pathology findings.3. Identify imaging pitfalls on ultrasound and MRI.4. Discuss image-based prediction of degree of myometrial invasion.5. Review latest guidelines regarding PASD imaging, including MRI lexicon and protocols.

TABLE OF CONTENTS/OUTLINE

Overview:1. Incidence, risk factors, and complications of PASD2. Unusual PASD: PASD without previa, myomectomy, IVF3. Pathophysiology and updates in pathologic grading4. Multidisciplinary approach - our institutional model5. Role for IR and UAEImage examples:1. Myoadherent (accreta) and myoinvasive (increta, percreta)2. Posterior and lateral invasive placentae better seen on MRI3. Anterior invasive placenta better seen on ultrasound4. Cervical protrusion of placenta previaImaging pitfalls/mimics:1. Volume averaging2. Engorged myometrium3. Decompressed bladder4. Uterine sacculation5. Uterine contractionImage-based prediction of degree of myometrial invasion:1. Placental bulge2. Uterine serosal vascularity, intraplacental vascularity3. Diffusion weighted imaging for problem-solvingReview of latest guidelines on imaging PASD:1. FIGO 2019:a. Latest FIGO grading scheme and lexicon2. SAR/ESUR Joint Consensus Statement 2020:a. Consensus MRI lexicon and imaging featuresb. MRI protocols at 1.5T versus 3T

RIEE-13   O-RADS MRI: Lexicon Terminology, Risk Stratification, And Management

Participants
Jane Shin, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit aims to increase understanding and acceptance of Ovarian-Adnexal Reporting and Data System Magnetic Resonance Imaging (O-RADS MRI). Although O-RADS Ultrasound is more widely known, O-RADS MRI is a newer topic that may be unfamiliar to some. There will be discussion on the ACR O-RADS MRI lexicon terms that were agreed on by the ACR O-RADS committee with the illustration of MRI findings in each. Participants will have a more confident understanding of ACR risk stratification, classification, and recommended management of various ovarian and adnexal masses on MRI. Pitfalls related to the O-RADS MRI lexicon will also be discussed.

TABLE OF CONTENTS/OUTLINE

1- ACR O-RADS MRI terminology/definitions: Physiologic, lesions (non-physiological), size, shape/contour, signal intensity, lesion components, enhancement, general and extra-ovarian findings2- Description of the O-RADS categories with the illustration of MRI findings in each and potential pitfalls3- Risk stratification and recommended management for each category4- MRI imaging protocol and patient preparation

RIEE-14   Cancer In Pregnancy: Imaging Of Common And Uncommon Pregnancy-related Cancers; Ethical And Safety Considerations And Recommended Imaging Protocols

Participants
Margaret Adejolu, FRCR,MRCP, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Radiological appearances of common pregnancy related cancers 2. Choice of imaging modality , preferred timing and dose consideration 3. Mimics of cancer in pregnancy

TABLE OF CONTENTS/OUTLINE

1. Epidemiology of cancer in pregnancy 2. Ethical Considerations in imaging 3. Safety consideration in imaging pregnant woman a. Imaging involving Ionizing radiation b. Imaging modalities not involving ionizing radiation c. Use of Contrast agents in imaging d. Moderate sedation and Image guided procedures 4. Optimal MRI protocols in oncological imaging of the pregnant patient 5. Imaging appearances of specific cancers a. Breast b. Melanoma c. Lymphoma d. Cervical e. Ovarian f. Gastrointestinal 6. Mimics of cancer in Pregnancy a. Ovarian Torsion b. Fibroid c. Dermoid d. Decidualization in the ectopic endometrial stroma of an endometrioma e. Decidualization in endometrium and cervixf. Lactating adenoma and other pregnancy related changes in breast

RIEE-15   High-resolution Diffusion-weighted Imaging By Multiplexed Sensitivity Encoding (MUSE) For Cancer Staging In Gynecology And Genitourinary

Participants
Takashi Ota, MD,PhD, Suita, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Major teaching points of this exhibit are: 1. To describe high-resolution diffusion-weighted (DW) imaging by using multiplexed sensitivity encoding (MUSE) by comparing high-resolution DW imaging by using field-of-view optimized and constrained undistorted single-shot (FOCUS). 2. To describe advantages and disadvantages of MUSE and FOCUS. 3. To review some clinical images obtained by using MUSE for cancer staging in gynecology and genitourinary. 4. To discuss how radiologists can use MUSE in the clinical practice.

TABLE OF CONTENTS/OUTLINE

A. What is MUSE? How is it different from FOCUS and conventional DW imaging? B. Advantages and disadvantages of MUSE and

FOCUS B-1. Advantages: high-resolution imaging, reduce distortion, full field-of-view (FOV) of MUSE, etc. B-2. Disadvantages: reduced FOV of FOCUS, increase noise, etc. C. Application of MUSE to gynecologic and genitourinary cancer imaging C-1. Gynecologic cancers: endometrial cancer, cervical cancer, ovarian cancer, etc. C-2. Genitourinary cancers: prostate cancer, bladder cancer, kidney cancer, etc. D. Discuss about usefulness of MUSE in the clinical practice

RIEE-16   Sonography Of Pelvic Inflammatory Disease

Participants
Samuel C. Johnson, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

TEACHING POINTS 1. Acute Pelvic inflammatory disease (PID) results in a spectrum of severity involving the fallopian tube, from acute salpingitis to pyosalpinx and tubo-ovarian abscess (TOA). 2. Early and accurate sonographic identification of the extent of infection aids successful implementation of the appropriate treatment regimen including ultrasound guided drainage. 3. Residual or chronic PID, including actinomycotic infections, may present a diagnostic dilemma, indistinguishable from malignancy.

TABLE OF CONTENTS/OUTLINE

TABLE OF CONTENTS I. IntroductionII. Salpingitis a. Normal fallopian tube b. Acute salpingitis c. Chronic salpingitisIII. PyosalpinxIV. Tubo-ovarian abscess a. Acute b. Chronic/organized c. ActinomycosisV. Peritonitis a. Adhesions b. Peritoneal inclusion cyst VI. Abscess Drainage a. Approach i. Transvaginal ii. Transabdominalb. Technique i. Catheter placement ii. Aspiration & lavageVII. HydrosalpinxVIII. Differential Diagnosis a. Endometriosis b. Hemorrhagic ovarian cyst c. Ovarian cystic teratoma d. Ovarian malignancy e. Ectopic pregnancy f. Appendicitis g. Diverticulitis

RIEE-17   Role Of MR Imaging For Fertility And Reproductive Function Preserving Treatments In Patients With Gynecologic Tumors

Participants
Mayumi Takeuchi, MD, PhD, Tokushima, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The development of conservative or minimally invasive treatments that preserve fertility and reproductive function, or reduce the post-operative side effects such as lymphedema and dysuria contributes to the quality of life of the patients of reproductive age affected by gynecologic tumors. 2. The role of MRI has increased in the accurate evaluation of diseases required to make appropriate diagnostic and treatment decisions, and more detailed MRI interpretation is needed to determine the indications for fertility-preserving treatments. 3. Appropriate use of advanced MR sequences (reduced FOV DWI, computed DWI, susceptibility-weighted sequence, 3D-T2WI, 3D-DCE MRI, and MR spectroscopy) for the accurate tumor size measurement and localization, the evaluation of minute tumor invasion or local extension, and the estimation of tumor grade and histological subtypes is important.

TABLE OF CONTENTS/OUTLINE

Oocyte retrieval procedure /cryopreservationCervical cancer-Conization /Radical trachelectomy-Ovarian transposition before radiation-Less invasive surgery (Nerve-sparing radical hysterectomy, omitting lymphadenectomy)Endometrial cancer-Hormone therapyMyometrial tumor-Minimal invasive treatments (Myomectomy, UAE, MRgFUS, hormone therapy) for leiomyoma-Tumorectomy for low-grade ESSOvarian tumor-Fertility-preserving options for borderline and malignant tumors

RIEE-18   Cancer In Pregnancy

Awards
Identified for RadioGraphics

Participants
Liina Poder, MD, Mill Valley, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Balance maternal benefit and fetal risk2. Optimize imaging and treatment in a multidisciplinary team3. Use contrast materials when benefit outweighs risk4. Involve, inform, and counsel patients about risks of imaging and consent5. Learn how to image more common malignancies in pregnancy

TABLE OF CONTENTS/OUTLINE

Cancer in pregnancy is challenging. Though rare (~1:1000 pregnancies) the incidence is rising from postponed childbearing. Cancer related symptoms can be disguised by gestational physiologic changes. Imaging, management, and treatment require a carefully choreographed multidisciplinary team. The risk-benefit of every imaging modality, the strategies to balance the safety of mother and fetus, and the support of the patient and family at every step are mandatory. Because they lack ionizing radiation, US and MRI are usually chosen, but certain conditions require other modalities. We aim to provide a clear review of the imaging triage, safety considerations, and case-based disease specific imaging of cancer in pregnancy.1. Epidemiology2. Effects of Ionizing Radiation, Teratogenesis & Carcinogenesis3. Radiologist's Role in Multidisciplinary Team Decision Making4. Patient Prognosis, Counseling, and Informed Consent5. Imaging Modalities - Risks and Benefits6. Contrast agents (CT, MR, NM, US), Risks (maternal & fetal), & Breastfeeding7. Fertility sparing and imaging findings (ovum retrieval, surgical options, etc.)8. Case based review - (Breast, Lymphoma, Cervix, Leukemia, Ovary, Other)

RIEE-19   Recent Progress In Endometriosis: What Radiologists Should Know

Awards
Certificate of Merit

Participants
Yumiko Oishi Tanaka, MD, Tokyo, Japan (*Presenter*) Research Grant, F. Hoffmann-La Roche Ltd;

TEACHING POINTS

1. To review the imaging findings of classical ovarian endometriotic cysts, deeply infiltrating endometriosis (DIE). 2. To describe the

points for differential diagnosis of endometriotic cysts and DIE with technical consideration of MR. 3. To discuss the conservative therapy for endometriosis and those outcome evaluated by MR. 4. To discuss the imaging findings of complications of the endometriosis, including infection, rupture, malignant transformation, and deciduosis during pregnancy.

TABLE OF CONTENTS/OUTLINE

Fundamentals of pelvic endometriosis (Definition -Pathogenesis -Epidemiology -Symptoms -Treatment) - Classic imaging findings of endometriotic cysts of the ovaries and its variation (Shading, T2-dark spot sign, Adhesion) - Deeply Infiltrating Endometriosis (DIE) and Focal Adenomyosis located in the Outer Myometrium (FAOM) or extrinsic adenomyosis (Definition, Relationship between DIE and FAOM) - Staging systems (Revised ASRM staging, ENZIAN classification) - Treatment option and outcome diagnosing with MR (Gonadotropin-Releasing Hormone antagonist and agonist, Progesterone, Oral contraceptives)- Complications (Infection, Rupture) - Neoplasms arising from endometriosis (Incidence, Risk factors, Histopathological types of the tumors and their imaging findings) - Mimickers of malignant tumors arising from endometriosis (Polypoid endometriosis, Deciduosis)

RIEE-2   Didn't See It Well? Endovaginal Gel!

Participants
Marcela Lauar, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

It is known that regular transvaginal sonography has limitations in evaluating cervical and vaginal disorders. Gel sonovaginography has shown an improvement in visualization, resolution and assessment of local lesions and structures, because of the partial distension and standoff of vaginal walls caused by the introduced gel. It also forms an acoustic window between the surrounding structures and the transducer, which provides better assessment of the vaginal walls, fornices, cervix, pouch of Douglas, rectovaginal septum, anterior rectal wall, paravaginal and parametrial tissues and bladder.This method can be performed as an extension of regular transvaginal sonography, not causing extra harm to the patient.To demonstrate vaginal lesions that had limited evaluation in transvaginal/translabial ultrasound, and could be better identified and characterized by the use of vaginal gel. To didactically review some cases in which the use of vaginal gel was essential for diagnosis and evaluation of the findings, in order to help radiologists remember this tool, and how it can be helpful.

TABLE OF CONTENTS/OUTLINE

Evaluation of a series of transvaginal ultrasounds that required endovaginal gel for proper diagnosis, including some common pathologies in this location - like endometriosis, endocervical polyp, recto-vaginal fistula, vaginal and periurethral cysts, among others -, as well as 3-D reconstructions when adequate, and correlation with other imaging methods, based on our service's digital archive.

RIEE-20   Getting The Fetal Right Ventricle Right!

Participants
Bhargavi Sovani, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Fetal echocardiography holds an exceptional place in detecting fetal cardiac anomalies and thus predicting syndromic associations. Both the ventricles are equal in size in a normal fetus. Chamber discrepancy is often the first whistleblower for cardiac anomalies. The right ventricle has specific features that aid in its identification.Z scores help indicate the pathological ventricle in case of chamber discrepancy. The status of the right ventricle mirrors the milieu of the fetus and reflects systemic cardiovascular derangements if any. This exhibit focuses on identification of right ventricular anomalies, altered physiology, associated abnormalities and underlying conditions, based on abnormal right ventricle size.

TABLE OF CONTENTS/OUTLINE

1.Normal right ventricle on fetal echocardiography2.Physiological causes of ventricular size discrepancy3. Pathological causes of ventricular size discrepancy4.Case series of various causes of small right ventricle: PAIVS(pulmonary atresia intact ventricular septum) ,TAVSDPA(tricuspid atresia ventricular septal defect with pulmonary atresia), TAVSD with MAPCA(multiple aorto pulmonary collateral arteries) /CAT(common arterial trunk)5.Case series of various causes of large right ventricle: Hypoxia, Vein of Galen malformation, absent Ductus Venosus, premature closure of Ductus Arteriosus , AVSD(arteriovenous septal defect)+ DORV(Double outlet right ventricle), myopathies, Non compaction cardiomyopathy, right ventricular aneurysm

RIEE-21   Hysterosalpingography And Endometriosis: Beyond The Tube Patency

Participants
Danielle Teles Leal, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Approximately 10 percent of reproductive-age women globally have endometriosis, and it has been reported up to 50 percent of women with infertility. The hysterosalpingography (HSG) is the most common first-line diagnostic test used for infertility investigation. The purpose of this presentation is to demonstrate that signs of endometriosis can be and should be suspected in hysterosalpingography, beyond the tubal patency, correlating these findings with other imaging methods (ultrasound and magnetic resonance imaging), based on our service's digital archive.

TABLE OF CONTENTS/OUTLINE

Evaluation of endometriosis' signs in hysterosalpingography, comparing these findings with other imaging methods.Illustrational cases of endometriosis, including pelvic adhesions, forced uterine reflection, and uterine tube changes tube (e.g contour irregularities, hematosalpinx, medialization and diverticulas).

RIEE-22   Do Not Lose Your Nerve! What Every Radiologist Should Know About Endometriosis-associated Neuropathy.

Awards
Certificate of Merit

Participants
Danielle Teles Leal, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Endometriosis is a common gynecological disease, which affects women of reproductive age. This disease is frequently associated with chronic pain however, the mechanisms for this symptom are not yet well defined. It is believed that this pain can be nociceptive, inflammatory, neuropathic or a combination of these.Nerve involvement by endometriosis is rare and often overlooked in imaging exams, but the early diagnosis and treatment is essential to avoids chronic sensorimotor neuropathy.Recent studies also shows that presence of pathological DTI findings of the sacral nerve roots correlates with the type of pain, adhesions, and deep endometriosis, providing a better understanding of pain.The purpose of this presentation is to review the anatomy of pelvic nerves and show neural involvement cases in endometriosis.

TABLE OF CONTENTS/OUTLINE

Present a brief review of the anatomy of the nerves of the pelvis.Demonstrate the imaging findings of the pelvic nerve's involvement in endometriosis, directly and indirectly, thought the resonance magnetic imaging, lumbosacral tractography 3D reconstructions and DTI values changes (Fractional Anisotropy).

RIEE-23   Endometrial Neoplasms In MRI: A Practical Guide For The Radiologist

Participants
Luciana Piccolo, MD, Campo Grande, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Describe magnetic resonance imaging findings in endometrial tumors. Demonstrate the applicability of magnetic resonance imaging in endometrial cancer, and its limitations. Detail the different stages of endometrial cancer and discuss the use of diffusion-weighted and dynamic contrast-enhanced magnetic resonance imaging for endometrial cancer staging. Describe potential imaging pitfalls and propose strategies to avoid them. Propose a structured reporting for local staging purposes.

TABLE OF CONTENTS/OUTLINE

Endometrial cancer contributes substantially to female mortality and morbidity around the world. Guidelines recognize that magnetic resonance imaging is the best method for an evaluation which is essential in determining the correct approach for treatment. The depth of myometrial invasion is considered the most important morphological prognosis factor. Therefore, a good quality exam together with an appropriate technique, is fundamental. Recognizing pitfalls can be challenging and we therefore propose strategies to confront these diagnostic challenges. Practical tips, potential pitfalls, discussions about imaging findings, and a structured report are also considered in this work with the aim of contributing to the day-to-day practice of radiologists, improving information quality, and objectivity in relating the findings.

RIEE-24   Multi-imaging Evaluation Of The Most Common Surgical "Blind-spots" On Endometriosis

Participants
Thiago Pereira Fernandes da Silva, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To Review the fundamental concepts of endometriosis on imaging through a systemic revision of pelvic imaging anatomy in correlation with the most common MRI and US findings.To highlight the fundamental anatomic structures and imaging findings relevant to the preoperative stage of the disease. To illustrate US and MRI findings of peculiar "blind-spots" endometriotic lesions. To correlate US and MRI features with intraoperative laparoscopy findings of pelvic and extra-pelvic endometriosis, with a focus on the potential "blind-spots" in the surgical approach.

TABLE OF CONTENTS/OUTLINE

- Revisit Background Concepts on Endometriosis.- Anatomy of the Pelvis- Imaging Endometriosis: basic patterns.- MRI vs US in endometriosis- Flowchart: "the blind spots" - Series of cases and teaching points related to each "blind-spot", mostly illutrated with MRI and US. Teaching points will be highlighted

RIEE-25   The Many Faces Of Endometriosis: A Systematic Compartment Based MRI Approach

Participants
Surabhi Kaushik, MD, New Delhi, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

•Enlist the various anatomic locations and morphologic types of endometriosis in female pelvis.•Describe the MR imaging appearances of pelvic endometriosis.•Provide a compartment based approach and structured imaging reporting template.

TABLE OF CONTENTS/OUTLINE

•Morphological types and subtypes of Endometriosis :-ØSuperfcial endometriotic implantsØDeep infltrative endometriosisØOvarian endometriomas•Compartment based approach :-Ø The anterior compartment -anatomic spaces and structures posterior to the pubic symphysis and anterior to the anterior wall of the uterus and vagina.Ø The middle compartment- midline structures including the uterus, vagina, uterine ligaments, fallopian tubes, and ovaries.Ø The posterior compartment - structures and spaces posterior to the posterior wall of the uterus and vagina.•MR Imaging Protocol (Sequences and rationale) :-Ø T2WI echo-planar fast spin echo sequences without fat suppression.Ø T1WI with and without fat suppression (Fat-suppressed T1-weighted 3D gradient-echo LAVA sequence).Ø Difusion-weighted imaging (DWI)Ø Subtraction sequences post-contrast T1WI with fat suppressionØ Susceptibility weighted imaging•MR Imaging appearances of Endometriosis•Structured reporting template :- A comprehensive endometriosis-specific report which improves presurgical mapping of lesions.

RIEE-26   ACR O-RADS MRI Lexicon - Made Simple!

Awards
Certificate of Merit

Participants
Michelle Zhang, MD, Montreal, Quebec (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Describe and understand the 7 categories of the O-RADS MRI lexicon.2. Describe ovarian/adnexal lesions in a standardized fashion using the O-RADS MRI lexicon.

TABLE OF CONTENTS/OUTLINE

1. Backgrounda. Why utilize the O-RADS MRI lexicon?b. Overview of the 7 categories2. Category #1: Major categoriesa. Physiological: (i) Follicles (ii) Corpus luteumb. Lesion: (i) Cystic lesion (ii) Solid component (iii) Solid lesion3. Category #2: Size4. Category #3: Shape or contour of the solid lesion/solid tissue a. Smoothb. Irregular5. Category #4: Signal intensitya. Homogeneityb. T1 signal intensityc. T2 signal intensityd. B-value/DWI6. Category #5: Lesion components a. Cystic (i) Simple fluid (ii) Non-simple fluid (iii) Fluid/fluid level (iv) Shadingb. Solid (i) Solid tissue - Papillary projection - Mural nodule - Irregular septation/wall -Larger solid component(ii) Other (solid appearing material but not considered truly solid tissue) - Smooth septations - Blood clot, debris, fibrin strands - Fat, hair, calcification, Rokitansky nodule7. Category #6: Enhancement a. Time intensity curves (i) Low risk (ii) Intermediate risk (iii) High riskb. Visual analysis (i) </= myometrium (ii) > myometrium8. Category #7: General and extra-ovarian findingsa. Peritoneal fluidb. Fallopian tubesc. Peritoneal inclusion cystd. Ovarian torsione. Peritoneal thickening/nodules9. Summary10. Multiple choice questions concentrating on the main learning points with reference back to the previous information slides

RIEE-28   Role Of MRI In Endometrial Cancer: An Update

Participants
Cibele Luna, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To describe the current role of MRI in the management of endometrial cancer (EC) 2. To display the MRI appearance of EC according to the various FIGO stages 3. To revise the MRI appearance of recurrent and metastatic EC.

TABLE OF CONTENTS/OUTLINE

1. Overview of EC: Current statistics and magnitude of the problem, Current histopathologic and molecular classification, Overview of current management of EC 2. Role of MRI in EC: Role of imaging according to National Comprehensive Cancer Network guidelines, MRI in the initial workup of EC (Selection of patients for fertility-sparing therapy), MRI in the follow-up and surveillance of EC, MRI in recurrent and metastatic EC. 3. MRI Technique and optimization of protocol 4. Normal uterine zonal anatomy on MRI 5. General MRI appearance of EC on T2 weighted, diffusion weighted and dynamic contrast-enhanced images 6. Initial workup of EC: FIGO staging* Early-stage disease, Advanced-stage disease, Comparison with Union for International Cancer Control TNM staging. 7. MRI in recurrent and metastatic EC** Pelvis, Peritoneum, Lymph nodes, Liver, Other abdominal organs, Musculoskeletal and soft tissue, Central nervous system. *For each stage, a representative illustration and MRI images will be provided.**Representative images for each site of recurrence will be provided.

RIEE-29   Acute Abdominal Pain In Women Can Surprises You: Spectrum Of Gynecologic Emergencies

Participants
Cecilia Ruiz de Castaneda, Toledo, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To describe gynecologic anatomy and review the visceral spaces of the female pelvis. 2. To review and illustrate the computed tomography (CT) imaging features of acute gynecologic diseases. 3. To analyze the differential diagnosis and provide diagnostic keys to identify pitfalls.

TABLE OF CONTENTS/OUTLINE

Gynecologic emergencies in premenopausal women are commonly presented to the emergency department with non-specific abdominal pain. For this reason, it can be challenging to differentiate gynecologic pathology from urologic and gastrointestinal diseases. When the suspicion of gynecologic disease is high, the first-line imaging test usually obtained is pelvic ultrasound. However, if the initial diagnosis is very broad or there is no suspicion of gynecologic pathology, CT may be the initial imaging study for acute abdominal pain. A high level of suspicion and knowledge of the CT imaging features of gynecologic diseases are essential for prompt diagnosis. We propose a radiological approach based on the recognition of computed tomography imaging patterns.

RIEE-3   Ultrasound Of The Pelvic Floor: Don't Be Afraid Anymore!

Awards
Certificate of Merit

Participants
Marcela Lauar, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Pelvic floor dysfunctions can have a significant impact in woman's life quality, especially after the fifth decade. Physical examination has limits evaluating pelvic floor, since it can underestimate the involvement of compartments. - Although 3-D and 4-D translabial ultrasound are relatively new methods, their high accuracy in the evaluation of pelvic floor dysfunction has provided an ascending role in clinical evaluation and providing pre operative information.- The purpose of this presentation is to review the normal anatomy in pelvic floor translabial ultrasound, as well as the most common pathologies and their image findings.

TABLE OF CONTENTS/OUTLINE

- Case-based didactic review of how the most common findings in pelvic dysfunction manifest in pelvic ultrasound, including stress urinary incontinence, pelvic organs prolapses, slings evalutation, among others - based on our service's digital archive.- Correlation with 3D reconstructions, magnetic resonance image (MRI) are also established when appropriate.- Take-home messages- References

Endometrial Cancer From Diagnosis To Cure: A Multidisciplinary And Multimodality Review

Participants
Marta Flory, MD, Davis, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Learning Objectives: 1.Understand the approach to diagnosis and management of endometrial cancer, including risk factors, high risk histopathologic features, and the role of imaging. 2.Effectively identify endometrial cancer on US, including high grade features, as well as on MR and other imaging modalities, and be familiar with the FIGO staging and imaging correlates. 3.Understand the pathways of spread of endometrial cancer, and be able to alert surgeons to imaging features that impact management such as >50% myometrial invasion and disease outside of the uterus (such as locoregional invasion, distant metastases, and peritoneal disease). 4.Incorporate a focused GYN ONC search onto your basic search pattern that addresses the most frequent areas of recurrence and metastases. 5.Be familiar with the current standard & cutting edge surgical and medical oncology treatment strategies, as well as the role of radiation therapy in the treatment of endometrial cancer.

TABLE OF CONTENTS/OUTLINE

1.Diagnosis: a-Clinical features of endometrial cancer b-Risk Factors c-Histopathology d-Pelvic US 2.Imaging: a-Endometrial cancer on US, MRI, & PET/CT, with multimodality review of FIGO stages b-Review pathways of lymphatic spread of endometrial cancer c-Common sites of metastases & recurrence 3.Treatment: a-Surgical Treatment: TLH, Sentinel Lymph Node resection b-Medical Oncology Treatment: Chemotherapy, Immunotherapy c-Radiation Therapy: Pelvic Radiation, Vaginal Cylinder & Cervical Brachytherapy, & Interstitial Brachytherapy

RIEE-31 O-RADS MRI Risk Stratification System: Pearls And Pitfalls

Awards
Cum Laude

Participants
Stephanie Nougaret, MD, Montpellier, France (*Presenter*) Nothing to Disclose

TEACHING POINTS

To understand the components of the O-RADS MRI risk scoreTo accurately recognize solid tissue and solid components not considered solid tissue To correctly analyze diffusion weighed imaging and time intensity curves in order to accurately assign an O-RADS MRI risk score

TABLE OF CONTENTS/OUTLINE

1. Briefly review the components of O-RADS MRI risk score2. Pearls and Pitfallsa. Technical aspectsi. Pre-contrast1. T2 weighted sequences with thin slices <3mm2. Acquire T2 weighted and DWI series in a similar planeii. Setting up appropriate post-contrast scans for time intensity curve analysis1. 3mm slice thickness2. 15 second time resolution3. Acquire one set of images prior to contrast injection to allow for subtractionb. Differentiating solid tissue from other solid components not considered solid tissue i. Fat, clot, debrisii. Normal ovarian parenchymaiii. Rokitansky protuberanceiv. Endosalpingial foldsv. Tubal fimbriaevi. Thickened/smooth wall or septac. Differentiate simple vs non simple fluidd. Analyzing DWI accuratelyi. T2 black out effectii. T2 shine through effectiii. Pitfalls related to restricted DWIe. Analyze time intensity curves accurately when the solid tissue isi. Small in sizeii. Weakly enhancingiii. Adjacent or within high signal fluid

RIEE-32 O-RADS US + O-RADS MRI: Understanding Their Complementary Roles

Participants
Marisa Martin, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Ultrasound is often the first-line imaging modality for adnexal mass characterization given its relatively high sensitivity for malignancy, however specificity is imperfect-Up to 30% of adnexal masses remain sonographically indeterminate-Patients managed with only US have a risk of inappropriate treatment that could be mitigated by using a higher specificity modality such as MRI, but not all patients need MRI. Examples include:1. MRI may downscore lesions from US when dark T2/dark DWI pattern is present or fat is clearly demonstrable2. MRI may upscore lesions when small soft tissue elements are not visible at US within large cysts-Key differences between O-RADS US and O-RADS MRI1. O-RADS US provides management recommendations; O-RADS MRI does not2. Vascularity is determined by color scores on O-RADS US; O-RADS MRI assesses lesion enhancement using perfusion characteristics3. The same O-RADS scores have different positive predictive values for malignancy-O-RADS US 5 lesions have a 50% or greater positive predictive value for malignancy, compared with ~90% for O-RADS MRI 5-Ultrasound is a primary test and MRI is a confirmatory test for adnexal mass characterization, so sensitivity/specificity vary accordingly

TABLE OF CONTENTS/OUTLINE

-Brief review of the history and applications of the O-RADS systems-Review the key differences between the O-RAD US and O-RADS MRI systems-Review the complementary roles of O-RADS US and O-RADS MRI through multimodality imaging examples-Summary of key concepts

RIEE-33 Atypical, But Not Critical: Differentiating Uterine Sarcomas From Atypical Myomas

Awards
Cum Laude

Participants
Fernanda Pegoraro I, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Leiomyomas are the most common neoplasm found in the uterus, with a prevalence reaching 70-80% among women aged 50 years and older. Conversely, gynecological sarcomas are rare and highly aggressive tumors that require prompt radical resection, with leiomyosarcoma being the most commom histological type. Typical fibroids are easily identified on MRI, as they have characteristic

features. However, there are several leiomyoma variants, such as cellular and atypical leiomyomas and so they can demontrate atypical images appearance that may be difficult to differentiate from leiomyosarcomas. In pre-menopausal patients, the preservation of the uterus is prioritized with conservative therapies. In such cases, mini-invasive surgery may lead to tumor fragmentation, and sometimes to spillage in the case of malignancy. Therefore, it is extremely important to differentiate between benign leiomyomas and leiomyosarcomas before the therapeutic decision.

TABLE OF CONTENTS/OUTLINE

This study aims to familiarize radiologists with the algorithm proposed by "Cendus Abdel Wahab, MD et al", which will be applied to a several cases being illustrated as a quiz. We hope to highlight the useful radiological signs for the differentiation between atypical leiomyomas from uterine sarcomas. The criteria considered in this study are hight T2 and diffusion-weighted imaging signal and low apparent diffusion coeficiente (ADC) as predictors of malignant sarcomas.

RIEE-34   Where The Fluid Stops: Adhesions And Peritoneal Pockets

Participants
Stephannie Santana, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Abdominal adhesions are formations of fibrous tissue that develop between structures in response to tissue damage. Prior abdominal surgery, peritonitis, pelvic inflammatory diseases, endometriosis, and radiotherapy to the abdominal area all are factors known to induce intraabdominal adhesions.• Intraabdominal adhesions are a common cause for chronic abdominal pain, bowel obstruction, especially of the small bowel in up to 75%, mechanical ileus in adult patients, infertility and difficult in subsequent surgery, causing increased morbidity and mortality.• The findings obtained in laparoscopic surgery are the most accurate way to determine the adhesions, although surgery itself is widely regarded to be leading cause of adhesions. Thus a non-invasive technique could be of significant benefit.• Ultrasonography and cine-magnetic resonance imaging is used as an important tool in determine adhesions, however imaging methods are not always reproducible.• Thus some secondary peritoneal changes seen in conventional imaging methods could be better explored.

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• This study proposes indirect radiological signs that suggest the presence of adhesions, such as peritoneal pockets, loculated peritoneal fluid, peritoneal failure, recto-uterine pouch (POD) adhesions and atypical uterus positioning, correlating these signs with surgical findings, aiming to corroborate with pre-existing kwonledge.

RIEE-35   Staging Of Uterine Malignancies: What Radiologists Need To Know

Participants
Cristina Gomez Varela, MD, Pontevedra, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

We review the epidemiology of uterine cancer, the FIGO staging system and the role of imaging in the staging of uterine malignancies.

TABLE OF CONTENTS/OUTLINE

Background. Imaging modalities. Dissemination patterns: lymphatic spread, intraperitoneal seeding and hematogenous dissemination. FIGO staging of uterine malignancies: endometrial cancer, uterine sarcoma and cervical cancer. Conclusions.

RIEE-36   Peering Into The Pelvis With 3D Uterine Ultrasound - What You Need To Know!

Participants
Colin Rowell, MD, Fruit Cove, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

Ultrasound is the first-line screening and diagnostic imaging tool to evaluate the uterus. It is helpful to evaluate pelvic anatomy and to diagnose pelvic problems such as pelvic pain, bleeding, and suspected benign or malignant pathologies. After reviewing this case-based exhibit, the learner will be able to: - Describe pelvic ultrasound techniques with particular attention on 3D sonography. - Recognize the normal uterine and endometrial appearance on 3D ultrasound. - Diagnose uterine and endometrial pathology with some case-based cross-sectional correlation. - Determine whether additional imaging with pelvic MR may be warranted.

TABLE OF CONTENTS/OUTLINE

I. Objectives II. BackgroundIII. 3D Ultrasound of the UterusA. Ultrasound technique, tips, and pitfallsB. Uterus i. Normal anatomy 1. Endometrium 2. Congenital variants a. Arcuate vs. Septate uterus b. Bicornuate uterus c. Uterus didelphys ii. Problem Solving and Pathology with 3D Ultrasound 1. Normal vs. malpositioned intrauterine device 2. Endometrial polyps 3. Uterine Leiomyomas a. FIGO Staging (FIGO 0-8) and Submucosal FibroidsIV. Conclusions

RIEE-37   Malignancies In Pregnancy: Imaging Considerations And Management

Awards
Certificate of Merit

Participants
Lekui Xiao, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. For many women, it is during pregnancy that the ovaries are first imaged. It is imperative that clinicians and imaging specialists understand the characteristic findings and follow-up for incidentally detected ovarian lesions in pregnancy. Early diagnosis, although complicated by pregnancy, is key in optimizing evaluation and treatment. 2. Cervical cancer incidence peaks during childbearing years and is clinically managed through Pap screening. This malignancy is usually managed well before imaging is needed. However, staging of invasive cancer requires cross-sectional imaging. 3. Uterine, vulvar, and vaginal malignancies are rare in pregnancy.

However, they are best diagnosed through clinical exam, pelvic ultrasound, and subsequent MRI for staging. 4. Diagnosis of non-gynecological malignancies relies more on ionizing radiation through modalities such as computed tomography or mammography. 5. When weighing the pros and cons of contrast use and radiation, the benefit to the mother in making an early and accurate diagnosis often outweighs the theoretical risk to the fetus.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Incidental ovarian masses detected on prenatal ultrasound a. Benign versus malignant b. Management 3. Cervical cancer a. Imaging considerations b. Management4. Other less common gynecologic malignancies a. Uterine malignancies b. Vaginal & vulvar malignancies5. Imaging of non-gynecologic malignancies in pregnancy a. Safety b. Radiation considerations6. Teaching Points

RIEE-38   MRI Features Of Ovarian Lesions: How Far Can We Go In Predicting Histology?

Participants
Natália Cavalcante, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Indeterminate adnexal masses are commonly referred to MRI for further diagnostic work-up after initial ultrasound evaluation. Although imaging features can often be non-specific, correlation with clinical and epidemiologic features can aid in the diagnostic approach. In MRI, T2 morphology plays an essential role in narrowing the differential diagnosis of these lesions. The adequate characterization of features that are suspicious for high-grade malignancy can help determine treatment options and improve outcomes, especially when preservation of fertility is desirable. The purpose of our exhibit is: 1. To illustrate morphologic T2 features of low grade, borderline and malignant adnexal lesions; 2. To review the main differential diagnosis of adnexal masses based on simplified workflows; 3. To present cases with histologic confirmation.

TABLE OF CONTENTS/OUTLINE

Introduction of optimal pelvic MRI protocols; Overview of the most common types of neoplastic ovarian masses; Proposed flowcharts to guide the differential diagnosis of ovarian lesions;Presentation of cases of low grade, borderline, and malignant adnexal lesions, with emphasis on the T2 morphology.

RIEE-39   The 2021 Update On MRI For Endometrial Cancer: What The Radiologist Needs To Know

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Ekta Maheshwari, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Endometrial cancer is the most common gynecologic malignancy in industrialized countries, where its incidence is increasing. Globally, it remains the sixth most common cancer in women. Contemporary evidence based data and expert opinions recommend MRI for endometrial cancer in non surgical candidates, patients with suspected cervical involvement, those desiring fertility sparing or other conservative management, and in patients with recurrence being considered for pelvic exenteration. MRI provides critical information on tumor size, depth of invasion and lymph node status. This case-based review reflects a multidisciplinary international collaboration and will summarize updated information concerning the role of MRI for endometrial cancer staging, treatment planning and follow up, including information regarding dedicated MRI protocols, tips for MRI reporting and strategies for image quality optimization. Emerging MRI techniques will also be discussed.

TABLE OF CONTENTS/OUTLINE

1. How MRI improves patient management for early stage, fertility sparing, advanced disease, follow-up and recurrence assessment. 2. Dedicated MRI protocols, including patient preparation, role of functional MRI sequences & tips for MRI reporting. 3. FIGO stage-specific MRI findings and tips for assessing challenging cases. 4. Case-based review of MRI for initial treatment planning, response assessment & post therapy follow up. 5. Future directions, including new DWI methodologies, fast MR techniques & PET/MRI for endometrial cancer imaging.

RIEE-4   Mimickers Of Gynecologic Tumors

Participants
Tsukasa Saida, MD, Tsukuba, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Various organs exist around the female reproductive organs, and tumors arising from these organs can be mistaken for gynecologic tumors. In this exhibition, we introduce various tumors in various organs other than the female reproductive organs that need to be differentiated from gynecologic tumors, and explain the diagnostic points in a quiz format. The teaching points of this exhibit are: 1. Tumors of the rectum, appendix, bladder, ureter, abdominal wall, and nerves can be mistaken for gynecological tumors, and it is important to closely observe the continuity between the tumor and surrounding organs. 2. Various types of tumors, such as gastrointestinal stromal tumors, myxoma, schwannomas, desmoid, sarcomas, and epithelial tumors other than in gynecologic organs, need to be distinguished from gynecologic tumors and we indicate their typical imaging findings.

TABLE OF CONTENTS/OUTLINE

A. Quiz imagesB. Explanation of interpretations of quiz images with reference to additional imagesC. Overview of the disease, including imaging findings

RIEE-40   Myometrial Scar Ectopic Pregnancy - A Review

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Participants
Lucien Rizzo, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Myometrial scar ectopic pregnancies are associated with a high morbidity rate.2. Specific findings on pelvic ultrasound should raise concern for a myometrial scar ectopic pregnancy.3. Adjunct imaging can be beneficial in confirming the diagnosis of myometrial scar ectopic pregnancy.4. As there are no standardized guidelines regarding the therapeutic management of myometrial scar ectopic pregnancy the radiologist is likely to be consulted for diagnostic and/or therapeutic dilemmas.5. Uterine artery embolization by the interventional radiologist can be incorporated into the surgical management of myometrial scar ectopic pregnancy.

TABLE OF CONTENTS/OUTLINE

I. IntroductionII. Spectrum of Ultrasound Findings in Myometrial Scar Ectopic Pregnancy [Imaging pearls. Indications and recommendations for adjunct imaging.]III. Therapeutic and Management Options [Including uterine artery embolization.]IV. Multimodality Case ReviewV. Test Your Knowledge

RIEE-41   3D Pelvic Ultrasound: Plane And Simple

Participants
Iris Chen, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Ultrasound (US) is the mainstay of pelvic imaging given its broad availability, real-time imaging, cost-effectiveness, and lack of radiation. Three-dimensional (3D) US for the female pelvis has revolutionized the evaluation of pelvic anatomy and pathology with multiplanar assessment. Current applications for 3D US not only include evaluation of common pathologies, but also can be utilized in the workup of infertility and as imaging guidance for procedures. Limitations of 3D US include quality dependence on two-dimensional image resolution, artifact recognition in 3D reconstructions, and learning curve associated with 3D US manipulation by the examiner. As 3D US becomes more widespread in clinical practice, it is important to understand how to optimize 3D US for both the user and interpreter to improve diagnostic evaluation.

TABLE OF CONTENTS/OUTLINE

The exhibit will introduce normal pelvic anatomy as visualized on 3D US with both user- and interpreter- techniques to optimize 3D US of the pelvis to best evaluate its common pathologies. We will include a comprehensive overview of entities in which 3D ultrasound plays a key role in making the diagnosis. These include congenital uterine anomalies, endometrial polyps, fibroids, intrauterine devices, hydrosalpinx, pelvic floor and mesh evaluation, and pregnancy. Learning is reinforced through an interactive case review with quiz.

RIEE-42   Recurrent Tumors Of The Uterine Cervix And Corpus: Multimodality Imaging Review And Implications For Clinical Management

Participants
Ekta Maheshwari, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Recurrent tumors of the uterine cervix and corpus are challenging clinical scenarios for which radiologic imaging is essential for salvage therapy planning and follow-up. Therapeutic strategies for local pelvic recurrences include surgical exenteration and radiotherapy. While potentially curative, these therapies are not without risk and necessitate precise delineation of tumor extent. Patients presenting with extensive pelvic recurrence or with distant disease are typically triaged to systemic therapy, for which imaging is equally vital to evaluate tumor extent and subsequent response to therapy. This case-based review reflects a multidisciplinary international collaboration and will summarize the role of imaging for recurrent tumor detection and delineation, treatment planning and post-therapy follow up.

TABLE OF CONTENTS/OUTLINE

1. Summary of key surgical, radiation oncology and medical oncology strategies for recurrent disease.2. Case-based review illustrating the role of imaging (CT, PET/CT, MRI, PET/MRI) for detection, treatment selection and treatment planning of recurrent cancers of the uterine cervix and corpus (i.e. endometrial & mesenchymal neoplasms).3. Illustrative case-based review of uterine cervix/corpus recurrence cases, including treatment strategy and rationale with examples of post-therapy follow up.4. Guidelines for radiologic reporting.

RIEE-43   MR Imaging Review Of Gynaecological Malignancies In Pregnancy

Participants
Alexandra Renn, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

o Understand the incidence, presentation and management of gynaecological malignancies in the pregnant patient.o Demonstrate the imaging characteristics of gynaecological malignancies in the pregnant patient.o Recommendations to avoid potential pitfalls when faced with challenging clinical dilemmas.

TABLE OF CONTENTS/OUTLINE

Epidemiology of Gynaecological Malignancies in the pregnant patient.• Pathophysiology (with focus on hormonal changes/immune suppression)• Clinical presentation and its limitations (including challenges regarding tumor markers (specifically CA-125))Pictorial demonstration of specific gynaecological cancers in the pregnant patient, including learning points for each (please see PDF upload):• Cervical (to include comparison with the non-pregnant patient to emphasize limitations of accurate staging)• Ovarian (including borderline ovarian tumors)• Endometrial• Vaginal and Vulval.'Tumor Mimics' in the pregnant patient, with a discussion regarding methods to minimise misdiagnosis.Imaging recommendations (focus upon MRI but with a general discussion regarding ultrasound and CT)• Strategies for image optimisation• Potential imaging pitfalls.Ethical issues in the investigation and management:• Subsequent challenges in imaging• Surgery• Chemotherapy/radiotherapy• Risk to foetus/motherConclusion

RIEE-44　　**Placenta Accreta Spectrum: The Role Of MRI**

Awards
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Participants
Joanna Ohlendorf, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Placenta accreta spectrum (PAS) disorders are increasing in prevalence and can be a major cause of maternal morbidity and mortality, especially if not detected prior to delivery. The management of PAS requires a multidisciplinary approach, which includes imaging evaluation to tailor the treatment plan. Ultrasound is the screening imaging modality of choice, however, MRI is a valuable adjunct for assessing the depth of placental invasion and extent of uterine and extra-uterine involvement. We aim to review the role of prenatal and postpartum MRI in PAS, focusing on MRI findings, management implications, and pathologic correlation. We will do this via a case-based approach, emphasizing the standardized imaging protocol and reporting system described in the PAS joint consensus statement by SAR and ESUR. Accurate, standardized reporting of the imaging features of PAS by the radiologist will help guide the appropriate management of this increasingly common disease.

TABLE OF CONTENTS/OUTLINE

A. Review of normal MRI placental findings during pregnancy.B. Review of standardized MRI techniques and sequences.C. Review the MRI findings and reporting lexicon of PAS.D. Case based review of PAS MRI emphasizing the imaging findings, depth of invasion, topography of invasion, and extra-uterine extension. Examples during pregnancy with implications on delivery planning, as well as postpartum monitoring in the setting of conservative management will be included. Operative and pathology report correlation will be provided.

RIEE-45　　**Urinary Tract Endometriosis: Imaging Features, Complications And Preoperative Evaluation**

Participants
Ruggeri Guimaraes, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1 - To review usual and unusual location and imaging features of urinary tract endometriosis and its complications. 2 - To provide a set of the main radiological features helpful in the management of urinary tract endometriosis towards the most correct therapeutic approach. 3 - To illustrate cases of urinary complications resulting from surgical treatment of endometriosis.

TABLE OF CONTENTS/OUTLINE

1 - Diagnostic tools, including transvaginal ultrasound and magnetic resonance imaging, as well as the correlation and comparison between them. 2 - Imaging protocols. 3 - Usual and unusual location, imaging features, and urologic complications. 4 - Current conservative and surgical management. 5 - Role of imaging in surgical planning, relevant report information and advantages of a structured report. 6 - Urinary complications resulting from surgical treatment of endometriosis.

RIEE-46　　**From Head To Toe: Acute Presentations Of The Pregnant And Postpartum Patient**

Participants
Sarah Moorman, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Both physiologic and mechanical risk factors predispose pregnant and postpartum patients to complications and injuries2. There are certain "can't miss" pathologies that radiologists must recognize to prevent complications to the mother and/or fetus3. Other common and uncommon processes can also occur during pregnancy and may present with acute symptoms

TABLE OF CONTENTS/OUTLINE

1. Review risk factors that may predispose pregnant/postpartum patients to certain complications2. Review multi-organ system pathology and complications in pregnant and postpartum patients:a. Neuroradiology: dural venous sinus thrombosis, hemorrhagic infarct, stroke, posterior reversible encephalopathy syndrome, reversible cerebral vasoconstriction syndromeb. Cardiothoracic: pulmonary embolus, aortic dissectionc. Musculoskeletal: pelvis stress fractures, transient osteoporosis of the hip, muscular and ligamentous injury/tearsd. Abdominopelvic: appendicitis, ectopic pregnancy, placenta percreta, degenerating fibroid, pyelonephritis, obstructing calculus, deep venous thrombosis3. Summary of key findings/features by organ system

RIEE-47　　**Growing Pains: Multi-modality Pre-natal Imaging Of Fetal Tumors With Post-natal Correlation**

Participants
Murat Oztek, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Review of pre-natal detection and evaluation of fetal benign and malignant tumors based on anatomical location- Review of imaging appearance, with post-natal correlation- Review of potential complications, such as hydrops, and airway obstruction-Discuss management techniques including in utero intervention and alternative modes of delivery such as ex utero intrapartum treatment (EXIT)- Role of the radiologist in the multi-disciplinary team

TABLE OF CONTENTS/OUTLINE

1. Fetal tumors, both benign and malignant, will be reviewed head to toe, based on anatomical location.-Intracranial: Glioma, craniopharyngioma, teratoma, lipoma, and choroid plexus papilloma-Neck: Teratoma, lymphangioma, and angiomas-Cardiac: Rhabdomyoma (including tuberous sclerosis association) and fibroma-Soft tissue: Infantile fibrosarcoma, rhabdomyosarcoma, and PNET-Abdominal: Hemangioendothelioma, mesenchymal hamartoma, hepatoblastoma, mesoblastic nephroma, Wilms, and neuroblastoma-Pelvis: Sacrococcygeal teratoma,ovarian cystic mass2. Imaging techniques: ultrasound, including use of 3D imaging, MRI, imaging for in utero intervention, and delivery planning3. Potential complications4. Role of the radiologist in management of pregnancy and delivery planning5. Post-natal imaging correlation and role of the radiologist in management6. Flow chart outlining

imaging approach, emphasizing role of the radiologist

RIEE-48   Don't Stress-Do Your Best: Case-based Review Of Common (And Some Uncommon) Fetal Genetic Anomalies

Participants
Hassan Aboughalia, MBBCh, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Case-based presentation of commonly encountered fetal genetic syndromes. 2. Case-based presentation of several less commonly encountered fetal genetic syndromes.3. Review of the clinical and imaging approach with suggested timelines for follow up and re-imaging to clarify findings, and the role of the radiologist in the management team. 4. Algorithmic approach to distinguishing features and differential diagnosis.

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1. Commonly encountered syndromes (Trisomy 21, 18, 13, 9).2. Less commonly encountered syndromes (Turner, chromosomal transpositions and translations, Beckwith Weidemann, caudal regression, Meckel-Gruber, Joubert syndrome, Pentalogy of Cantrell, VACTERL, Holt-Oram, and prune belly syndrome).3. Imaging appearance on US, 3D US, and MRI, and associated pathology photos.4.Review the clinical approach from the time of US diagnosis and the need for further imaging when indicated/appropriate.5. Describe the role of the radiologist in management of such pregnancies. 6. Provide an algorithmic approach based on the pattern of anomalies, to arrive at a differential diagnosis or a specific diagnosis.

RIEE-49   Comprehensive Multi-modality Imaging Review Of Uterine Leiomyomas And Associated Complications

Participants
Bahar Mansoori, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Review the classification of leiomyomas by location and histopathology 2) Overview the common and uncommon imaging findings of leiomyomas on plain film, US, CT, MRI, and PET-CT 3) Multi-modality imaging review of potential complicationsAlgorithmic approach to differential diagnosis and mimics 4) Overview the role of imaging and image-guided interventions in the management

TABLE OF CONTENTS/OUTLINE

Classification of leiomyomas by location (FIGO classification)Classification of leiomyomas by histopathology, review of multi-modality imaging, and clinical significance of subtypesHistopathologically typical leiomyomaNon-degeneratedDegenerated (Fatty, carneous, cystic, hyaline, myxoid)Histopathologically variant leiomyoma (Mitotically active,cellular, STUMP tumor,atypical)Imaging of atypical growth pattern and clinical relevanceDisseminated peritoneal leiomyomatosis,Benign metastasizing leiomyoma,Intravenous leiomyoma,Parasitic leiomyoma,Broad ligament leiomyomaMulti-modality imaging review of potential associated complicationsHemorrhage,Torsion,Prolapse,Infarction,Mass effect on adjacent organs,Metastatic,Malignant degenerationAlgorithmic approach to differential diagnosis and pitfallsReview of treatment optionsPre-surgical planningPlanning for uterine artery embolizationReview of available interventions and associated complicationsHIFU (high-intensity focused ultrasound) treatmentIndications and techniques for MR-guided HIFU and US-guided HIFU

RIEE-5   Cesarean Scar Ectopic Pregnancy: Intrauterine But Not Ok!

Awards
Certificate of Merit

Participants
Michelle Debbink, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Early first trimester is the best time to diagnose a cesarean scar ectopic pregnancy (CSEP); 2) Accurate diagnosis requires a high index of suspicion, complete patient history, imaging the entire uterus, and recognition of imaging findings; 3) Key imaging findings for CSEP include low implantation, cross over sign, and decreased residual myometrial thickness; 4) Differential diagnoses include low-lying but normal gestational sac, abortion in progress, or cervical ectopic; 5) Missed or late diagnosis of CSEP can lead to hemorrhage, uterine rupture, or severe placenta accreta spectrum (PAS) disorder; 6) Early recognition of CSEP is critical for appropriate medical or surgical management to reduce maternal morbidity and preserve fertility

TABLE OF CONTENTS/OUTLINE

CSEP overview: Incidence increasing in parallel with cesarean rates; frequently missed diagnosis; intrauterine location does not always imply normal; Key sonographic issues: Wide field of view, sac location, cross over sign, cardiac activity. Key findings to guide management: Residual myometrial thickness, exogenous vs endogenous growth; Management options: guided by growth type; include: laparoscopic/hysteroscopic resection; suction D&C; transcervical balloon compression; high frequency ultrasound; or medical management (e.g., methotrexate); Consequences of CSEP (worsened by late diagnosis or management): Hemorrhage, uterine rupture (early and late), gravid hysterectomy, severe PAS necessitating preterm birth and hysterectomy, maternal death.

RIEE-50   Benign, Malignant Or In Between? From Fibroids To Leiomyosarcomas. A Cased-based Review Of The Spectrum Of Uterine Smooth Muscle Tumors

Participants
Wendy Tu, MD, Edmonton, Alberta (*Presenter*) Nothing to Disclose

TEACHING POINTS

As the management of uterine leiomyoma has evolved, so too has the role of cross-sectional imaging in fibroid assessment before and after treatment. MRI in particular is highly accurate in characterizing fibroid distribution, prompting efforts to systematize description of fibroid sub-locations within the uterus in a manner that is actionable by gynecologists. Though many fibroids have characteristic imaging features, even benign fibroids may exhibit a range of atypical appearances related to degeneration. Moreover, challenges remain in non-invasively deciphering benign fibroids from those along an atypical histologic spectrum ranging

from cellular leiomyoma to leiomyosarcoma, a distinction with potentially immense clinical significance.

TABLE OF CONTENTS/OUTLINE

This exhibits aims to: Discuss the histology and multimodality imaging findings of typical, degenerated, histologically atypical and malignant uterine smooth muscle tumors. Discuss imaging and clinical findings which may help differentiate malignant from benign smooth muscle tumors (diffusion, enhancement, washout), as well as use of radiomics and spectroscopy. Describe the use of standardized reporting for uterine fibroids using FIGO classification. Highlight the role of imaging in preoperative assessment, including 3D printing in pre-treatment planning. Discuss the current role of uterine fibroid embolization and post-operative imaging monitoring, specifically the parameters for response assessment.

RIEE-51   CT-virtual Hysterosalpingography Normal And Pathologic Findings With Correlation With Other Diagnostic Modalities And Surgery

Participants
Patricia M. Carrascosa, MD, Buenos Aires City, Argentina (*Presenter*) Speakers Bureau, General Electric Company

TEACHING POINTS

CT virtual hysterosalpingography provides accurate and complete evaluation of the female reproductive system. • To be familiar with the normal anatomy and pathologic disorders on CT virtual hysterosalpingography studies. • To illustrate the typical imaging findings of different pathologies on CT virtual hysterosalpingography exams. • To correlate the CT virtual hysterosalpingography findings with other imaging modalities (US, MRI, X-ray HSG), hysteroscopy and surgery. • To be noticed of the advantages and limitations of the procedure.

TABLE OF CONTENTS/OUTLINE

• Description of the CT virtual hysterosalpingography procedure. Patient preparation. • CT scanner requirements. Description of CT image acquisition protocol. • The importance of the contrast injection protocol. • Image analyses, post-processing tools and image interpretation. Role of the endoluminal virtual views. • Spectrum of normal and pathologic fallopian tubes findings. • Correlation with other imaging modalities, such as US, MRI and X-ray HSG o Normal anatomy o Cervical stenosis o Uterine cavity and cervical canal synechiae o Uterine polyps o Uterine wall pathology (Myomas; adenomyosis) o Uterine malformations o Tubal pathology • Correlation with hysteroscopy and surgery o Uterine polyps and submucous myomas o Uterine cavity and cervical canal synechiae o Hydrosalpinx • Summary

RIEE-52   Uterine Leiomyoma A Resident Guide To Classify Typical And Not So Typical Fibroids

Participants
Mary Arevalo Molina, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To review leiomyoma appearance and classification system (FIGO).- To understand the different degeneration types and most common associated pathologies.- Provide an illustrative tutorial highlighting the utility of MRI to detect unusual uterine leiomyomas.- Understand the advantages of MRI as an important diagnostic test in uterine leiomyomas affection.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Indications3. Technique4. FIGO Classification5. Pictorial review common and unusual uterine leiomyomas6. Take home points7. References

RIEE-53   From Adhesions To Septa: Imaging Findings In Infertility And Impact On Management

Participants
Akshya Gupta, MD, Pittsford, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. There are a variety of underlying conditions that can impact fertility in women. Having an understanding of the associated imaging findings of ovarian, tubal, and uterine pathology is essential for the practicing radiologist.2. There are specific imaging findings that can impact the likelihood of success of assistive reproductive technology. These findings should be highlighted in the radiology report.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Overview of imaging techniques for the evaluation of the female reproductive tract including ultrasonography, sonohysterography, hysterosalpingography, and magnetic resonance imaging 3. Review of the typical clinical and imaging paradigm in the workup of infertility 4. Review of pathologies that can impact the management of infertility including: a. Endometrial polyp b. Endometrial adhesions c. Uterine fibroids d. Adenomyosis e. Endometriosis f. Hydrosalpinx/Tubal Occlusion g. Mullerian Anomalies 5. Briefly review potential complications of reproductive therapy including ovarian hyperstimulation 6. -Highlight future directions in imaging of infertility, such as imaging of uterine transplantation

RIEE-54   Practical Approach To Typical And Atypical Fibroids: A Primer For Radiologists.

Participants
Brenda Hernandes dos Santos Teixeira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1 - To improve the understanding of typical and atypical fibroids and their histological features. 2 - To review FIGO classification system of fibroids, emphasizing the relevant imaging characteristics that must be present in the report. 3 - Point out the advantages of the structured reporting of Magnetic Resonance Imaging (MRI) pelvis for &7;broids and its importance to clinical and surgical practice. 4 - To illustrate the main imaging methods to assess fibroids, such as Ultrasound (US) and MRI, and to highlight the importance of appropriate image acquisition protocols in MRI. 5 - To show the typical and atypical imaging characteristics of fibroids and how to differentiate them on MRI.

RIEE-55 Revisiting Endometrial Cancer: Review And Update

Participants
Joao Pedro Costa, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Briefly review the main histological subtypes of endometrial cancer and its implications on prognosis and managementDescribe the MRI protocol and diagnostic value of each sequence for tumor stagingRecognize the classic appearance of endometrial cancer on MRIPropose a systematic MRI evaluation to understand the landmarks in the FIGO staging classificationDiscuss the role of MRI to aid the decision of lymphadenectomy, fertility sparing surgery, lymph node sentinel approach and FDG PET/CT staging.

RIEE-56 Step By Step Evaluation Of The Risk Stratification In Benign Pathology According To The O-RADS Us Consensus. What Every Resident Should Know.

Participants
Estefania Gallego Diaz, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

The Ovarian-Adnexal Reporting and Data System US risk stratification and management system is designed to provide concrete interpretations, to decrease ambiguity in US reports, and to provide a management recommendation for each risk category.To explain the importance of O-RADS US and unify concepts used here. To Review benign categories, specifying precisely what should and should not be seen in benign pathologies and how to approach the possibility of malignant pathology.To present in a didactic way with diagrams and clinical cases the most relevant findings of the most frequent O-RADS US categories. (1to 3) To Simplify the evaluation of the ovary for residents. What every resident should know to accurately rule out benign pathology.

RIEE-57 Malignancy In Pregnancy: Multimodality Imaging And Treatment

Participants
Silvana C. Faria, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Cancer is the second most common cause of death in women of reproductive age. Cancer can be seen in 0.1% to 0.2% of pregnant women, affecting 1 in 1000 pregnancies. However, since women are delaying childbearing to the third and fourth decade of life, we are seeing an increase in cancer cases in pregnant women. The most commonly diagnosed malignancies during pregnancy include cervical cancer, breast, lymphoma, leukemia, melanoma, thyroid, colon and ovarian cancer. The imaging issues in pregnant women with cancer may be challenging. There are important considerations for the radiologist in the diagnosis and staging of malignancy during pregnancy. The diagnosis of cancer in pregnancy may be delayed due to mistaken attribution of symptoms to the pregnancy itself. Additionally, the effects of pregnancy on tumor biology and the potential deleterious effects of oncologic treatment in the fetus will be discussed. Imaging plays an important role in the diagnosis, staging, management and monitoring of treatment response of malignancy during pregnancy. Our aim is to review imaging features of malignancy in pregnant women with examples from US, CT, MRI and PET/CT images.

RIEE-58 Placenta Accreta Spectrum Imaging: Cardinal Signs, Pitfalls And Advances In Predicting Severe Invasive Disease

Participants
Inessa Goldman, MD, Bronx, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

To outline the cardinal imaging signs with best sensitivity and specificity to make diagnosis of placenta accreta spectrum disorder (PAS) on US and MRI.Illustrate common pitfalls encountered in imaging of PAS on US and MRI.Emphasize placental bulging sign (PBS) as the best sign that correlates with presence of severe PAS (s-PAS) (i.e. placenta increta and percreta).

1.List various imaging signs on US used to diagnose PAS.2. Cardinal imaging signs on US that show highest accuracy in predicting PAS and their pitfalls:a. Loss of clear zoneb.Myometrial thinningc. Abnormal lacunaed. Placental bulge sign - highest accuracy in predicting s-PAS. 3.Signs used to diagnose PAS on MRI with emphasis on cardinal features, such as a.heterogenous placenta; b.dark intraplacental bands c. PBS.d. abnormal subplacental vascularity. 4. Pitfalls on MRI including hemorrhage or thrombosed vessels; fibroids; contractions. 5. PBS has highest accuracy in predicting S-PAS both on US and MRI. 6. Briefly discuss high interobserver variability and its implications.

RIEE-59   Placenta Accreta: When Placenta Is Out Of Place

Participants
Carlos Riquelme, MD, Providencia, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.On MRI, the normal placenta appears homogeneous with intermediate signal intensity on T2-weighted image, including clear distinction from the underlying myometrium.2. Previous cesarean section and placenta previa are the two major risk factors for placenta accreta. 3.The MRI sequences for the diagnosis of placenta accreta includes: a.T2-SSFSE: information about anatomic detail, position, attachment and depth of placental invasion b.Balanced steady state gradient echo sequence or Fast Imaging Employing Steady state Acquision: anatomical assessment, vascularity and evaluation of adjacent structures. c.T1-weighted sequence: evaluation of hemorrhage d.Diffusion-weighted image: myometrial invasion3.- The most sensitive and specific MRI signs to evaluate invasive placentation are: a. Uterine bulging: includes placenta with lumpy contour and rounded edges b. Heterogeneous placental signal c. T2 dark intraplacental bands d. Focal gap in myometrium e. Bladder tenting.

TABLE OF CONTENTS/OUTLINE

1.Introduction2.Normal Placenation3.Placenta Accreta: a.Classification b.MR imaging protocols c.Normal MR imaging appeerence of placenta d.Imaging in placenta accreta vera e.Imaging in placenta incretaf.Imaging in placenta percreta4. Pearls and pitfalls5. Summary

RIEE-6   The Confounding Ultrasound Diagnosis Of Ectopic Pregnancy: Lessons Learned From Peer Learning

Awards
Certificate of Merit

Participants
Jung Yun, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand importance of accurate US diagnosis of ectopic pregnancy (EP) when medical therapy will be used, to avoid inadvertent treatment of a desired intrauterine pregnancy (IUP) 2. Differentiate tubal EP from a corpus luteum (CL) by echogenicity relative to ovarian parenchyma, push technique and claw sign 3. Distinguish interstitial EP from eccentrically located IUP (angular) 4. Use trophoblastic flow in abnormal intrauterine locations to help identify intrauterine EP in Cesarean scar or cervix 5. Recognize that hemoperitoneum without visualized EP may be due to EP or hemorrhagic cyst 6. Distinguishing an abortion in progress from a pregnancy of unknown location (PUL) may not always be possible and requires clinical follow-up

TABLE OF CONTENTS/OUTLINE

(I) Definitions with examples (A) PUL = "normal pelvic US" (B) Definitive tubal EP: yolk sac or embryo (1) Extrauterine tubal EP (2) Interstitial EP (C) Likely tubal EP (1) Tubal ring/bagel (2) Hematosalpinx/blob (D) Intrauterine EP (1) Cesarean scar (2) Cervical (E) Hemoperitoneum: amount, location (II) Diagnostic dilemmas (A) Tubal EP vs CL (1) Grayscale appearance (2) Color Doppler (3) Maneuvers (B) Normal IUP vs Intrauterine EP (1) Interstitial EP vs "angular" IUP (2) Cesarean scar or cervical EP vs abortion in progress (3) Tips (a) Coronal reformat (b) Trophoblastic flow (c) Gestational sac shape (d) Presence of embryonic cardiac activity (C) Hemoperitoneum (1) Ruptured EP vs hemorrhagic cyst (2) Heterotopic pregnancy (III) Other (A) Mullerian duct anomaly (B) Fibroids (C) Mirror image

RIEE-60   Mullerian Duct Anomalies: The Diagnosis Is In The Eye Of The Beholder.

Participants
Ana Villamizar, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Discuss the clinical relevance of Müllerian duct anomalies and the main classification used for its assessment (AFS and ESHRE)2. Recognize the performance of both classifications as a tool of particular value when imaging uterine anomalies.3. To evaluate the MRI findings in normal and abnormal uterus and anomalies associated.4. Illustrate classic examples of the different uterine variations.1. To teach about the Müllerian duct anomalies and the syndromes associated, how to describe and classify them through the review of our own cases.

TABLE OF CONTENTS/OUTLINE

1. Definition of normal embryology of the Mu¨llerian duct2. Description of the American and European classification of the Mu¨llerian duct anomalies3. Discussion of associated anomalies and syndromes with examples from our own cases.4. Conclusions

RIEE-61   Pitfalls Of Pregnancy: An Organ-system Review Of Non-obstetric Complications And Emergencies In The Pregnant Patient

Awards
Identified for RadioGraphics

Participants
Gayatri Joshi, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Assessment of the emergent pregnant patient can be challenging due to nonspecific presenting symptoms, altered anatomy,

physiologic aberrations in physical exam & laboratory findings, and magnified risk of poor outcome for clinically significant missed diagnoses.After completion of this exhibit, learners should: 1. Be familiar with the spectrum of non-obstetric complications and emergencies during pregnancy, with an understanding of differential considerations by organ system. 2. Differentiate between non-obstetric emergencies based on multimodal imaging & clinical features. 3. Proficiently facilitate optimized imaging workup for the pregnant patient based on clinically suspected diagnosis & ACR appropriateness guidelines.

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This exhibit will: 1. Review non-obstetric complications and emergencies of pregnancy by organ system. 2. Illustrate multimodal imaging findings and clinical features of each entity. 3. Discuss diagnostic pitfalls & methods for improving diagnostic accuracy in the setting of physiologically altered anatomy and physical exam during pregnancy. 4. Review ACR appropriateness criteria in the work-up of pregnant patients. 5. Briefly discuss management considerations, as applicable to the radiologist, to aid in appropriate direction of patient care.

RIEE-62-HC Uterine Niche; The Spectrum Of Findings On MRI

Participants
Roisin MacDermott, MBBCh,MRCS, Dublin 4, Ireland (*Presenter*) Nothing to Disclose

TEACHING POINTS

The number of caesarean sections preformed annually is increasing worldwide, leading to the growing recognition of the long term sequelae of this procedure. One such pathology which is of increasing interest is that of a uterine niche (diverticulum or isthmocele), defined as an indentation of the myometrium of at least 2mm in depth at the site of a CS scar. It is associated with a number of obstetric and gynaecological consequences including ectopic pregnancy, malplacentation and abnormal uterine bleeding. MRI is gaining popularity as an adjunct modality to US for the assessment of uterine niche and its secondary associations.The purpose of this exhibit is; 1)To summarise the prevalence and risk factors for development of Uterine Niche.2)To highlight the associated Gynaecological and Obstetric sequelae.3)To demonstrate the MR appearances of the uterine niche, from diagnosis to post operative appearances.4)To review management based on imaging findings

TABLE OF CONTENTS/OUTLINE

Introduction.Prevalence and Risk factors.Obstetric associations.Gynaecological associations. Management. MR Imaging appearances-Diagnosis,Complications,Post operative appearances.Take home points.

RIEE-63-HC Role Of Ultrasound In Partial Androgen Insensitivity Syndrome

Participants
Samvid Kotia JR, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.Ultrasound plays a major role in diagnosing various types of DSD (Disorders of Sex Development) by detecting the presence or absence of ovaries, testes, or ovotestis; as it presents as a socio-endocrinological emergency before sex is assigned to a neonate 2. The presence or absence of Mullerian structures helps in further sub-categorization. 3.Ultrasound and FNAC helps in the early detection of malignant changes in the gonads.

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1.Introduction-DSDs are disorders of sexual development with discordance between genotype, phenotype (external genital organs), and internal reproductive organs. PAIS is an XY type of DSD with defective androgen receptors. 2. Pathology- PAIS manifests as an X-linked recessive condition. Despite normal testosterone production, the active form of DHT is not detected due to defective androgen receptor formation leading to under-masculinized/ambiguous genitalia in the fetus. 3.Diagnosis-It is based on biochemical, karyotyping, and imaging correlation. On USG, there is absence of Mullerian structures (uterus, fallopian tubes), absence of ovaries with the presence of well-formed testes in the inguinal canal or the labia. The prostate and seminal vesicles are also absent. The distal 1/3rd of the vagina is present. Breast ultrasound helps in the detection of gynecomastia. Due to stimulation from LH; Leydig cell/Sertoli cells hyperplasia occurs which presents as a focal hypoechoic lesion near the rete testes. 4.Role of ultrasound in the diagnosis of malignancy

RIEE-7 Beyond Television Screens: An Update Of 3-d Ultrasound In The Evaluation Of The Female Pelvis

Participants
Marcela Lauar, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

3-Dimensional ultrasound has been gaining an ascending role in clinical evaluation, as it provides images in planes previously unavailable in 2-D ultrasound, allowing their users to not be limited by conventional planes.It has shown great potential in the evaluation of gynecological patients, providing a coronal view of the uterus, outlining its external contour and cavity. It is also a valuable tool in urogynecological translabial evaluation, since it clearly illustrates the relationship of the vagina, urethra, rectum, muscular pelvic floor, and even synthetic materials (slings), when present. As it provides accurate and in a cost effective setting, clinicians can have important benefits in improving their skills and adding 3-D ultrasound in their gynecological routine.

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Clinical and epidemiological aspects.A pictorial review of gynecological pathologies better evaluated with ultrasound 3-D reconstructions, and the technique used to obtain them, based on our service's digital archive of a range of different conditions (from the common ones to the rarest), correlated with 2-d ultrasound images, hysterosalpingography and magnetic resonance imaging (MRI), including adenomyosis, Mullerian anomalies, deep pelvic endometriosis, intrauterine dispositive dislocation, endometrial polyps, pelvic floor disorders, among others. Take-home messages.References.

RIEE-8 OBs SOS!

Participants
Marcela Lauar, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The main complaints by women in childbearing age in the emergency department are pelvic pain and vaginal bleeding. Combined with clinical evaluation, physical examination and laboratorial tests, imagingfindings can help lead to an assertive medical management. Among various radiology exams, sonography consists on the main imaging method to evaluate pelvic pathologies, such as vasa previa, placental abruption, placenta previa, ovarian torsion, pseudoaneurysm, retained products of conception, appendicitis, invasive mole, among others.

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A pictorial review of cases of emergency findings of woman in childbearing age based on our service's digital archive, in order to assist radiologists to recognize the various pathologies in the diagnosis of obstetric and gynecologic emergencies through the imaging findings, associated with the patients' clinical information.

RIEE-9   **Gynecologic Oncology Tumor Board: How The Radiologist Adds Value**

Participants
Hannah Recht, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The radiologist plays a key role at gynecology oncology tumor board.2. Advanced imaging provides additional information beyond the clinical examination, traditionally used for staging in gynecologic oncology.3. Disease specific imaging findings guide diagnosis and management in gynecologic oncology patients.

TABLE OF CONTENTS/OUTLINE

1. Introduction: Key role of the radiologist during gynecologic oncology tumor board discussions.2. Female pelvic anatomy and key surgical anatomic landmarks3. Ovarian cancera. Preoperative risk stratification of adnexal masses - US, MRI, and DE CTb. Staging: Assessment of disease extent and sites predisposing to suboptimal cytoreduction or necessitating neoadjuvant therapyc. Evaluation of tumor response; recommendation of biopsy site in recurrent diseased. Recurrence and extension of relapse4. Cervical cancera. Staging: MRI to assess extent of disease to determine hysterectomy vs. radiation treatment (RT); assessment for trachelectomy and fertility sparing; PET/CT for nodal and distant metastasesb. Evaluation of tumor response; follow up vs. salvage therapyc. Relapse and exenteration5. Endometrial cancera. Staging: Preoperative extent of diseasei. Myometrial invasion, nodal involvement, assessment for RTb. Recurrence: Assessment of size of vaginal cuff recurrence6. Special considerationsa. Vaginal and vulvar cancer stagingb. Uterine sarcomac. Primary tumor of unclear etiologyd. Pregnancy

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> **NPMEE**
>
> ## Noninterpretive Education Exhibits

Sub-Events

NPMEE-10 Management To Achieve Zero Non-action For SUFs

Participants
Tomoyuki Noguchi, MD, PhD, Fukuoka City, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

There are some serious cases in which the attending physician who ordered an imaging test such as CT or MRI did not check the radiological report thoroughly and left the patient without proper and timely practice, with serious consequences. The main reason for this malpractice is that the attending physician who requested the imaging examination is unaware of incidental and significant findings outside his/her area of interest. This incidental and significant finding was called "Significant Unexpected Findings (SUFs)" by the Royal College of Radiologists. Patients are the victims of untreated SUFs, and the mission of medical staffs is to take steps to save them by eliminating untreated SUFs. The purpose of this educational presentation is to introduce the measures for SUFs in the radiological reports at our institution and to publicize that we can achieve zero non-action on SUFs.

TABLE OF CONTENTS/OUTLINE

1. Frequency of SUF malpractice, 2. Pathology of SUF malpractice, 3. Responsibility for SUF malpractice, 4. Read acknowledgement system, 5. SUF alert system, and 6. Our fail-safe system for SUFERR (SUF Errors in Radiological Reports).

NPMEE-11 Digital Flashcards: A Silent Revolution in Medical Education

Awards
Certificate of Merit

Participants
Julie Adhya, DO, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

As technology advances, so too should the methods of education within medicine. Digital flashcards provide an effective and practical method of studying with proven long-term retention if properly utilized. Digitizing information allows for a lightweight, yet robust database with automated scheduling and universal accessibility.

TABLE OF CONTENTS/OUTLINE

1. Compare conventional versus digital flashcards.2. Provide a brief overview on how to make and use digital flashcards.3. Discuss the benefits and positive impact of digital flashcards on medical education for students and residents.

NPMEE-12 As COVID-19 Continues, What CT Intern Technicians Need To Know?

Participants
Hui Hao, Xi'an, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

What CT intern technicians need to know in the COVID-19 epidemic;What new technologies can help us in the COVID-19 epidemic;Focus on the innovation of teaching mode for intern CT technicians.

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What CT intern technicians need to know Identify three areas: contaminated, semi-contaminated, and clean areas; and two channels: staff and patient channels. Understand infection control principles: wear personal protective equipment and keep distance when possible. Clarify disinfection plans: floor and air in scanning room; machine surface; air, surface and contact items in operation room What can technology help Non-contact positioning: remote bed height adjustment, AI-assisted patient positioning High-resolution or dual-energy chest CT for more accurate diagnosis AI technology for rapid lesion detection and diagnosis Focus on the innovation of teaching mode for intern CT technicians Emphasize professional knowledge, be skillful and flexible in application Enhance standards and procedure training for handling public health emergencies Strengthen the standardized teaching and assessment of protection, infection control and disinfection Combine practice with drills to motivate students

NPMEE-13 Valuable In-Person Feedback Between Radiology Faculty And Trainees

Awards
Certificate of Merit

Participants
Charmi Vijapura, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review benefits of radiology faculty and trainee in-person feedback2. Discuss key components of effective two-way communication and in-person feedback3. Identify barriers and biases seen when providing in-person feedback4. Recommend possible interventions to improve faculty and trainee in-person feedback

TABLE OF CONTENTS/OUTLINE

• Background• Feedback methods• Components of effective feedback• Timeline during rotations• Feedback settings• Evaluation settings• Biases and special considerations• Barriers to communication• Interventiono Pre-intervention faculty assessmento Annual workshopo Educational lecture by in-house or external experto Role-play scenarios

NPMEE-14   RadDiscord, The Big Bang: A COVID-19 Era Digital Educational Platform

Participants
Grace Zhu, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. RadDiscord is a novel, pandemic-era, open-access digital educational platform available to the global radiology community. 2. RadDiscord has an impact on clinical radiology through transforming the education of radiology residents around the world and improving access to knowledge to radiologists.3. After reviewing this exhibit, the reader will understand the community's origins, growth trajectory, distribution of members, member recruitment process, and future directions.

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1. Introduction to RadDiscorda. Community's Origin2. RadDiscord's growth trajectory since inception on 10/10/20213. RadDiscord's distribution of membersa. Institutions representedb. Countries represented4. RadDiscord usage patterns by members (residents, fellows, faculty)5. RadDiscord's approach to educationa. Group study sessionsb. Faculty-led case based reviewsc. Faculty-led didacticsd. Live, interactive question and answer between faculty and traineese. Member created educational content6. Future directions7. How to get involved

NPMEE-15   Essential Ingredients For Building A High Performing Team

Awards
Identified for RadioGraphics

Participants
Jonathan Kruskal, PhD, MBChB, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

To deliver top quality imaging care to all patients, a well structured and effectively functioning cohesive team of caregivers is required. Team structure should be diverse and intentionally inclusive, and led by an inclusive, adaptive and participating leader. For the team to function effectively, members must be aware of personal implicit biases, should be culturally sensitive and humble, and must function as ally's and upstanders. Additionally, open bidirectional communication must exist, along with effective decision making processes, and wellbeing and safety must be prioritized. All roles and expectations are clearly defined, the vision and mission is well enunciated, and processes exist to manage conflicts when these arise. Team members are held accountable in a learning and improvement environment.

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Building blocks of a high performing teamHoe the pandemic has impacted each of the required components, The inclusive, adaptive, participatory, servant meta-leader, Implicit biases and stereotyping, Cultural awareness, sensitivity and humility, Micro-aggressions - examples and interventional response toolkit, Equality, equity and deconstructing systemic barriers, Wellness and professional fulfillment

NPMEE-16   Practical Applications Of Behavioral Economics Theories To Drive Radiology Based Population Health

Participants
Dayna Levin, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Behavioral economics and asymmetric paternalism can be utilized to improve the practice of radiology.Common decision heuristics can be leveraged to design interventions to support population health.Within radiology, designing incentives to nudge patients toward high value screening studies can improve population health.Behavioral based incentives including social comparison and choice architecture can be utilized to change ordering physician and radiologist practice.

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Define behavioral economics and understand its utility in modularizing patient and physician behaviors.Describe various decision errors that can be leveraged to optimize incentive design to change behaviors such as framing, status quo bias, loss aversion, overweighting small probabilities and present bias preferences.Discuss how interventions can be designed within radiology practices to nudge patients and ordering physicians toward appropriate utilization of high value imaging and decrease utilization of low value imaging.Choice architecture and defaultsOpt-in for low value imaging Pre schedule annual screening testsIncentives Rewarding adherence with clinical decision supportIncent usage of templated reporting with evidence based imaging follow-up.Social comparisonDashboard tracking of performance data Provide comparative data for clinical decision support ordering compliance

NPMEE-17   Alternative Payment Models: Overview, Remaining Questions, And Unmet Needs For Radiology Six Years Into The Medicare Access And Children's Health Insurance Program Reauthorization Act

Participants
Kayla Berigan, MD, Burlington, Vermont (*Presenter*) Nothing to Disclose

TEACHING POINTS

? Under the Medicare Access and CHIP Reauthorization Act (MACRA), value-based care legislation passed in 2015, providers may choose to participate in the Merit-Based Incentive Payment System (MIPS) or Alternative Payment Models (APMs).? APMs offer added financial incentive for quality and cost-effectiveness, and CMS is encouraging the transition to APMs as the next step in value-based care's evolution.? While quality metrics for Radiology exist under MIPS, the measurement of quality in Radiology under APMs and the resultant impact on reimbursement are less clear. ? The Vermont All Payer ACO, a first-of-its-kind APM developed in partnership with CMS, places Medicare, Medicaid, and commercial payers under one payment structure. Quality metrics under this and other APMs are pertinent mainly to Primary Care providers, and the development of metrics that demonstrate Radiology's impact on quality remains an unmet need.? Physician-Focused Payment Models (PFPMs), a subtype of APM, were thought to offer a promising pathway for specialist participation in APMs, but none of the proposed models have been approved by CMS. Thus far, there have been no proposed PFPMs for Radiology.

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I. Evolution of Value-Based Care II. Structure of MACRA and the QPP III. Structure of APMs IV. Vermont All Payer ACO: structure & metricsV. Relevance of APMs for Radiologists B. Physician-Focused Payment Models (PFPMs): a proposed pathway to APMs for specialists? C. Remaining questions and unmet needs

NPMEE-18 A Grassroots Approach To Forming A Diversity, Equity, And Inclusion Committee In An Academic Radiology Department: Early Successes And Lessons Learned

Awards
Identified for RadioGraphics

Participants
Sarah Averill, MD, Iowa City, Iowa (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Differences in institutional culture, population characteristics, and available resources require adaptive approaches to foster successful diversity, equity, and inclusion (DEI) initiatives.2. Collaborative and shared decision-making leadership models allow for intradepartmental communities to form organically and can create pathways for effective "bottom up" organizational change. 3. Voluntary participation as compared to mandatory participation can be an effective strategy for team building and for cultivating diversity champions in radiology departments with multiple different working groups.

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1) Learn about the formation and function of a DEI committee representing multiple working groups within an academic radiology department.2) Discuss collaborative leadership and committee management models, such as shared decision-making and self-determination theory, to facilitate change through intrinsic motivation and cultivation of diversity champions.3) Present committee initiatives such as development of a DEI-informed technologist recruitment plan and department-wide professional development series.4) Discuss strategies for using institutional resources and national DEI networks to develop educational programming.5) Present literature-based discussion of the issue of mandatory versus voluntary participation in anti-racism and implicit bias trainings.6) Review pitfalls, lessons learned, and next steps for education, department staff engagement, trainee recruitment.

NPMEE-19 Assessing The Impact Of Radiology Integration During Gross Anatomy Curriculum On Diversity In Medical Student Perceptions And Interest

Participants
Annelise Silva, MEd, Beavercreek, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Comprehensive surveys can lead to holistic assessment of how institutions are meeting radiology curricular benchmarks and identify areas for opportunity; specifically in support of students from underrepresented groups in medicine-Earlier radiology integration into curriculum can impact general student perception of radiology and as a career option-At institutions with/without integrated radiology curriculum in gross anatomy, first-year students responded that radiology education was "inadequate/very inadequate" & "much more teaching is needed"

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Background Despite 2014 recommendations made by the American College of Radiology (ACR), there remains no standard radiology instruction in US medical school curriculum. Recent prioritization of gender & racial diversity opens opportunities to examine student attitudes toward radiology in gross anatomy instruction as it relates to promoting more engagement in the field. Thus, this study seeks to assess gender and degree of radiology integration into gross anatomy curriculum as mediators of student attitude toward radiologyMethods Following education research committee & IRB approvals, 170 first year medical students from two US allopathic medical schools invited in retrospective self-reported survey on general attitudes toward radiology and its integration into gross anatomy curriculumResults Data for the survey was collected and extracted from Google Forms software & inputted into Microsoft Excel, followed by SPSS for final statistical analysis

NPMEE-20 Putting The "Culture" Back Into Just Culture: Engaging Radiology Departments In The Journey To Safer Care

Participants
Sarah Bastawrous, DO, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Define the just culture model and its role in radiology 2. Discuss importance of systems errors using real-life radiology department scenarios 3. Explore critical steps in the creation of a just culture model, to include peer learning 4. Discuss foundations of success for maintaining just culture that can improve communication and decision making skills

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1. Overview of origins of just culture across industries and impact on healthcare/medical errors 2. Individual versus organizational accountability and responsibility to systems improvement 3. Team training with real-life examples of error in radiology departments

4. Human behaviors and human reactions to error a. Define and provide examples of behaviors b. At risk behavior 5. Radiology leadership responsibilities: a. Education of learners b. Patient centered care c. Peer learning d. Prioritization of environments of learning, transparency and valuee. Basic faculty patient safety competencies 6. Second victim: a. Definition of second victim b. How to support the second victim 7. Maintenance of just culture in radiology a. Safety as department goal b. Encourage reporting c. Front line staff and solutions d. Establish process and policy 8. Conclusion

NPMEE-21 "How Do You Do In Clinic?" -- A Quick And Easy Guide On How To Calculate A Radiologist's Workload And Clinical Productivity

Participants
Timothy Waits, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Almost all radiologists want to know how they perform in clinic but not everyone knows how to calculate their clinical productivity.2. Radiologist's clinical productivity can be easily calculated with work Relative Value Units (wRVU) based on the CPT codes of common radiology exams/procedures and compared to the benchmarks.3. Knowledge of clinical productivity measurement and management can provide insights for radiologist's value and workload to benefit both radiology practice and individual radiologists.

TABLE OF CONTENTS/OUTLINE

1. wRVU: definition, utilization, and limitsA. Define the Relative Value Unit (RVU) and differentiate the three typesB. Explain how wRVU is limited by CPT codeC. Describe utilization of wRVU by administrators and radiologist for compensation and workload.2. Lists of CPT codes and wRVUs of major exams and procedures for radiology subspecialties (body, breast, Chest/Thoracic, MSK, Neuroradiology, Nuclear medicine, Pediatrics, and Interventional radiology).3. Discuss how to evaluate clinical productivity with wRVU and benchmarks.4. Using a case-based format, apply the above information to calculate daily wRVUs to monitor productivity and workload to meet the goals.

NPMEE-22 Resonant And Diverse Teams For Patient Centered Care

Participants
Mary Rachel Nute, BS, Davie, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

· Teamwork is a component of the patient centered care curriculum. Effective teams deliver clinical care, however are also critical in reorganizing departments to adapt to modern conditions and support staff wellness· Explain teams vs working groups· Describe team resonance and strategies for building emotional intelligence (EI) of groups· Understand the origins of Agile Leadership. Describe the central tenets, agile teams vs. conventional teams, and how to apply in medicine· Describe the benefits of diversity and inclusivity in teams, and strategies for an inclusive team culture

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Teamwork is key to an agile organization's response to changing care environmentsImpact on quality and safetyDemands of multidisciplinary careRedesign to refocus on patientsRSNA Patient Centered Care CurriculumDifferentiate working groups from teams. InterdependenceAccountabilityLeadershipWork productBarriers to teamwork in academic departmentsMission complexityMentalityOrganizational structureEI and team resonanceEmotional intelligence builds trust, identity and efficacyStrategies for building EI of groups. Creating norms around emotional awarenessAgile Leadership and TeamsOrigin and evolutionConventional Teams vs Agile TeamsCentral Tenets of Agile TeamsConditions favorable for Agile TeamsTeam Diversity and InclusivityBenefits of team diversityUnderstand equity vs. equalityIndividual engagement to pursue equity and inclusivityDiversity strategies overlap with Agile Leadership and Just Culture

NPMEE-23 Snowball Sampling On Social Media: Advantages And Methodology Of Using Twitter As A Survey Distribution Tool In Radiology

Participants
Andrea Harris, BA, Silver Spring, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

Snowball sampling is a statistical strategy to gather data in difficult to access populations such as alternative social groups, exclusive membership, and groups with health disparities. Aligning this technique with social media channels, such as Twitter, provide a cost-effective alternative to traditional survey distribution methods. This exhibit will provide a step-by-step explanation of the snowball sampling method, including: IRB approval, selection of initial respondents, key messaging points, troubleshooting steps, and collection of results. Review of current medical literature on traditional survey response vs. social media-based snowball sampling will provide context for the value of this method. We also present a case study on clinician ordering preferences for CT in COVID-19 management.

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Introduction to snowball sampling and respondent-driving samplingMethods for survey recruitment on social media, including selection of initial respondentsDemographics of Twitter users and respondents, including specialty and geographyRespondent results from case study on ordering of CT for COVID-19 managementBenefits and limitations of Twitter as a social media platform for snowball samplingComparison to alternative methods of survey distributionSummary and conclusions

NPMEE-24 Webinars For Continuous Medical Education During COVID-19: A Cross-sectional Survey Of Attendees' Perspectives

Participants
Kiran Hilal SR, MBBS, Karachi, Pakistan (*Presenter*) Nothing to Disclose

TEACHING POINTS

To assessed the accessibility, adaptability, and convenience of the medical profession through virtual learning.how effective was

virtual learning during the COVID-19 pandemic among medical professionals in Pakistan.To assess the major drawbacks of virtual learning and there solutions.Local survey to a new era of virtual learning how we can make it better.

TABLE OF CONTENTS/OUTLINE

Total 12 webinar-based CME sessions were conducted from the period between June to December 2020. The attendees of the online webinars consisted of radiologist/non-radiologist physician /radiology technicians. At the end of webinar feedback survey responses were recorded through online polling.The purpose of gathering feedback from the participants of CME activities was to gain insights on the acceptance for conducting such activities online, and how likely they are willing to participate in these activities in future.questions were designed in such a way to gather responses on non-traditional aspects affecting the life of medical professionals during the COVID 19 pandemic and how online education has gained popularity and feasibility in their new routine practices

NPMEE-25   An Interactive Web-based Radiology Career Awareness Program Design For School ; Undergraduate Career Labs.

Participants
ANANYA SINGH, Land OLakes, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

The exhibit:1. Systematically explains, design of proposed interactive web-based tool for promoting radiology awareness in school/college career lab programs and its fusion with existing tools2. Provides valuable take-away points for radiology professionals in various roles; parents, educators, students, health policy/practice professionals & leaders

TABLE OF CONTENTS/OUTLINE

1. Introduction of existing tools to determine career cluster focus in school & college career labs & limitations.2. Proposed introductory healthcare & radiology modules & fun-quiz at elementary /middle school level:a. Module 2a: Great American teach-in programs: Proposed web-based tool to enhance parental participation from radiology profession b. Module 2b: Introduction to radiology career hybrids with other profession & fun-quiz: Career fusion with Army, community health, business, global health3. Raising awareness in high school/college:a. Module-specific design for understanding common diseases, radiology & global healthcare. b. Resolving new career conflicts in high school: dedicated module-based interactive education of hybrid radiology career fusions: biostatistics, government & policy, community service, Mathematics, genetics/molecular biology, law, business c. Introduction to clinical radiology, radiology physics, workflow, technologist education, research, policy/practice d. Module integration with career labs & certification: Likerts psychometric scale, pre & post test performance on 5 point scale, didactic quiz

NPMEE-26   A Virtual Reality: Developing A Mock Virtual Interview Program For Residency Applicants

Participants
Jesse Conyers, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Interviews are a key component of the residency application process. 2. Practice virtual interviews can help applicants prepare for the unique social and technical challenges for residency interviews. 3. Implementing an international, free mock interview system can increase residency applicants' confidence with video conference interviewing and help applicants develop connections in radiology.

TABLE OF CONTENTS/OUTLINE

BackgroundDesign and implementation:Recruiting volunteer interviewersScheduling interview time slots based on interviewer availabilityDeveloping an online scheduling system and booking pageLinking online appointments to video conference softwareApplicant sign-up processCommunicationFeedback using pre and post-interview surveysConclusion

NPMEE-27   Communication Tools Returning Our Focus To Patient Centered Care: Principles, Blind-spots, Structured Communication And Checklists

Participants
Mary Rachel Nute, BS, Davie, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

· Discuss the importance of communication. Recognize it as a component of the RSNA patient centered care curriculum, as well as a leading source of error leading to medical harm· Understand our strengths and weaknesses communicating as radiologists· Develop proficiency in two commonly used tools for structured communication (SBAR and AIDET)· Consider the use of checklists in medicine, and identify opportunities for use in Radiology

TABLE OF CONTENTS/OUTLINE

· Effective and evolved communication is a central tenet of Patient Centered Care, however cultural and institutional obstacles exist· Conveyance vs. Convergence as arenas of communication· Our stakeholders and the value communication adds to our practice· Ineffective communication is the leading cause of medical error? Four types of communication failures Examples of litigation, legislation and regulations born from radiology communication failures· Seven principles for effective communication· Two standardized tools for structured communication to know? AIDET is widely used for all types of patient encounters and favored by hospital administrators? SBAR, adapted from workflow on nuclear submarines, organizes critical time-sensitive situational communication· Checklists are innovative tools to bring an individual or group to common focus? Combats human tendency to drift from best practices, promoting efficiency and safety? Five characteristics of a good checklist? Example checklists for use in your practice and a group exercise for trainee or professional development

NPMEE-28   Elements Of Style For Radiologists - Grammar, Syntax, And Style Tips For A Well-written Radiology Report

Participants
Hailey Choi, MD, San Francisco, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

By viewing this educational exhibit, the reader will be able to: Recognize the importance of effective writing in producing radiology reports, in the era of increasing health care transparencySuccessfully communicate salient points for a radiology report in simple English languageAvoid common mistakes in grammar and syntax

TABLE OF CONTENTS/OUTLINE

BackgroundIncreasing attention on radiology reports with recent drive for information un-blocking (21st Century Cures Act) A well-written, error-free radiology report provides vital information for patients and providers, increases radiologist's credibility, and showcases his/her expertiseGrammar and syntaxSubject-verb agreementDouble negativesModifying gerunds ("improved diminishing")Split infinitivesStyle and compositionUse active voice: put topic as the subject and action as the verbKeep to one tensePut statements in positive formClarityAim for precisionWord choiceBrevity: write short information-rich sentencesEmphasize what is importantErrors to avoidRun-on sentenceWordiness and inflation (constitutes, represents, exists, serves, facilitates)JargonDangling modifier"T" (tea) party (unclear ineffective pronouns, this, that, these, those, there)AbbreviationsConclusions in the findings or repetition of findings in the impressionCase examples

NPMEE-29   Incorporating Diagnostic Imaging Into Undergraduate Medical Education: A Guide For Educators.

Awards
Cum Laude

Participants
Francisco Garrido Cisterna, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Integration is the organization of teaching matter to interrelate or unify subjects frequently taught in separate academic courses or departments. 2. There are several strategies for integrating radiology into undergraduate curricula, from isolated courses to transdisciplinary programs. 3. The incorporation of radiology in the undergraduate allows to show its role as a member of the interprofessional health team. 4. The learning objectives to be developed in undergraduate medical training include the indication of imaging studies according to the clinical scenario and the recognition of typical patterns of frequent diseases.

TABLE OF CONTENTS/OUTLINE

1. Introduction 1.1. Current status 1.2. Why radiology is important in undergraduate medical education?2. Integration strategies in the curriculum 2.1. Harden's steps on the integration ladder 2.2. Curriculum integration in radiology3. What to teach? 3.1. Learning objectives and the local and national needs assessments 3.2. Radiology in the international outcome frameworks for undergraduate medical education 3.3. Recommendations from leading scientific societies in radiology4. How to teach? 4.1. Traditional methodologies 4.2. Using technology: mobile apps and simulated workstations5. How to assess?6. Summary

NPMEE-3   The Radiology Patient Experience: Key Concepts And Strategies To Maximize Success

Awards
Certificate of Merit

Participants
Miltiadis Tembelis, Mineola, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The patient experience has become an increasingly recognized and important component of quality measures.2. It is important to understand and appreciate what patients may experience during their time in the radiology department and interventional radiology suite.3. Embracing key concepts involving the patient experience can help radiologists build stronger relationships with patients, provide excellent care, and be committed to maximizing patient centered care, patient engagement, and patient satisfaction.4. Effective communication, interest in the patient's agenda, empathy, and patient involvement in care are central to the patient experience and are often included on questionnaires to patients regarding their experience.

TABLE OF CONTENTS/OUTLINE

-Define "the patient experience"-Describe how this relates to diagnostic and interventional radiology-Share how the patient experience is evaluated-Highlight key concepts regarding the patient experience and holistic care from the available medical literature, specific to diagnostic and interventional radiology-Suggest strategies for and directions of future discussions, engagements, and innovations in the patient experience

NPMEE-30   Ergonomics In The Radiology Workplace

Participants
Anand Rajan, MD, Columbus, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Occupational repetitive stress injuries are very common and can be debilitating for a Radiologist. Most radiologists spend more than 8 hours per day at the computer and are at increased risk for repetitive stress injuries.2. Repetitive stress injuries are occupational overuse syndromes that result from repetitive motions and sustained awkward movements. These include carpal tunnel syndrome, ulnar neuritis, upper extremity tenosynovitis, gluteal tendinitis, neck and back pain.3. Optimizing your radiology workstation will reduce the risk of repetitive stress injuries.4. Radiology workplace ergonomics continues to be an area of interest for Radiologists. Familiarity with the latest literature and recommendations can improve your practice.

TABLE OF CONTENTS/OUTLINE

1. Background - Review current literature regarding prevalence of musculoskeletal injuries affecting Radiologists.2. Review the most common occupational repetitive stress injuries affecting radiologists.3. Recommendations for Desk and Seating - How to make adjustments for optimal comfort at the workstation. Includes basic tutorial on how to adjust an ergonomic chair (knobology).4. Recommendations for Monitor Displays - Setup options for efficiency, neck comfort, and reduce eye strain.5. Recommendations for Office Equipment - Examples of commonly available office equipment that you are using now and how to use them ergonomically.6.

Recommendations on when to take breaks, standing, and looking away from the monitor.7. Summary of Recommendations8. References

NPMEE-32   Why Has AI Not Replaced Radiologists?

Participants
Anurima Patra, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

Using case study examples from our AI program, we will drive the following teaching points•AI is at the peak of inflated expectations•Major barriers for clinical grade AI include lack of large datasets, quality gaps in public datasets and the 'black-box' nature of AI methods•Imaging AI has to follow the paradigm "first, do no harm". Bias elimination is critical to avoid perpetuation of existing disparities and inspire trust in stakeholders•Domain expertise of radiologists is essential to define use cases, data curation and annotation, interpretation of results and lifecycle management of AI models•Although imaging AI has strong business potential, a cascade of payment reforms are needed for commercially viable AI solutions

TABLE OF CONTENTS/OUTLINE

•Hype around imaging AI: Doomsday predictions from AI experts•Impact of ImageNet on computer vision research•Complexity of imaging vs tasks in ImageNet•AI development pipeline?Case study: AI for automated volumetric pancreas segmentation on CT•Barriers for clinical grade AI?Lack of annotated datasets•Case study: Novel approaches for creating annotated datasets?Quality gaps in imaging datasets on the Cancer Imaging Archive (TCIA) •Case study: Pancreas cancer imaging datasets on TCIA ?Trust & Transparency: Foundations for imaging AI?Unique risks of bias in imaging AI•Measures to mitigate unintended consequences•Business of imaging AI? Patents, mergers & acquisitions, investments? Challenges of current payment models? Blueprint of reforms to promote imaging AI on a commercial scale

NPMEE-33   From Peer Review To Peer Learning: Lessons Learned From Successful Implementation

Participants
James H. Birkholz, MD, Lebanon, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Provide examples of obstacles encountered during the creation of a Peer to Peer Learning process (P2PL) at our institution. 2) Discuss specific solutions utilized in the successful creation of our P2PL, including existing PACS options, cloud based PACS case anonymisation and survey creation, virtual meetings. 3) Discussion of our current P2PL process flow, including the case dissemination and group review.

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1) Obstacles Encountered During Creation of a P2P Process 2) Case Collection & Anonymisation 3) Survey Creation & Case Dissemination 4) Case Review & Discussion 5) Departmental & Divisional Support (Continuing Medical Education credit & Funding)

NPMEE-34   Community-Based Participatory Research (CBPR): A Practical Guide For Radiologists

Awards
Identified for RadioGraphics

Participants
Arissa Milton, BS, Madison, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Traditional research approaches have neither engaged the interests of communities nor addressed health disparities adequately.- CBPR:o Collaborative process that recognizes unique strengths and equitably involves all partners in the research process.o Begins with a research topic important to the communityo Combines civic engagement with expertise from scientists and the community to catalyze social and policy change to improve health.

TABLE OF CONTENTS/OUTLINE

1. Rationale for CBPR approacha. Gaps in current researchb. History of abuse and mistrust of researchersc. Decreased rate of knowledge translation between research activities and community adoption of evidence-based practices2. CBPR Guidea. Basicsi. Definitionii. Principlesiii. Exemplarsb. Establish a Partnershipi. Find community collaboratorsii. Build and maintain relationshipsiii. Utilize strengths and resourcesc. Identify a Questioni. PICO formatii. Based on importance/relevance to the communityd. Execute Research with Collaboratorse. Translate Resultsi. Collaborative nature creates a more holistic and authentic framework for translationii. Advocate for social change benefiting the communityiii. Inform evidence-based interventions3. Applications for Radiologya. Cancer Screeningb. Barriers to Imaging Technologiesc. Engagement and Recruitment of Participants

NPMEE-35   Establishing An Institutional Women In Radiology Group: A Toolkit From The American Association For Women In Radiology

Awards
Certificate of Merit

Participants
Sarah Kamel, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Despite increasing representation in medical schools and surgical specialties, recruitment of women into radiology has been stagnant. Furthermore, women in academic radiology are less likely to be promoted to full professorship or leadership roles. A robust support system from women in radiology groups has been shown to produce numerous benefits: develop mentorship, guide career trajectory, improve camaraderie and increase awareness of gender-specific issues, to name a few. The aim of this presentation is to describe a pathway to establishing a women in radiology group at the institution level with the goal of promoting the advancement of women in radiology. Teaching points: 1) Women in radiology groups are necessary to foster mentorship, promote

leadership, recruitment, and advancement of women in radiology.2) Anyone at any stage of their career can accomplish creation of a women in radiology group using the framework and tools provided here. 3) Formally structured groups with departmental support are strongly encouraged to maintain the success, outreach, and longevity of the group.

TABLE OF CONTENTS/OUTLINE

1) Evidence in support of women in radiology groups and the potential benefits. 2) Pathway to establishing a women in radiology group: a) determine level of collaboration desired. b) initial planning and member recruitment. c) determining group goals and structure. d) acquiring institutional support. e) barriers to implementation. 3) Recommended resources for a women in radiology group. 4) Data regarding experiences of others.

NPMEE-36   A Review Of Diversity In Radiology

Participants
Jerome Watts JR, Silver Spring, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

A lack of diversity exists in the field of Radiology. Ongoing studies are addressing this disparity in a variety of ways.

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We reviewed the lack of diversity in radiology in the United States and how future studies and initiatives can begin to address this gap. We used a review of the literature targeting articles addressing five themes: 1) recruitment, 2) exposure 3) policy and regulation, 4) levels of diversity, and 5) trainee and faculty perception of diversity. We found that this lack of diversity is multifactorial, including biases within policies and committees at medical institutions, a lack of role models and early exposure to radiology, and missed opportunities to secure the interest of underrepresented in medicine (URM) in radiology. We summarized recommendations from eight studies that obtained the insight of specific populations, such as medical students, women, and URM faculty on matters of diversity as well as factors that influence their specialty choice via surveys. However, not many studies surveyed URM trainees on these matters. To address this gap, future studies may want to use surveys in collaboration with medical institutions with diverse pools of students, such as historically black colleges/universities, to inquire about their perspectives and use this to improve recruitment and retention of said students.

NPMEE-37   Technological Tools In Neuroradiology Online Education. How To Engage Medical Students For Online Neuroradiology Classes?

Participants
Juliana Duarte, Porto Alegre, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

-The improvement action offered aims to present practical elements for the use of resources from the virtual learning environment in neuroradiology made available by the University to teachers.-Use of free technological tools aims at greater interaction with students.

TABLE OF CONTENTS/OUTLINE

The teaching material with links to videos explaining all the tools was available since beginning of training. Hyperlinks in presentation files are great resources. The training structure included the presentation of the features of the Academic Moodle, other web conferencing rooms such as Teams, Elos and GMeet and technological tools based on the practical experience of the teacher responsible for the training. The shared technological tools included: Padlet, Kahoot, Mentimeter, Screencastify, Mural, Google Drive, WhatsApp, Telegram and Plickers. Moodle resources are the functionalities that the teacher can make available to the student. The main ones are: Archive; Book; Page; Folder; Label; URL. Moodle activities are the functionalities that promote interaction and interactivity with the student through the delivery and performance of activities. The main ones are: Daily; Choice; Forum; Glossary; Evaluation Laboratory; Research; Quiz; Assignment; and web conferencing rooms. It is possible to chain them together, that is, to perform a task the student must complete another one beforehand. In this way the student follows a path in his learning process. Final remarks.

NPMEE-38   Lessons Learned: What I Learned In Training That I Wish I Had Paid Attention To.

Participants
Krishna Mundada, MBBS,MBBS, mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit categorizes and highlights the errors I wish I should have paid attention to in my training and possible solutions to these errors.Online portals for reports collection resulted in radiology reports being scrutinized by patients and relatives. This poses a challenge when radiologists are cross-questioned in a setting involving incomplete patient knowledge. This exhibit introduces steps to face such dilemmas and highlights the relevant soft skills.Updating one's skills and knowledge using an understanding of relevant research, to be more up-to-date is important in the current pandemic.A spectrum of disorders associated with the infection have emerged. It is important to have knowledge of both statistically and insignificant associations, for knowing etiology and mitigating diagnostic dilemmas.COVID-19 has overburdened many specialties, including radiology. This exhibit discusses ways to alleviate workplace frustration and promote radiology wellness.

TABLE OF CONTENTS/OUTLINE

Evidence Based PracticeSystem Based PracticePractice Based LearningLearning Conceptual Evidence Pyramids and its approachApplications of Evidence Based Practice during COVID 19Patient Centric RadiologyPatient communicationEducation of Patient and FamilyManagement of Patient AnxietyAssuring patients of interdepartmental communicationErrors in Radio-DiagnosisTypes of ErrorsCause of ErrorsPotential solutions to errors.Radiologist BurnoutBurnout during residencyCauses of BurnoutWays to mitigate burnout

NPMEE-39   Real-time Streaming Virtual Reality Video Feeds For Socially Distanced Radiology Education

Participants

Peter J. Haar, MD, PhD, Richmond, Virginia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Real-time streaming VR video feeds present panoramic, stereoscopic visual and auditory information that is experienced with a head-mounted display to provide a vivid and immersive first-person learning experience, as the instruction is taking place. The teaching points of this exhibit include the following: first, to provide an overview of VR and streaming video feeds; second, to describe methods of creating remote streaming VR learning experiences; and third, to explore potential benefits of real-time VR feeds compared to traditional methods of instruction.

TABLE OF CONTENTS/OUTLINE

1) Overview of the vivid, three-dimensional simulated environment of VR. 2) Description of the advantages and limitations of first-person perspective real-time VR video feeds. 3) Equipment and resources necessary to develop real-time VR training experiences. 4) Designing the experience, room and camera set-up, and technical issues. 5) Potential benefits of streaming VR feeds in radiology education. 6) Early feedback from residents on the effectiveness of real-time streaming VR educational experiences.

NPMEE-4   Are You Ready!! Finance Basics For Trainees For Their First Job

Awards
Certificate of Merit

Participants
Achint K. Singh, MD, San Antonio, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Physicians get extensive training in their respective medical field but there is no training in the finances - To learn basics of finances related to debt management, budgeting and investing- To learn the core principles of investing

TABLE OF CONTENTS/OUTLINE

This presentation will be organized in the following mannerA) Debt ManagementB) BudgetingC) Investing- Basics of investing- Retirement accounts- Taxable accounts

NPMEE-41   Programming Knowledge For The Radiology Resident: A Tool To Improve The Workflow

Participants
Henrique Lino, MD, Sau Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiology and computers are intrinsically related. The recognition of basic patterns of programming logic may help to develop scripts and simple software to help on regular tasks. Script languages as AutoHotkey can prototype custom applications helping to develop structured reports, macros, and text expansion.

TABLE OF CONTENTS/OUTLINE

Introduction: Computers are now an intrinsic tool for the radiologist. Understand programming help to improve its use, save time and organize the workflow. Objectives: (1) to review the use of programming in radiology. (2) to review sample codes in AutoHotkey to help with radiology workflow and structured reports. Methods: We provide same samples and comment our codes to work as reference for radiology residents. Discussion: The base syntax of programming languages is easy to learn and with some hours the resident may develop applications to save larger amounts of time. Dictionary of useful terms in programming: basic terms to understand reference texts. Conclusion: An organized and efficient workflow as well time saving features are always a benefit for the resident.

NPMEE-42   Equity Diversity And Inclusion In Canadian Radiology

Awards
Certificate of Merit

Participants
Kiana Lebel, Montreal, Quebec (*Presenter*) Nothing to Disclose

TEACHING POINTS

Diversity in medicine is associated with numerous benefits for the health care system and patients Women are underrepresented in Canadian Radiology There is no data regarding ethnic diversity or indigenous representation in Canadian Radiology Actionable strategies exists to promote and increase diversity in Canadian Radiology Leadership commitment is required to increase diversity in Canadian Radiology, with the ultimate goal of improving patient care

TABLE OF CONTENTS/OUTLINE

1.Value of diversity in medicine and Radiology Demonstrated benefits of diversity in medicine and industry, including innovation, empathy and improved patient outcomes 2. Gender diversity in Canadian Radiology Gender disparity is decreasing in medicine but persistent in Canadian RadiologyPaucity of women in Canadian Radiology leadership Paucity of women in Canadian Radiology academia Gender pay gap in Canadian radiology3. Ethnic diversity in Canadian Radiology2015 Canadian Truth and Reconciliation Commission report called for increased indigenous healthcare workers However, there is currently no data on ethnic diversity or indigenous representation in Canadian Radiology 4. Strategies to improve diversity in Canadian Radiology: National/International level Institutional levelDepartmental/Practice levelIndividual level

NPMEE-43   Clinical Oncology Module For The ESTRO Core Curriculum

Participants
Yannick Eller, MD, Bern, Switzerland (*Presenter*) Nothing to Disclose

TEACHING POINTS

B: Clinical oncologists are physicians with the competencies to manage cancer patients through the entire disease pathway combining the competencies of radiation and medical oncologists. The 4th edition of the European Society for Radiotherapy and Oncology Core Curriculum for Radiation Oncology/Radiotherapy has received wide support by the clinical oncology community. The aim was to develop a clinical oncology module that could be combined with the ESTRO curriculum to enable clinical oncology trainees to follow a single curriculum.M: A range of stakeholders including National Society representatives, an oncologist from a low- middleincome country, and a recently appointed specialist, developed and commented on iterations of the curriculum. Further modifications were made by the ESTRO Education Council.

TABLE OF CONTENTS/OUTLINE

R: The module is based on the CanMEDS 2015 framework and identifies 20 enabling competencies in the Medical Expert role that are required in addition to the ESTRO curriculum for the training of clinical oncologists. Recommendations are made for the levels of Entrustable Professional Activities (EPAs) to be attained by the end of training.D: The Clinical Oncology module, when combined with the ESTRO curriculum, covers the entire cancer pathway rather than being modality specific. It is hoped it will aid in the development of comparable standards of training in clinical oncology across Europe and may also have utility in low- and middleincome countries as well as providing a single curriculum for trainees.

NPMEE-44 Entrepreneurship 101: A Primer To Start-up's And New Ventures

Participants
Aman Saini, DO, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Radiologists and interventional radiologists are increasingly becoming involved in new ventures and start-up's.2. Knowledge of the basics of establishing a team, patent licensing, business plan, seed round and Series A funding is essential for a successful start-up.3. Creating an effective pitch deck is essential to securing funding and mentorship early on.4. Everything begins and ends with the patent; what a great patent should include.

TABLE OF CONTENTS/OUTLINE

Business plan 1. Executive summary2. Company and business model—vision, mission, structure. 3. Market conditions-industry analysis, definition of target market, trends, competitive analysis (SWOT)4. Product/service explanation—current problem, proposed product/solution, competitive advantage, intellectual property. 5. Management and operations roles—well rounded team, diverse backgrounds, strengths, and experience. Good mentorship. 6. Marketing and sales—marketing, sales strategy, growth, distribution7. Financial plan with costs (fixed and variable), funding, revenue projections8. Funding: seed/angel investing, accelerator, SBA loan, crowdfunding, venture capital 9. Legal structure—sole proprietorship, partnership, LLC, corporation Pitch Deck: Selling your idea and company to potential investors.

NPMEE-45 Beyond Black And White: Launching A Multitiered Equity, Diversity, And Inclusion Initiative At A Large Academic Radiology Department

Participants
Ramesh S. Iyer, MD, Sammamish, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Disparities and inequities in healthcare are pervasive.2. A multi-pronged departmental approach is necessary to address gaps in equity and diversity in radiology.3. Coordinating lectures by subject experts is integral to such an initiative, but is only one component.4. Harmonizing with broader institutional efforts is beneficial.5. Regularly "spotlighting" non-physician personnel at faculty meetings may foster a culture of inclusivity and flatten hierarchies.6. Outreach programs at local schools may generate interest in science and technology and foster mentorship opportunities between radiologists and young people in the community.

TABLE OF CONTENTS/OUTLINE

1. Review our departmental experience in creating an EDI committee comprised of four subcommittees focused on education, recruitment, recognition, and building a pipeline.2. Describe efforts to establish an educational curriculum for physicians and staff that includes both invited speakers and online EDI modules.3. Convey our experience with recruiting underrepresented minority students, trainees, faculty, and staff to our department.4. List strategies for ensuring a less biased candidate selection and interview process for recruitment efforts.5. Describe how structured mentoring initiatives can improve faculty retention including EDI faculty.6. Share methods of highlighting EDI efforts of radiology team members.7. Highlight community outreach efforts that introduce young people to radiology and foster interest in science and technology.

NPMEE-5 Injury Prevention: Ergonomic Considerations For Mammography Technologists

Participants
Dana Smetherman, MD, MPH, New Orleans, Louisiana (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Widespread adoption of digital mammography has resulted in changes in workload and job activities of mammography technologists, including shorter appointments and higher exam volumes.2. As a result, mammography technologists may spend more of their work day engaged in repetitive movements of patient positioning and image acquisition, with less variability in work activities than in the past.3. This evolution could put mammography technologists at risk for repetitive stress and other overuse injuries.4. Department leadership partnered with physical therapy to conduct an ergonomic assessment of the breast imaging department.5. Short and long term measures were implemented to improve technologist body mechanics and work environment.

TABLE OF CONTENTS/OUTLINE

I. Review of job dutiesII. Assessment of physical environmentIII. Risk factor identification (OSHA W-1 Basic Screening Tool)IV. RULA Employee Worksheet Assessment Tool scoreV. Mammographic positioningA. PostureB. Height discrepancy between technologist and patientVI. Placement of other devicesA. Wall paddle storage unitsB. PrintersC. TelephonesD. Computer monitorsE. WorkstationsVII. Other considerationsA. Anti-fatigue floor mats B. Non-adjustable workstation heightsC. Overmount push buttons for exposure without foot pedalsVIII. Review of mitigation measures to reduce potential for musculoskeletal injury

NPMEE-6　Delivering Informed And Inclusive Imaging Care To Transgender Patients

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Crysta Iv Kyrazis, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Transgender persons experience a high prevalence of adverse health outcomes, with 28% postponing necessary medical care due to fears of discrimination.2. Educating healthcare providers about terminology and disparities faced by transgender people has been shown to improve patient experience and comfort with seeking care.3. Radiologists are important providers of healthcare and should be aware of these issues, as well as relevant imaging features.

TABLE OF CONTENTS/OUTLINE

1. Introduction a. Terminology b. Appropriate use of language: Correct use of names and pronouns, avoiding gendered assumptions, defining offensive or intrusive language2. Barriers to healthcare among transgender individuals a. Stigmatization and discrimination b. Access to healthcare and insurance c. Changes to screening protocols in primary care3. Improving inclusivity in a radiology department (as supported by the ACR) a. Etiquette b. Provider education (e.g., Respectful imaging acquisition, trauma informed approach to care) c. Environment (e.g., "Women's" imaging, all-gender restrooms and dressing rooms, gowns) d. Electronic medical record: Gendered language in documentation e. Institutional4. Imaging review of gender affirming surgeries, particularly genital reconstruction a. Pre-operative surgical planning b. Post-operative appearance and complications5. Conclusion

NPMEE-7　Transition From Peer Review To Peer Learning: Lessons Learned.

Participants
Sirus Saeedipour, DO, Olathe, Kansas (*Presenter*) Nothing to Disclose

TEACHING POINTS

One of the most common causes of radiology misses is an error in perceptionPeer learning embraces errors as opportunities to increase engagement and educationChallenges are expected when transitioning from traditional peer review to peer learning, which present as opportunities for improvement

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MOTIVATIONLimitations of Peer ReviewHistorically, a system to meet hospital and regulatory requirementsInconsistent selection of cases with inherent problems (e.g., low inter-reader reliability, skewed miss rates due to disease prevalence, etc)Environment of defensiveness and feelings of being "singled out"Benefits of Peer LearningFocus on the group, not the individualHelps identify system issuesLearning for all (e.g., inclusion of residents during conference)No scoring systemCases selected based on value-add that will improve diagnostic accuracySatisfies hospital licensure and reg. requirementsTRANSITIONING TO PEER LEARNINGProcessEach division accumulates cases in rolling 1-4 month periodsIdeal learning opportunities selected by section QI liaison who:Reviews submitted case with reporting radiologist; Selects cases for peer learning conferencePeer Learning Conference LayoutLearning OpportunitiesBiasClassificationsPerceptionInterpretationTechnical FactorsReportingCommunicatingRadiologist RecommendationsGreat Calls ChallengesLegal considerationsChallenges with case miningAccountability by each sectionLessons learned with example cases and classification

NPMEE-8　Equality, Equity, Disparity: Why Radiology Community Should Care?

Participants
Kheng L. Lim, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to expose the radiology community to the research done in the social sciences highlighting the consequences of extreme disparity and the reasons we should care. We will take a closer look through the lens of social science literature and present research-based evidence. This exhibit will explore the issue of extreme inequality and disparity and how these factors affect our health and wellbeing.

TABLE OF CONTENTS/OUTLINE

Explain the concept of equality and equity. Explore the social determinants of health. One of the five domains is access to quality healthcare. Present the reasons why we should promote equity. Review the literature showing correlation of violent crime and poverty, and correlation of increased risky behavior with perceived inequality. Illustrate the "sense of fairness" through the lens of primate research. Present facts of unequal rise in the household incomes of lower class, middle class, and upper class over the past five decades in the USA. Explain the Gini coefficient as a measure of inequality in a distribution. Show the linear correlation of income inequality and index of health and social problems among developed countries. Compare age-adjusted mortality in poor versus rich zip codes in the USA. Present the "Great Gatsby curve" which counters the ideals of the American dream. Reveal the unconscious biases we may subject ourselves to as we climb the rungs of the social ladder.

NPMEE-9　How We Got Here: A Review Of Anti-Black Discrimination And Inequities In Radiology

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Julia Goldberg, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: 1. Review a timeline of systemic anti-Black discrimination in medicine, focusing on biased practices in diagnostic radiology during its inception in the early 1900s. 2. Recognize pioneering Black radiologists who advanced scholarship,

patient care, and diversity within medicine and radiology. 3. Acknowledge where we are as a field today with regards to workforce diversity and racial healthcare disparities. 4. Identify opportunities for anti-racism work within the field of radiology today.

TABLE OF CONTENTS/OUTLINE

1. Background of institutional racism within the field of medicine in the late 19th to early 20th centuries. 2. Early radiology organizations' involvement with structural discrimination. 3. Pioneering Black radiologists and their work to advance the field of radiology. 4. Effects of discrimination on radiology-delivered patient care and healthcare disparities. 5. Current challenges and opportunities to address racial bias within radiology.

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Abstract Archives of the RSNA, 2021

Sub-Events

CHEE-1   Multimodality Imaging Of Pathologic Conditions Involving Extrapleural And Paravertebral Compartments

Participants
Daniel Rodriguez-Vargas, MD, Huelva, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Recognition of each mediastinal compartment and its contents is important since facilitates differential diagnosis on imaging examinations and avoids misdiagnosis of normal structures as pathologic conditions. Furthermore, recognition of the extrapleural space, which is often overlooked on cross-sectional imaging, may also avoid inadequate management of certain entities that might appear herein. After viewing this presentation, participants will be able to recognize boundaries between prevascular, visceral, paravertebral and extrapleural compartments and their normal contents, following the latest ITMIG classification and identify post-traumatic, neoplastic and miscellaneous conditions in extrapleural and paravertebral spaces.

TABLE OF CONTENTS/OUTLINE

1.CT images and anatomic diagrams of mediastinal and extrapleural spaces and their contents (diagrams remain original design from the authors) 2.*Review of pathologic conditions 2.1. Extrapleural hematoma 2.2. Ewing and Ewing-like sarcomas 2.3. Neurogenic tumors 2.3.1. NST: schwannoma, neurofibroma, plexiform neurofibroma and MPNST 2.3.2. Neurogenic neoplasms of the autonomic ganglia 2.4. Extranodal lymphoma 2.5. Solitary fibrous tumor 2.6. Extramedullary hematopoiesis. *Each condition exposed is accompanied by at least one radiologic case and explanatory diagrams whose design remains original work from the authors, noting the most important epidemiologic and radiologic features within a table entitled "red flags" 3. Conclusion 4. Acknowledgement

CHEE-10   AEF And/or CPFE? That Is The Question

Participants
Carlos Suevos, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To clarify the multiple synonyms the entity Airspace Enlargement with Fibrosis (AEF) has been given lately in order to differentiate it from the Combined Pulmonary Fibrosis and Emphysema (CPFE) syndrome• To learn the pathophysiology underlying AEF and CPFE, so as to understand their radiological translation in Chest Computed Tomography scans• To recognize, when possible, the distinctive radiological characteristics among AEF and CPFE in order to ensure a correct treatment and detect complications in follow-up in the latter

TABLE OF CONTENTS/OUTLINE

1. Nomenclature: confusing terminology. 2. Pathology. 3. CT Findings. 4. Differential Diagnoses. 5. Conclusion

CHEE-102   Dynamic Chest X-ray Using A Flat-panel Detector System: An Update

Participants
Takuya Hino, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Dynamic X-ray (DXR) with a flat-panel detector has unique features such as high temporal resolution, simple examination in standing position. DXR can provide sequential images and can help to represent or identify continuous change of lung and thorax. Previous studies have reported that DXR has the efficacy in visualizing the temporal change of translucency of lung fields. This technique is also applied to pulmonary ventilation and circulation. Recently, dynamic motion of thorax, diaphragm and lung visualized by DXR are also drawing attention. This exhibition shows the update of DXR with the latest findings, including lung field planimetry, pulmonary circulation, and motion analysis.

TABLE OF CONTENTS/OUTLINE

1. Dynamic diaphragm motion by DXR2. Ventilation map by DXR3. Perfusion map by DXR4. Projected lung area (PLA) and its temporal change by DXR5. Vector field dynamic X-ray (VF-DXR) in bilateral lung field

CHEE-104   Posterior Mediastinum Diagnostic Approach

Participants
Valentina Escandar, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review Mediastinal Compartments Division and posterior mediastinal relevant anatomy.2. Recognize important features and signs in Chest X-Ray that indicates we are dealing with a posterior mediastinal mass.3. Approach to the posterior mediastinal lesions based on their anatomic origin.4. Identify the main imaging features of posterior mediastinal lesions and relationship with neighboring structures that can provide a definite diagnostic information.

TABLE OF CONTENTS/OUTLINE

1. Introduction. a. International Thymic Malignancy Interest Group (ITMIG) classification. 2. Important features and signs in Chest X-Rays for localizing posterior mediastinal lesions. 3. Schematic classification of the posterior mediastinal lesions according to their anatomic origin.4. Main imaging features and helpful diagnostic clues for common and uncommon posterior mediastinal masses.5. Conclusions.

CHEE-105   A Thoracic Radiologist's Guide To Identification And Management Of Mammary Findings On Chest Ct

Participants
Toma Omofoye, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

To understand: 1. The appearance of characterizable benign and malignant mammary findings on Chest CT 2. Chest CT appearances and evolution of the post-treatment breast 3. Categorize management recommendations for thoracic radiologists encountering CT breast abnormalities.

TABLE OF CONTENTS/OUTLINE

Based on cases at a tertiary oncologic referral center, a review of CT findings with multimodality correlation (mammography/ultrasound/MRI/pathology). Including: • Benign appearances (cystic disease, oil cysts, macro vs microcalcification, fibroadenomas) • Malignant appearances (primary breast cancer, invasive ductal, metastases, etc) • Post cosmetic augmentation (breast implants/expanders variants) - normal/abnormal evolution (ruptures, anaplastic lymphoma, silicone granulomatosis) • Post breast cancer surgery (resection variations) • Autologous tissue flap variants evolution/complications (e.g. fat necrosis, recurrence) • Other procedures (localization devices, breast management options, direct silicone injections, etc) • Inflammatory breast cancer and mimics (infection, radiation, fibromatosis) • Age related breast density, HRT, systemic disease. • Indeterminate findings • Specific best recommendations for further imaging/management • Reporting tips to improve breast imaging correlation • Role of the thoracic radiologist

CHEE-107   High Attenuation Pulmonary Opacities And Calcifications: A Case-based Review

Participants
Murilo Peixoto, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

There are a number of clinical scenarios that can lead to the appearance of high-attenuation pulmonary opacities and calcifications, most of which associated with the deposition of calcium, such as in infectious and non-infectious granulomatous conditions; or other high attenuation substances from medical treatment or occupational and recreational exposure like amiodarone, iron, mercury, barium and talc.Though there are distinctive clinical informations that can help differentiate these conditions, the patient's past medical data and history of exposure to substances are not always readily available. The aim of this exhibit is to explore the conditions that can present with high-attenuation pulmonary opacities and calcifications on chest computed tomography with emphasis on their distinctive imaging features through a case-based review.

TABLE OF CONTENTS/OUTLINE

1. Series of cases illustrating conditions that feature high-attenuation pulmonary opacities and calcifications on chest CT.2. Discussion of their distinctive characteristics, which can be helpful to differentiate these conditions when clinical information is not available, and provide a rationale for proposing possible differential diagnoses.3. Take-home messages.4. References.

CHEE-108   Here We Go Again: Anatomic And Pathologic Causes Of Recurrent Pulmonary Infections

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Michael Harowicz, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Review the potential etiologies and pathophysiology of recurrent pneumonia2) Identify the imaging characteristics of these anatomic variants, congenital and pathologic disorders3) Discuss radiologic features that affect prognosis and determine optimal management

TABLE OF CONTENTS/OUTLINE

Tracheobronchial anatomic variants tracheal diverticulum and diverticulosis, cardiac bronchus,Congenital disorders: scimitar syndrome, proximal interruption of pulmonary artery, intralobar and extralobar sequestrationEsophageal disorders: achalasia, scleroderma-associated esophageal dysmotilityImmunodeficiency: Good syndrome, common variable immunodeficiency, cystic fibrosisOthers: atypical mycobacterial infection, right middle lobe syndromeClinical considerations: clinical algorithm for determining the appropriate treatment based on patient presentation, microbiology, and imaging findings; imaging findings that are associated with morbidity/mortality

CHEE-109   Portable Chest Radiology: Pearls And Pitfalls

Participants
Max American, MD, Fairfield, California (*Presenter*) Nothing to Disclose

1. Describe different pitfalls and misses in portable chest radiology.2. Discuss multiple categories of different pathology entities in the chest.3. Demonstrate various cases and examples of portable chest radiographs.4. Develop plans, strategies and patterns to avoid pitfalls and misses.

TABLE OF CONTENTS/OUTLINE

Introduction- Portable chest radiology- Pitfalls and missesCategories and Cases- Lines, tubes and devices: Examples- Airways, lungs and pleura: Examples- Heart and mediastinum: Examples- Bones, soft tissues and upper abdomen: Examples- Other entities: ExamplesPlan- Strategies to avoid pitfalls and misses- Proposed Patterns

CHEE-11   Role Of Radiology In Addressing The Challenge Of Lung Cancer After Lung Transplantation.

Participants
Francis Delaney, MD, Dublin, Ireland (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Primary lung cancer is an increasingly recognised complication of lung transplant and may become an important survival-limiting factor with growing use of extended-criteria donors and improved management of other complications. • Radiologists have a key role to play in tackling this issue at multiple stages in the transplantation pathway. • Pulmonary nodules are commonly identified in lung transplant patients, have a spectrum of etiologies which varies depending on time since transplant and cannot be managed according to standard clinical guidelines. • Pre-transplant recipient CT detects suspicious lung nodules. Chest CT also forms part of the donor assessment for smokers in some centres and similarly identifies suspicious lung lesions as well as structural lung disease that increases the risk of developing cancer in the allograft. • Criteria for lung cancer screening in high-risk patients have recently been expanded. Based on the risk of lung cancer after transplant, evidence from single studies and extrapolation of findings from lung cancer screening trials, the role of regular follow-up chest CT after lung transplant is now under consideration and has been adopted in some institutions with a focus on single lung transplant recipients and cases with a donor smoking history.

TABLE OF CONTENTS/OUTLINE

1. Current Trends in Lung Transplantation 2. Pulmonary Nodules in Transplant Patients - Etiology and Management 3. Primary Lung Cancer after Lung Transplant 4. Pre-transplant Assessment 5. Post-transplant Screening - What is the Evidence?

CHEE-110   Seeing Through Ground - Glass Opacities: A Survival Guide For General Radiologists.

Participants
David Castanedo SR, MD, Santander, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the main imaging features of the wide range of diseases that radiologically present with Ground - Glass Opacities. 2. To provide a diagnostic approach of Ground - Glass Opacities in different clinical scenarios.3. To focus on the diagnostic pearls that enable a correct diagnosis. 4. To study other patterns in which Ground- Glass Opacities appear: crazy - paving and mosaic patterns.

TABLE OF CONTENTS/OUTLINE

1. Definition and Etiology of Ground - Glass Opacities (GGO). 2. Classification of GGO. 3. Diffuse GGO and acute dyspnea. 3.1. Cardiogenic pulmonary edema. 3.2. Permeability pulmonary edema with diffuse alveolar damage. 3.3. Alveolar hemorrhage. 4. Diffuse GGO and chronic dyspnea. 4.1. Non-specific interstitial pneumonia (NINE). 4.2. Desquamative interstitial pneumonia. 4.3. Lymphocytic interstitial pneumonia. 4.4. Radiation pneumonitis. 5. Diffuse GGO in immunocompromised patients. 5.1. Pneumocystis pneumonia. 5.2. Viral pneumonias. 6. Centrolobulillar GGO. 6.1. Aspiration. 6.2. Hypersensitivity pneumonitis. 6.3. Respiratory bronchiolitis. 7. Crazy paving pattern. 8. Mosaic pattern. 9. Conclusion. 10. References.

CHEE-111   A Pictorial Roadmap Of Thoracic Manifestations Of Tuberculous And Non-tuberculous Mycobacterial Infection

Participants
Alberto Paternain, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To describe the typical and less common imaging manifestations of pulmonary tuberculosis (TB). - To illustrate the different radiologic patterns of non-tuberculous mycobacteria (NTM) lung infection.

TABLE OF CONTENTS/OUTLINE

- Tuberculous and non-tuberculous mycobacteria. Classification.A. Pulmonary tuberculosis: prevalence, transmission, infection and disease.- Radiological manifestations of pulmonary tuberculosis: primary tuberculosis (mediastinal lymphadenopathy), pulmonary consolidations, pleural effusion. - Radiological manifestations of post-primary tuberculosis: cavitation, endobronchial spread.- Tuberculosis in the immunocompromised patients: miliary tuberculosis.- Uncommon findings of thoracic tuberculosis: chronic empyema, bronchiolithiasis, Rasmussen aneurysm, aspergilloma, pericarditis.- Latent and inactive tuberculosis: Ghon focus and Ranke complex, cicatrization atelectasis, traction bronchiectasis, apical pleural thickening, peribronchial fibrosis. B. Non-tuberculous mycobacteria: species and characteristics.- Cavitary form (classic form): Middle-aged men, smokers. - Bronchiectatic form (non-classic form): white and elderly women. Cylindrical bronchiectasis in the middle lobe or lingula, with centrilobular nodules in a "tree in bud" pattern(bronchiectatic-nodular form)- Immunocompromised patients: disseminated disease: lymphadenopathy and small opacities and pulmonary nodules.- Nodular form.- Patient with deglutition problems.- Hypersensitivity form.

CHEE-112   Attention Mechanism And Weakly Supervised Learning Solve Complicated Problems: Principles And Application To IIP Classification

Participants
Nonoko Takeuchi, RT,MS, Toyoake, Japan (*Presenter*) Nothing to Disclose

In order to develop deep learning model for medical images, it is necessary to provide correct label to the input images. However, it is sometimes difficult even for experts to correctly label unclear disease such as interstitial lung disease. Therefore, weakly supervised learning is a method to solve this problem. In addition, it is known that the attention mechanism, which has received much focus in recent years, can dramatically improve the accuracy. The purpose of this exhibit is to show the principle of the weakly supervised learning method using the attention mechanism and an example of its application to the classification of idiopathic interstitial pneumonias (IIP).The major teaching points of this exhibit are:1. It's very important and difficult for medical AI to prepare the accurate labels.2. Weakly supervised learning solves the issue.3. Attention mechanism boost up the classification performance.4. Attention based weakly supervised learning classify IIP pattern with high accuracy.

TABLE OF CONTENTS/OUTLINE

1. Data issue for medical AI development2. Principle of weakly supervised learning: Multiple instance learning3. Attention based multiple instance learning4. Application for classification of IIP patterns in CT images

CHEE-113 Airway And Parenchymal Respiratory Papillomatosis With Malignant Transformation

Participants
Meng Hao, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Respiratory papillomatosis is caused by infection with HPV and often manifests as nodular lesions most commonly in the laryngeal and subglottic region, but can extend into the lower respiratory tract and lung parenchyma. 2. Although rare, there is a risk for malignant transformation into squamous cell carcinoma. 3. Findings associated with malignant transformation such as increased size of pulmonary nodule/mass or development of cystic features.

TABLE OF CONTENTS/OUTLINE

Respiratory papillomatosis is an infection caused by the human papillomavirus and most frequently localized to the laryngeal and subglottic region. However, in approximately 5%, and fewer than 1% of respiratory papillomatosis involve the trachea and pulmonary parenchyma. Among those with pulmonary parenchymal involvement, the risk for malignant transformation is cited to be 2-3%. This exhibit will present cases and review imaging findings of respiratory papillomatosis involving the trachea and pulmonary parenchyma. We will also present the CT and FDG PET/CT imaging findings of patients with biopsy proven malignant transformation to squamous cell carcinoma. We will provide bronchoscopy and pathology imaging correlates. While malignant transformation of respiratory papillomatosis is a rare entity, it is important to recognize these imaging features to prompt early biopsy and treatment planning.

CHEE-116 How To Interpret Esophageal Cancer MR For Practical Use In Oncologic Decision Making

Participants
Rohee Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To discuss the issues and role of the radiologist in oncologic decision making for esophageal cancer 2. To recognize the optimal MRI protocol indicated for tumor staging of esophageal cancer 3. To illustrate imaging features of esophageal cancer on dynamic contrast-enhanced MR in each stage

TABLE OF CONTENTS/OUTLINE

I. Introduction A. Epidemiology of esophageal cancer B. Diagnosis - pros and cons of different imaging modalities and advantage of MR for evaluation of esophageal cancer C. Treatment D. The role of the radiologist in the oncologic multidisciplinary teamII. MRI scanning protocol A. T2-weighted image B. Diffusion-weighted image C. Dynamic contrast-enhanced T1-weighted imageIII. Structure of esophagus - normal anatomyIV. Esophageal cancer staging using MR: correlation with endoscopic findings A. T1 B. T2 C. T3 D. T4V. Esophageal MR for evaluation of treatment responseVI. Summary

CHEE-117 Deep Learning Reconstruction In Chest CT - Issues Considered From The Dose Reduction And Image Quality In Clinical Cases -

Participants
Hiroshi Moriya, MD, Fukushima, Japan (*Presenter*) Advisor, NantWorks LLCResearch Grant, Canon Medical Systems Corporation

TEACHING POINTS

1. Various noise reduction processing technologies2. Deep learning reconstruction (DLR)3. Lung CT images using AiCE lung (Techniques tuned for lung images)4. Mediastinal CT image using AiCE body and body-sharp (Techniques tuned for abdominal images)5. Radiation dose and image quality on chest CT6. Relationship between radiation dose and image quality reduction effect using DLR

TABLE OF CONTENTS/OUTLINE

Noise reduction technology for X-ray CT such as MBIR and DLR is evolving. This technology is used for low-dose imaging such as lung cancer CT screening. The DLR includes training with low quality datasets and tunes how to generate high quality images from low quality images while maintaining signal and spatial resolution. As a result, under the current imaging conditions of 1 mSv to 2 mSv for lung cancer screening, good noise reduction was obtained with the technology tuned for lung CT and abdominal CT. However, the noise reduction effect was not sufficiently obtained with ultra-low dose CT (0.1 mSv to 0.2 mSv), and processing that increased noise was also observed. In some cases, abdominal DLR was better than lung DLR. To optimize the noise reduction process, it is necessary to tune the training data to include the ultra-low dose CT datasets.

CHEE-118 Test Yourself!: A Case-based Quiz On Interstitial Lung Disease

Participants
Ana Gandara, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

- Identify through a series of image-based cases the different interstitial lung diseases.- Emphasize the accurate description of each morphologic pattern.- Recognize the different clinical features that help categorize each entity. - This exhibit will help residents and radiologist reinforce the radiological and clinical characteristics of the interstitial lung diseases, keeping in mind that interdisciplinary consensus remains the gold standard for the diagnosis.

TABLE OF CONTENTS/OUTLINE

The cases will be presented in a quiz format with 4 answer options. The list of cases includes but is not limited to:- Idiopathic interstitial pneumonias-- Usual interstitial pneumonia -- Nonspecific interstitial pneumonia-- Cryptogenic organizing pneumonia-- Respiratory bronchiolitis - interstitial lung disease-- Desquamative interstitial pneumonia-- Lymphoid interstitial pneumonia-- Acute interstitial pneumonia- Combined pulmonary fibrosis and emphysema- Anti-Jo-1 antibody positive interstitial lung disease- Lymphangitis carcinomatosis- Langerhans cell histiocytosis

CHEE-119   Putting The Pieces Together: A Clinical-based Imaging Approach For The Diagnostic Challenge Of HIV-associated Opportunistic Pneumonias

Participants
Maria G. Gracia Munoz, MD, Tlalpan, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

The diagnosis of pulmonary infections is an everyday challenge for the radiologist; in immunocompromised patients, the difficulty is increased by the wide variety of possible etiologies. By integrating the imaging findings with the clinical and laboratory information available, we increase the certainty of our diagnoses and we can better guide the referring physicians in the complex management of these patients. The teaching points of this exhibit are: to describe the epidemiology of HIV infection and the morbidity and mortality of opportunistic pneumonias in immunocompromised patients, to identify an appropriate imaging approach for opportunistic pneumonias by adjusting the ACR Appropriatness Criteria and by implementing strategies for CT radiation dose optimization, to ilustrate the high-resolution CT patterns associated with opportunistic pneumonias, outlining the importance of clinicalinformation and CD4-cell count and to describe the treatment and prevention strategies of HIV-associated opportunisticpneumonias.

TABLE OF CONTENTS/OUTLINE

Facts about HIV infection and opportunistic pneumoniasRecomendations and CT protocols for chest imaging in immunocompromised patientsHigh resolution CT findings in opportunistic pneumoniasTreatmentPrevention

CHEE-12   "Forgotten Third Circulation": Rediscovering The Thoracic Lymphatic System

Participants
Manoel Felipe Cavalcanti, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Review the anatomy, embryology, and physiology of the thoracic lymphatic system.- Discuss about the current view of lymphangiogenesis, the identification of new lymphatic markers and its role in diseases like lung cancer and metastasis.- Demonstrate the main imaging techniques available for the evaluation of the lymphatic system.- Describe through illustrative cases common and uncommon lymphatic diseases in the chest.

TABLE OF CONTENTS/OUTLINE

1- Introduction.2 - Anatomy and physiology of the lymphatic system.3 - Imaging techniques and protocols for the study of the thoracic lymphatic system.4 - Imaging review of thoracic lymphatic diseases and diseases with a lymphatic distribution: lymphocele, lymphangioma, lymphangioleiomyomatosis, sarcoidosis, Kaposi sarcoma, pulmonary lymphoma, among others.

CHEE-120   The Traumatic And Non-traumatic Tracheal Disease

Participants
Ana Villamizar, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To provide the radiologist the knowledge with the knowledge tools to recognize the normal anatomy and to help to create a mental map of the non-traumatic and traumatic pathologies that affect the trachea.2. Propose a classification that facilitates the recognition of non-traumatic pathologies involving the trachea3. To describe the abnormal CT findings of the different traumatic and non-traumatic pathologies. 4. Expose main scenarios with a checklist, to provide an easy form of evaluating the trachea.

TABLE OF CONTENTS/OUTLINE

1. Anatomy of the trachea2. Main Tracheal Traumatic Injuries. 3. Classification of the Tracheal Disease. 4. Practical approach to dealing with tracheal disorders; checklist5. Conclusions

CHEE-121   Looking For A Sign?: A Case-based Quiz Of Classic Signs And Patterns Of Lung Infections

Participants
Gustavo Alonzo Correa I, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

To describe the imaging appearance of classic signs and patterns of pulmonary infections.To explain the pathophysiologic basis of classic signs and patterns of pulmonary infections.To discuss the differential diagnosis of classic signs and patterns of pulmonary infections.

TABLE OF CONTENTS/OUTLINE

IntroductionConsolidation and air bronchogramFeeding vessel signHalo signReverse halo signAir crescent signFinger in glove signSplit pleura signAir fluid levelMiliary patternTree in bud patternCrazy paving patternLobar pneumoniaBronchopneumoniaInterstitial

pneumoniaConclusions

CHEE-122-HC   Nonaortic Mediastinal Emergencies: What The Radiologist Needs To Know

Participants
Mikel Jauregui Garcia, Galdacano, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

CT is the modality of choice for evaluation of mediastinal emergencies. In esophageal emergencies, like intramural dissection or complete perforation (Boerhaave syndrome), a CT with both intravenous contrast and oral contrast will help us to make the correct diagnosis. When we see an abscess on deep neck spaces which spreads to retropharyngeal space, we should extend our study to the chest in order to rule out mediastinitis. Patients with COVID-19 pneumonia seems to have more prevalence of pneumomediastinum when undergoing invasive mechanical ventilation.

TABLE OF CONTENTS/OUTLINE

The group of nonaortic mediastinal emergencies includes a variety of entities that will be, many of the times, life-threatening. These pathologies, as they are not very common, and clinically may be nonspecific, are often not easy to diagnose. There will be different pathophysiologic etiologies, as internal trauma, infection, malignancy or conditions secondary to invasive procedures. We review the different esophageal injuries we can find, as esophageal dissection, perforation or fistulas between the esophagus and the respiratory tract. Acute mediastinitis, remembering its different foci and routes of dissemination, is another important pathology. It seems that COVID-19 infection has impact on mediastinum too, leading to some conditions as pneumomediastinum or bronchopleural fistulas. The correct and timely diagnosis of all these entities will be crucial for an accurate and optimal management of them.

CHEE-123-HC   Mechanism Of AIs In COVID-19 CAD And Techniques To Improve AI Performance

Participants
Masahiro Oda, PhD, Nagoya, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of our exhibit are:1. To learn how AIs in COVID-19 CAD system understand and diagnose chest CT images2. To learn lung diseases that COVID-19 AI commonly misdiagnoses3. To learn how to improve recognition performance of COVID-19 AI

TABLE OF CONTENTS/OUTLINE

COVID-19 CAD- Demand of COVID-19 CAD for chest CT images- Its mechanismAIs used in COVID-19 CAD- Segmentation AI: segment lung normal, ground-glass opacity, consolidation, pleural effusion regions from CT images- Diagnosis AI: classify CT images into diagnosis resultLung diseases that AI misdiagnoses as COVID-19 cases- Organized pneumonia, bacterial pneumonia, lung cancer- Why they are misdiagnosedTechniques to improve AI recognition performance- CT image preprocessing: multiple window level/center image and multiple resolution image generations to capture shadows in lung, lung anatomical structure-aware data augmentation- AI models: lung local and global spatial feature extraction model by dense pooling and dilated convolution, aggregation of estimation results by multiple AI models to improve accuracy- Learning method of AIs: unsupervised learning that reduces manual annotation cost for AI training- Postprocessing: geometrical feature-based false positive reductionContribution of COVID-19 CAD to radiologist- Provide rapid diagnosis result- Quantitative analysis of lung condition- Reduce misdiagnosis

CHEE-124   The Radiographic Findings Of NTM Lung Disease

Participants
John Baek, Daegu, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

To present the epidemiology and clinical presentation of nontuberculous mycobacterial (NTM) pulmonary infections in endemic areas. To illustrate different imaging presentation of pulmonary NTM in patients with or without comorbidities and other conditions. To discuss the clinical and imaging clues that can help narrow down the differential diagnosis

TABLE OF CONTENTS/OUTLINE

Epidemiology and pathophysiology of NTM lung disease The classical pattern of NTM lung disease: fibrocavitary and nodular bronchiectatic forms Radiographic findings of NTM lung disease in the patients with or without comorbid disease, such as chronic obstructive pulmonary disease, prior tuberculosis, idiopathic interstitial pneumonia, and bronchiectasis. Several nodules or masses in asymptomatic patients A solitary nodule or mass in asymptomatic patients Hot tub lung Rare radiologic findings: disseminated and endobronchial NTM Summary

CHEE-13   Imaging Of Vascular Complications After Lung Transplantation

Participants
Arzu Canan, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Although vascular complications are rare after lung transplantation, they are associated with high mortality and morbidity.Differentiation of expected post-surgical appearance of vasculature from vascular complications is essential for early diagnosis and management of complications.Knowledge of expected post-surgical changes on imaging is also pivotal for avoiding unnecessary interventions and treatments.

TABLE OF CONTENTS/OUTLINE

1. Indications for lung transplant. 2. Surgical technique. 3. Expected post-surgical appearance of vasculature on CT. a. CT protocols (chest CT, chest CTA and gated chest/cardiac CTA). 4. Post-transplant complications. a. Stenosis of anastomosis site; Types, mechanisms and imaging findings on CT. i. Pulmonary artery stenosis ii. Pulmonary vein stenosis. b. Pulmonary embolism. 5. Other imaging modalities for diagnosis; invasive angiography, magnetic resonance angiography. 6. Treatment. 7. References. 8. Conclusion

CHEE-14   No Signs of Stopping: Remembering All The Chest CT Signs, With Radiopathologic Correlation

Participants
Fumiko Yagi, MD, Shinjuku-ku, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Understanding lung anatomy that radiologists need to know for chest CT imaging.(2) Understanding the CT imaging findings, differential diagnoses, and correlations between CT and pathology for each characteristic CT sign.

TABLE OF CONTENTS/OUTLINE

I. IntroductionII. AnatomyIII. Parenchymal signs-Halo sign-Reversed halo sign (atoll sign)-Air crescent sign-Meniscus sign-Mosaic attenuation pattern-Three-density pattern (headcheese sign)-Crazy-paving appearance-Galaxy sign-Comet tail sign-Popcorn calcification-Melting ice cube signIV. Airway signs-Air bronchogram sign-Signet ring sign, string of pearls sign, tram line sign-Tree-in-bud sign-Gloved finger sign-Frown sign-Saber-sheath tracheaV. Vascular signs-CT angiogram sign-Feeding vessel sign-Polo mint sign-Scimitar signVI. Pleural signs- Split pleura sign

CHEE-15   Common Blind Spots Of Chest Radiography And How To Avoid Them

Participants
Cato Chan, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Common "blind spots" on chest radiographs include the apices, retrocardiac space, osseous pathology, subdiagphramatic space, hilar pathology, faint airspace opacities, expiratory radiographs. Examples of such and basic strategies to mitigate these pitfalls are reviewed in this exhibit.

TABLE OF CONTENTS/OUTLINE

1. Introduction (Prevalence, Indications) 2. Causes of misses on Chest Radiographs (Scanning, Recognition, Decision-making, Technical limitation) 3. List of common chest radiograph "blind spots" 4. Example cases and potential strategies a. Rib and Retrocardiac Opacities (Bone Suppression, Angulation, Dual Energy Radiographs) b. Apical Opacities (Window and level, Lordotic View) c. Apical Lucencies (Positioning) d. Rib fractures (Sharpening) e. Lytic Bone lesions f. Subdiagphramatic Opacities (Correlation with prior Abdomen imaging) g. Hilar opacities (Correlation with prior Cardiac imaging) h. Faint airspace opacities (Computer aided detection) i. Expiratory Radiograph 5. Technical limitations of Chest Radiography 6. Discussion 7. Conclusion

CHEE-16   Chest CT Imaging: From Classical CT Signs To Up-To-Date CT Features

Participants
Masahiro Yanagawa, MD, PhD, Suita, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The morphological diagnosis using CT images is very useful and important for diagnosing pulmonary diseases. Especially, high resolution CT is indispensable for diagnoses. High-spatial-resolution (HSR) CT is a recently developed device which may provide more detailed information for lung anatomy and disease states by clearly delineating CT findings. This education exhibit focuses on classical CT signs of conventional CT and novel features of HSR CT. It is much appreciated if our information would be useful in your clinical and research setting.

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1. The definition and clinical significance of classical CT signs and patterns for differential diagnoses: air crescent sign, angiogram sign, beaded septum sign, comet tail sign, crazy-paving appearance, feeding vessel sign, galaxy sign, gloved finger sign, halo sign, mosaic attenuation pattern, pitfall sign, reversed halo sign, signet ring sign, split pleura sign, and tree-in-bud pattern. 2. About high-spatial-resolution (HSR) CT: 1) equipment performance, 2) image quality, and 3) usefulness and future directions in thoracic imaging. 3. Diagnostic performance of HSR CT for lung cancer in clinical cases: 1) prediction for the invasiveness of lung adenocarcinoma, and 2) impact on clinical staging of lung cancer (T descriptor).

CHEE-17   Dynamic Digital Radiography Of The Thorax: What The Radiologist Needs To Know

Participants
Nicolas Gillingham, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To describe the principles and image acquisition technique of dynamic digital radiography (DDR)2. To illustrate advantages and potential pitfalls for interpreting DDR radiographs by presenting clinical images3. To demonstrate various thoracic applications and case studies of DDR radiography, including real-time cines of rapid-acquisition dynamic imaging.

TABLE OF CONTENTS/OUTLINE

1. Principles and image acquisition techniquea. Acquisition techniqueb. Patient positioning and respiratory instructionsc. Radiation dose compared to standard x-ray and CT2. Advantages and potential pitfalls for interpreting DDR radiographsa. Ability to visualize the motion of the entire diaphragm throughout the respiratory cycleb. Patient compliance with breathing instructionsc. Effective review and reporting of exams containing static and dynamic image series3. Thoracic DDR applicationsa. Characteristics of lung function observed with dynamic imaging:i. Lung inflationii. Synchronicity of diaphragmatic motioniii. Visualization of relative diaphragm excursioniv. Assessment of intercostal musclesv. Chest wall motionvi. Abdominal wall motionb. Dynamic (cine) imaging of obstructive lung diseasec. Dynamic (cine) imaging of restrictive lung diseased. Dynamic (cine) imaging of neuromuscular disease

CHEE-18   Stepwise Diagnostic Algorithm Of High Attenuated Pulmonary Abnormalities On CT

Awards
Certificate of Merit

Participants
Taiki Fukuda, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

To demonstrate a proposed stepwise diagnostic approach to high attenuated pulmonary lesions. To learn 8 categories of high attenuated pulmonary abnormalities. To acknowledge their pathologic backgrounds.

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1) Mechanism of high attenuated pulmonary abnormalities on CT When calcification is not detected by CT? : partial volume effect, aeration etc. 2) Five-step diagnostic algorithm STEP 1: Are they associated with metallic artifacts? If STEP 1 is no, go to STEP 2. STEP 2: Are they linear, consolidation, ground glass opacity or others? If STEP 2 is others, go to STEP 3. STEP 3: Are they associated with soft tissue or not? If STEP 3 is yes, go to STEP 4. STEP 4: Are they solitary or multiple? If Step 3 is no, go to STEP 5. STEP 5: Are they located in peripheral or non-peripheral area of the lung? 3) Representative cases of 8 categories With metallic artifact: seed migration, cement migration, barium aspiration, metal foreign body. Linear pattern: pulmonary alveolar microlithiasis, staple line, diffuse pulmonary ossification, etc. Consolidation pattern: amiodarone, lipiodol embolism, etc. GGO pattern: metastatic calcification. Solitary nodule: lung cancer, hamartoma. Multiple nodules: metastasis, pneumocytoma, hyalinizing granuloma, etc. Peripheral: thoracolithiasis, talc pleurodesis. Non-peripheral: broncholithiasis, mucoid impaction. 4) Conclusion Our proposed algorithm will help to determine whether the lesion needs to start prompt treatment.

CHEE-19   Scratching The Surface: Exploring Cutaneous And Subcutaneous Lesions Of The Chest

Participants
William Stutzman, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Cutaneous and subcutaneous lesions of the chest contain valuable information for developing primary diagnoses, or for providing evidence for syndromes.2. A wide variety of superficial soft tissue lesions are common in clinical practice which include benign and malignant tumors, tumor-like conditions, infectious and inflammatory lesions, and trauma as well as treatment related processes.3. The expanding availability of radiologic imaging with CT, F18 FDG PET/CT, and ultrasound helps narrow down the differential diagnosis.4. The differential diagnosis may be limited further by considering the age of the patient, anatomic location of the lesion, salient imaging features, and clinical manifestation.

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1. Review normal chest wall anatomy.2. Classification of a variety of superficial pathology of the chest wall.3. Characteristic radiographic findings and useful teaching points.a. Malignant tumor: Primary and metastatic.b. Benign tumor.c. Tumor-like conditions: Keloid, tumoral calcinosis, silicone injection.d. Infectious.e. Inflammatory.f. Traumatic.g. Treatment related: surgery, radiation therapy.h. Recognize cutaneous and subcutaneous lesions that can be seen in various syndromes.

CHEE-2   Benign And Malignant Complications Following Esophagectomy

Participants
Jeanne Kochkodan-Self, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Both benign and malignant complications may occur following esophagectomy. 2. Knowledge of the common sites of benign complications, such as ischemic ulcers or strictures, as well as the common sites of cancer recurrence can help radiologists make the correct diagnosis. 3. Knowledge of the normal post-operative appearance of a gastric conduit will help radiologists recognize complications when they occur.

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1. Surgical approaches to esophagectomy 2. Benign complications a. Anastomotic dehiscence b. Ischemic ulcer and perforation c. Stricture d. Para-conduit hernia 3. Malignant complications a. Anastomotic recurrence b. Mediastinal recurrence c. Tracheo-esophageal fistula

CHEE-20   Lung Stereotactic Body Radiation Therapy (SBRT)

Participants
Sebastian M. Gill, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) To review the concept of SBRT, the differences with conventional radiotherapy, and its indications in lung cancer. 2) To recognize the early and late CT imaging findings after SBRT. 3) To identify the signs of suspected local recurrence after SBRT on CT. 4) To know the possible complications of SBRT.

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1) Introduction. General aspects of radiotherapy. 2) Overview and general aspects of SBRT. 3) Indications and other possible uses of SBRT. 4) Differences between conventional radiotherapy and SBRT. Examples. 5) Imaging findings after pulmonary SBRT. 6) Early CT findings. Examples. 7) Late CT finding. Examples. 8) Signs of suspected local recurrence on CT. 9) Difficulties in the early detection of local recurrence. 10) Local recurrence. Examples. 11) Assessment of the response to treatment after SBRT. Role of complementary PET-CT. Future: Radiomics? 12) Summary of the possible complications after SBRT treatment. 13) Key points 14) References.

CHEE-21   Three-dimensional Image Of Intralobular Structure By Ultra-high-resolution CT

Participants
Hiroshi Moriya, MD, Fukushima, Japan (*Presenter*) Advisor, NantWorks LLCResearch Grant, Canon Medical Systems Corporation

TEACHING POINTS

Ultra-high-resolution CT (UHRCT) is a CT that achieves high spatial resolution by reducing the detector size to 1/4. In the previous studies, the bronchial visualization ability of UHRCT with SHR mode (matrix: 1024, 0.25 mm thickness) was superior compared with conventional HRCT. In the depiction of lung field structure, bronchi with an inner diameter of 0.4 mm are delineated. Contrast enhancement and deep learning reconstruction method (DLR) enhances the contrast effect of peripheral blood vessels and improves visualization. By improving the resolution of these existing structures, it has become possible to display the intralobular structure in three dimensions.

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This presentation will show the following four points.1. Depiction of intralobular structure by UHRCT2. Improvement of blood vessel visualization ability by DLR3. How to create a 3D image in the lung lobule4. Three-dimensional display of the structure and lesions in the lobules of typical diseases

CHEE-22   Chest Ultrasound For The Screening And Diagnosis Of Pulmonary Lymphatic Diseases In Children

Participants
Karen Ramirez Suarez, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Pulmonary lymphatic anomalies encompass several conditions such as pulmonary lymphangiectasia, plastic bronchitis, idiopathic chylothorax, among other conditions. - Dynamic contrast MR lymphangiography (DCMRL) has demonstrated a common pathway of abnormal lymphatic flow into the mediastinum, lung parenchyma, pleural surfaces, and bronchial submucosa (pulmonary lymphatic perfusion syndrome). - While DCMRL is an accurate technique to evaluate lymphatic perfusion in children; it is an invasive and costly procedure and its access may be limited because it requires expertise. - Chest ultrasound shows features that correlate with DCMRL findings and it appears to be a promising noninvasive tool to screen for pulmonary lymphatic diseases in children. - Chest ultrasound findings of pleural irregularity, subpleural cystic-appearing structures accompanied by complex pleural effusions and/or underlying pulmonary edema suggest the diagnosis of pulmonary lymphatic disorders. - Ultrasound findings can then be used to decide patients that will required DCMRL for definitive diagnosis and potential interventions.

TABLE OF CONTENTS/OUTLINE

1. Indications and imaging correlation of US and DCMRL findings. 1.1 Normal findings in Chest US and DCMRL 1.2 Suggestive findings of pulmonary lymphangiectasia. - Chest US findings: Pleural irregularity, Subpleural cystic spaces, Pleural effusion, B lines - DCMRL findings: Lung lymphatic perfusion, Pleural enhancement, Pleural effusions with Gadolinium leakage, Pulmonary edema (T2-W images).

CHEE-23   Pulmonary And Disseminated Blastomycosis. Common And Uncommon Imaging Manifestations

Participants
Ana Villanueva, BMedSc, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the wide spectrum of radiological manifestations of pulmonary and disseminated blastomycosis 2. To review entities that mimic blastomycosis and learn how to narrow differential diagnosis based on combination of epidemiologic, clinical and radiologic findings

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North American blastomycosis caused by Blastomyces dermatitidis is an uncommon, but potentially lethal invasive fungal disease, endemic in Canada and the upper Midwest of the United States. Clinically, blastomycosis can be difficult to recognize even in the endemic areas. It is often initially misdiagnosed as community acquired pneumonia, malignant tumor or tuberculosis resulting in treatment delays and unnecessary surgery (Fig.1). Consolidation and masses, with or without cavitation are the most common findings. Uncommon findings include miliary disease, cysts and pleural effusions. Extrapulmonary sites of dissemination include skin, bones, genitourinary system and CNS. Bone involvement has been reported in up to 25% of extrathoracic cases (Fig.2). Only seven cases of thyroid involvement have been published (Fig.3). Blastomycosis may respond to antifungal therapy, however rarely, pulmonary involvement may progress rapidly to respiratory failure, requiring ventilation (Fig.4).

CHEE-24   Incidental Breast Findings At Chest CT: What The Radiologist Needs To Know

Awards
Certificate of Merit
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Participants
Justin Stowell, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

Incidental breast findings occur in 0.1% of CT exams and are often overlooked or incompletely characterized. Not all require breast imaging evaluation. Fleischner Society Glossary for Thoracic Imaging define a mass as "any pulmonary, pleural, or mediastinal lesion greater than 3 cm" while the BI-RADS Lexicon define it as a 3D, space-occupying lesion of any size. Nodule is not a BI-RADS descriptor. Suspicious CT features of malignancy include irregular shape, spiculation, and rim enhancement as well as new skin/trabecular thickening or axillary lymphadenopathy. Unilateral axillary/subpectoral lymphadenopathy requires correlation with vaccination history before initiating a diagnostic evaluation.Posttreatment changes may evolve for years following intervention. Suspicious findings include new masses in the operative bed, increasing distortion, skin/trabecular thickening, and size of fluid collections following a period of stability.

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Background, Incidence, Application of BIRADS Lexicon (nodule vs mass)Parenchymal/Axilla a. Masses/cysts, Distortion/Asymmetries, Calcification (malignant Ca++ too small for CT resolution, coarse Ca++ benign) b. Breast density reporting c. Hormone effects d. Axillary lymph node measurement/evaluation especially in era of COVID vaccination Postop a. Augmentation (implants, autologous fat transfer, free silicone) b. Lumpectomy c. Mastectomy techniques i. Reduction mammoplasty ii. Skin-sparing, Radical iii. Flaps:

DIEP, TRAM, latissimus d. Complications

CHEE-25   Radiological-pathological Correlation In Nonspecific Interstitial Pneumonia: State-of-the-art Images By Ultra-high-resolution Computed Tomography

Participants
Tae Iwasawa, MD,PhD, Yokohama, Japan (*Presenter*) Support, Canon Medical Systems CorporationSupport, Ziosoft Inc.Speaker, FUJIFILM Holdings CorporationSpeaker, Boehringer Ingelheim GmbH

TEACHING POINTS

Nonspecific interstitial pneumonia (NSIP) is one of the common radiological and histological patterns in interstitial lung diseases (ILD). NSIP is frequently seen in collagen disease-related ILD, interstitial pneumonias with autoimmune features (IPAF), and in smokers after treatment of desquamative interstitial pneumonia. NSIP has heterogeneous characteristics in terms of disease behavior and prognosis, and some patients still experience disease progression despite therapy. In conventional high-resolution computed tomography (HRCT) with 512 × 512 matrix size, ground-glass opacity overlapped reticulation along the broncho-vascular bundles is a common radiological pattern. On the other hand, ultra-high-resolution computed tomography (U-HRCT) with 1024 × 1024 matrix size, 0.25-mm slice thickness, and a deep learning reconstruction algorithm for the lung can clearly visualize intralobular reticular opacities. In U-HRCT, we can easily understand the "temporal and spatial homogeneity," which is a characteristic histological NSIP finding. In this presentation, we will show the state-of-the-art U-HRCT images of NSIP in a variety of diseases compared with histological specimens.

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What is NSIP? What is U-HRCT? (Fig.1) The characteristic CT findings of NSIP (Fig.2). Comparison between NSIP and usual interstitial pneumonia in U-HRCT (Fig.3). NSIP in systemic sclerosis. NSIP in rheumatoid arthritis (Fig.4). NSIP in smokers (Fig.5)

CHEE-26   Multidisciplinary Approach To Chronic Thromboembolic Pulmonary Hypertension (CTEPH), Surgical Technique, And Complications

Awards
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Cum Laude

Participants
Lewis Hahn, MD, San Diego, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Chronic thromboembolic pulmonary hypertension (CTEPH) is defined as mean pulmonary artery pressure > 25 mm Hg, pulmonary capillary wedge pressure < 15 mm Hg, and presence of chronic thromboembolic disease after 3 months of anticoagulation. Imaging features of CTEPH include peripheral thrombus, intraluminal webs, bands, and small caliber/occluded pulmonary arteries. Enlargement of the right heart and main pulmonary artery is seen due to pulmonary hypertension. CTEPH diagnosis and treatment strategy should ideally be made through a multidisciplinary discussion between cardiac surgeons, pulmonologists, cardiologists, and radiologists. Treatments for CTEPH include pulmonary thrombolectomy (PTE), balloon pulmonary angioplasty (BPA), and medical therapy. PTE is the only curative therapy for CTEPH. PTE is performed via arteriotomy followed by dissection of the pulmonary arteries between the intima and media. BPA is performed similarly to coronary balloon angioplasty with visualization of disease on catheter angiogram followed by angioplasty. Complications of PTE and BPA include reperfusion edema, hemorrhage, pulmonary artery injury, rethrombosis/pulmonary embolism, and pericardial effusion/hemopericardium.

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CTEPH pathophysiology and imaging features; Multidisciplinary approach to CTEPH; PTE indications and technique; Normal post-operative imaging following PTE; Complications of PTE; BPA indications and technique; Normal post-operative imaging following BPA; Complications of BPA

CHEE-27   Ultra-low-dose Lung CT For COVID-19 Viral Pneumonia Using Deep Learning Reconstruction.

Participants
Seiko Kobayashi, RT, Hakodate, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

CT images play a pivotal role in not only screening for COVID-19 viral pneumonia findings, but also assessing severity and related complications. However, in some cases, we may avoid taking follow-up inspection or applying to young patients worrying about radiation dose. We developed an appropriate scan protocol for balancing diagnostic accuracy and exposure dose reduction so that we scan take the inspection as necessary.

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We applied an ultra-low-current CT protocol for assessing COVID-19 viral pneumonia. Thin-slice CT images were reconstructed using deep learning algorithm optimized for lung diagnosis, and data acquisition was performed by ultra-low-current scanning (40mA). Compared to the conventional method (auto exposure control SD=10 at 5mm thickness, hybrid iterative reconstruction (IR)), diagnostic ability is sufficient to detect lung ground-glass opacity findings. Depending on physique, the exposure dose was reduced by up to 83% (4.85mSv?0.8mSv). Additionally, in the noise characterization (Noise-Power-Spectrum), our new protocol is equal to or better than the conventional ones. The ultra-low-current scanning and deep learning reconstruction (DLR) is clinically available and promising for reducing exposure dose and providing important image findings for establishing therapeutic strategy in patients with COVID-19 infection.

CHEE-28   Imaging Of Immunotherapy In NSCLC

Awards
Cum Laude
Identified for RadioGraphics

Participants
Girish S. Shroff, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Familiarize radiologists with: 1. The principles and indications of immunotherapy in NSCLC 2. The imaging manifestations of typical and atypical response patterns to therapy and unique complications of therapy

TABLE OF CONTENTS/OUTLINE

Based on extensive imaging experience from a leading cancer center:Introduction•Background on immunotherapy•Simplified principles of immune checkpoint inhibitor therapyImmunotherapy in NSCLC•Indications•Biomarkers (PD-L1, tumor mutational burden) Response assessment & atypical response patterns compared to conventional chemotherapy•Response criteria (immunotherapy versus conventional chemotherapy)•Pseudoprogression•HyperprogressionImaging Complications of Therapy•Immune related adverse events with focus on those that can be misinterpreted as metastatic or progressive disease and those that can have clinical implications (hypophysitis, neurological, thyroiditis, pneumonitis, sarcoid-like reaction, cardiac, colitis, hepatitis, cholangitis, pancreatitis, adrenalitis)•Clinical treatment implications of imaging

CHEE-29   Complications In Lung Transplant Recipients: What The Radiologists Need To Know

Participants
Masaki Katsura, MD, PhD, Tokyo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Overview the currently available procedures of lung transplantation. (2) Discuss the physiologic changes following lung transplantation. (3) Describe the common and uncommon complications according to the time elapsed from lung transplantation. (4) Recognize radiological manifestations of posttransplant complications on follow-up imaging.

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(1) Overview of lung transplantation procedures; single lung transplantation, bilateral lung transplantation, cadaveric lobar transplants, transplantation of lobes from living donors, heart-lung transplantation. (2) Physiologic changes following lung transplantation; airway hyperreactivity, impaired cough reflex and mucociliary clearance, oropharyngeal and gastroesophageal dysfunction, respiratory muscle dysfunction, changes in pulmonary function test results. (3) Primary graft dysfunction; ischemia-reperfusion injury. (4) Surgical complications; bronchial anastomotic, vascular anastomotic, and pleural complications. (5) Immunological complications; acute allograft rejection, bronchiolitis obliterans syndrome, restrictive allograft syndrome. (6) Infectious complications; bacterial, fungal, mycobacterial, viral, and parasitic infections. (7) Malignancy after lung transplantation; posttransplant lymphoproliferative disorder, native lung malignancy in single lung transplant patients. (8) Other complications; drug-induced complications, pulmonary embolism and infarction, recurrence of primary disease.

CHEE-3   Benign Lymphatic Abnormalities In The Thorax

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Participants
Thomas Shum, PhD, Rockville, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand normal pulmonary lymphatic drainage and how drainage is impacted in disease states. 2. List imaging manifestations of impaired thoracic lymphatic drainage. 3. Describe the imaging and treatment of thoracic duct injury.

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1. Normal lymphatic pathways in the lung and mediastinum 2. Pulmonary lymphatics a. Reversal of lymphatic flow b. Pulmonary lymphangiectasia c. Intrapulmonary lymph node engorgement 3. Chylous pleural effusion 4. Mediastinal lymphatic malformations 5. Thoracic duct injury

CHEE-31   Neuroendocrine Lung Tumors: Classification, Clinical And Imaging Findings With Pathologic Correlation

Participants
Carlos Senra, MD, Barcelos, Portugal (*Presenter*) Nothing to Disclose

TEACHING POINTS

Regarding lung neuroendocrine tumors (Lu-NENs), we aim to:- Review the classification of Lu-NENs;- Explore the differences of clinical and nuclear medicine behavior between low- to intermediate-grade tumors and high-grade carcinomas.- Review the main imaging findings of Lu-NENs with pathologic correlation.

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Lu-NENs are a heterogeneous family of neoplasms classified in 4 distinct histologic subtypes (i.e., typical carcinoid, atypical carcinoid, small cell lung carcinoma and large cell neuroendocrine lung carcinoma). Diffuse idiopathic pulmonary neuroendocrine cell hyperplasia is a preinvasive lesion associated with carcinoids. Classification of Lu-NENs is based on mitotic count, necrosis and cytologic features. Although not part of the classification criteria, Ki-67 proliferative index is an essential prognostic parameter. Lu-NENs are characterized by wide clinical behavior spectrum, including low-grade tumors with 98% 5-year survival to high-grade carcinomas with less than 20% 5-year survival. Pathology is the gold-standard test for the diagnosis of Lu-NENs. Nonetheless, key imaging/morphologic features and avidity for FDG and somatostatin analogues (i.e., DOTA-peptides) in PET examination may be used to support the diagnosis.

Neuro-pulmonary Disorders

Participants
Furkan Ufuk, MD, Denizli, Turkey (*Presenter*) Nothing to Disclose

TEACHING POINTS

? To review diseases that may affect both the lung and central nervous system (CNS) simultaneously or at different times. ? To review the imaging findings of neuro-pulmonary disorders.

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Infectious diseases: Although many conditions can affect both the lungs and the CNS, tuberculosis, fungal infections (especially mucormycosis), parasitic diseases (e.g., cyst hydatid), and viral diseases (varicella-zoster) are common. Inflammatory conditions: Systemic inflammatory diseases may involve both the CNS and the lungs. The most common of these diseases can be sarcoidosis, systemic lupus erythematosus, and Behçet's disease. Vascular disorders: Vasculitis and thromboembolic events can affect both the lungs and the CNS. Vascular anomalies can be found in both lung and CNS in Hereditary Hemorrhagic Telangiectasia (Osler-Weber-Rendu disease). Tumoral disorders: Primary tumors can metastasize to both the lungs and the CNS. Primary lung malignancies can metastasize to the CNS, and rarely CNS neoplasms can metastasize to the lungs. In addition, the lungs can be affected by neurocutaneous syndromes such as neurofibromatosis or tuberous sclerosis.

CHEE-33 **Don't Judge A Book By Its Cover - Uncommon Pulmonary Nodules And Mimickers Of Primary Lung Cancer**

Participants
Anitha Kini, MD, DMRD, Bangalore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To present the differential diagnosis of pulmonary nodules other than primary lung cancer, including both solid and subsolid lesions, with histopathological correlation2. To discuss the imaging features of these lesions with emphasis on findings that may help to differentiate them from primary lung cancer

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Pulmonary nodules are commonly found on CT of the chest. Most of these nodules are deemed indeterminate and will require surveillance or further management, including biopsy, to exclude lung cancer. The goal of this educational exhibit is to discuss the differential diagnoses of pulmonary nodules other than lung cancer, with emphasis on CT findings that may help in the differential and to discuss the best management strategies for final diagnosis, notably the role of follow up, fine needle aspiration and core needle biopsy. Awareness of these conditions with an understanding of their pathologic background, careful attention to the clinical information, imaging findings and correct management steps will help achieve a correct diagnoses.

CHEE-34 **Biomarkers In Pneumonia: It's Time For Radiologists To Close The Gap**

Participants
Julia Asmar, MD, Kansas City, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

Explain relevance of biomarkers in evaluating pulmonary infection and their impact on diagnosis/prognosisHighlight the incorporation of biomarker data in the formulation of an appropriate imaging differential diagnosis

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Biomarkers are measurable molecules that predict the presence of disease, indicate its severity, and guide duration of therapy. Procalcitonin (PCT), R-Reactive Protein (CRP), erythrocyte sedimentation rate (ESR), and ß-D-glucan (Fungitell®) are universally available biomarkers of pulmonary infection. PCT secretion is upregulated in bacterial but not in viral infections, and elevated PCT in the appropriate imaging context often indicates bacterial pneumonia. A normal PCT helps support the diagnosis of viral infection (e.g. influenza and COVID-19) in affected patients with pulmonary opacities. Elevation of ß-D-glucan, a component of fungal cell walls (e.g. Aspergillus, Histoplasma), helps distinguish certain fungal infections from bacterial/viral pneumonia, and enables timely diagnosis of angioinvasive aspergillosis. Certain biomarkers (e.g. Ferritin, CRP, PCT) help predict disease severity in COVID-19 before clinical deterioration.Radiologists can mine the electronic medical record for biomarker data to support specific diagnoses in suspected pulmonary infection or non-specific airspace disease. Moreover, when imaging findings are suggestive, radiologists may recommend determination of specific biomarkers to enable timely definitive diagnosis and treatment.

CHEE-36 **The Many Faces Of Pulmonary Aspiration: Aspiration Pneumonia, Aspiration Pneumonitis, Diffuse Aspiration Bronchiolitis And Microaspiration. (mechanisms And Imaging Clues With Pathologic Correlation)**

Participants
Tomas C. Franquet, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review and discuss characteristic clinical, imaging, and pathological findings that can aid the radiologist in prioritizing the differential considerations when faced with aspiration disordersUnderstanding their specific imaging features is crucial for making an accurate and early diagnosis, which impacts management.

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Aspiration is often the result of impaired swallowing, which allows oral or gastric contents, or both, to enter the lung.The diagnosis of pulmonary aspiration depends on a characteristic clinical history, risk factors, and compatible findings on chest radiography. We provide an overview of aspiration-related pulmonary disorders, focusing particularly on those entities not widely appreciated and on recent advances in our understanding of aspiration-related pulmonary syndromes, which can be broadly grouped into those predominantly affecting the airways or the lung parenchyma. Understanding their specific imaging features is crucial for making an accurate and early diagnosis, which impacts management.

CHEE-37   Peripheral Pulmonary Artery Imaging Using Ultra-high Resolution CT - A New Method Of Evaluating Vascularity In The Lung Field -

Participants
Hiroshi Moriya, MD, Fukushima, Japan (*Presenter*) Advisor, NantWorks LLCResearch Grant, Canon Medical Systems Corporation

TEACHING POINTS

1. Pulmonary artery visualization with 3DCTA2. Enhancement of contrast medium of small blood vessels by ultra-high resolution CT (UHRCT)3. Depiction of intralobular blood vessels4. How to display the vascularity of peripheral blood vessels in the lung field5. Pulmonary artery thromboembolism case presentation

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1. UHRCT improves the visualization of small pulmonary arteries compared to conventional 3DCTA.2. In UHRCT, the reliability of CT values of small structures is improved by reducing the partial volume effect due to the miniaturization of voxels. In particular, the contrast effect of small vessels with a diameter of 1 mm or less is enhanced. In addition, deep learning reconstruction reduces lung noise and sharpens vascular contours.3. Intralobular blood vessels are visualized, and blood vessels around lung cancer and subpleural blood vessels are depicted using UHRCT.4. How to display the vascularity of peripheral blood vessels in the lung field. Contrast effect of small vessels are displayed by subtraction between UHRCT and conventional CT. MIP images display the distribution of contrast medium in the lung field.5.Pulmonary artery thromboembolism (PE) case presentation. The outline of the contrast-enhanced blood vessel and CE defect are clearly visualized. The PE area is visualized as a blood vessel miniaturization and avascular area. Peripheral pulmonary artery imaging may be used to evaluate blood flow in the lung field.

CHEE-39   The Female Thorax - A Case Based Review Of Thoracic Pathology In The Female Patient

Awards
Certificate of Merit
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Participants
Katerina Konstantinoff, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to:1. Illustrate the importance of sex differences when formulating differential diagnoses for thoracic imaging findings.2. Provide a case based review of imaging features of a selection of thoracic pathology that is unique to or predominantly affects females.

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1. Tracheobronchial-Pulmonary: Lymphangioleiomyomatosis, Thoracic endometriosis, Meigs' syndrome, Ovarian hyperstimulation, Idiopathic laryngotracheal stenosis2. Cardiovascular: Spontaneous coronary artery dissection, Vasculitis, Takotsubo cardiomyopathy, Turner syndrome3. Autoimmune diseases: Scleroderma, Rheumatoid arthritis, mixed connective tissue disease, Sjogren's.4. Neoplasms: Benign: Benign metastasizing leiomyoma. Malignant: Breast cancer, metastases (Ovarian, Choriocarcinoma, Uterine leiomyosarcoma)5. Pregnancy Related: Amniotic fluid embolism, Eclampsia, Peripartum cardiomyopathy6. Chest wall: Gigantomastia, Elastofibroma dorsiSummary: Certain diseases are unique to or disproportionately affect the female sex and may manifest as important findings across cardiothoracic imaging studies of various modalities. These entities range from benign to malignant, and from primary diseases affecting thoracic organs, to localized manifestations of systemic disease. Awareness of these pathologies with female preponderance is important when formulating a robust differential diagnosis in order to avoid diagnostic pitfalls and help guide patient management.

CHEE-4   Proposal Of Optimal Contrast Method For Pulmonary Artery/vein Separation Imaging: How To Accomplish Faster 3d Image Construction, Reduced Contrast Agent Dose, And Improved Image Quality

Participants
Kazuaki Hoyama, Kagoshima, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

3D images of the pulmonary vasculature in preoperative CT assessments for video-assisted thoracic surgery are excellent means to show positional relationships of tumors and blood vessels and provide useful surgery support information. However, false recognition of artery/vein or poor depiction of the vasculature can occur during automatic pulmonary arteriovenous extraction depending on the imaging method and conditions used.This study aimed to propose the use of the Split Bolus Tracking (SBT) method to accomplish faster 3D image construction, reduced contrast agent dose, and improved image quality as a result of improved accuracy of automatic extraction.In the SBT group, the contrast agent could be reduced by 75% on average, and the mean difference in the CT value between pulmonary arteries and veins (220 HU) was significantly higher (p < 0.01). As a result, falsely recognized blood vessels were decreased, visual evaluation was improved, and 3D construction time was reduced by 42 min (p < 0.01).

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A.Advantages of the SBT method in pulmonary artery/vein separation imagingB.Faster 3D construction of the pulmonary vasculature using a workstationC.Percentage of contrast agent dose reductionD.Difference in the CT value between pulmonary arteries and veinsE.Improved visual evaluationF.Schematic diagram of the SBT method

CHEE-40   Beyond Idiopathic In Pulmonary Fibrosis: Genetics, Immunology And More

Awards
Certificate of Merit

Participants
Rosita M. Shah, MD, Villanova, Pennsylvania (*Presenter*) Nothing to Disclose

1.Beyond supporting an IPF diagnosis, imaging findings of pulmonary fibrosis are relevant as a guide for biopsy in indeterminate for UIP or alternate diagnosis patterns, surveillance in at risk patients including familial pulmonary fibrosis, and anti-fibrogenic therapeutic options. 2.Genomic abnormalities including shortened telomere length(TERT), abnormal mucin (MUC5B) and surfactant production (SFPTC) are associated with increased risk of developing IPF and other interstitial lung disease with accelerated course. 3.MUC5B is associated with dominant UIP pattern in hypersensitivity pneumonitis and rheumatoid arthritis. 4.Evolving fibrosis patterns at imaging may be associated with chronic granulomatous inflammation syndromes and COVID-19. 5.Dominant cystic pattern in young patients with IPF may be associated with genetic surfactant deficiency.

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1.Established and newly recognized risk factors/associations in pulmonary fibrosis •Genomic variants •Immune mediated inflammation •Post-infectious/inflammatory fibrosis including COVID-19 •Non-sarcoid chronic granulomatous inflammation 2. Lung injury versus repair •Pathophysiology of fibrosis •Therapeutic considerations 3.Imaging in diagnosis, surveillance and therapeutic decision making in pulmonary fibrosis 4.Clinical syndromes beyond idiopathic pulmonary fibrosis •Familial pulmonary fibrosis •Hermansky-Pudlak •Anti-synthetase •Surfactant C deficiency •IgG4 •Granulomatous lymphocytic interstitial lung disease

CHEE-41   Organizing Your Approach To Lung Injury

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Travis Henry, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Non-traumatic lung injury can be caused by a variety of insults. Regardless of cause, the most common pathologic response to injury is usually organizing pneumonia (OP) and/or diffuse alveolar damage (DAD).-Identifying the cause of lung injury on imaging is usually not possible. It is imperative that the imager recognize the findings of lung injury and understand the temporal changes that occur with different the phases of lung injury so that the clinical team can investigate the cause.-OP is a common and usually milder form of lung injury that typically presents weeks to months after an insult. The significance of OP on biopsy is variable - it may be the cause of a patient's symptoms or a minor component of another disease-DAD is a severe form of injury from damage to the epithelium and/or endothelium. DAD has three phases with distinct (but often overlapping) imaging: acute/exudative; proliferative/organizing; chronic/fibrotic.-Acute respiratory distress syndrome (ARDS) is a clinical diagnosis based on the level of hypoxemia and presence of lung injury on imaging. DAD is the histologic correlate of ARDS, however patients with DAD may not have ARDS, and patients with ARDS may not have DAD on pathology.

TABLE OF CONTENTS/OUTLINE

A. IntroductionB. Common forms of lung injury (OP, DAD)C. Imaging timeline of lung injury (days-acute; weeks-organizing; months-fibrotic)D. Differential diagnosis clinical aspects (ARDS; Cryptogenic OP)E. Clues to differentiate lung injury from mimics on imaging

CHEE-42   Mesothelioma Imaging: Current Practice And Future Directions

Participants
Chad D. Strange, MD, Seabrook, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

To understand: - Combined imaging and surgery are necessary for complete staging. -Unique features of current staging in mesothelioma with focus on resectable vs. unresectable disease. -Unique modifications of RECIST 1.1 criteria to assess response after therapy. -3D volumetric techniques provide new opportunities for mesothelioma imaging.

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Based on the clinic-radiological experience of a tertiary oncological referral center. Introduction: -Impact of pathological variations on imaging -Unique growth pattern impact on evaluation Staging mesothelioma: -Multimodality CT, MRI, PET/CT, and Surgery staging -Current mesothelioma staging and limitations with examples -Discuss criteria for unresectability with example cases -Surgical/oncological implications of staging Response Assessment: -Modified RECIST 1.1 -Discuss how uniquely modified for mesothelioma with example cases Future Directions: -Volumetric analysis of mesothelioma

CHEE-43   PET/CT Assessment Of Esophageal Cancer

Participants
Staci Gagne, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

The incidence of esophageal cancer in the United States has grown more rapidly than any other solid tumors over the past several decades. Despite being one of the ten most frequent cancers in the world, it continues to carry a poor prognosis with a less than 15% 5-year survival rate. To further understand this disease, this exhibit aims to 1) characterize the unique difficulties in diagnosing and treating esophageal cancer, 2) present the current diagnosis and staging guidelines, 3) expand on the role of the radiologist and how PET/CT has evolved within the diagnosis and management of esophageal cancer, and 4) discuss current and investigative treatment strategies to include surgery, chemotherapy and radiation.

TABLE OF CONTENTS/OUTLINE

1. Epidemiology and anatomy of esophageal cancer: presentation, esophageal anatomy, types of esophageal cancer, and the effects these have on staging and prognosis2. Current diagnosis and staging guidelines of esophageal cancer: invasive and noninvasive tests used3. PET/CT and the assessment of esophageal cancer how its role has evolved and how it is used now; its role in multidisciplinary conference, and its pitfalls4. Current and investigative areas of treatment and management algorithms: surgery, chemotherapy, and radiation often in combination and imaging

CHEE-44   Emerging Phenotypes Of Chronic Lung Allograft Dysfunction (CLAD) In Long-term Lung Transplant Survivors

Participants
Staci Gagne, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Lung transplantation has come a long way in the past several decades and yet still trails behind other solid organ transplants in terms of survival. One of the main complications affecting long-term survival is the development of chronic lung allograft dysfunction (CLAD). Therefore, identifying CLAD in a lung transplant is vital to the prognosis of the patient and provides a crucial role for the radiologist. The purpose of this exhibit is to 1) learn what CLAD is and what it means for the patient and their lung transplant, 2) review imaging findings of the emerging phenotypes of CLAD and correlative pulmonary functions and pathology, 3) understand the clinical implications of these phenotypes, and 4) discuss the current and investigative areas of management and treatment. Presented cases are from the experiences at a tertiary academic center with the largest lung transplantation program in the region. The exhibit is designed to provide a practical guide in diagnosis and management of CLAD which is relevant to an ever-growing number of patients.

TABLE OF CONTENTS/OUTLINE

1. Current definition of CLAD Definition, epidemiology, and clinical implication2. Risk factors of CLAD: recurrent infection, rejection, gastroesophageal reflux, etc.3. Emerging phenotypes of CLAD Bronchiolitis obliterans syndrome (BOS) and Restrictive allograft syndrome (RAS) - clinical presentations, course, and prognosis with correlative pathologic findings4. Management of CLAD: Current recommendations and future directions with emphasis on a role of radiologists

CHEE-45   Two Thin Layers Of Trouble. A Journey Through Pleural Neoplasms.

Awards
Certificate of Merit

Participants
Alvaro Bartolome Solanas, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Pleural tumours are a small but significant kind of chest neoplasms. The basic imaging techniques are CXR and CT scan. MRI can play an important role helping on the characterization of some pleural tumours. In any case the imaging characterisation of the different pleural neoplasms is a difficult task because of the big overlap between imaging characteristics. Usually the final diagnosis is obtained through biopsy where the US could play a major role.This pictorial review intends to bring some light to this matter by:-Reviewing basic pleural anatomy and general imaging features of pleural neoplasms-Describing a comprehensive classification and an approach to pleural neoplasms-Illustrating key clinical and imaging features of the different pleural neoplasms-Illustrating some tumor-like pleural lesions that simulate pleural neoplasms

TABLE OF CONTENTS/OUTLINE

Introduction:Anatomy and basic histologyImaging generalities of pleural tumoursGeneral classification of pleural neoplasmsPictorial review with key clinical and imaging features of the different pleural neoplasms:- Primary neoplasms:Mesothelial (Malignant mesothelioma), Mesenchymal (Solitary fibrous tumour, lipoma, liposarcoma, synovial sarcoma...), Lymphoproliferative (Primary pleural lymphoma)- Secondary neoplasms:Metastatic implants, Pleural invasion- Tumor-like lesions

CHEE-46   Sternum - A Small Big Bone

Participants
Vivien Bonadio, MD, Bebedouro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review anatomy of sternum. 2. To approach anatomical variations. 3. To discuss mechanic and traumatic pathologies and expected image patterns. 4. To overview different image finding of spondyloarthropathy, infectious diseases, tumors and post-operative conditions.

TABLE OF CONTENTS/OUTLINE

1. Review bone, ligamentous and joint anatomy of sternum and what can be evaluated on image exams in a multimodality approach. 2. To approach sternal anatomical variations and image aspects, such as: disproportion of its components, sternal foramina, xiphoid shape variations, pectus carinatum and pectus excavatum. 3. Mechanic/traumatic pathologies and image findings, particularly arthritis, mechanical overload, acute and healed fracture. 4. Expected image findings on spondyloarthropathy, emphasizing SAPHO syndrome. 5. Infectious diseases that can affect the sternum, focusing on septic arthritis and also addressing other rarer infections, such as sporotrichosis. 6. Sternum tumors, such as enchondroma and chondrosarcoma. 7. Post-operative conditions of the sternum, such as pseudoarthrosis and sternal prostheses.

CHEE-47   Hypersensitivity Pneumonitis: An Update Based On The New American Thoracic Society Guideline

Participants
Pegah Khoshpouri, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

TEACHING POINTS

Familiarize radiologists with new ATS guideline for diagnosis of hypersensitivity pneumonitis (HP).Review radiological terms and features that help radiologist in diagnosis of HP.Understand the chest HRCT scan features that help categorize scans into the typical HP, compatible with HP, and Indeterminate for HP.Provide an algorithmic approach for diagnosis of HP with emphasis on the role of radiologists.

TABLE OF CONTENTS/OUTLINE

Review of the natural history and epidemiology of HP.Review of the pathogenesis of HP with radiological correlation.Recommended

chest HRCT protocol parameters in the diagnosis of HP.Review and update on radiological terms for heterogeneous lung attenuation.Chest HRCT scan features of the nonfibrotic HP pattern (Typical HP, Compatible with HP, and Indeterminate for HP): A pictorial review.Chest HRCT scan features of the fibrotic HP pattern (Typical HP, Compatible with HP, and Indeterminate for HP): A pictorial review.Review of the histopathological criteria for the diagnosis of HP.Algorithmic approach for evaluation of HP.

CHEE-48   Pulmonary Hypertension: Updated Clinical Classification And CT Pulmonary Angiography Evaluation

Awards
Certificate of Merit

Participants
Farah Tamizuddin, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Pulmonary hypertension (PH) is a chronic progressive disease classified into five groups, each with similar clinical presentations and therapies. Recent 2019 updates address pulmonary capillary hemangiomatosis (PCH), pulmonary veno-occlusive disease (PVOD), and lymphangioleiomyomatosis (LAM), given better understanding of their pathophysiology. Computed tomography pulmonary angiography (CTPA) is key in PH evaluation and can aid in early diagnosis, increasing chances of survival and symptom improvement. Therefore, the objectives are to a) review the updated 2019 PH classification with pertinent pathology correlation and b) discuss the role of imaging and review helpful findings for PH diagnosis on CTPA.

TABLE OF CONTENTS/OUTLINE

1. PH definition (hemodynamic parameters, clinical presentation). 2. Updated 2019 PH classification [group 1, pulmonary arterial hypertension (PAH); group 2, left heart disease; group 3, lung disease and/or hypoxia; group 4, pulmonary artery obstruction; group 5, unclear/multifactorial]. 3. Role of imaging in early PH diagnosis (V/Q scan, CTPA, Fleischner 2021 position paper). 4. Key CTPA features of PH: A. Signs of PH. B. Group 1, imaging features of idiopathic PAH, venous/capillary causes (PVOD/ PCH), cirrhosis/ portal hypertension, intracardiac shunts. C. Group 2, imaging features of heart and valvular causes. D. Group 3, CT indicators of obstructive/restrictive PH, LAM. E. Group 4, identifying CTEPH (webs, vascular strictures, dual energy CTPA iodine defects).

CHEE-49   Spectrum Of Hepatopulmonary Diseases: From Imaging Features To Clinical Management

Participants
Pegah Khoshpouri, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

TEACHING POINTS

Familiarize radiologists with the intrathoracic manifestations of hepatic diseases.Educating different hepatic and intraabdominal manifestation of pulmonary and cardiac diseases.Comprehensive review of imaging features, clinical manifestations, and management of diseases affecting both lungs and liver.

TABLE OF CONTENTS/OUTLINE

Review of the hepatopulmonary axis anatomy and potential communications.Review of the portosystemic shunt pathways.Pulmonary manifestation of portal hypertension: 1. Hepatopulmonary syndrome 2. Portopulmonary hypertension 3. Portopulmonary fistula/shunt 4. Portosystemic (non-pulmonary) fistula/shunt 5. Hepatic hydronephrosisDiseases with Hepatic and Pulmonary manifestations: 1. Cystic fibrosis 2. Alfa-1 antitrypsin deficiency 3. Hereditary hemorrhagic telangiectasia 4. Drug toxicities 5. Autoimmune diseasesCardiopulmonary manifestations of hepatic carcinoid disease.Hepatic manifestations of pulmonary hypertension and right heart strain.

CHEE-5   Interstitial Lung Abnormality (ILA) And Lung Cancer

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Akinori Hata, MD, Suita, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Interstitial lung abnormalities (ILA) are defined as incidental CT findings of non-dependent abnormalities affecting more than 5% of any lung zone, including ground-glass or reticular abnormalities, lung distortion, traction bronchiectasis/ honeycombing, and non-emphysematous cysts. ILA is often progressive and associated with reduced exercise capacity, decline in lung function, and increased mortality. The clinical importance of ILA is increasingly recognized. In addition, ILA often coexists with lung cancer. The purpose of this exhibit is 1) To learn the findings of ILA; 2) To know the evidence of poor prognosis in lung cancer patients with ILA; and 3) To understand the clinical importance of ILA in management for lung cancer patients.

TABLE OF CONTENTS/OUTLINE

1. Typical findings and subtypes: non-subpleural, subpleural non-fibrotic, and subpleural fibrotic2. Imaging pitfalls: aspiration, osteophyte-related fibrosis, centrilobular nodularity, pleuroparenchymal fibroelastosis-like lesion, dependent abnormality 3. Clinical pitfalls: co-existing ILA and lung cancer and its implication in diagnosis and treatment 4. Prognostic implications: Association with survival in early and advanced stage lung cancer. 5. Recommended management in lung cancer patients with ILA.

CHEE-50   Beyond The Usual And Emerging Interstitial Lung Diseases: What Radiologists Need To Know

Participants
Pegah Khoshpouri, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

TEACHING POINTS

Familiarize radiologists with less reported and emerging interstitial lung diseases (ILD).Educating clinical correlations of less known ILDs.Teaching expected imaging findings in less known ILDs.Review of treatment options and management of emerging and less

known ILDs.

CHEE-51   Do You Really Know Lung-RADS®v1.1?: The Screening And Management Card Game

Participants
Lucas Farias, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1) To play with cards imaging characteristics related to Lung-RADS® v1.1. 2) To review Lung-RADS® v1.1 assessment categories and updates. 3) To correlate important findings with the with histopathological diagnosis. 4) To discuss image findings according to Lung-RADS® v1.1 in order to enhance radiologists' skills. 5) To highlight their characteristics in order to familiarize the multidisciplinary medical society for thoracic radiology with these conditions, preventing unfavorable patient outcome.

CHEE-52   The Battle Of Our Era, A Constant Fight; A Pictorial Review Of The Radiologic Techniques And Imaging Features Of Coronavirus Disease 2019

Participants
Nancy Margarita Gutierrez Castaneda, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

To describe the general characteristics of COVID 19.To review the pathophysiology, transmission, clinical features and diagnosis of COVID 19.To know the clinical utility and imaging features of the modalities most commonly used in diagnosis and evaluation of coronavirus disease 2019.To describe the CO RADS description.To examine thromboembolic and extrathoracic imaging features in COVID 19. To know the pulmonary and systemic complications of COVID 19.To discuss the appropriate treatment and follow up of the COVID 19

CHEE-54   Mediastinal Teratoma: From Basic To Advanced

Participants
SANGGYUN KIM, MD, Gwangju, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Identify the diagnostic strategy in approaching the patients with mediastinal teratoma 2. Describe the multimodality imaging findings of mediastinal teratoma 3. Discuss the unusual clinical and radiologic manifestations of mediastinal teratoma

CHEE-55   Fat Containing Lesions Of The Chest: A Pictorial Review With Computed Tomography And Magnetic Resonance Imaging Findings

Participants
Tugce Agirlar Trabzonlu, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

Fat-containing chest lesions may be encountered on many cardiothoracic examinations on daily workflow. When a fat containing cardiothoracic lesion is identified, its anatomic origin and characteristic imaging appearance often allow a definitive radiologic diagnosis, and often preclude further invasive diagnostic procedures. Although chest CT allows easy identification of the macroscopic fat, several MR imaging techniques can provide further information to identify microscopic fat, which can be helpful in characterization of some entities such as thymic hyperplasia or arrhythmogenic right ventricular dysplasia. This exhibit will review fat containing chest lesions based on their anatomic locations with describing the role of the computed tomography (CT) and magnetic resonance imaging (MRI) in their diagnosis.

liposarcoma, lipomatous hypertrophy of the interatrial septum, arrhythmogenic right ventricular dysplasia)- Pulmonary parenchymal and endobronchial lesions (Hamartoma, lipoid pneumonia, lipoma)-Pleural and Chest Wall Lesions (Lipoma, hibernoma, extrapleural fat, liposarcoma, lipomatosis, elastofibromatodorsi, fat necrosis)-Diaphragmatic hernia (Morgagni hernia, Bochdalek hernia, hiatal hernia, juxtacaval fat)

CHEE-56   Do You Know Many Diseases Share The Same CT Findings With COVID-19 Pneumonia?: Diseases Spectrum, Pathologic Background And Differential Diagnosis

Participants
Takeshi Johkoh, MD, PhD, Amagasaki, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.To know the diseases sharing the same CT findings with COVID-19 pneumonia (COVID-19P) . 2. To understand pathological causes. 3. To acknowledge key CT findings for the differentiation

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1. Diseases which share the same CT findings: A. Moderate COVID-19P; cellular NSIP , COP,EP, Drug Related Pneumonia (DRP) , desquamative Interstitial Pneumonia (DIP) , early anti MD-5 antibody positive dermatomyositis pneumonia (AMD5P), and moderate H1N1 influenza pneumonia(H1N1P). B. Severe COVID-19P; acute interstitial pneumonia , advanced AMD5P, severe DRP, and severe H1N1P .2. Pathological Causes. A. Moderate COVID-19P and differential diseases shares either cellular infiltration, alveolar filling or, intraluminal organization. B. Severe COVID-19P and differential diseases share OP with supervening fibrosis and/or organizing diffuse alveolar damage. Note; all diseases have immunologic reaction. 3. Differentiation Points. A. Moderate COVID-19P: Moderate COVID-19 P; round ground-glass opacity (GGO). COP/EP/moderate DRP; relatively large amount of consolidation. DIP; emphysema in GGO. early AMD5P: rapidly progressing. B. Severe COVID-19P: Almost impossible, however, they share the same treatment such as ECMO, strong immune suppressive therapy , etc. With this exhibit, unnecessary repeated PCR , long isolation, and inappropriate therapy will be able to be reduced.

CHEE-57   Estimating Respiratory Volume By Measuring Thoracic Volume - Analysis Performed Using Respiratory Dynamics CT Data -

Participants
Hiroshi Moriya, MD, Fukushima, Japan (*Presenter*) Advisor, NantWorks LLCResearch Grant, Canon Medical Systems Corporation

TEACHING POINTS

Pulmonary function test requires a deep breath of the subject, so there is a high risk of droplets and aerosol diffusion. Therefore, we investigated a method for measuring respiratory function from the movement of the subject's body surface.1. Respiratory CT method2. Examining the correlation between lung volume and trunk volume from respiratory function CT data3. Estimate lung volume only from body surface measurements

TABLE OF CONTENTS/OUTLINE

Fifty patients who underwent four-dimensional respiratory dynamics CT (5-second respiratory cycle image) for preoperative diagnosis of lung resection.1. Measurement of lung volume: Extract the air region in the body and calculate the lung volume at each respiratory phase.2. Measurement of trunk volume: The trunk of the imaging range is extracted from the four-dimensional respiratory dynamics CT image, and the volume of the entire trunk in each respiratory phase is calculated.3. Comparison of volume fluctuations due to respiration Correlation and reliability evaluation of fluctuations in lung volume and trunk volume due to respiratory phase.4. Comparison of volume fluctuation and measured value of respiratory function test. In the case of chest breathing, the respiratory volume and the volume fluctuation of the thorax are almost the same. In the case of abdominal breathing, it is necessary to include the abdomen in the measurement.

CHEE-58   Role Of Imaging In Lung Transplantation: A Primer For Radiologists

Participants
Kaustav Bera, MBBS, Cleveland, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the history, indications and surgical techniques for lung transplantation.2. To discuss the role of various imaging modalities for patient selection and assessing the post-transplant complications of lung transplantation.3. To understand the spectrum of post-transplant imaging findings using a case-based format.

TABLE OF CONTENTS/OUTLINE

Introduction and history of lung transplantation. Indications and contraindications for lung transplantationTypes of lung transplants and surgical techniques for transplantationImaging modalities and their role for proper patient selection. Classification of post lung transplantation complications(with sample cases)a. Based on anatomy/etiologyi. Pulmonary parenchymal complications(reimplanatation response, rejection- hyperacute and acute rejection, infection, Posttransplantation Lymphoproliferative Disorder, Chronic lung allograft dysfunction (CLAD)recurrence of primary disease). ii. Pleural complications(Pneumothorax, air leak, hemothorax, pleural effusions, empyema). iii. Infections(Bacterial, viral and fungal). iv. Vascular complications (Vascular anastomotic stenosis). v. Airway complications(bronchial dehiscence and stricture). vi. Mechanical and other complications (donor-recipient mismatch, pulmonary torsion).b. Base on time of occurrencei. Immediate (<24 h).ii. Early (>24 h-1 week). iii. Intermediate (8 days-2 months).iv. Primary late (2-4 months).v. Secondary late (>4 months).

CHEE-59   "What Goes Around Comes Round" To The Lungs - A Pictorial Review Of The Different Radiological Presentations Of Pulmonary Metastases.

Participants
Camila Franco, BMedSc, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

I. Discuss the role of imaging in the initial assessment and follow-up of patients with suspected pulmonary metastases.II. Review

the most common tomographic patterns of pulmonary metastases and understand the main pathways of tumor spread to the lungs.III. Recognize atypical manifestations and complications of pulmonary metastases and their differential diagnosis.IV. Identify post-treatment changes and what is important to report.

TABLE OF CONTENTS/OUTLINE

1. The role of different imaging techniques in evaluating pulmonary metastases:a. Radiographyb. Computed tomography (CT)c. PET/CT2. Pathophysiology of tumor spread to the lungsa. Hematogenous spreadb. Tumor embolic. Lymphatic spreadd. Aerogenous metastasese. Pleural seeding and "drop metastases"3. Different (common and uncommon) presentations of lung metastases in specific casesa. Calcified metastasisb. Cavitated metastasisc. Hemorrhagic metastasisd. Spontaneous pneumothoraxe. Miliary metastasisf. Cannonball metastasisg. Pleural carcinomatosis and "drop metastases"4. Post-treatment changesa. Surgeryb. Radiotherapy modalitiesc. Ablation techniques

CHEE-6   When To Call On-call: 15 Must Know Portable Cxr Cases And Mimics

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Leah Strickland, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand the technical challenges of portable radiography 2. Discuss common artifacts and mimics that lead to portable chest radiograph misinterpretations 3. Review must know portable chest x ray cases

TABLE OF CONTENTS/OUTLINE

Portable Radiograph Technique - 1. Comparison with standard PA chest radiographs 2. Technical and quality challenges 3. Patient factors (phase of respiration, patient rotation); Lines that don't end where they should - 1. Cases: Chest tubes, left paramediastinal cath tips, IAPBs, ECMO; Not the textbook pneumonia - 1. Cases: Lower lobe collapse, torsion, cavitary pneumonia, abscess 2. Mimics: overlying soft tissue, layering pleural effusion, atelectasis, aspiration, technical factors; Where is that air? - 1. Cases: Pneumothorax (floating fat pad sign, deep sulcus sign), pleural effusion, hydropneumothorax, pneumomediastinum (Naclerio V sign of esophageal rupture) 2. Mimics: Pneumothorax (skinfold artifact, severe bullous emphysema), Pleural effusion (asymmetric overlying soft tissue, patient rotation), Pneumomediastinum (mach effect, pneumopericardium, major fissure with lordotic positioning, medial pneumothorax, inflated IABP); The mediastinum is too wide - 1. Cases: Hematoma, pericardial effusion 2. Mimics: Mediastinal widening (soft tissue, technical factors); There's something on the edge of the film - 1. Cases: cupola sign (pneumoperitoneum), shoulder dislocation 2. Mimics: Free air (stomach gas)

CHEE-60   Beyond Pulmonary Embolism Diagnosis: Advanced Clinical Applications Of Dual-energy Lung CT

Awards
Certificate of Merit

Participants
Daisuke Yamada, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Dual-energy lung CT has been used for diagnosing pulmonary thromboembolism (PTE); however, the applications are actually diverse. The teaching point of this exhibit is to demonstrate the imaging findings of dual-energy CT in lung diseases in addition to PTE.

TABLE OF CONTENTS/OUTLINE

1. To demonstrate the principle of dual-energy CT. 2. To demonstrate pseudo lesions that can be mimics 3. To demonstrate the imaging findings of dual-energy CT for lung diseases in addition to PTE. Cases include : Pseudo lesion •Misalignment of scan timing for contrast-enhanced •Beam hardening artifact •Respiratory motion artifact •Metal artifact Abnormalities of bronchial/lung parenchyma •Bronchial atresia •Congenital pulmonary airway malformation (CPAM) •Emphysema •Acute Exacerbation in Interstitial Lung Disease •Combined pulmonary fibrosis and emphysema (CPFE) Abnormalities of pulmonary blood vessels •Pulmonary tumor thrombotic microangiopathy (PTTM) •Chronic thromboembolic pulmonary hypertension (CTEPH) •Hepatopulmonary syndrome •Coronavirus disease 2019 (COVID-19) •Varicella Zoster virus (VZV) vasculitis •Intravascular lymphoma •Major thoracic vascular invasion of lung cancer •Pulmonary vein stenosis after catheter ablation

CHEE-61   Pleural Effusion: What Every Radiologist Should Know

Participants
Llúria Cornellas Escayola, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:- To review pleural effusion's main features regarding its etiology, epidemiology, clinical aspects and management.- To depict the main findings in various imaging modalities and their clinical implications.- To update key concepts in the role of imaging-guided interventional procedures in pleural effusion's management.

TABLE OF CONTENTS/OUTLINE

1. Pleural effusion: definition, etiology and clinical aspects.2. Imaging findings in pleural effusion: a pictorial review - Chest x-ray - Ultrasound - Computed tomography - Magnetic resonance imaging3. Imaging-guided interventional procedures in pleural effusion: - Thoracentesis - Pleural biopsy - Pleural drainage

CHEE-62   Interpreting Portable Chest X-rays: Pears And Pitfalls

Participants
Stacey V. Weisman, MD, Port Washington, New York (*Presenter*) Nothing to Disclose

1. Portable chest x-rays are common, but often difficult to interpret, due to limitations such as magnification, overlying hardware, supine position of the patient, and often very ill patients with complex health conditions and many multiple x-ray abnormalities. 2. A systematic approach is key to accurate interpretation. 3. Special attention should be made to certain blind spots on the image, where abnormalities are often overlooked. 4. For post-operative x-rays, understanding potential complications, and therefore knowing what to look for, is key. 5. It is important to recognize how the imaging appearance of both normal and abnormal x-ray findings may differ between the supine and upright position.

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I) Over-diagnosis A) Magnification of the mediastinum and pulmonary vasculature B) The effect of body habitus C) The effect of positioning (supine versus upright; rotation) II) Blind spots A) Superimposed on the aortic knob B) Medial apices C) Near the hila D) Subcarinal region E) Anterior/posterior costophrenic angles III) Understanding post-operative complications A) Mediastinal hematoma B) Hemothorax and extra-pleural hematoma C) Torsion D) Sternal dehiscence IV) Common acute diffuse lung abnormalities A) Hydrostatic pulmonary edema B) Diffuse aspiration C) Pneumonia D) Acute lung injury V) Easily overlooked support device complications A) Hyperinflated endotracheal tube balloon cuff B) Catheter fracture and migration C) Retained guide wire

CHEE-63   Thoracic Vasculitis: Survival Guide For A Radiologist

Participants
Llúria Cornellas Escayola, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:- To review the most relevant features of the main thoracic-involving vasculitis and the role of imaging techniques in their diagnosis.- To depict the thoracic imaging findings most commonly associated with vasculitis.- To update some aspects concerning vasculitis classification, diagnosis and treatment

TABLE OF CONTENTS/OUTLINE

1. Background2. The role of the imaging techniques in vasculitis management3. Imaging findings in thoracic-involving vasculitis:- Large-vessel vasculitis- Behçet disease- ANCA-associated small-vessel vasculitis- Other thoracic-involving vasculitis

CHEE-64   Micro CT Assisted Cross-modality Super-resolution - Toward Observing Micrometer-scale Anatomical Structure From Clinical CT Utilizing AI

Participants
Tong Zheng, Nagoya, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To learn the concept of super-resolution and its applications in radiology images2. To learn what micro CT is and how we build micro CT - clinical CT dataset to aid super-resolution of clinical CT images3. To understand how our AI system performs super-resolution of clinical CT images utilizing pre-prepared micro - clinical CT dataset4. To understand how the super-resolution of clinical CT images helps radiologists' diagnosis

TABLE OF CONTENTS/OUTLINE

1. AI-based super-resolution: fundamental concepts and application in radiology imaging- Super-resolution of radiology images utilizing medical AI2. Review of micro CT image scanning of excised lung- Resected lung specimen creation- Anatomical structures observable on micro CT images3. Building micro CT - clinical CT database for aiding clinical CT super-resolution- Micro CT scanning and clinical CT scanning of resected lung- Building aligned lung micro - clinical CT dataset by aligning micro - clinical CT images4. AI system for clinical CT super-resolution- Training medical AI on aligned micro - clinical CT images dataset- Using AI for finding the best super-resolution result automatically5. Super-resolution results of clinical CT images and our contributions- Super-resolution results of lung clinical CT images- One of possible applications: helping radiologists to measure bronchus' maximum diameter more precisely.

CHEE-65   Update On Chronic Thromboembolic Pulmonary Hypertension Imaging: What Lies Ahead?

Participants
Marta Porta Vilaro, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- -To describe image findings in chronic thromboembolic pulmonary hypertension (CTEPH) - -To compare the utility of the different techniques used for the radiological evaluation of CTEPH - - To describe imaging methods for the pretreatment assessment and treatment guidance

TABLE OF CONTENTS/OUTLINE

- Background - Classification of pulmonary hypertension - Diagnostic approach to pulmonary hypertension of unknown etiology - Physiopathology of chronic thromboembolic pulmonary hypertension - Imaging techniques in the diagnostic algorithm of pulmonary hypertension - CT angiography features of CTEPH - Dual Energy CT Angiography (DECT) - Perfusion patterns in CTEPH - Ventilation/Perfusion Scintigraphy and DECT comparison - Other Applications of the spectral imaging - Main differential diagnosis of CTEPH - Digital angiography - Treatment algorithm - Pre and Post-Thromboendarterectomy Evaluation - Balloon pulmonary angioplasty: pretreatment assessment and treatment guidance

CHEE-66   C.H.E.S.T: Trainee-focused Approach To Portable Chest X-ray

Participants
Daniela Garcia, MBBS, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Accurate interpretation of findings on portable chest x-ray can be challenging in critically ill patients 2. Critical findings can be

hidden on portable chest x-ray 3. Suboptimal technique impairs detection of normal and pathological findings 4. Comparison with previous studies improves diagnostic accuracy 5. Consistent, systematic approach may decrease the number of missed diagnoses in clinical practice

TABLE OF CONTENTS/OUTLINE

Portable chest x-ray is a first line imaging modality used on regular basis in clinical practice. Cost-effectiveness and time-saving are some of the strengths of this diagnostic tool; however, it bears considerable limitations in technique that impairs accurate interpretation, especially in the evaluation of critically ill patients. Historically, up to 30% of missed diagnoses have been acknowledged on chest x-ray. Familiarity with pitfalls like magnification, rotation, interpreter bias, among others must be addressed early in training to reduce missed diagnoses. Through an easy and memorable acronym in this image rich educational exhibit, we present a systematic approach targeted towards trainees with the goal of reducing missed diagnoses and errors in the interpretation of portable chest x-ray.

CHEE-67   Congo, Are You REaDy? Exploring The Cardiothoracic Manifestations Of Amyloidosis

Participants
Murillo Polizelli, MD, Sao Jose do Rio Preto, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching Points:I. Present epidemiology and types of amyloidosis elucidating its pathophysiology.II. Identify the cardiothoracic manifestations III. Recognize the main differential diagnoses

TABLE OF CONTENTS/OUTLINE

Table of Contents/Outline:1. Amyloidosis: a systemic diseasea. Epidemiology and clinical featuresb. Pathophysiology and subtypesc. Non-thoracic findings - some tips for the radiologist2. Amyloidosis and the Chesta. Pulmonary amyloidosis subtypesb. Tracheal amyloidosisc. Mediastinal amyloidosisd. Cardiac amyloidosis3. Differential diagnosis for cardiothoracic amyloidosisa. Lungsb. Trachea and main bronchi c. Mediastinumd. Heart

CHEE-68   Imaging Adults In Extracorporeal Membrane Oxygenation (ECMO): What The Radiologist Should Know.

Participants
Israel Diaz, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

Recognizing configurations variants and normal positioning of ECMO cannulas.How to identify displaced cannulas.Protocols for contrast enhanced studies in ECMO.ECMO-related complications.

TABLE OF CONTENTS/OUTLINE

ECMO systems: Venoarterial (VA-ECMO) or venovenous (VV-ECMO).Normal positioning of cannulas in different ECMO configurations: femoro-jugular VV-ECMO, femoro-femoral VV-ECMO, dual lumen cannula VV-ECMO, femoro-femoro-jugular VAV-ECMO, central VA-ECMO, peripheral VA-ECMO.Imaging modalities and ECMO: Ultrasound, portable chest radiographs, CT scans.Chest radiograph features: normal position of cannulas, what to include on the report, and how to recognize a displaced cannula.CT scan: How to perform a contrast enhanced study in patients on ECMO, contrast enhancement protocols in venoarterial and venovenous devices.ECMO related complications: Pneumothorax, pneumomediastinum, arterial dissection, pseudoaneurysm, hematoma.

CHEE-69   Targeted Therapy In Lung Cancer: Concepts And Radiological Implications

Participants
Ioannis Vlahos, MRCP,FRCR, Houston, Texas (*Presenter*) Director, Grayscale Ltd;Co-owner, Grayscale Ltd;

TEACHING POINTS

To understand:1. The principles of targeted therapy in lung cancer2. The associated impact on radiological appearances, surveillance and management.

TABLE OF CONTENTS/OUTLINE

Based on the multidisciplinary meeting proceedings of a tertiary lung cancer referral center at a major cancer center this case-based review will highlight current radiological issues in the management of lung cancer with targeted therapies.Topics covered will include:• A guide to targetable genes for radiologists• Mechanism, use and imaging of existing targeted therapy (EGFR, ALK)• Novel targeted therapies (ROS1, RET, BRAF, KRAS)• Distinct radiology/demographics of activated mutation lesions• Expected timelines of response, modified response assessment• Drug generations, expected differences in regional response (e.g. pulmonary versus brain), toxicity imaging• Treatment Resistance: expected effect duration, imaging escape mutations (e.g T790M, C797S)• When to re-biopsy (Loss/Gain of mutations, Small Cell Transformation, non-mutation resistance)?• Impact of liquid biopsy and next gen sequencing on physical biopsy• Impact of combined therapy on radiology assessment, outcome and combination toxicity

CHEE-7   Pictorial Review Of Ulcer-like Projections In Thrombosed False Lumen Of Aortic Dissection

Participants
Xi He, Nagasaki, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To explain the pathology of ulcer-like projections (ULPs)2. To explain the complications associated with ULPs.3. To show imaging findings of ULPs in thrombosed false lumen.4. To know clinical significances of different imaging findings of ULPs development.5. To discuss the therapeutic strategies and management of ULPs.

TABLE OF CONTENTS/OUTLINE

1. Explanation of pathology of ULPs.2. Explanation of complications related to ULPs.3. Explanation of CT findings of ULPs in different

developing stages.4. Explanation of clinical significances of CT findings of ULPs.5. Explanation of treatment strategies of ULPs in various circumstances.6. Illustrative cases- Presentation of CT findings of ULPs in thrombosed false lumen.- Presentation of complications of ULPs, including aneurysmal change or rupture of ULP, or both, and the relative effects.7. Discussion8. Directions and summary

CHEE-70   Acute Respiratory Distress Syndrome: Imaging Findings And Correlation With The Pathological Stage Of The Disease.

Participants
Alberto Paternain, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the definition and causes of acute respiratory distress syndrome (ARDS).To show the pathological stages of this nonspecific inflammatory condition of the lung.To illustrate the radiological findings (both on X-ray and CT) of the different phases of the disease. To identify and recognize possible complications related to ARDS with the different imaging tests.To provide the most relevant differential diagnosis.To review the management and prognosis of patients with ARDS in the ICU.

TABLE OF CONTENTS/OUTLINE

A. ARDS:- Definition (criteria).- Causes and clinical disorders associated with ARDS: direct and indirect lung injury. B. Pathophysiology.- Stages of the disease (exudative, inflammatory and fibroproliferative phases).C. Correlation of imaging findings with pathological stage of the disease.- Exudative or acute phase (1-7 days): anteroposterior density gradient.- Proliferative or intermediate phase (8-14 days): patchy airspace and reticular opacities; thickening of the alveolar septa; bronchiectasis and honeycombing, as signs of poor prognosis.- Fibrotic phase (>15 days): Thick reticular pattern and ground-glass opacifications in the anterior region of the lung; pulmonary cysts and bullae.- Resolution phaseD. Complications:- Barotrauma: pneumomediastinum and pneumothorax- Pneumonia and abscesses.?. Differential diagnosis: cardiogenic edema, diffuse hemorrhage and acute interstitial pneumonia.F. Management and prognosis.

CHEE-71   Get To The Heart Of The Matter: What Every Radiologist Needs To Know About CT TAVI/TAVR Planning.

Participants
Irline Cordeiro de Macedo Pontes, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Computed tomography (CT) in context of transcatheter aortic valve implantation (TAVI)/ transcatheter aortic valve replacement (TAVR) has become widely used. In this way, radiologists must be familiarized with the main parameters of such exams. Therefore, the aim of this exhibit is to:1. Review the anatomy of the thoracic aorta.2. Describe the CT protocol in the context of TAVI/ TAVR, including the technical parameters and contrast administration.3. Detail the key points which need to be assessed in a CT before and after TAVI/ TAVR.4. Highlight the essential components of the report.

TABLE OF CONTENTS/OUTLINE

1. Introduction: the increasing role of CT in context of TAVI/ TAVR.2. Anatomy of the thoracic aorta.3. CT protocol.4. Assessment:- Aortic root.- Coronary arteries.- Vascular access.- Incidental findings.- Post TAVI/TAVR.5. Report.

CHEE-72   Pulmonary Infection Or Malignancy: A Case-based Quiz With Radiologic-pathologic Correlations

Participants
Marcelo Mota, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To illustrate typical and atypical imaging features of the most common infections that mimic pulmonary malignancies in a quiz-based approach. - To integrate clinical, imaging and histopathologic data in creating a differential that may establish a diagnosis in challenging cases. - To review current and future strategies for benign versus malignant differentiation in the textural analysis era.

TABLE OF CONTENTS/OUTLINE

Introduction - Infectious diseases are common causes for pulmonary nodule, mass or nodal disease and can mimic or co-exist with malignancy. - Histopathological correlations are essential for precise diagnosis and appropriate treatment. Interactive case-based quiz - Illustrative cases with radiologic-pathologic correlations. Clinical and imaging findings - Clues for differential diagnosis. Present and future directions - Textural analysis and other new techniques. Take home messages

CHEE-73   Surgical Repair Of Chest Wall Abnormalities: What The Radiologist Needs To Know

Awards
Certificate of Merit

Participants
Thomas Battey, MD, Charlottesville, Virginia (*Presenter*) Nothing to Disclose

TEACHING POINTS

The management of congenital chest wall anomalies is commonly surgical. Imaging plays an important role in treatment planning and post-operative surveillance.After viewing the exhibit the learner will be able to:Understand relevant chest wall radiologic anatomy Recognize most common clinically significant congenital abnormalities of the chest wallDescribe characteristic imaging findings that impact managementIdentify related surgical interventions, postoperative imaging findings, and common complications

TABLE OF CONTENTS/OUTLINE

1. Illustration of radiologic chest wall anatomy2. Most common congenital abnormalities, imaging findings and surgical management thereof:Pectus carinatum/excavatum: Sternal depression/protrusion quantifiable with Haller index, treated with Nuss or Ravitch procedureJeune dysplasia: Bell-shaped narrow thorax causing chest wall rigidity, surgery tailored to patient anatomyPoland

syndrome: Nongenetic absence of unilateral pectoralis muscles, treated with omental flap reconstruction if lung herniation, lung/cardiac injury, or cosmetic concernsCleidocranial dysostosis: Incomplete ossification of the clavicles, improper development of pubic bones, vertebrae, long bonesSprengel Deformity: Elevation of the scapula, omovertebral barCervical rib: Supernumerary rib originating from C7, can cause thoracic outlet syndrome, treated with rib resection, vascular stenting3. Imaging findings of post surgical complications4. Conclusions

CHEE-74 Radiogenomics In Lung Cancer: New Approaches Toward Diagnosis And Treatment In The Precision Medicine Era

Participants
Karla Schoen, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

? Summarize basic concepts of genomics in lung cancer.? Describe the concept of radiogenomics and its role in a systems biology approach. ? Explain the radiogenomics workflow process. ? Present the most relevant applications of radiogenomics in lung cancer imaging, focusing on non-small lung cancer. ? Discuss the limitations and challenges to be overcome before its implementation into clinical routine.

TABLE OF CONTENTS/OUTLINE

? INTRODUCTION - General concepts: precision medicine, "omics" integrative framework, radiomics and radiogenomics ? LUNG CANCER MUTATIONS AND TARGETED THERAPIES - Systems Biology Approaches in Lung Cancer: genomics, next-generation sequencing and other "omics" research - Clinical perspectives: molecular pathways and therapeutic targets ? RADIOMICS AND RADIOGENOMICS - A PRACTICAL GUIDE - Image acquisition - Creation of a dataset - Image segmentation - Feature extraction and categories - Feature selection and prediction model - Validation ? RADIOGENOMICS APPLICATIONS IN NON-SMALL CELL LUNG CANCER - CT imaging - PET-CT imaging (metabolic radiogenomics) ? DATA INTERPRETATION - Systematic approach to evaluate the results published in the literature ? LIMITATIONS AND CHALLENGES - Limitations, pitfalls and challenges ? FUTURE DIRECTIONS - What is on the horizon?

CHEE-75 A Heavy Burden Of Chest Neoplasms: A Diverse Spectrum Of Radiologic-pathologic Correlation.

Awards
Certificate of Merit

Participants
Jossue Espinoza SR, MD, Lima 01, Peru (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Illustrate imaging features of the common and rare chest wall malignant neoplasms. 2. Emphasize the role of multiparametric MRI techniques in establishing the diagnosis, follow-up during and after treatment, and evaluation for residual disease after surgery. 3. Review histopathologic correlations of the common and rare chest wall malignancies. 4. Emphasize diagnostic difficulties, potential pitfalls and differential diagnoses of these masses.

TABLE OF CONTENTS/OUTLINE

The goals of this exhibit are to: Provide a pictorial review of the diverse imaging appearances of the chest wall neoplasms. Discuss specific imaging and pathological characteristics of the several rare and unusual chest wall malignancies. Familiarize the audience with the imaging features of the chest wall malignant masses, thereby helping in formulation of a complete differential diagnosis. Describe the importance of multiparametric MRI techniques that include: • DWI and exponential ADC maps in assessment of tumor cellularity • Perfusion MRI and dynamic contract enhanced imaging in estimation of vascularity, tissue perfusion and capillary permeability The entities include: Chondrosarcoma Osteosarcoma Ewing Sarcoma Plasmacytoma Liposarcoma Angiosarcoma Malignant peripheral nerve sheath tumor Metastasis Chest wall invasion by intrathoracic malignancies Lymphoma Radiation-associated malignancies

CHEE-76 High-attenuation Pulmonary Abnormalities - Pictorial Essay And Systematic Approach.

Participants
Ana Duarte, MBBS, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- To review the conditions associated with both focal and diffuse lung high attenuation lesions.2- Help general radiologists to recognize the patterns and distribution of high attenuation lesions of the lung.3- To propose a new systematic approach to high-attenuation abnormalities based mainly on their distribution in the lung parenchyma.4- To illustrate image findings of diverse causes of high attenuation lesions of the lung.

TABLE OF CONTENTS/OUTLINE

(A) Focal high-attenuation lesions.(B) Diffuse high-attenuation lesions in upper lung fields.(C) Diffuse high-attenuation lesions in lower lung fields.(D) Non-preferential field distribution: perilymphatic, vascular and randomic high-attenuation lesions.

CHEE-77 Expecting The Unexpected: A Practical Imaging Review Of (un)expected Pathologies Of The Pulmonary Arteries.

Participants
Melody Lebouche, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Discuss the role of imaging in the initial evaluation of the pulmonary arteries.2. To review clinical and epidemiological features of different pulmonary artery diseases.3. To discuss and illustrate unusual conditions of pulmonary arteries, going beyond classic pulmonary embolism. 4. To provide tips and tricks on identifying pitfalls on pulmonary arteries evaluation and protocol optimization

TABLE OF CONTENTS/OUTLINE

1. The role of different imaging techniques in evaluating pulmonary arteries and their diseases- Radiography- Computed tomography (CT) and Computed tomography angiography- Angiography- Magnetic resonance2. Pulmonary thrombotic and non thrombotic embolism -Multiples types of embolism- Synthetic embolism: vertebroplasty cement, valve RA-PT with endocarditis, catheter tip, projectile embolus.- Chronic thromboembolism3. Aneurysm- Rasmussen4. Vasculitis- Behçet- Takayasu- Giant cell arteritis5. Neoplasm- Angiosarcoma- Pulmonary neoplasm involving pulmonary artery- Tumor embolism6. Congenital- Pulmonary artery agenesis- Pulmonary artery sling - Aortic origin of a pulmonary artery- ARCAPA and ALCAPA- Pulmonary atresia

CHEE-78   Imaging Of Thymus In The Textural Analysis Era: New Insights Into Radiologic-Pathologic Correlations

Participants
Samya Alves, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

This presentation aims to: Discuss the role of imaging in the evaluation of thymic lesions, focusing on benign versus malignant differentiation; Summarize the most important imaging and histopathologic features listed in the main staging systems for thymic malignancies; Review imaging and histopathologic features in the differentiation of low- and high-grade thymic malignancies; Present recent insights in the histology prediction of thymic lesions using textural analysis techniques.

TABLE OF CONTENTS/OUTLINE

NORMAL THYMUS: Normal anatomy, radiography, ultrasound, computed tomography and magnetic resonance imaging; Histopathology of the thymus: a guide for radiologists. BENIGN THYMUS: Case-based review with radiologic-pathologic correlations; Pearls and pitfalls. MALIGNANT THYMUS: Case-based review with radiologic-pathologic correlations; Pearls and pitfalls; Clinical-pathologic staging systems for thymic malignancies: Masaoka-Koga, World Health Organization (WHO) and International Thymic Malignancy Interest Group (ITMIG); Resectability assessment: what to report?. RADIOMICS AND TEXTURAL ANALYSIS: General concepts; Applications, challenges and perspectives in thymic malignancies.

CHEE-79   Getting Reacquainted With The Subclavian Artery

Awards
Identified for RadioGraphics
Cum Laude

Participants
Caroline Robb, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

• The subclavian artery is an important structure that, given its location at the periphery of the field of view, is often overlooked on routine chest, and head and neck imaging. • Radiologists should be aware of the normal anatomy of the subclavian artery in relation to surrounding structures, as well as common and uncommon anatomic variants. • Radiologists play a key role in evaluating the subclavian artery and determining its potential role in a variety of pathologies, including entities such as thoracic outlet syndrome, subclavian steal syndrome, vasculopathies, and trauma. • The subclavian artery can play a key role as a thoracic collateral vessel and may contribute to potential complications, including endoleak and hemoptysis. • Post-procedural changes from prior vascular access may mimic vascular pathology. Given the increasing utilization of the subclavian artery for vascular access, radiologists must be able to distinguish true subclavian arterial pathology from potential mimics.

TABLE OF CONTENTS/OUTLINE

• Review the normal anatomy of the subclavian artery, and common and uncommon anatomic variants. • Examine pathologies that can affect the subclavian artery, including thoracic outlet syndrome, subclavian steal syndrome, vasculopathies, and trauma. • Evaluate the subclavian artery's role as a collateral vessel and how associated complications may present. • Discuss the appearance of mimics of subclavian pathology and how to distinguish these mimics from true pathologic entities.

CHEE-8   Radiological Intervention Of Type 2 Endoleak After Endovascular Aortic Aneurysm Repair

Participants
Xi He, Nagasaki, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To explain various causes of type 2 endoleak after endovascular aortic aneurysm repair.2. To show imaging findings of type 2 endoleak after endovascular aortic aneurysm repair.3. To explain therapeutic strategies of type 2 endoleak after endovascular aortic aneurysm repair.4. To show interventional radiology procedures in the management of type 2 endoleak after endovascular aortic aneurysm repair.

TABLE OF CONTENTS/OUTLINE

1. explaination of various causes and therapeutic strategies of type 2 endoleak after endovascular aortic aneurysm repair.2. Illustrative cases- Review of imaging findings of type 2 endoleak after endovascular aortic aneurysm repair.- Review of interventional radiology procedures in the management of type 2 endoleak after endovascular aortic aneurysm repair.3. Discussion4. Directions and summary

CHEE-80   Thoracic Findings In Hepatic Cirrhosis Patient

Participants
Ana Duarte, MBBS, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- To review and illustrate main chest CT complications in cirrhotic patients 2- To recognize how these pulmonary alterations may correlate with the patient's outcomes

TABLE OF CONTENTS/OUTLINE

(A) Brief epidemiology and pathophysiology of thoracic findings in a cirrhotic patient. (B) Cirrhosis, its complications and the Chest: - Hepatopulmonary syndrome. - Portopulmonary hypertension. - Intrathoracic portosystemic collateral vessels. - Hepatic hydrothorax. - SARS and Lung infections in cirrhotic patients. (C) Cirrhosis common cases and the Chest: - Hepatocellular carcinoma metastasis to the chest - Interstitial lung diseases induced by medications frequently used in patients with cirrhosis and their complications. (D) How chest alterations in the context of cirrhosis may affect patients prognosis and eligibility to liver transplantation

CHEE-81   Pseudoaneurysms Of The Chest: Infrequent But Lethal

Participants
Patricia Rios, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the main causes and clinical importance of pseudoaneurysms of the chest2. To describe imaging findings of pseudoaneurysms in different intrathoracic locations3. To review therapeutic options and illustrate imaging characteristics in post-treatment follow-up4. Outline the primary differential diagnosis

TABLE OF CONTENTS/OUTLINE

1. Definition of pseudoaneurysms2. Etiology of pseudoaneurysms of the chest3. Classification of pseudoaneurysms of the chest: aortic, pulmonary artery, pulmonary vein, and cardiac pseudoaneurysms4. Imaging findings in computed tomography angiography (CTA) of aortic pseudoaneurysms: aortic root, ascending and descending aorta. Differential diagnosis and post-treatment follow-up5. Imaging findings in CTA of pulmonary artery pseudoaneurysms. Selective pulmonary angiography treatment6. Imaging findings in CTA of pulmonary vein pseudoaneurysms (intrapericardial and extrapericardial). Treatment by Brockenbrough technique7. Imaging findings in CTA of cardiac pseudoaneurysms. Main differential diagnosis

CHEE-82   Differential Diagnosis Of Endobronchial Lesions - A Pictorial Essay

Participants
Ana Duarte, MBBS, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

(A) Discuss the role of imaging in detection and characterization of endobronchial lesions and the importance of a clear communication with the referring physician (B) Review the main pathologies that may present with endobronchial lesions and its imaging patterns on multimodality imaging and correlate them to bronchoscopy(C) Describe imaging pearls and pitfalls related to luminal lesions and familiarize to features that can help distinguish inflammatory from neoplastic lesions

TABLE OF CONTENTS/OUTLINE

The role of different imaging techniques - Radiography- Computed tomography (CT)- Magnetic resonance (MR)- PET/CTMain pathologies - cases from our institution - Malignant endobronchial neoplasms- Benign endobronchial neoplasms- Endobronchial vascular lesions- Endobronchial infections- Foreign body- Secretion / mucous plug - Amyloidosis (tracheobronchial)- BroncholithiasisDifferential diagnosis - a practical approachWhat is important to report - a suggestion of structured report

CHEE-83   Acute Aortic Syndrome: Think Fast, Act Faster! A Radiology Residents Guide

Participants
Laura Machado, MD, Darby, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To describe pathophysiology (including emerging concepts) and characteristics CT findings pertinent for intramural hematoma, penetrating aortic ulcers and aortic dissection-Discuss worrisome features of each entity-Outline a practical approach for quick and effective radiology reporting

TABLE OF CONTENTS/OUTLINE

-Types of aortic syndromes: brief discussion on pathophysiology including emerging concepts on IMH etiology-Pictorial review of acute aortic syndromes with specific necessary information to include in the radiology report-Demonstrate worrisome features associated with risk of progression and death, such as size and depth of PAU and ulcer like projections as well as extension of IMH-Pseudoaneurysms imaging characteristics and how to differentiate from PAU-Discussion of appropriate treatment and brief review on postop imaging

CHEE-86   Lung Transplantation Related Complications On Chest Imaging: A Guide For The Radiologist

Participants
Damaris Goncalves, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are: • To list the main indications for lung transplantation (LT) in adults; • To illustrate with computed tomography (CT) images the signs of LT; • To illustrate the main complications of LT surgery, organizing them according to the time after transplantation they tend to show up (whether immediately - in the first 24 hours; early - in up to 2 months; or late - more than 2 months after the procedure).

TABLE OF CONTENTS/OUTLINE

- Brief summary on LT; - Main indications for LT; - Signs of LT on imaging; - Classification of main complications according to time of onset after LT; - Chest images of immediate (pneumothorax, pneumomediastinum, medical device mispositioning), early (acute rejection, infection, pulmonary embolism, bronchial dehiscence) and late (chronic lung allograft dysfunction, bronchial stenosis, organizing pneumonia) complications of LT.

CHEE-87   Pulmonary Findings In COVID-19 Recovery Phases: What Do We Know So Far?

Awards
Certificate of Merit

Participants
Mariana Peleja, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1) To review usual and unusual cases from the recovery phases from the COVID-19 infection.2) To present imaging findings of post-COVID-19 pulmonary fibrosis.3) To discuss late pulmonary complications related to COVID-19 infection.4) To compare the differences between the acute and the recovery phases of COVID-19.5) To go through several COVID-19 aspects on chest CT and facilitate radiological understanding and diagnosis.6) To highlight their characteristics in order to familiarize radiologists with these conditions, preventing unfavorable patient outcome.

TABLE OF CONTENTS/OUTLINE

1) Evolutionary tomographic aspects of COVID-19 infection from response to recovery.2) Review of imaging findings according to illustrative cases of:a) Pulmonary fibrosis;b) Long-term infection;c) Reinfection;d) COVID-19 simultaneous infection with other pathogens;e) COVID-19 complications: pulmonary embolism and pneumomediastinum.3) Reporting language for CT findings related to COVID-19 recovery phase.4) Sample cases of pearls, pitfalls, diagnostic difficulties, and mimics.5) Summary and gained knowledge.

CHEE-88   Solitary Fibrous Tumors: Not So Solitary After All

Participants
Christopher Sears, MD, Charlottesville, Virginia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Solitary fibrous tumors (SFTs) are rare neoplasms of mesenchymal origin, representing less than 2% of all soft tissue tumors. While initially thought to involve the pleura exclusively, numerous extra-pleural sites have been described, such that these so-called extra-pleural solitary fibrous tumors (ESFTs) are in fact more common.After reviewing this educational exhibit the learner will be able to:1) Recognize the most common ESFTs2) Describe the imaging characteristics of ESFTs according to location3) Recognize the most common differential diagnosis of ESFT4) Identify the role of imaging in the diagnosis and management of ESFTs

TABLE OF CONTENTS/OUTLINE

1) Overview of ESFTs2) Imaging Characteristics according to location: the role of imaging in diagnosis3) Case-based review of most common ESFTs and differential diagnosis

CHEE-89   What Radiologists Need To Know About Extracorporeal Membrane Oxygenation (ECMO): Expected And Abnormal Imaging Appearances

Awards
Certificate of Merit

Participants
Felipe Sanchez, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to:1. To review the basics concepts and different types of ECMO.2. To discuss the technical consideration for performing contrast-enhanced CT examinations in patients with ECMO.3. To illustrate the normal appearance and complications of ECMO in chest X-ray and chest CT.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Basics of ECMOa. Backgroundb. Types of ECMO: cannula position and indicationsi. Veno-venous ECMOii. Veno-arterial ECMOc. ECMO in the COVID-19 pandemic3. Technical considerations for contrast-enhanced CT during ECMOa. Parenchymal enhancement and CTAb. CT pulmonary angiography4. Normal imaging appearancea. Expected appearance on Chest radiographyb. Expected appearance on CT5. ECMO complicationsa. Abnormal cannula position/migrationb. Intracranial hemorrhagec. Intrathoracic complicationsi. Air collections.ii. Hemorrhagic complications.d. Abdominal complications6. Final considerations

CHEE-9   Test Your Knowledge: Lung Ultrasound From A-lines To Z-lines

Participants
Thomas Marini, MD, Rochester, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Lung ultrasound is a versatile and highly sensitive and specific imaging modality, yet interpreting lung ultrasound is not a routine component of diagnostic radiology education in the United States. In this presentation, we review all aspects of lung ultrasound for the diagnostic radiologist in an image-rich quiz format including the clinical indications for lung ultrasound imaging, the physics of lung ultrasound, the imaging features of pulmonary pathology on lung ultrasound, and the relationship between lung ultrasound and chest x-ray.

TABLE OF CONTENTS/OUTLINE

Quiz questions will be predominantly case-based with example lung ultrasound images. Initial questions will focus on image acquisition in lung ultrasound and the basic clinical indications for its use. Questions involving ultrasound physics will involve both illustrative case examples and original illustrations. The remainder of the presentation will highlight pulmonary pathology on lung ultrasound including common entities like pneumonia, pulmonary edema, and pleural effusion as well as less frequently encountered disease states like pulmonary abscess, empyema, vaping-induced lung injury, and COVID-19 infection.

CHEE-90   Advanced Techniques And Clinical Utility Of Computed Tomography Temporal Subtraction

Participants
Takatoshi Aoki, MD, PhD, Kitakyushu, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To introduce advanced CT temporal subtraction techniques and their applications. 2. To recognize the clinical benefits of CT temporal subtraction method. 3. To understand the clinical implication and challenges of CT temporal subtraction method.

TABLE OF CONTENTS/OUTLINE

1. Introduction: Overview of CT temporal subtraction 2. Image registration method for CT temporal subtraction (feature-based registration, new image registration frameworks based on convolutional neural networks, etc.) 3. Application for CT temporal subtraction to reduce misregistration artifacts 4. Clinical studies of CT temporal subtraction for lung nodule detection 5. Clinical studies of CT temporal subtraction for bone lesion detection 6. Summary of the role of CT temporal subtraction and future challenges Summary; Temporal subtraction (TS) is one of the computer-aided detection techniques in which previous images are subtracted from current images so that interval changes are enhanced. We reviewed article introduces CT-TS techniques and their applications in assessing abnormalities on chest CT. To generate CT-TS images more precisely, further development of the region extraction methods and applications is desired.

CHEE-91   A Painful Path! A Comprehensive Imaging Review Of Pleural Fistulas From Diagnosis To Management

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Vaibhav Gulati, MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The expanse of the pleural space and its proximate relationships with various visceral and extra-thoracic spaces and organs makes it susceptible to developing a variety of fistulas with varying prognostic and management implications. 2. Although the clinical presentation can be quite varied, the different pleural fistulas share a common set of diagnostic findings. Given their rarity and often subtle imaging findings, the diagnosis of a pleural fistula can be missed or delayed resulting in significant morbidity. 3. The majority of the plural fistulas are secondary to surgery or foreign body related but they can also occur de-novo with infection or inflammation. The diagnosis of pleural fistulas is on the rise with increasing frequency of advanced anatomic and non-anatomic thoracic surgeries, often with use of intensive chemoradiation regimens which can predispose to poor anastomotic healing, in an already challenging patient cohort.

TABLE OF CONTENTS/OUTLINE

• Clinical features and epidemiology• Pathogenesis• Review of available imaging modalities• Direct and ancillary imaging features• Case examples with clinical and imaging pearls• Imaging pitfalls• Brief approach to management• Summary Of the various types of pleural fistulas including: o Pleuro-cutaneous o Broncho-pleural o Alveolar-pleural o Nodo-pleural o Pleuro-esophageal o Gastro-pleural o Pleural-pericardial o Pleural-subarachnoid o Pancreatico-pleural o Biliary-pleural o Colo-pleural o Nephro-pleural

CHEE-92   Gone, But Not Forgotten: Long-term Sequelae Of Pulmonary Infections

Participants
Abdullah Al Khalifah, MBBS, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To discuss the specific organisms that can produce chronic post-infectious pulmonary changes.• To identify imaging manifestations of various pulmonary infections and their evolution from the acute to the chronic phase.• To highlight the importance of recognizing these imaging patterns in order to provide guidance on microbiology testing and patient treatment.

TABLE OF CONTENTS/OUTLINE

• Types of pulmonary infections leading to possible long-term sequelae:o Bacterial (septic emboli, abscess, non-tuberculous mycobacterial infection).o Tuberculosis (Ranke complex, Ghon's focus, upper lobe fibrosis).o Histoplasmosis (fibrosing mediastinitis, histoplasmoma).o Aspergillosis (ABPA and bronchiectasis, mycetoma, air crescent sign).o Viral (post-acute COVID-19 or post-ARDS fibrosis, organizing pneumonia).• Review of characteristic imaging findings of long-term sequelae.• Analysis of current understanding of how acute phase imaging findings evolve into specific long-term sequelae.• Discussion of possible guidance on microbiology testing and patient management.

CHEE-93   What Should We Know About Immunotherapy And Pulmonary Reactions?

Participants
Camila V. Machado, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

After attending to this exhibit, the learner should be able to 1. Recognize the main manifestations associated with immunotherapy 2. Understand the risk factors for immunotherapy related pneumonitis 3. Describe the radiological patterns of immunotherapy related pneumonitis 4. Recognize the sarcoid-like reaction 5. Identify possible differential diagnoses

TABLE OF CONTENTS/OUTLINE

- Introduction to immunotherapy and associated adverse reactions through the body - Focus on immunotherapy related pneumonitis: risk factors and symptoms - Radiological patterns of immunotherapy related pneumonitis (diffuse alveolar damage, organizing pneumonia, non-specific interstitial pneumonia and hypersensitivity pneumonitis) - Sarcoid-like reaction - Pseudoprogression - Differential diagnoses (infection, edema, recurrence / progression, alveolar hemorrhage, pulmonary infarction, idiopathic interstitial lung diseases)

CHEE-94   2020: The Big Changes In The Diagnosis Of Hypersensitivity Pneumonitis (hp) In Adults, What Does The Radiologist Need To Know?

Awards
Certificate of Merit

Participants
Alan Hummel, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. What is hipersensitivity pneumonitis? 2. What were the major changes that occurred in 2020 in the new Diagnostic protocol published by the American tharacic society? 3. New PH diagnostic criteria4. Nonfibrotic PH5. Fibrotic PH6. Tips to make your day-to-day easier

TABLE OF CONTENTS/OUTLINE

1)Key recommendations2) Clinical and pathological features - The basic3) Radiological features4) Nonfibrotic phenotype - Typical HP or Compatible with HP- Parenchymal infiltration;- Small airway disease;- Distribution;5) Fibrotic phenotype - Typical HP or Compatible with HP or Inteterminate for HP- Lung fibrosis pattern and distribution;- Abnormalities that can indicate small airway disease- When can I suggest the indeterminate pattern6) Usual interstitial pneumonitis- Tips on how to differentiate

CHEE-95   Diffusion Weighted Imaging Of The Chest: A Primer For Radiologists

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Jordi Broncano, MD, Cordoba, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the physical mechanisms, acquisition schemes, artifacts, tips and tricks to adequately set up a diffusion weighted imaging (DWI) in a state - of - the - art chest magnetic resonance (ChMRI) protocol.2. To describe the clinical applications of DWI as a game - changer in the characterization of thoracic masses, staging chest tumors, differentiating potential pitfalls and treatment monitoring.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Physical basis and analysis of DWI • Monoexponential DWI • Intravoxel Incoherent Motion (IVIM) • Diffusion Kurtosis Imaging (DKI) • Computed DWI (cDWI) 3. How to set up DWI in a clinical ChMRI protocol • Important technical parameters • Cardiac and respiratory motion• Echo Planar Imaging DWI (EPI - DWI) • Turbo Spin Echo DWI (TSE - DWI) • Single shot vs. Multishot DWI • Artifacts: How to avoid them • Multiparametric ChMRI protocol 4. Clinical applications • Lung lesions o Lesion characterization o Lung cancer staging o Treatment monitoring • Mediastinal lesions • Cystic thoracic lesions • Chest wall tumors • Pitfalls: Value of multiparametric ChMRI • Surgical planning: hybrid DWI-CT 3D printing 5. Conclusions

CHEE-96   Aspergillosis Revisited

Awards
Certificate of Merit

Participants
Bruna Loureiro, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To conduct a brief review of the current classification from different forms of pulmonary aspergillosis and correlate it with the previously described patterns 2. Understand the clinical and immunological context of the host as a pathological basis for the different forms of disease involvement 3. Recognize the radiological findings from each form of aspergillus involvement in the lung, with emphasis on the chronic forms

TABLE OF CONTENTS/OUTLINE

1. Changes in pulmonary aspergillosis spectrum nomenclature2. Interplay between the pathogen and host immune dysfunction or hyperactivity3. Radiological findings in different forms of pulmonary aspergillosisa. Acute invasive aspergillosisb. Subacute invasive aspergillosisc. Chronic pulmonary aspergillosisi. Aspergillus noduleii. Single (simple) pulmonary aspergillomaiii. Chronic cavitary pulmonary aspergillosisiv. Chronic fibrosing pulmonary aspergillosisd. Allergic bronchopulmonary aspergillosis

CHEE-97   Imaging The Post-operative Lung And Pleura: What To Expect And What To Look Out For

Awards
Certificate of Merit

Participants
Cristina Marrocchio, MD, Trieste, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Be informed on the indications and types of surgical procedures of the lung and pleura.2. Be able to recognize the normal post-surgical chest X-rays findings and their evolution in time, in order to immediately recognize any abnormality.3. Review the CT findings that are to be expected immediately after the procedure and during follow-up.4. Have a comprehensive review of the early and late complications that may occur, their imaging appearance and the normal findings after surgical revisions.

TABLE OF CONTENTS/OUTLINE

1. Introduction: • Description of pulmonary surgical procedures (pneumonectomy, lobectomy and non-anatomical resections) and

surgical approaches (open or thoracoscopic). • Description of pleural surgical procedures, including pleurodesis and decortication.2. Chest X-rays and CT findings that are expected after surgery and their evolution in time, according to the pathophysiological compensatory mechanisms that occur in the thorax.3. Description of early complications, including:• Pulmonary edema, pneumonia, acute respiratory distress syndrome, atelectasis• Hemothorax, chylothorax, empyema• Bronchopleural fistula, persistent air-leak4. Description of late complications, including:• Infections• Bronchial anastomotic stenosis• Post-pneumonectomy syndrome• Esophageal-pleural fistula• Tumor recurrence

CHEE-98   Simplifying Lung Cancer Staging Classification

Participants
Marcelo Dutra, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are: 1. To simplify the 8th edition of the Lung Cancer Stage Classification (LCSC).2. To demonstrate a didactic method for learning and reminding important information on lung cancer staging, highlighting imaging features which should be stated in the radiology report. 3. To present the main changes that occurred in this latest version compared to the previous one. 4. To illustrate different manifestations of lung lesions at imaging in everyday practice. 5. Characterize lesions that are not included in this classification.

TABLE OF CONTENTS/OUTLINE

- Simple 5-question model to guide lung cancer staging - Adequate technique for lesion measurement and evaluation - Images of the main presentations of lung cancers and their prognosis - Images of the main relations of the lung lesion with surrounding anatomical structures - Classification of the tumor according to: Size. Relation to the adjacent thoracic structures. Identification of metastasis for clinical management.

CHEE-99   Chest Signs From A To Z: An Iconographic Guide.

Participants
Marina R. Rocha, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Describe and discuss some radiological signs used in thoracic radiology, detected both in plain radiography, and in computed tomography. (2) Favor the diagnosis of pathologies corresponding to the signs, and their differential diagnoses. (3) Expand the knowledge of these signs to radiologists and non-radiologists. (4) Emphasize that the main signs, associated with relevant clinical data, allows for a closer diagnosis and better patient care.

TABLE OF CONTENTS/OUTLINE

Several radiological images will be presented in each case, representing the most relevant signs and findings in chest radiology, listed below:(1) Air broncogram sign. (2) Air crescent sign. (3) Bat wing sign. (4) Bulging fissure. (5) Cervicothoracic sign. (6) Continous diafragma sign. (7) Comet tail sign. (8) Crazy paving sign.(9) Donut sign. (10) Eggshell calcification. (11) Finger in glove sign. (12) Ginko leaf sign. (13) Golden S sign. (14) Hamptons hump. (15) Hillum overlay sign. (16) Honeycomb. (17) Kerley lines. (18) Luftsichel. (19) Mosaic pattern. (20) Reversed halo sign. (21) Scimitar sign. (22) Silhouette sign. (23) Sinet ring sign. (24) Split pleura sign. (25) Tram track sign. (26) Tree-in-bud sign. (27) Westermark sign.

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Abstract Archives of the RSNA, 2021

Sub-Events

CAEE-1   Photon Counting Detector CT In Cardiovascular Imaging (CVI) - The Future Is Here

Awards
Cum Laude

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the physics & principles of photon counting detector (PCD) CT2. To discuss the advantages of PCD CT compared to conventional CT in cardiovascular imaging (CVI)3. To illustrate additional information and flexibility in CVI clinical applications using PCD CT in illustrative cases

TABLE OF CONTENTS/OUTLINE

PCD CT Physics & PrinciplesTechnologies of PCD CT- Single source, Dual sourceAdvantages of PCD CT- Multienergy binning- k-edge imaging- Improved spatial resolution- Elimination of electronic noise- Decreased artifacts- Lower radiation- Lower contrast dosesApplications of PCD CT in CVI with case examples- High iodine CNR- Low contrast dose, salvage of suboptimal studies, small vessel visualization- Perfusion imaging- Lungs, heart, muscles- Delayed iodine enhancement- Myocardial scar- Ultra-high resolution- Improved vascular definition, small vessels, stents, characterization of complex plaques, improved calcium scoring- Decreased artifacts- Calcium blooming, metal artifact, beam hardening- Decreased electronic noise- Useful in large patients- Potential for multi-contrast and novel contrast imaging - e.g- iodine & gadolinium- Approaches to radiation dose reduction - e.g., through use of virtual monoenergetic images- Advanced material separationLimitations, pitfalls- Additional, complex data- Noise in high-resolution mode

CAEE-10   Imaging Evaluation Of Congenital Abnormalities Of The Aorta: From Embriology To Pathology To 3d Modeling.

Participants
Sara Rodriguez, MD, Cali, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Abnormalities of the aorta account for a great percentage of the congenital cardiac abnormalities. Aortic arch malformations account for almost 20% of all malformations and aortic coarctation by itself corresponds to up to 8%.Congenital aortic malformations are caused by genetic mutations or by environmental factors. Understanding of the normal embryological development will facilitate the interpretation of the pathologic conditions affecting the aorta.Computed tomography (CT) and Magnetic Resonance Imaging (MR) can give more detailed information on the anatomy and function; therefore, they are usually used as a preoperative complementary tool. CT and MR can also give valuable information regarding other mediastinal and lung abnormalities.When evaluating CHD, it is important to do a segmental analysis, assessing sidedness of the heart, situs, atrioventricular connections, ventricoartial connections, and the aorta and pulmonary vessels.The objectives of this article are to describe the embryological development of the aorta, to review the pathologic conditions and its imaging findings and to discuss associated cardiac abnormalities. As a secondary objective, we will present some 3D models of the aorta.

TABLE OF CONTENTS/OUTLINE

IntroductionImaging protocolsNormal development of the aorta (embryology)Abnormalities of the ascending aortaAbnormalities of the aortic archAbnormalities of the descending aorta3D printingConclusions

CAEE-11   Cardiovascular Imaging In Women- Spectrum Of Normal And Abnormal

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the differences in normative values in women in cardiovascular imaging (CVI)2. To highlight differences in several critical parameters in women3. To illustrate the spectrum of cardiovascular abnormalities that affect women

TABLE OF CONTENTS/OUTLINE

Differences in quantitative CMR in women from men - Lower ventricular volumes & mass- Higher EF, strain- Higher native T1, ECV- do not increase with age- Higher T2- Smaller atrial volumesPathological conditionsA. Heart failure- Concentric modeling more common- Diastolic dysfunction common with ageB. Aortic stenosis- Lower mass, fibrosis, cavity size, stroke volume- Preserved EF, more diastolic dysfunctionC. Aortic regurgitation- LV dilation not seen, underestimates diseaseD. Coronary artery disease- Higher

nonobstructive coronary arteries- Higher rates of angina- MRI useful in acute coronary syndrome- Stress MRI in chronic syndrome for ischemia and microvascular dysfunctionE. MINOCA- Higher in women- Coronary microvascular dysfunction, coronary plaque erosion, TakotsuboF. Peripartum cardiomyopathy- Low EF, mid myocardial/subepicardial LGE, risk stratificationG. CMR In pregnancy-Dissection, coarctation, cardiomyopathy, myocarditis, complex CHDH. Breast cancer chemotherapy cardiotoxicity- Lower EF, abnormal strain- High T1, T2- LGEI. Connective tissue disease- Rheumatoid arthritis, systemic sclerosis, SLE, vasculitisJ. Women carriers- Muscular dystrophies, Fabry diseaseK. Turner syndrome- Bicuspid valve, coarctation, aortic dilation, PAPVR

CAEE-12　Pre-procedure And Post-procedure CT Angiogram In Transcatheter Bicaval Valve System Implantation

Participants
Ana Barrio Alonso, MD, Gijon, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Pre-procedure and post-procedure CT protocol. Mandatory measurements on pre-procedure CT. Post-procedure complications assessment.

TABLE OF CONTENTS/OUTLINE

BackgroundTricuspid valve disease is a common condition which is currently undertreated. Most patients with severe tricuspid regurgitation (TR) require medical treatment since surgical intervention is associated with high in-hospital mortality rates. Over the last few years, several transcatheter options have been specifically developed for TR treatment. Transcatheter bicaval valve systems are self-expanding biological valves which are implanted into the superior and inferior cava veins to reduce cava reflux and tricuspid insufficiency symptoms.Findings and procedure detailsMeasurements on pre-procedure CT are necessary to select patients and valves size. We obtained images using a Gated-ECG Cardiac Dual Source Multidetector Computed Tomography (MDCT). Images were transferred to a 3D Multi-Planar Reconstruction software (3D MPR) and measurements were taken by trained radiologists. Control post-procedure CT was performed in all patients.ConclusionsTranscatheter bicaval valve system is an innovative procedure wich requires measurements on CT with a specific pre-procedure protocol. This measurements must be taken by trained personal. Post-procedure CT is mandatory in order to detect eventual complications.

CAEE-13　Nuclear Medicine 101 For A Cardiac Radiologist

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

A cardiac imager should know the basics of nuclear medicine relevant to cardiovascular disease.1. To review the common nuclear medicine techniques used in cardiovascular imaging2. To illustrate the applications of common nuclear medicine techniques in cardiovascular diseases3. To correlate nuclear medicine findings with cardiac CT and/or MRI

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Role and advantages of nuclear medicine in cardiovascular diseases (CVD)3. Techniques - SPECT, SPECT/CT, PET/CT, PET/MRI4. Discussion of the following nuclear medicine techniques, including basic technical aspects, interpretation, correlation with cardiac CT/MRI and comparative diagnostic performanceA. Myocardial ischemia Physiological (exercise) or pharmacological stressSPECT- 201-Thallium or 99-Technetium PETAmmonia (13-NH3) oxygen (15-O2)B. Myocardial infarction-Evaluation of viability PET- FDGSPECT- Thallium redistributionC. SarcoidosisFDG-PET + PerfusionD. Other inflammatory disordersFDG-PETE. AmyloidosisBone scintigrams - Tc pyrophosphate, Tc- DPD, Tc-HMDP for ATTR types11C-Pittsburgh compound B (PiB)18F-Sodium Fluoride (NaF)F. Quantification of ejection fractionTechnetium labeled RBCs MUGA scanG. Cardiac masses FDG PET- primary & metastatic tumorsGa68 DOTATATE - Neuroendocrine tumors- ParagangliomasH. VasculitisFDG, TSPO agents, fibroblast activation protein (FAP)I. Infections of prosthesis and graftsFDG-PETLabeled WBCs (Tc or In-111)Ga 68J. Heart failureImaging autonomic nervous system

CAEE-14　Cardiac Magnetic Resonance In Acute Myocardial Infarction. A Step By Step Guide.

Participants
Miguel Cruz, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To review cardiac magnetic resonance (CMR) protocols in acute myocardial infarction (AMI).• Examine CMR sequences used in AMI and what information each of them provides: "must have" sequences and novel sequences that soon will be "must haves".• Provide a simple guide to interpreting CMR in AMI with endpoints and dobutamine stress imaging.• Outcomes and follow up.

TABLE OF CONTENTS/OUTLINE

1. A review of the impact of CMR in AMI.2. A review Imaging sequences: what you must have and what is novel.a. Must have: Scout, FSE, SSPF, T2, T2*, first pass perfusion, LGE.b. Novel: T1 and T2 Mapping and 3D angiography.c. Dobutamine stress.3. A step-by-step approach to sequence integration and interpretation in AMI.a. What each sequence means and how to proceed.4. Viability and myocardial salvage reasoning and interpretation algorithm in CMR for AMI.5. Outcomes and follow up.a. Complications: Aneurysm, thrombus, wall rupture.

CAEE-15　Outpouchings Of The Heart

Awards
Identified for RadioGraphics
Certificate of Merit

Participants

Cameron Hassani, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. Review the imaging appearances of various outpouchings of the heart, by chamber 2. Discuss the associated clinical findings for each outpouching, where relevant 3. Review associated imaging findings for each outpouching, where relevant

TABLE OF CONTENTS/OUTLINE

RA Subthebesian pouch Cavotricuspid isthmus RV Diverticulum Psuedoaneurysm (post cath) ARVD Constrictive pericarditis RVOT TOF aneurysm LA Accessory appendage Diverticula Septal pouch (incomplete closure) Interatrial septal aneurysm Heart transplant Partial absence of pericardium LV VSD (spontaneous closure) Patch aneurysm Ventricular Cleft (Myocardial Crypt) Diverticulum Aneurysm Apical Balooning Pseudoaneurysm Double left ventricle LVOT Pseudoaneurysm aortic mitral intervalvular fibrosa Sinus of Valsalva aneurysm (ruptured and non ruptured) Mimics Metastatic disease

CAEE-16   Precautions For Late Gadolinium Enhancement MRI Interpretation To Identify False Findings

Participants
Tomoyuki Kido, Toon, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Cardiovascular magnetic resonance imaging (MRI) can evaluate cardiac disease from various directions. In particular, late gadolinium enhancement (LGE) MRI can visualize fibrosis of the myocardium and plays an important role in myocardial characterization in clinical practice. Occasionally, LGE MRI presents various false findings, making diagnosis difficult. It is important for radiologists to know the types of false findings on LGE MRI and precautions for accurate image interpretation. The purpose of this exhibit is: 1.To review the role and principle of LGE MRI. 2.To explain the types of false findings on LGE MRI and their solutions. 3.To show points to note in interpretation for accurate diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Late gadolinium enhancement magnetic resonance imaging - Role, advantages, limitations. 2.Principle of LGE MRI. 3.Example images of false finding on LGE MRI. 4.How to reduce false finding on LGE MRI. 5.Points to note in interpretation of LGE MRI. 6.Future directions and summary.

CAEE-17   Diastology With Cardiac MRI- A Practical Guide

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

Diastolic dysfunction is an important cause of morbidity, accounting for 55 % of heart failure.1. To understand the basic concepts of normal and abnormal diastolic function2. To review the MRI techniques available for the evaluation of diastolic function3. To illustrate the role of MRI in the evaluation of patients with Heart Failure with preserved Ejection Fraction (HFpEF)

TABLE OF CONTENTS/OUTLINE

Diastolic functionEcho for diastolic function-normal, abnormal, pseudonormalDefinition of HFpEFMRI techniques for evaluation of diastolic functionA. Cine imaging-Left atrium (LA)---- LA relaxation---- LA enlargement----Contractile function- Left Ventricle (LV)----LV filling curve: Decreased peak filling rate & increased time to peak filling rates----LV fractional area change----Myocardial feature tracking- Abnormal LV relaxationB. Myocardial tagging-Abnormal LV relaxationC. Phase-contrast- Mitral inflow----E/A----Deceleration time of E peak filling velocity- Myocardial phase mapping----E/e' ratio- Pulmonary venous flow-----S, D, A waves- 4D flow----Intraventricular pressure gradients at late ejectionD. MR elastography- Increased myocardial stiffnessCase-based review of MRI in common causes of HFpEF- Infiltrative disorders (e.g. amyloid, sarcoid)- Storage disorders (e.g. Fabry disease)- Hypertrophic cardiomyopathy- Endocardial fibroelastosis- Radiation- Pericardial disorders- Hypertension, coronary artery disease

CAEE-18   Role Of Multimodality Imaging In The Planning And Follow-up Of Percutaneous Pulmonary Valve Implantation

Participants
Marguerite Faure, MA, Wilrijk, Belgium (*Presenter*) Nothing to Disclose

TEACHING POINTS

To discuss the role of percutaneous pulmonary valve implantation (PPVI) in patients with (repaired) congenital heart diseases involving the right ventricular outflow tract (RVOT). To show which transthoracic echocardiography (TTE) and MRI findings with regard to RV and pulmonary valve dysfunction contribute to establish the indication for PPVI. To demonstrate the role of computed tomography (CT) in pre-operative planning by evaluating the size and morphology of the RVOT and pulmonary trunk, valve sizing as well as assessing the risk of coronary compression. To give an overview of potential complications after PPVI including endocarditis. To discuss the role of TTE, MRI, CT, and positron emission tomography in the follow-up after PPVI to confirm normal valve functioning and possible complications.

TABLE OF CONTENTS/OUTLINE

1. Background of the PPVI procedure and commonly implanted valve types. 2. TTE, MRI, and CT analysis prior to PPVI: RV volume, valve functioning, quantification of pulmonary conduit, RVOT size and function and assessment of its morphology. 3. CT analysis prior to PPVI: assessment of coronary compression risk in candidate patients for PPVI. 4. Overview of potential complications after PPVI. 5. TTE, MRI, and CT imaging after PPVI: evaluating valve prosthesis, anatomical changes, and possible complications. Tips and tricks for image acquisition and interpretation with the different modalities. 6. MR imaging before and after PPVI: ventricular function and flow measurements including 2D and 4D flow in PPVI patients.

CAEE-19   Usefulness Of Simulated 3D-CT Imaging In Pulmonary Vein Isolation

Participants
Fumiaki Sasaki, BSC, Akita, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

In this exhibition, we will introduce pulmonary vein isolation (PVI) simulation 3D-CT images developed in our hospital. To understand the importance and efficacy of preoperative 3D-CT in PVI. To understand the observation points of preoperative 3D-CT in PVI. To emphasize that preoperative 3D-CT images can be used to simulate PVI in addition to understanding the anatomical structures. To emphasize that the suitable method of PVI can be selected from the 3D-CT.

TABLE OF CONTENTS/OUTLINE

Pathogenesis of atrial fibrillation. Anatomy of the left atrium and pulmonary veins. Types and characteristics of PVI method. Simulation image for radio frequency ablation (RFA). Simulation image for cryo balloon ablation (CBA). Utilization of 3DCT during PVI. Characteristics of pulmonary vein morphology that influence the difficulty of CBA.

CAEE-2   Utility Of Multi-modality Imaging In The Planning Of Complex TAVR Procedures

Awards
Certificate of Merit

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

TAVR has now been expanded to low-risk patients and several complex scenarios1. To review the complex clinical scenarios in which transcatheter aortic valve replacement (TAVR) is performed.2. To understand the role of multimodality imaging in the evaluation of complex TAVR3. To illustrate the specific measurements and adaptations required for CT in these complex situations.

TABLE OF CONTENTS/OUTLINE

Multimodality imaging in TAVR- Echo, CT, MRICT protocolsMRI in severe renal dysfunction- ProtocolReview of the following complex scenarios, with case examplesA. Low-flow low-gradient severe aortic AS- Aortic valve calcium score in CT (> 2000 in men, > 1200 in women)- Dobutamine stress echocardiography- Diagnostic algorithmB. Bicuspid valve- Morphological classification- Sizing of annulus- 2nd orthogonal plane parallel to device landing zone- Concomitant aortopathy- Horizontal aorta- < 30 degrees- Coronary artery anomalies- Coronary ostial heightC. Native aortic regurgitation- Large annulus- Poor visualization at fluoroscopy- Absent calcification- Impaired fixation in annulus- AortopathyD. Valve-in-valve (VIV) TAVR- Bioprosthetic valve evaluation- Prosthetic valve sizing- Virtual valve to coronary ostial distance- Coronary ostial height- Sinus of Valsalva diameter- Measurements for BASILICA procedureE. Concomitant valvular disease- Mitral regurgitation (30 %)- Tricuspid regurgitation (24 %)- Planning for other transcatheter interventionsF. Severe renal dysfunction

CAEE-20   Cardiac Amyloidosis. The Role Of Multimodality Evaluation

Participants
Patricia M. Carrascosa, MD, Buenos Aires City, Argentina (*Presenter*) Speakers Bureau, General Electric Company

TEACHING POINTS

To describe the role of each imaging modality in the diagnosis of cardiac amyloidosis. To show typical imaging findings of cardiac amyloidosis in echocardiography, cardiac MRI and radionuclide imaging. To emphasize advantages and disadvantages of each modality.

TABLE OF CONTENTS/OUTLINE

Definition, pathophysiology and classification of amyloidosis. Echocardiography - Acquisition technique - Description of imaging findings - Advantages and disadvantages Cardiac MRI - Acquisition technique - Description of imaging findings - Advantages and disadvantages Radionuclide imaging - Acquisition technique - Description of imaging findings - Advantages and disadvantages Sample cases illustrating the importance of multimodality approach Summary.

CAEE-21   Coronary Artery Calcium Scoring: Current Practice And Future Directions

Awards
Certificate of Merit

Participants
Leah Strickland, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand the Agatston score (AS) including CT acquisition, interpretation, and predictive value 2. Understand the role of coronary artery calcium (CAC) scoring as it pertains to clinical guidelines 3. Discuss strengths/weakness of AS, alternative scoring methods, and future directions 4. Understand the role of CAC on non-gated CT exams

TABLE OF CONTENTS/OUTLINE

Background on AS: 1. CT acquisition 2. Derivation/interpretation of AS 3. Comparison of AS with alternative scoring methods (volume and mass scores) 4. Limitations of AS Current practice and clinical significance of CAC: 1. Predictive ability of AS for obstructive CAD2. Predictive ability of AS for major adverse cardiovascular events, importance of age, sex and race 3. Performance of AS compared to other risk assessment tools (Framingham Risk Score and Pooled Cohort Equation) 4. Recognition that CAC is a unique tool for risk stratificationA because it is a composite measure of cumulative risk factor exposure 5. Discussion of the 2019 American Heart Association (AHA)/American College of Cardiology (ACC) guidelines regarding role of CAC for patient risk stratification and preventive statin therapy 6. Clinical value of reporting of CAC on non-gated CT exams Future directions: 1. Improving CAC scoring beyond AS, including calcium density, CAC distribution, and lesion-specific assessment 2. Optimizing CT

acquisition, including dose reduction 3. Optimizing CAC assessment on non-gated CTs 4. Use of CAC scans for assessment of extracoronary biomarkers, such as epicardial fat etc.

CAEE-22   Vascular Rings And Slings: The Jewels Of Cardiac Angiographic Imaging

Participants
Kathleen Clancy, DO, Rochester, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Vascular rings and slings have a rare incidence (less than 1%), recognizing them is important because in some cases surgical treatment is necessary to relieve symptoms related to vascular compression. We provide a pictorially rich, comprehensive review of the different anatomic imaging appearance of vascular rings and slings on cardiac angiography (CT and MR).

TABLE OF CONTENTS/OUTLINE

Case based review anatomic features of the different rings and slings, including double aortic arch (with/without atretic segments), right aortic arch with aberrant left subclavian, and pulmonary sling.Briefly discuss how patients will present, why imaging is important, and what complications to look for in each condition.Discuss the pros and cons of cardiac MRI versus cardiac CT imaging, with an emphasis on when to choose each imaging modality.Review the role of imaging in both pre-surgical planning and post-surgical evaluation/follow-up, including the role of 3D modeling, which will assist in the surgical management of these patients.

CAEE-23   Exploring The Role Of Epicardial Fat In Atherosclerotic And Inflammatory States

Participants
Nahom Seyoum, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

Current studies suggest that increased EFV can be an early predictor of coronary artery disease progression. Epicardial fat volume (EFV) can be quantified by 3D region of interest analysis of CT with radiodensity thresholds. However, uncertainty is present in existing studies on whether HIV and HCV infections promote early atherosclerosis and whether EFV plays a role in the inflammatory process of these infections.

TABLE OF CONTENTS/OUTLINE

I. What is fat and epicardial fat a. Location b. Function c. Epicardial fat as an active endocrine organ II. Pathologic effects of epicardial fat a. Myocardial inflammation b. Insulin resistance c. EFV and systolic and diastolic heart dysfunctionIV. Atherosclerosisa. Pathogenesisb. EFV as a biomarkerIV. Inflammatory states: HIV and Hepatitis C a. HIV 1. Evidence for increased rates of atherosclerosis, cardiovascular disease, and cardiovascular mortality 2. Association with increased EFV 3. EFV increase related to antiretroviral therapy and chronic inflammation 4. EFV - a connection between HIV infection and early atherosclerosis versus association with just one b. HCV 1. Evidence for increased rates of atherosclerosis, cardiovascular disease, and cardiovascular mortality 2. EFV significantly increased in chronic HCV patients, especially with cirrhosis 3. Therapeutic clearance and reduced cardiovascular risk 4. EFV - a connection between HCV infection and early atherosclerosis versus association with just oneIV. How to measure epicardial adipose on CT

CAEE-25   CT Comes To The Rescue: A Review Of Findings Missed On Echo

Participants
Muhammad Aziz, MBBS, Birmingham, Alabama (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Despite being the first line of diagnosis in evaluating congenital and acquired cardiovascular disease patients, echocardiography is limited due to several factors; including operator experience, filed of view, and artifacts among others.- Due to its excellent spatial and temporal resolutions, fast acquisition, wider field of view, and ability to tailor the CT technique along with improved postprocessing methods, CT significantly improves evaluation and detection of various subtle and otherwise difficult to image cardiovascular abnormalities misinterpreted or missed on echocardiography.- Using multiple case examples, review and emphasize the role of cardiac CTA as a problem-solving tool in a variety of cardiovascular diseases where echocardiography was unable to provide complete or entirely correct assessment.

TABLE OF CONTENTS/OUTLINE

- Review of cardiac CTA methods of image acquisition, different contrast protocols and modification options.- Using multiple multimodality image examples, highlight the ability of cardiac CTA to clarify, confirm or refute findings seen or missed on transthoracic or transesophageal echocardiography, including examples of postsurgical complications like; paravalvular leaks, dehiscence, pseudoaneurysms, abscesses and dissection, intracardiac thrombus, and congenital abnormalities.

CAEE-26   Clinical Benefits Of D-SPECT And A-SPECT Combination In Myocardial Perfusion Imaging

Participants
Takuji Nanno, Suita, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Dedicated cardiac single-photon emission computed tomography (SPECT) with cadmium-zinc-telluride detectors (D-SPECT) provides superior image quality compared to conventional Anger SPECT (A-SPECT). Upright and supine images can be obtained by D-SPECT and shifting attenuation effects is useful to detect artifacts. However, it takes time and effort to acquire images in a different position in need of adjusting the imaging chair. Since planar images (PIs) cannot be acquired by D-SPECT, heart-to-lung-ratio (H/L) cannot be evaluated. In this study, we suggest acquiring supine A-SPECT images in a shorter scan time than usual for combining them with upright D-SPECT images. It has another benefit for creating virtual PIs (VPIs) from A-SPECT projection data and calculating the H/L ratio without obtaining conventional PIs. This study presents a novel method of integrating properly normalized D-SPECT and A-SPECT data and introduces the Combined Polar map (C-Polar map). The short-time protocol with Collimator Broad Correction and reconstruction in A-SPECT are explained. The methods of assessing the H/L ratio on VPI are also described. These techniques help to detect the false-positive caused by attenuation artifacts and improve the diagnostic sensitivity in MPI without decreasing patient throughput.

CAEE-27   Spontaneous Coronary Artery Dissection (SCAD): An Uncommon Diagnosis Of A Common PresentationPrimer For Cardiothoracic Radiologists

Participants
Mohammad Madani, MD, Sacramento, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is 1. To understand the epidemiology, risk factors, associations (including fibromuscular dysplasia), pathophysiology, clinical manifestation and management of spontaneous coronary artery dissection (SCAD). 2. To familiarize with the multi-modality imaging findings that can be seen in the setting of SCAD including those that indicate its severity, types and associated myocardial infarction. 3. To learn the role of coronary CTA (CCTA) for both initial diagnosis (including differentiation from atherosclerotic coronary artery disease and evaluation of related extra-coronary vascular pathologies) as well as its role for follow-up in patients with SCAD.

CAEE-29   Capturing The Heart: A Case-based Module On Improving Image Quality Of Challenging Coronary Computed Tomography Angiography

Participants
Rokas Liubauskas, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

This interactive, case-based module highlights pitfalls and proposes solutions when obtaining diagnostic CCTA in five clinical scenarios: atrial fibrillation, chronic kidney disease, transplant evaluation, obesity, and contraindications to routine medications. Methods to ensure diagnostic CCTA quality in patients with atrial fibrillation include heart rate control, retrospective EKG-gating, whole-heart coverage scanners, and the development of intra-cycle motion correction algorithms. Protocol considerations in CKD include adequate pre- and post-procedural hydration, use of contrast/saline mix, high contrast injection rate, dual-energy CT, post-processing techniques (bone kernels). Liver and kidney transplant candidates can benefit from cohort-specific contrast selection, contrast volume adjustment. The utilization of specific image acquisition and reconstruction parameters is reviewed. For high BMI patients, tube output, contrast volume, and injection rate algorithms, iterative reconstruction are reviewed. Certain clinical scenarios prevent the use of typical pre-medication regimens. Alternative pre-medication options, including the indirect advantages of diltiazem and ivabradine, will be discussed.

CAEE-30   Hemoptysis In Congenital Heart Disease: Role Of The Radiologist

Awards
Certificate of Merit

Participants
Vimal Mondy, MBBS,MD, Trivandrum, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.Hemoptysis is a rare but potentially lethal complication in congenital heart disease (CHD). 2.The various causes and factors contributing to hemoptysis in CHD include systemic arterial supply to lungs in the setting of congenital defects causing decreased blood flow, Eisenmenger syndrome, pulmonary arteriovenous malformations (PAVM), pulmonary venous congestion, pulmonary infections secondary to increased pulmonary blood flow, coagulopathy and anticoagulant toxicity, and associated malformations. 3.Imaging, especially multidetector CT (MDCT), plays an important role in identifying the source of hemoptysis in CHD. These include hypertrophied bronchial arteries, major aortopulmonary collaterals (MAPCAs) arising from the aorta or its branches, PAVM, shunts causing Eisenmenger syndrome, causes of pulmonary venous congestion like an obstructed total anomalous pulmonary venous circulation and associated malformations like pulmonary sequestration. 4.MDCT can identify the involved lung and lobe which has important implications in management. 5.The interventional radiologist plays a key role in by offering minimally invasive procedures like embolization of hypertrophied bronchial arteries, MAPCAs and PAVM, which are often the common sources of hemoptysis.

CAEE-31   Comprehensive Pre And Post-transcatheter Aortic Valve Implantation Assessment With Cardiac CT Angiography

Participants
Desiree Louise Batista, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) To discuss the acquisition protocols in different CT systems and main pitfalls; (2) To review the post-processing workflow required for procedure planning; (3) To discuss the main uses of Cardiac for identifying post-TAVI complications: hypoattenuation affecting motion, thrombus and pannus differentiation.

TABLE OF CONTENTS/OUTLINE

(1) Introduction and Background; (2) Present the main acquisition protocols with different vendors including ultra-high pitch, variable high pitch, etc.; (3) Present the workflow for post-processing and adequate measurement of aortic annulus, coronary ostia and aorta; (4) Present common complications after TAVI in which cardiac CT adds valuable information; (5) Take-Home messages, future directions and teaching points.

CAEE-32 Rarest Of The Rare: Institutional Case-based Presentation Of Unusual Coronary Artery Anomalies Using 3D-Cinematic Renderings

Participants
Abtin Jafroodifar, MD, Syracuse, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review all types of coronary artery anomalies, including the underlying aortic and coronary anatomy, that a radiologist should be able to recognize. Identify and familiarize the rarest coronary artery anomalies based on imaging findings (ALCAPA, ARCAPA, high-take off, and single coronary artery). Learn to properly communicate and report coronary artery anomalies, as they can have an increased risk of mortality and morbidity.

TABLE OF CONTENTS/OUTLINE

1)Review normal coronary artery anatomy with 3D-cinematic rendered images and relevant imaging findings trainees should know to quickly evaluate coronary artery take-off and pathway. Briefly describe ascending aortic anatomy, including multiplanar imaging of aortic root and sinotubular junction. 2)Present a case-based review of more common configurations of coronary artery anomalies involving the aortic cusps, including anomalous right main, left main, and circumflex arteries. 3)Introduce the concept of anomalous coronary arteries arising from the pulmonary vasculature, using CT angiography and 3D-rendered images. Present our cases depicting anomalous left and right coronary arteries from the pulmonary artery (ALCAPA and ARCAPA), which have an incidence of 0.000003% and 0.002%, respectively. 4)Present high take off right main coronary artery arising from an ascending aortic diverticulum. 5)Present a single coronary artery case from our institution using CT angiographic and cinematic renderings. Illustrate Lipton's classifications of single coronary artery.

CAEE-33 Cardiac Septal Pathologies - More Than Holes In The Heart

Participants
Shradha Somani JR, MBBS,MD, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Knowing various congenital and acquired pathologies affecting interatrial and interventricular septa is important. Their identification on cardiac CT and cardiac MRI. Development of radiological approach to diagnose interatrial and interventricular pathologies.

TABLE OF CONTENTS/OUTLINE

Development and normal anatomy of interatrial septum Development and normal anatomy of interventricular septum Spectrum and classification of interatrial and interventricular septal pathologies Congenital pathologies of interatrial septum and interventricular septum Acquired pathologies of interatrial septum and interventricular septum Various ancillary findings suggesting septal pathologies Radiological approach for diagnosis of cardiac septal pathologies

CAEE-34 Heart Of Stone: Dismystifying Incidental Cardiac Calcification On Computed Tomography.

Participants
Pedro L. Lino, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1) To review usual and unusual cases of incidental cardiac calcifications. 2) To correlate important findings with the anatomy and pathophysiology. 3) To highlight their characteristics in order to familiarize cardiologists, cardiothoracic surgeons, and radiologists with these conditions, preventing unfavorable patient outcome. 4) To discuss the role of the radiologist in the differential diagnosis of these incidental findings, guiding the management. 5) To suggest reporting recommendations for cardiac calcifications.

TABLE OF CONTENTS/OUTLINE

1) Applied pathophysiology and etiologies of cardiac calcifications: a) dystrophic b) metastatic c) idiopathic. 2) Classifications and associated conditions. 3) CT protocols in the evaluation of patients with suspect cardiac calcification. 4) Review of imaging findings according to illustrative cases of calcifications of: a) myocardium b) endocardium c) pericardium d) valves e) vessels: pulmonary artery f) epipericardial fat. 5) How do I report?: reporting recommendations. 6) Outcomes and complications. 7) Sample cases of pearls, pitfalls, diagnostic difficulties, and mimics. 8) Summary and take-home messages.

CAEE-35 Non-tumoral Cardiac Complications In Oncology Patients

Participants
Jitesh Ahuja, MD, MBBS, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Familiarize radiologists with: 1. Cancer therapeutic related cardiac dysfunction (CTRCD) and several other cardiac complications in oncology patients 2. Role of Cardiac MR (CMR)

TABLE OF CONTENTS/OUTLINE

Cardiac dysfunction is the 2nd most common cause of morbidity and mortality in oncology patients after cancer recurrence. Cancer

therapeutic agents including newer novel immunotherapeutic agents have improved cancer survival. At the same time, cardiac complications are increasing in oncology populations due to common risk factors for cardiac diseases and cancer, longer survival and adverse effects of cancer therapeutic agents. 1. Cancer therapy related complication a. CTRCD: chemotherapy and radiation therapy related left ventricular systolic dysfunction b. Myocarditis c. Pericarditis d. Iron overload 2. Complications due to cancer itself excluding cardiac tumors a. Cardiac amyloidosis b. Stress cardiomyopathy (Takotsubo) c. Cardiac bland thrombus 3. Newer CMR techniques may help identifying cardiac dysfunction at subclinical stage a. Parametric myocardial mapping (T1, T2, T2*) and extracellular volume (ECV) fraction b. Strain imagingEarly detection and management of cardiac complications is critical in this patient population to complete their cancer treatment and reduce cardiac morbidity and mortality

CAEE-36   State-of-the-art Imaging Of Adult Congenital Aortopathies

Participants
Katherine Moore, MBChB, BSC, Cardiff, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Understand embryology and key anatomical variants of the thoracic aorta2) Demonstrate imaging strategies for the investigation of adult aortopathy3) Highlight a spectrum of aortopathies on multimodality imaging with clinical correlation4) Appreciate the clinical work-up and surveillance of adult aortopathy patients

TABLE OF CONTENTS/OUTLINE

1) Embryology2) Anatomy and variants3) Imaging strategiesa. MRI sequences and parametersb. CT technique4) Syndromic aortopathiesa. Marfan syndromeb. Loeys-Dietz syndromec. Ehler-Danlos syndromed. Williams syndrome5) Non-syndromic aortopathiesa. Bicuspid aortic valveb. Coarctationi. Repair strategies and complicationsii. Differentiation from pseudocoarctationc. Familial thoracic aortic aneurysmd. Miscellaneous e.g. SMAD-3, ACTA-26) Clinical work-up and surveillance strategies in adult aortopathya. Special considerations: pregnancy/pre-pregnancy planning

CAEE-37   Advanced Imaging Of The Tricuspid Valve

Participants
Brian Pogatchnik, MD, Stanford, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

• -Primary tricuspid regurgitation is due to structural abnormalities of the valve leaflets or chordae. • -Secondary/Functional tricuspid regurgitation is due to annular dilation, leaflet tethering and/or adverse right ventricular remodeling. It is the most common cause of severe tricuspid regurgitation. • -Transcatheter tricuspid valve replacement is a promising new technique that requires a firm understanding of the tricuspid valve apparatus for optimal valve sizing and deployment.

TABLE OF CONTENTS/OUTLINE

Imaging Techniques: -CT: Contrast technique, gating, reconstructions/analysis -MRI: Cardiac planes for TV, cine imaging, phase contrast (PC) / 4D flow imaging Anatomy: Annulus, leaflets, subvalvular apparatus, anatomic variation Tricuspid Stenosis: causes, imaging (doming, opening area, gradient, etc), interventions Tricuspid Regurgitation: Identifying primary (intrinsic valvular abnormality) versus secondary (dilated annulus, right ventricular enlargement, leaflet tethering) regurgitation. Methods of classifying severity (difference in right and left ventricular ejection fractions, PC/4D flow, coaptation defect). Masses: papillary fibroelastoma versus direct extension of other tumors Endocarditis: Appearance and complications Interventions: Imaging of surgical (repair/annuloplasty, replacement), transcatheter (clip, native valve replacement, valve in ring/valve) and their complications.

CAEE-38   More Than Marfan: Understanding The Imaging, Presentation And Complications Of Aortopathies

Awards
Identified for RadioGraphics

Participants
Kacie Steinbrecher, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Aortopathies, both inherited and non-inherited, include a heterogenous group of disorders that are distinct from acquired, degenerative disease of the aorta- Inherited aortopathies can be divided between syndromic and non-syndromic diseases- Syndromic inherited aortopathies include Marfan syndrome, Loeys-Dietz syndrome, Turner Syndrome, and vascular Ehlers-Danlos syndrome- Non-syndromic inherited aortopathies include heritable thoracic aortic diseases defined by the presence of abnormal genes as well as bicuspid aortic valve- Non-inherited aortopathies include vasculitides and fibromuscular dysplasia- Identification of aortopathies has implications on both pharmaceutical and surgical management of the aorta - When inherited aortopathies are suspected, testing of family members is often warranted- Multimodality imaging provides insight to diagnosis, preoperative planning, and assessment of disease activity

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- Review the clinical characteristics of patients with inherited aortopathies, particularly those which are syndromic- Discuss multimodality imaging findings that can aid in the diagnosis of various aortopathies- Review complications of various aortopathies including aneurysm, dissection/intimomedial defects, and wall/perivascular inflammation- Describe the implications of an aortopathy diagnosis on surgical management of the aorta- Identify imaging features which should be reported in patients presenting with a known history of an aortopathy

CAEE-39   Value Of CMR In Cardiac Remodeling: A Primer For Radiologist

Participants
Archana Rai, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the types of cardiac remodeling, underlying pathophysiology and the value of cardiac magnetic resonance imaging (CMR) in guiding clinical management.2. To discuss main CMR derived biomarkers of cardiac remodeling that may have important

prognostic implications.

TABLE OF CONTENTS/OUTLINE

1. Background 2. Cardiac remodeling definition and pathophysiology• Adverse remodeling• Reverse remodeling 3. Cardiac imaging modalities for cardiac remodeling: Pros & cons 4. CMR biomarkers in cardiac remodeling 5. Physiologic remodeling: Exercise adaptation 6. Pathological remodeling:• Myocardial infarction• Pressure overload: Stenotic valvular heart disease, Hypertensive heart disease, Pulmonary hypertension• Inflammatory myocardial disease (myocarditis)• Dilated cardiomyopathy/volume overload• Hypertrophic cardiomyopathy• Cardiotoxicity• Adiposity related 7. Reverse remodeling• Medical treatment• Resynchronization therapy• Surgical interventions 8. Cardiac remodeling and prognosis 9. Conclusions

CAEE-4   Utility of CT and MRI In Tricuspid Valve Interventions

Awards
Identified for RadioGraphics
Cum Laude

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the indications for tricuspid valve (TV) interventions2. To discuss the role of CT and MRI in the evaluation of TV interventions3. To illustrate the critical parameters needed for TV interventions.

TABLE OF CONTENTS/OUTLINE

A. Tricuspid valve pathologies- Regurgitation, stenosis, infections, massesB. Multimodality imaging- Echo, CT, MRIC. CT & MRI techniques and protocolD. Indications of treatmentE. Treatment Options- Surgery including minimally invasive- repair, annuloplasty, replacement- Transcatheter TV replacement (TTVR)F. Minimally invasive/transcatheter devices-Annuloplasty, coaptation devices, heterotopic caval valve- TTVR Devices-GATE, FORMA, CardiobandG. Establishing etiology of TR- Functional- LV disease,PHT, RV cardiomyopathies- Congenital (Ebstein's)- Pacemaker- InfectionH. Quantification of TR- MR- Indirect from PA flow and RV stroke volume or RV-LV stroke volume; Direct through 2D/4D flow- CT- RV-LV strokeI. Quantification of RV volumes and functionJ. Morphology of tricuspid apparatusK. Measurement of tricuspid annulus- AP, septolateral diameters, perimeter, areaK. Landing zone geometryL. Proximity to right coronary arteryCourse of artery in AV grooveM. Adjacent structures- Prominent papillary muscles, trabeculations, moderator bandN. Coplanar fluoroscopic anglesO. RVOT obstructionP. Access- Diameter of IVC, SVC, jugular veinsQ. Post-procedural complications- Recurrent TR- Infection- Thrombus- Pannus- Paravalvular leak

CAEE-40   Transcatheter Aortic Valve Replacement - Special Situations

Participants
Luis A. Sosa, MD, Menomonee Falls, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

Briefly review relevant anatomy and CT measurements for preoperative TAVR in normal trileaflet aortic valvesDiscuss the preoperative CT evaluation in presence of bicuspid aortic valve Review the preoperative CT evaluation in presence of prosthetic aortic valve

TABLE OF CONTENTS/OUTLINE

Anatomy of aortic valve and rootMeasurements in preoperative TAVR CT in bicuspid valve Relevance of Sievers, Bavard and Makkar/Yoon classifications for pre-procedure planning Supra-annular sizing using the circle methodMeasurement in preoperative TAVR CT in the presence of prosthetic valve (valve-in-valve) Intraluminal diameter Simulated new valve-in-valve New valve to coronary ostia

CAEE-41   Role Of Cardiac CT Angiography In Pre- And Post-Procedural Evaluation Of Percutaneous Left Atrial Appendage Occlusion With Watchman Device

Participants
Archana Rai, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Role of Cardiac CT angiography (CCTA) in pre-procedural planning for left atrial appendage (LAA) occlusion with Watchman device in patients with atrial fibrillation. 2. Role of CCTA in post-procedural evaluation and assessment of post-procedural complications.

TABLE OF CONTENTS/OUTLINE

1. Background: Types of Watchman Device 2. Pre-procedural planning on CCTA• CT protocol, post-processing and role of MPR reconstructions• Assessment of morphology of LAA on CCTA-Chicken wing type-Windsock type-Cauliflower and cactus type • Determining the size of LAA ostium, depth and length of LAA from the landing zone • Interatrial septal anatomy • Presence of accessory LAA or diverticulum • To exclude LA/LAA thrombus: Role of prone CT imaging • Evolving role of pre-procedural software to plan the trans-septal device implantation 3. Transcatheter deployment of Watchman device under fluoroscopy and TEE guidance. 4. Post-procedural evaluation 1) Multimodality imaging for post-procedural evaluation a. Use of TEE and CCTA - Emerging Role of CCTA, especially during the COVID-19 pandemic. Follow up (approximately after 3-4 months) to ensure no leak and complete endothelialization, characterized by absence of contrast opacification in LAA. 2) Evaluation of post-procedural complications a. Peri-device leak b. Trans-fabric leak c. Device associated thrombus d. Device embolization 5. Conclusion

CAEE-42   Cardiac Allograft Vasculopathy: The Unknown To Known

Participants
Yura Ahn, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To know the definition of cardiac allograft vasculopathy (CAV) and its natural history, clinical characteristics, and histopathologic findings2. To differentiate the pathophysiology, clinical characteristics and imaging findings between CAV and coronary atherosclerosis3. To learn the imaging findings of cardiac allograft vasculopathy for early diagnosis and management of patients with cardiac transplantation4. To demonstrate the comparison of dynamic perfusion computed tomography findings between the patients with and without CAV in a single-centered retrospective study

TABLE OF CONTENTS/OUTLINE

1. Definition of Cardiac Allograft Vasculopathy (CAV) (natural history)2. Clinical characteristics (prevalence, laboratory tests, mortality, factors affecting CAV etc.)3. Histopathologic characteristics: comparison with coronary atherosclerosis4. Diagnosis and management of CAV5. Non-invasive imaging evaluation of CAV- Cardiac computed tomography (ECV, dynamic perfusion)- Cardiac magnetic resonance imaging (ECV, T1 map, perfusion)- Myocardial single-photon emission CT (SPECT)6. Invasive coronary angiography (intravascular ultrasound, IVUS)7. Histopathologic findings

CAEE-43 Mitral Valve Prolapse From Benign To Malignant

Awards
Certificate of Merit

Participants
Camila V. Machado, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

After attending to this exhibit, the learner should be able to1. Tell what is the diagnostic criteria for mitral valve prolapse (echocardiogram and MRI).2. Understand how MRI can be useful for the diagnosis and characterization of mitral valve prolapse.3. Recognize the main associated findings in the valve apparatus morphology.4. Recognize the main associated findings in the ventricular myocardium.5. Say which finding can be considered specific for mitral valve prolapse.6. Understand why mitral valve prolapse may have an association with sudden cardiac death.

TABLE OF CONTENTS/OUTLINE

1. Diagnosis of mitral valve prolapse (reference measures)2. Importance of MRI for the diagnosis and characterization of mitral valve prolapse (assessment of mitral apparatus morphology and myocardial fibrosis)3. The main associated findings in the valve apparatus morphology (elongated mitral leaflet, papillary muscle traction, mitral annular disjunction, mitral annulus dilatation)4. The main associated findings in the ventricular myocardium (systolic curling, ballerina foot deformity, left ventricle fibrosis close to the mitral annulus / basal LV, subendocardial / interstitial fibrosis at level of papillary muscles)5. Finding that can be considered specific for mitral valve prolapse (abnormal papillary muscle signal)6. Possible association between mitral valve prolapse and sudden cardiac death (changes in mitral morphology and ventricular myocardium that can serve as a substrate for complex arrhythmias)

CAEE-44 How To Report Preoperative CT For Common Cardiac Surgeries: A Primer For Community Radiologists

TEACHING POINTS

1. Emphasize the value of a multidisciplinary approach in preoperative evaluation of cardiac surgery patients - How radiologists can help2. Review information including incidental findings obtained on pre-op imaging which are relevant to the anesthesiologist and surgeon to assist in preoperative optimization and minimizing peri\postoperative pulmonary complications4. Review imaging consideration for open and minimally invasive surgery (MIS) cardiac surgeries requiring sternotomy and cardiopulmonary bypass (CPB)5. Review imaging consideration for each of the common open/MIS and transcatheter cardiac surgeries

TABLE OF CONTENTS/OUTLINE

1. What the anesthesiologist would want to know 2. Anesthetic considerations - pleural, pulmonary, cardiovascular anatomic findings and risk factors for peri\postoperative complications and morbidity including atelectasis, pneumothorax, and aspiration3. What the surgeon would want to know 4. General radiological evaluation of cardiac surgeries requiring CPB or sternotomy5. How to report preoperative CT of the common cardiac surgeries - Radiological approach to open and MIS coronary artery bypass graft, redo-sternotomy, open, MIS, and transcatheter valve surgeries6. Inclusive checklists for organized and systematic reporting of the pre-op CT evaluation of the common cardiac surgeries

CAEE-45 Spontaneous Coronary Artery Dissection (scad): An Uncommon Diagnosis Of A Common Presentation

Participants
Marcela Rosa, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The aim of this exhibit is: To review spontaneous coronary artery dissection (SCAD) pathophysiology, associated conditions and clinical presentation. To review and illustrate angiographic and multimodal imaging findings of SCAD, correlating findings in different imaging methods.

TABLE OF CONTENTS/OUTLINE

INTRODUCTION TO SCAD: pathophysiology, associated conditions and clinical presentation. Imaging findings of SCAD demonstrated by teaching cases from our department.

CAEE-46 Challenges In Diagnosis And Management of Spontaneous Coronary Artery Dissection: Pearls and Pitfalls on CT Evaluation

Participants
Ubenicio Dias JR, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1 - Definition and epidemiological aspects of Spontaneous Coronary Artery Dissection (SCAD). 2- Pathophysiology and clinical

aspects of SCAD.Imaging methods used in the evaluation of SCAD. 3- Imaging methods used in the evaluation of SCAD.4 - Technique, advantages, main findings and pitfalls in evaluation by Coronary CT Angiography in SCAD.

TABLE OF CONTENTS/OUTLINE

1. INTRODUCTION AND MANAGEMENT OF SCAD - SCAD epidemiology, pathophysiology, clinical concepts, treatment guidelines and algorithms.2. DIAGNOSTIC IMAGING (emphasis in Coronary CT Angiography) - Advantages and disadvantages of each imaging modality. Preparation. Imaging protocol and how to optimize it. Difficulties and how to overcome them. Systematic approach to evaluate. What the multidisciplinary team need to know.3. FINDINGS OF CORONARY CT ANGIOGRAPHY IN SCAD - Primary Features Secundary Features Additional Considerations Pitfalls4. FOLLOW-UP - The role of coronary CT angiography on follow-up. Normal expected imaging features and pitfalls on follow-up.5. INTERACTIVE CASE-BASED DIDACTICS - Challenging cases in SCAD to illustrate and solidify concepts6- FUTURE DIRECTIONS ON IMAGING - What's on the horizon for coronary CT angiography and other imaging methods.

CAEE-47   In The Thick Of It - Cardiac Imaging In Left Ventricular Hypertrophy

Participants
Suman Prabhakar, MBBS,MD, Bangalore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To briefly understand the pathophysiology and enumerate various causes of left ventricular hypertrophy (LVH). • To discuss the key imaging features of various causes of LVH which help in prompt diagnosis and management with implication on risk stratification and prognostication.

TABLE OF CONTENTS/OUTLINE

LVH is one of the commonest pathologies with various causes which on ECHO appears just as thickened myocardium, MRI plays a vital role in deciphering the various causes. We review various causes of LVH in a case-based format emphasizing on key imaging findings, prognostication and risk stratification. • The following simplified classification and cases will be discussed: 1. Pressure overload: Hypertension, subaortic membrane, aortic valvular stenosis, Supravalvular aortic stenosis, coarctation of aorta. 2. Volume overload: Valvular regurgitation. 3. Infiltrative cardiomyopathies: Amyloidosis, Anderson-Fabry disease, Sarcoidosis, LV non compaction. 4. Non infiltrative cardiomyopathy: Hypertrophic cardiomyopathy 5. Neoplasm This exhibit is targeted to residents interested in cardiovascular radiology. MRI plays a vital role in deciphering the various causes, quantification of fibrosis, LV morphometry, functional analysis and plays a major role in prognostication and follow up after treatment.

CAEE-48   Multimodality Imaging Of Palliative Shunts For Congenital Heart Diseases

Participants
Arzu Canan, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Non-invasive imaging plays an important role for assessing the anatomy and function of palliative shunts in patients with congenital heart diseases (CHD). Although echocardiography is usually the first-line imaging modality during patient follow up, diagnostic quality relies on operator experience and existence of acoustic windows. Diagnostic yield can be also constrained by limited field of view and altered anatomy after the surgery. Non-invasive cross-sectional imaging with computed tomography or magnetic resonance not only provides comprehensive assessment of altered cardiovascular anatomy, but also allows delineation of shunt patency and evaluation of complications. The goal of this exhibit is to review the imaging aspects of the shunts most used for CHD palliation, underscoring the advantages and disadvantages of different imaging modalities.

TABLE OF CONTENTS/OUTLINE

A. Introduction/background B. Palliative procedures: Indications/ Normal anatomy/ Imaging features/ Complications 1. Blalock-Taussig (BT) shunt 2. Davidson or Central shunt 3. Waterston-Cooley shunt 4. Damus-Kaye-Stansel shunt 5. Glenn shunt 6. Fontan shunt 7. Potts shunt C. Echocardiography: Indications/ Advantages/ Disadvantages D. Cardiac CT: Indications/ Advantages/ Disadvantages E. Cardiac MRI: Indications/ Advantages/ Disadvantages F. CT and MRI protocol for evaluation of palliative shunts G. Conclusion

CAEE-49   Multimodality Imaging In Cardiac Strain Analysis: From Subclinical Disease To Severe Cardiomyopathy

Participants
Jose de Arimateia Araujo Filho, MD,PhD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the principles of cardiac strain analysis by echocardiography and cardiac magnetic resonance (CMR) imaging. To discuss the clinical value and specific advantages / disadvantages of these two imaging modalities in a comparative review. To illustrate the main applications of cardiac strain analysis in different clinical scenarios, focusing on its limitations and perspectives in clinical decision making.

TABLE OF CONTENTS/OUTLINE

1. Cardiac strain: Principles and techniques. 2. Speckle tracking echocardiography and CMR-feature tracking: intra- and intermodality agreement and variations. 3. Clinical applications: Quantification of global and regional left ventricular function; Ischemic versus non-ischemic cardiomyopathies and sub-clinical left ventricular dysfunction; Cardiotoxicity during chemotherapy; Risk assessment and prognosis; Heart failure with preserved ejection fraction; Miscellaneous (congenital heart disease, valvular heart disease, COVID-19 myocardial injury, etc); Others cardiac chambers (right ventricle strain, left atrial strain). 4. Future perspectives: standardization, automated image analysis and artificial intelligence tools.

CAEE-5   The Current State Of Nuclear Cardiac Imaging And Radiopharmaceuticals Of The Next Era

Participants
Kenneth Huynh, BS, Orange, California (*Presenter*) Nothing to Disclose

1. To demonstrate the utility of functional imaging in diagnosis and post-therapeutic surveillance of various cardiac diseases due to ischemic, inflammatory, infiltrative, and neurohormonal processes.2. To review the current options for nuclear cardiac imaging, including SPECT and PET options, with their characteristics, strengths, and shortfalls.3. To present the emerging options for nuclear cardiac imaging and discuss their advantages relative to current options.

TABLE OF CONTENTS/OUTLINE

The first component reviews and illustrates the current Nuclear Cardiology practice: Multigated exam (MUGA) for left ventricular ejection fraction with 99mTc-tagged RBC-SPECT/D; SPECT perfusion imaging with 99mTc-sestamibi and 99mTc-tetrofosmin; SPECT viability evaluation with Tl-201 chloride of decreasing use; Planar and SPECT/CT TTR amyloidosis evaluation with 99mTc-PYP; PET/CT myocardial perfusion imaging with 13N ammonia and 82Rb; PET/CT myocardial viability and sarcoidosis evaluation with 18F-FDG and 13N ammonia.The second part discusses the emerging novel radiopharmaceuticals: 18F-flurpiridaz, 18F-FBnTP, 18F-LMI1195, 18F-4F-MHPG, and 18F-3F-PHPG and their longer half-life imaging advantages.This educational exhibit is divided into four categories: ischemic, inflammatory, infiltrative, and neurohormonal, and will (1) review the current options of nuclear cardiac imaging per category, and (2) introduce novel agents and discuss their potential advantages in the diagnosis and surveillance of cardiac disease.

CAEE-50   Diagnostic Challenges In Cardiac Sarcoidosis: Can PET and CMR Be Of Help?

Participants
Juan Cruz Gallo, MD, Capital Federal, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

Sarcoidosis is a multi-system inflammatory disorder of unknown etiology characterized by the formation of non-caseating granulomas that can affect different organs. The prevalence of clinically evident cardiac involvement is ~5%, and is one of the major causes of disease-related death. Accurate diagnosis of cardiac sarcoidosis (CS) remains challenging because of the limitations of existing clinical criteria and the low diagnostic yield of endomyocardial biopsy related to the patchy and myocardial involvement.There is growing evidence of clinical relevance of combining cardiac magnetic resonance (CMR) and 18F-FDG PET for diagnosis, monitoring treatment response and progression of CS. CMR and 18F-FDG-PET evaluate different pathological processes, namely fibrosis via late gadolinium enhancement in the former and inflammation via labeled-glucose uptake of activated macrophages in the latter. Early and accurate detection of CS is of highest importance for therapeutic and prognostic purposes. Combining imaging modalities can improve the identification of the whole spectrum of myocardial involvement in CS patients (from early myocardial damage, inflammation to tissue fibrosis).

TABLE OF CONTENTS/OUTLINE

1) Cardiac sarcoidosis: definition, clinical-epidemiological data 2) Diagnostic Methods of myocardial inflammation: role of PET/CT 3) Assessment of myocardial fibrosis: role of CMR. 4) Evaluation of anti-inflammatory treatment response by PET/CT 5) Conclusions

CAEE-51   Cardiotoxicity In Cancer Treatment: New Frontiers In The Multimodality Diagnostic Approach

Participants
Roberto Torres, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To discuss the current definitions and controversies in the cardiotoxicity definition in oncologic patients 2. To review the role of cardiac imaging in the evaluation of oncologic cardiotoxicity, focusing on its value in clinical decision making 3. To illustrate a spectrum of cases utilizing different imaging modalities to evaluate cardiovascular effects related to cancer treatment

TABLE OF CONTENTS/OUTLINE

1. Cardiotoxicity: Definitions and controversies. 1.1 Chemotherapy: anthracyclines, trastuzumab and emerging drugs. 1.2 Radiotherapy: vascular toxicity, pericardial and heart valve disease. 1.3 Immune checkpoint inhibitors: myocarditis and immune-related adverse events. 2. Laboratorial markers: what the radiologist needs to know 3. Echocardiography imaging: left ventricular disfunction, 3D tissue doppler and speckle tracking imaging CT and US: vascular toxicity 4. Nuclear medicine: multigated radionuclide angiography, I-mIBG scintigraphy and FDG-PECTCT 5. Magnetic resonance imaging: edema, LGE, t1 and t2 mapping, feature-tracking myocardial strain 6. Clinical follow-up: early versus late cardiotoxicity 7. New technologies and future perspectives: new clinical and imaging markers

CAEE-53   All That Enhances Late, Is Not Ischemic : Pattern Based Approach Towards Late Gadolinium Enhancement In Cardiomyopathies, A Primer For Residents

Participants
Surbhi Singh, MD, Bangalore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To familiarize the readers with different patterns of late gadolinium enhancement on cardiac MRI and pathologic conditions associated with them 2. To discuss various ischemic and non ischemic cardiomyopathies that show these patterns typically 3. To demonstrate other important cardiac MRI features that are diagnostic of these cardiomyopathies

TABLE OF CONTENTS/OUTLINE

A retrospective evaluation of 500 cardiac MRI from July 2019 to July 2021 , revealed presence of post-gadolinium myocardial enhancement on delayed T1 sequence at 10 mins - late gadolinium enhancement(LGE), in 260 case. Various patterns of late gadolinium enhancements were seen in ischemic and non ischemic cardiomyopathies(CMP). The various patterns identified were- I. ISCHEMIC - 1. Transmural 2. focal Subendocardial II. NON ISCHEMIC- 1. Subepicardial - Myocarditis, Sarcoidosis, Fabry's 2. Global subendocardial - Amyloidosis, Systemic Sclerosis 3. Mesocardial(Mid-Wall)- Dilated CMP, Sarcoidosis, Myocarditis, endomyocardial fibrosis 4. Patchy/RV Insertion Points- Hypertrophic CMP, Right Ventricle (RV) OverloadA pattern based approach towards late gadolinium enhancement patterns of cardiomyopathies is demonstrated in our poster

CAEE-55   Clinical Application Of Full-color Bionic 3D Printing In Transcatheter Aortic Valve Implantation

Participants
Xi Yu, Zhengzhou, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.Explore the clinical application of full-color bionic 3D printing technology in transcatheter aortic valve implantation 2.Learn the basic workflow of a 3D printing model of the aortic valve 3.Learn how to use segmentation imaging software to generate the target anatomic structures 4.Learn the detailed procedure of digital imaging modeling of 3D printing

TABLE OF CONTENTS/OUTLINE

Background Objectives Technology Roadmap Conclusion

CAEE-56 The Added Value Of Cardiac MRI In The Evaluation Of Valvular Heart Disease

Awards
Certificate of Merit

Participants
Felipe Sanchez, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to:1. To briefly discuss the role of different imaging modalities in the evaluation of valvular heart disease.2. To illustrate the added value of different CMR sequences in the assessment of cardiac valves.3. To depict the normal appearance of the valvular apparatus and to review different valvular pathologies in which CMR plays a role.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Modalities used for assessment of valvular heart disease.a. Radiographyb. Echocardiographyc. CTd. MRI3. Cardiac MRI Techniques for valvular heart disease assessment.a. Assessment of valvular morphology, cardiac chamber size and function: cine and strain imagingb. Flow quantification: 2D Phase contrast and 4D-flowc. Tissue characterization: Parametric mapping and LGE4. AV valves assessment with MRI: normal and abnormal findings.a. Direct and indirect quantification methods for AV valvular regurgitationb. Mitral insufficiencyi. Etiology of mitral insufficiency: primary versus secondaryii. Severity stratification with cardiac MRc. Arrhythmic MVP and MADd. Tricuspid insufficiencyi. Tricuspid regurgitation mechanisms and severity quantification.5. VA valves assessment with MRI: normal and abnormal findingsa. Direct and indirect quantification methods for VA valvular regurgitationb. Aortic regurgitation: severity and risk stratification.c. Pulmonary regurgitation: severity and risk stratification.d. VA valve stenosis.6. Conclusion

CAEE-57 The Mad Heart - A Review of Mitral Annular Disjunction With Cardiac Echo And MRI Findings

Participants
Aishwarya Gulati, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Mitral annular disjunction (MAD) is associated with mitral valve prolapse (MVP) and malignant cardiac arrhythmia. 2. Cardiac ECHO, CT, and MRI are used in patients for pre-electrophysiology evaluation and MAD can be an incidental, less recognized finding on imaging. 3. Recognizing and quantifying MAD with MVP along with such as papillary muscle late gadolinium enhancement and myocardial fibrosis may have electrophysiology management implications.

TABLE OF CONTENTS/OUTLINE

1. Incidence and clinical significance 2. Anatomy of MAD 3. Pathophysiology of MAD 4. Cross sectional imaging findings 5. Quantification parameters of MAD 6. Late gadolinium enhancement findings of MAD and papillary muscles 7. Correlative electrophysiology mapping 8. MRI scan protocol

CAEE-6 Multimodality Imaging Of The Left Ventricular Outflow Tract

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the anatomy of the left ventricular outflow tract (LVOT)2. To discuss the role of multimodality imaging in the evaluation of LVOT3. To illustrate the several pathological lesions that affect the LVOT4. To provide a diagnostic algorithm for LVOT lesions

TABLE OF CONTENTS/OUTLINE

IntroductionAnatomy of the LVOT & variations- Arterial supplyRole of multimodality imaging- Echo, CT, MRIReview of several LVOT pathologies with illustrative case examples using multimodality imaging- Hypertrophic cardiomyopathy- Aberrant papillary muscles-Hypertrophy, hypermobility, anomalous insertion, accessory muscles- Subaortic membrane- Fibrous/muscular- Congenital- AV septal defect, Shone complex, Tetralogy, Transposition of great arteries, Double outlet right ventricle, truncus, interrupted aortic arch, hypertrophied subaortic conus- Valvular diseases- Rheumatic disease- Non neoplastic masses- Vegetations, pseudoaneurysm, abscess, thrombus - - Neoplasms- Fibroelastoma, myxoma, metastasis, sarcoma- Post-surgical - Mitral valve repair, aortic surgery, pulmonary banding- Post-interventional- TMVR, TAVR- Membranous septum- Aneurysm, muscularized septum, large elongated septum- Dynamic obstruction- HCM, sepsis, hypovolemia, mitral valve replacement- Aging, idiopathic- Glycogen storage diseaseDiagnostic algorithm for LVOT lesionsLVOT evaluation for interventions- TAVR, TMVRSurgical management- Myomectomy, Konno procedure

CAEE-7 Mri Evaluation Of Valvular Disease- Basics To Advanced

Awards
Certificate of Merit

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the role of MRI in the evaluation of valvular heart disease (VHD)2. To discuss the MRI sequences and planes used in VHD3. To illustrate the MRI quantification techniques used for grading stenotic and regurgitant lesions.4. To understand the role of MRI in providing information beyond the valve.

TABLE OF CONTENTS/OUTLINE

1. Introduction to VHD2. Role of imaging - Echocardiography, CT, MRI3. Indications of MRI in valvular heart disease- Suboptimal echo- Discordant findings- Eccentric jets- Multiple regurgitant jets- Evaluation of myocardium4. Morphological assessment of valve5. Quantification of lesionsA. Stenosis-Velocity, gradients, planimetryB. Regurgitation- Direct vs indirect- Cine imaging- LV/RV stroke volume- Phase-contrast MRI- Great vessel flow- Mitral/tricuspid regurgitant flow -Direct or indirect- Planimetry of Area of regurgitant orifice > 0.4 cm2 is significant- 4D flow- Valve tracking6. Mechanism of abnormality- Structural versus functional7. Normal and abnormal values8. Correlation with echo techniques9. Volumetric and functional changes in ventricles- Regurgitation-Ventricular/atrial enlargement, ventricular dysfunction- Increased LV/RV mass and volumes in stenosis10. Scarring/fibrosis in ventricles- Risk stratification- Late gadolinium enhancement- Parametric mapping11. Vascular changes- Dilated ascending aorta/pulmonary artery- Abnormal flow12. Indications of surgery for valvular pathologies13. Prognostic markers

CAEE-8   Myocardial T1 And T2 Mapping: Technique And Applications

Participants
James F. Glockner, MD, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Myocardial T1 mapping can be used to identify abnormal myocardium and to quantify myocardial fibrosis. 2. Diffuse myocardial fibrosis often cannot be seen on late gadolinium enhancement images; elevated T1 values correlate with diffuse myocardial fibrosis .3. Myocardial T1 is markedly elevated in amyloidosis. 4. Elevated myocardial T1 can be correlated with prognosis in patients with amyloidosis and cardiomyopathies. 5. Myocardial T1 is also elevated in myocardial edema, and can be helpful in identifying patients with myocarditis. 6. T1 measurement of myocardium and blood pool before and after gadolinium administration can be used to measure myocardial extracellular volume. 7. ECV is elevated in acute myocardial injury as well as in diffuse myocardial fibrosis. 8. Myocardial T2 mapping is most often used to assess conditions associated with myocardial edema, such as myocarditis or acute infarction. 9. Myocardial T2* measurement can be used to quantify myocardial iron deposition.

TABLE OF CONTENTS/OUTLINE

1. Relaxation theory 2. Myocardial T1 measurement techniques 3. Measuring myocardial T1 - tips and common errors 4. Myocardial T1 mapping: clinical applications 5. Calculation of extracellular volume (ECV) 6. ECV measurement: clinical applications 7. Myocardial T2 measurement techniques 8. Myocardial T2 mapping: clinical applications 10. Myocardial T2* measurement: technique and clinical applications 11. Summary and conclusions

CAEE-9   Shunt Procedures For Palliation Of Congenital Heart Disease: A Pictorial Guide

Participants
Catarina Janicas, MD, Lisbon, Portugal (*Presenter*) Nothing to Disclose

TEACHING POINTS

Patients with congenital right ventricular inflow/outflow obstruction, in consequence of the reduced pulmonary flow, frequently present with hypoplastic pulmonary arteries, counter-indicating single-stage corrective procedures.Palliative shunts, originating from the aorta and its branches, from the superior vena cava, or from the right ventricle, have been developed to stimulate pulmonary artery growth.Cardiac CT and MR imaging, including CT and MR angiography, provide high-quality noninvasive depiction of palliative shunts and pulmonary artery growth. Likewise, potential shunt-related or other complications can be assessed, such as shunt stenosis, thrombosis and infection, as well as pulmonary artery aneurysms or congestive heart failure.

TABLE OF CONTENTS/OUTLINE

Learning ObjectivesIntroduction- Importance of pulmonary artery caliber in patients considered for Fontan procedure- Nakata Index and McGoon Ratio- Role of palliative shunts in stimulating pulmonary artery growthImaging of Palliative Shunt Procedures-Aortopulmonary shunts o Blalock-Taussig shunt (classic, modified)o Melbourne shunto Davidson shunto Ductus stentingo Internal mammary artery-to-pulmonary artery shunto Waterston shunto Potts shunt- Cavopulmonary shuntso Glenn shunt (uni-, bidirectional)- RV-to-pulmonary artery conduitso Sano shunt- Complicationso Stenosiso Thrombosiso Infectiono Pulmonary artery aneurysmo Congestive heart failure- CT or MR evaluation: defining which technique to chooseConclusionsReferences

Abstract Archives of the RSNA, 2021

VAEE

Vascular Education Exhibits

Sub-Events

VAEE-10   A Walk-through Lower Limb Arteries: Atherosclerosis And Beyond

Participants
Daniel Montel, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Review current CTA and MRA techniques and protocols for better evaluation of the lower-extremity vessels, and their limitations and pitfalls; - Showcase several interesting findings in run-off CTA / MRA - such as vasculitis, traumatic injuries, expected postoperative conditions and their complications, iatrogenic injuries, malformations, and atherosclerotic disease; - Learn to identify and describe findings and their anatomic location to best assist with patient diagnosis and treatment planning; - Ascertain how lower limb CTA/MRA can help with differential diagnosis and consequently teach radiologists how to recognize critical findings that should be promptly reported, as they may need early vascular intervention.

TABLE OF CONTENTS/OUTLINE

1- CTA and MRA techniques and protocols; 2- Atherosclerotic disease and other vascular age-related changes, such as aneurysm and dissection; 3- Surgical procedures including normal expected radiological findings and complications; 4- Iatrogenic and traumatic vascular injuries; 5- Other non-atherosclerotic vascular diseases, including vasculitis and thromboembolism; 6- Vascular malformations; 7- Take home messages.

VAEE-11   There Is Always Another Path To Take: What We Need To Know About Aortoiliac Occlusion

Participants
Daniel Montel, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Recognize the main etiologies of aortoiliac occlusion and stenosis. Understand imaging findings and possible collateral pathways and how to map and report them. Expected findings before and after treatment, knowing how to recognize signs of postoperative complications.

TABLE OF CONTENTS/OUTLINE

1- Introduction: general aspects of the aortoiliac occlusion and radiological findings; 2- Main etiologies and occlusion classification (suprarenal, transrenal, juxtarenal, infrarenal); 3- Collateral pathways in the aortoiliac occlusion: -systemic-systemic pathways arising from the dorsal aorta; - visceral-visceral pathways arising from the ventral aorta; - systemic-visceral pathways arising from the lateral aorta; 4- Surgical treatment modalities and the radiological findings that we may encounter such as aortoiliac endarterectomy, aortobifemoral bypass, axillobifemoral bypass (extra-anatomic technique), endovascular therapy and examples of complications; 5- Take home messages.

VAEE-12   Pelvic Hemorraghes And Other Vascular Injuries: How Can We Help The Interventional Radiologist?

Awards
Certificate of Merit

Participants
Silvia Cayon Somacarrera, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

The aim of this work is to show easy tips to determine on CT the most probable bleeding artery in pelvic hemorraghes based upon a map which shows an approximation of the zonal pelvic vascularization.

TABLE OF CONTENTS/OUTLINE

Vascular pelvic injuries are the major cause of morbidity and mortality in blunt trauma patients. Historically they have been evaluated with arteriography. However, the development of CT allows us to perform a rapid non-invasive evaluation, helping us to differentiate between arterial and venous bleeding which is very important when considering the most suitable treatment. Once we have identified there is arterial active bleeding, knowing the zonal pelvic vascularization map can help us determine the most probable bleeding artery so that the interventional radiologist can perform a more selective arteriography. The CT findings have generally been found to correlate with findings detected later in the arteriography. However, it has been seen that in 20-40% of patients who did not show active arterial bleeding on CT, actually had it on arteriography. This could be due to intermittent bleeding secondary to arterial spasm or temporary tamponade by the hematoma itself.

VAEE-13   Ultrasound Of Extracranial Cerebral Vessels: A Primer

Participants
Parker Freels, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

US is an inexpensive, low risk, and non-invasive method for assessing hemodynamics, anatomy, and the extracranial vasculature pathology that affects the carotid and vertebral vasculature. There are three major components of a vascular ultrasound exam including grayscale analysis, color flow, and spectral doppler. US is dependent on operator capabilities, and proper technique is critical to appropriate image acquisition. The "3 P's" of extracranial cerebral vasculature US include: Probe, Position, and Protocol.

TABLE OF CONTENTS/OUTLINE

The physics and technique of vascular ultrasound acquisition will be reviewed (The "3 P's" - Probe, Position, and Protocol). This comprehensive sonographic assessment of the carotid and vertebral arteries will include: normal and abnormal flow patterns (with an emphasis on spectral doppler analysis), atherosclerotic disease, nuances of intimal-medial thickness & plaque characterization (The "3 S's" of plaque characterization: Sonolucency, Surface, Stability), NASCET criteria in evaluation of carotid stenosis, upstream vs. downstream lesions, antegrade vs. retrograde vertebral artery flow, assessment of pathology arising more centrally, pre and post carotid endarterectomy/stent evaluation, traumatic injuries and follow up guidelines, malignancy evaluation, and critical findings when evaluating vascular ultrasounds of the extracranial cerebral vessels. Pearls and pitfalls of extracranial cerebral vascular ultrasound will also be reviewed.

VAEE-14   **COVID-19 Pneumonia: Seeing Beyond What Meets The Eye With Subtraction CT**

Participants
Mario G. Santamarina, MD, Vina del Mar, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- Review the main perfusion imaging findings in COVID-19 Pneumonia.2- Review the main perfusion imaging findings in Post COVID-19 Syndrome.3- Compare conventional and perfusion imaging findings with other non-COVID-19 pneumopathies.

TABLE OF CONTENTS/OUTLINE

- Principles of Lung Subtraction CT angiography.- Pictorial review of the main conventional and subtraction CT imaging findings in COVID-19 Pneumonia and Post-COVID-19 Syndrome.- Sample cases of subtraction CT imaging findings in other non-COVID-19 Pneumopathies.Outline:COVID-19 infection may lead in some patients to acute respiratory distress syndrome, where severe gas exchange impairment can occur even in early stages, with only minor lung airspace disease. This may suggest that the shunt associated with the gasless lung parenchyma is not sufficient to explain this hypoxemia. The fact that the virus binds to ACE2 as the functional receptor for cell entry could be key to understanding the vascular tone dysregulation and perfusion abnormalities that occur in COVID-19 pneumonia.The expected hypoxic pulmonary vasoconstriction could be impaired in areas where there is airspace disease. On the other hand, thrombosis-mediated and vasoconstriction-mediated perfusion defects can also contribute to V/Q mismatching and hypoxemia.Our main purpose is to show the imaging findings in patients with COVID-19 Pneumonia and Post-COVID-19 Syndrome using Lung Subtraction CT angiography, which is a technique used to evaluate pulmonary perfusion based on iodine distribution maps.

VAEE-16   **Anomalies Of Great Vessels Venous Return: Do All Paths Lead To The Right Atrium?**

Participants
Lucas Farias, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1) To review usual and unusual cases of anomalies of the venous return. 2) To correlate important findings with the anatomy, embryology and pathophysiology. 3) To discuss image findings according to subgroups and classifications, in order to enhance surgeons and radiologists' skills. 4) To review CT and MRI protocols in the evaluation of patients with anomalies of great vessels venous return. 5) To highlight their characteristics in order to radiologists with these conditions, preventing unfavorable patient outcome.

TABLE OF CONTENTS/OUTLINE

1) Applied anatomy and embryology of the superior vena cava, inferior vena cava and pulmonary veins. 2) CT and MRI protocols in the evaluation of patients with suspected venous return anomaly. 3) Superior vena cava (SVC) anomalies: a. Left sided SVC; b. SVC duplication; c. Interrupted SVC. 4) Inferior vena cava (IVC) anomalies: a. Agenesis and hypoplasia; b. Pre-renal: azygos continuation of IVC; c. Renal: retroaortic left renal vein, circumaortic venous collar; d. Post-renal: transposition or left-sided IVC, duplication of IVC, retrocaval or circumcaval ureter, absent infrarenal inferior vena cava. 5) Pulmonary veins anomalies: a. Total anomalous pulmonary venous return (TAPVR); b. Partial anomalous pulmonary venous return (PAPVR) - Type I: Supracardiac; - Type II: Cardiac; - Type III: Infracardiac; - Type IV: Mixed. 6) Sample cases of pearls, pitfalls, diagnostic difficulties, and mimics. 7) Summary and take-home messages.

VAEE-17   **Perforator Flaps: A Pictorial Guide**

Participants
Ruben Guerrero Vara, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) To review the most common perforator flaps used in reconstructive microsurgery. 2) To review vascular anatomy and describe

the technique to identify the best perforator on CTA for any of this flaps. 3) To correlate radiological images with schematic illustrations and surgical pictures to better understand any of the surgeries.

TABLE OF CONTENTS/OUTLINE

1) Perforator flap: definition and characteristics. 2) History of preoperative perforator flap aseessment before and after CTA. 3) Description of the most common flaps used in reconstructive microsurgery: DIEP, SIEA, ALTF, SGAP, TDAP and SCIP. 4) Review of our protocol of scanning to evaluate perforator arteries. 5) Clinical indication of each flap, anatomy of the artery it is based on and description of the appropiate point of reference for each case. 6) Depiction of examples of every flap including preoperative CTA images, schematic illustrations, surgical pictures and real images of the final result. 7) Conclusions

VAEE-18   Follow The Flow: Doppler Ultrasound Assessment Of Chronic Venous Insufficiency

Participants
Juliana Sitta, MD, Jackson, Mississippi (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To review common lower extremity venous anatomy and variants, classification, and pathophysiology of chronic venous insufficiency (CVI)• To comprehend the role of ultrasound assessment in CVI • To describe ultrasound techniques and quality assessment • To discuss specific patterns of venous insufficiency and problem-solving techniques• To learn the current recommended reporting system

TABLE OF CONTENTS/OUTLINE

CVI is an extremely common pathology reported to be found in approximately 20% of the population. Although clinically significant, its assessment is commonly overlooked in clinical practice. Given the recent advancement in treatment techniques for superficial CVI, venous mapping has become imperative to accurately diagnose and to identify the source of reflux. This educational exhibit will review the lower extremity venous doppler ultrasound assessment components focusing on chronic insufficiency, including anatomy, classification, pathophysiology, and vascular doppler principles. We will review the role of ultrasound venous mapping in pre-surgical assessment and surveillance. Doppler ultrasound techniques for chronic venous insufficiency will be explored using didactic illustrations and sample cine case presentations. Quality assessment measures to ensure the validity of your vascular lab will be discussed. Finally, we will present a problem-solving section for common challenges such as ulcer assessment and atypical presentations.

VAEE-19   A Novel Simulation Method For Minimally Invasive Coronary Artery Bypass Grafting Utilizing Immersive Three-dimensional Virtual Reality System.

Participants
Koichi Osuda, RT, Hakodate, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Minimally invasive coronary artery bypass grafting (MICS CABG) via left small thoracotomy has a lower risk of associated complications including mediastinitis, and expected rapid rehabilitation compared to median sternotomy approach. However, surgical procedures are technically demanding due to narrow operative field and deep working space. We developed a novel approach for simulating MICS CABG procedures utilizing immersive three-dimensional (3D) virtual reality (VR) system.

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3D VR datasets were converted, using Computed Tomography data which has submillimeter spatial resolution. Patient-specific 3D VR models were successfully reconstructed without any misregistration and faithfully reproducing thoracic structures consisting of skin, rib, heart, aorta, coronary artery, internal thoracic artery (ITA), right gastroepiploic artery, and internal thoracic vein (ITV) in detail. Immersive 3D VR system is clinically available and enables surgeon to understand comprehensive anatomical structures, simulate surgical procedures like bi-lateral ITA harvesting. Furthermore, considering the bypass route, 3D precise measurement using VR system will be great support and promising for facilitating the graft design optimization. To accomplish MICS CABG safely, there will be contributions to clinical practice for preoperative accurate simulation using immersive 3D VR system.

VAEE-2   The 2020 STS And SVS Aortic Dissection Reporting Guidelines: What Radiologists Need To Know

Participants
Elliott K. Gozansky, MD, PhD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

In 2020, the Society of Vascular Surgeons and the Society of Thoracic Surgeons introduce a new reporting standards for Type B aortic dissections. The manuscript provides guidance well beyond what is suggested by the title and there are changes and material that radiologists would benefit from understanding. The aorta is now segmented into zones based on anatomic landmarks which enhances communication between physicians by improving clarity as to the extent of the dissection. Historically, the Stanford Type-A classification was utilized for dissections involving the ascending aorta with Type-B dissection being limited to the descending aorta. The new reporting standards more definitively delineates between dissection types and identifies a novel transition between Type-A and Type-B aortic dissections and how to describe a dissection when the entry tear cannot be identified. Finally, a systematic terminology was proposed but minor modifications are required for compatibility with radiology dictation systems and electronic medical records.

TABLE OF CONTENTS/OUTLINE

Review zonal segmentation of the aorta and distal branch vessels. Describe the new, more well defined, anatomical distinction between Type-A and Type-B dissections. Understand how the delineation of the entry tear determines dissection typing and how to report when the entry tear cannot be defectively identified. Discuss how to integrate the new standards into radiology reports.

VAEE-20   Contrast Enhanced Ultrasound Evaluation Of Abdominal Aortic Endovascular Stent Repair: Protocol, Pearls, ; Problem Solving

Awards

Participants
Lauren F. Alexander, MD, Jacksonville Beach, Florida (*Presenter*) Spouse, Stockholder, Abbott Laboratories;Spouse, Stockholder, AbbVie Inc;Spouse, Stockholder, General Electric Company

TEACHING POINTS

Repair of abdominal aortic aneurysm (AAA) and other acute aortic pathology can be performed with endovascular stents, but this treatment requires lifelong surveillance for potential endoleak and subsequent rupture. Multiphasic computed tomography (CT) has been the main imaging modality for surveillance and symptomatic evaluation, but ultrasound (US) serves as a useful alternative that avoids radiation and iodinated contrast. Color and spectral Doppler assessment are most commonly used, but contrast enhanced US (CEUS) is growing in use for surveillance and diagnosis in this patient population. After viewing this exhibit learners be prepared to:- Discuss typical endovascular aneurysm repair (EVAR) for acute aortic pathology - Describe a protocol for CEUS evaluation of AAA post EVAR - Recognize normal US findings after EVAR - Diagnose endoleak and other complications with Doppler and CEUS

TABLE OF CONTENTS/OUTLINE

1. Background a. Brief review of acute abdominal aortic pathology b. Typical EVAR techniques c. Role of imaging after repair 2. Ultrasound protocol for abdominal aorta evaluation after EVAR a. Grayscale b. Color & spectral Doppler c. CEUS 3. Case review of findings a. Typical AAA pretreatment b. EVAR without complications c. Endoleak & other complications

VAEE-21 Inflammatory Conditions Of The Aorta: A Pictorial Review

Participants
Andre Silva de Figueiredo, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

? Revisit basic concepts on the imaging evaluation of the aorta? Review the most relevant etiologies of aortitis and the most common imaging findings ? Discuss the role of multimodality imaging in the evaluation of inflammatory conditions of the aorta

TABLE OF CONTENTS/OUTLINE

• Multimodality imaging of diseases of the aorta o Ultrasound o Computed tomography o Magnetic resonance o Nuclear medicine ? Inflammatory conditions of the aorta: a pictorial review - Infectious aortitis: Illustrative cases - Noninfectious aortitis: Illustrative cases ? Pearls and pitfalls ? Invasive methods: when to perform? ? Summary and gained knowledge

VAEE-22 Complications In Endovascular Treatment Of Aortic Diseases: Diagnosis And Next Steps

Participants
Carla Machado, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the main complications post endovascular treatment of aortic diseases.2. To demonstrate the use of imaging methods to recognize most complications of endovascular treatment of the aorta, as well as the possible clinical and / or interventional approaches involved in the therapy of these entities.

TABLE OF CONTENTS/OUTLINE

Among the main complications of endovascular treatment of the aorta are endoleaks, prosthetic limb kinking and occlusion / thrombosis, prosthesis collapse and occlusion of the arterial branches.Demonstration of imaging findings mainly on computed tomographic angiography (CTA), the preferred diagnostic method for this analysis, through illustrations and cases of radiological practice, in addition to the role of interventional radiology in the treatment of these complications, mainly with the use of digital subtraction angiography (DSA).

VAEE-23 What All Radiologists Need To Know About Caval Obstruction And Venous Collaterals

Participants
Felipe Gomes, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate with schematic figures and cases collateral venous pathways resulting from superior vena cava (SVC) obstruction (above or below the junction of the azygos arch), and from inferior vena cava (IVC) obstruction. To describe different etiologies, mechanisms and differential diagnoses of SVC and IVC obstruction. To discuss treatment options and the role of imaging to plan therapy. To discuss technical challenges of vena cava imaging, as well as post-therapeutic evaluation.

TABLE OF CONTENTS/OUTLINE

Caval obstruction is a common finding which permeates the everyday practice of multiple imaging subspecialties, including head and neck, thoracic, abdominal, vascular and interventional radiologists. Hence, to schematize in an easy way the collateral venous pathways developed secondary to caval obstruction is of wide interest to facilitate diagnosis and treatment. Herein we describe the collateral pathways resulting from caval obstruction in non-contrast and contrast-enhanced CT, MRI and angiography. Graphic representations of the sites of obstruction and respective formed collaterals are depicted, as well as the azygos / hemiazygos system participation to the collateral venous return. The normal anatomy and anatomical variations which might play a role in the collateral system development are detailed. The main causes of obstruction will be discussed: extrinsic compressions, tumoral invasion, thrombosis and traumatic injury.

VAEE-24 Go With The Flow: The Role Of Color Doppler Ultrasound In Dialysis Access

Awards
Certificate of Merit

Participants
Sofia Arizaga, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

After the exhibit the reader would be ableTo understand the physiopathology of arteriovenous fistulas- To review preoperative vascular mapping- To recognize the maturation of the AVF- To identify adverse features and complications associated with fistulas

TABLE OF CONTENTS/OUTLINE

Table of contents 1.Introduction 2.Definition of AV fistulas 3. Physiopathology 4.Ultrasound Normal vascular mapping 5.Technical requirements and examination technique 6. AVF maturation and calculation of blood flow 7.Morphological assessment (B-mode) 8.Color Doppler examination 9.Monitoring/surveillance of the AVF (follow-up and early detection of complications) 10.Summary

VAEE-25   Carotid US: From Atherosclerosis To Vasculitis--a Pictorial Review For The General Radiologist

Participants
Marta Flory, MD, Davis, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Identify normal arterial waveforms on H&N US (CCA, ICA, ECA, VA). Review and know the NASCET criteria for evaluating atherosclerosis, and challenges to applying these criteria Recognize and diagnose important central pathology that is detectable on carotid US due to changes in waveform morphology (Pre steal, steal, AS, AR, cardiomyopathy, cardiopulmonary support devices) Diagnose other pathology seen in the carotid artery less frequently (AVF, pseudoaneurysm, thrombus, vasculitis, CCA-subclavian graft)

TABLE OF CONTENTS/OUTLINE

1-Principles of Doppler US2-Carotid and Vertebral Artery Waveform Review (Normal)3-Carotid Atherosclerosis: (Stenosis and NASCET criteria (with imaging examples); Sonographic NASCET Index; Tardus et Parvus; Atherosclerosis at other sites as manifested in Carotid Waveforms (Pre-steal, Steal, Dissection)) 4-Other Pathology causing Variations in Carotid Waveform morphology4a-Central Pathology: Valves, Heart and Devices (AS, AR (severe), Cardiomyopathy, Cardiopulmonary devices (IABP, ECMO, LVAD))4b-Trauma and Post Surgical Appearance (AVF, Pseudoaneurysm, CCA to Subclavian graft)4c-Vasculitis (Takayasus, GCA & Temporal Tap, FMD)

VAEE-27   Clinical Radiologists' Perspective Of ISSVA Classification Of Vascular Anomalies And Its Management: Cutting Through The Clutter.

Participants
Adarsh Hegde JR, MBBS, Jodhpur, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Explaining the latest ISSVA classification with emphasis on clinico-radiological correlation of various vascular anomalies. • Emphasizing on practicing specific and standardized nomenclature to a vascular anomaly in the case reporting. • The significance of each radiological modality in classifying the vascular anomalies with an imaging checklist. • Clinico-radiological algorithmic approach to a vascular anomaly which will aid in the further management.

TABLE OF CONTENTS/OUTLINE

1. Background 2. ISSVA classification of vascular anomalies (2018) with recent updates. 3. Role of imaging and checklist-Radiograph, Ultrasonography, Magnetic resonance imaging, Computed tomography, Digital subtraction angiography and Direct percutaneous phlebography. 4. Clinicoradiological algorithm-Approach to a suspected vascular anomalies taking ultrasound as the initial modality along with clinical information and MRI. 5. Case-based approach with examples- It includes vascular tumors, simple vascular malformations, syndromic associations and anomalies under provisionally unclassified group such as FAVA. 6. Mimickers of vascular anomalies- Neoplastic and Non-neoplastic aetiologies. 7. Management options and role of interventional radiology in the management of various vascular malformations with recent updates. 8. Take home message.

VAEE-28   Thoracic Outlet Syndrome: Unraveling The Anatomy, Organizing The Report, And Teaching The Protocols

Awards
Cum Laude

Participants
Natália Magero, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is1. To review thoracic outlet syndrome (TOS), covering the anatomy of the compartments involved, the main reported symptoms and the mechanisms by which the structures are affected.2. To describe the technique of examining computed tomography angiography (CTA) in a 320-detector row in order to demonstrate its efficiency and reproducibility.3. To make a brief tutorial on how to organize the report, highlighting the key points to be described and how to avoid the misdiagnosis.

TABLE OF CONTENTS/OUTLINE

A. Anatomy of compartments and compression mechanisms: -Scalene triangle -Costoclavicular space -Pectoralis minor spaceB. Symptoms of TOS: -Arterial -Venous -NeurogenicC. Image acquisition: -Advantages of cross-section CTA -Provocative maneuvers -Protocol parameters for the acquisitionD. Post-processing and Image analysisE. InnovationF. How to organize the report -Key points -Avoiding the misdiagnosis

VAEE-3   Post-TEVAR Imaging For Aortic Dissection

Awards
Identified for RadioGraphics

Participants
Jody Shen, MD, Palo Alto, California (*Presenter*) Nothing to Disclose

Thoracic endovascular aortic repair (TEVAR) is an evolving alternative technique to open surgical repair of patients with chronic aortic dissection. In addition to covering the entry tear with an endograft, several adjunct procedures are often required to achieve the goal of complete exclusion of false lumen flow. Challenges include a small true lumen in conjunction with a stiff flap and complex anatomy. Familiarity with post-operative imaging appearance is important to recognize expected changes and complications.

TABLE OF CONTENTS/OUTLINE

In this case-based review, we will discuss the purpose of and expected imaging findings of TEVAR for chronic aortic dissection. This education exhibit will describe the angiographic and CTA appearances of complicated techniques, such as the Provisional Extension To Induce Complete Attachment (PETTICOAT) technique, cheese-wire fenestration, false lumen embolization, and baffle stents.

VAEE-30   Cold-Blooded COVID-19: A Pictorial Review Of CTA Vascular Complications Of Torso And Extremity In Critically Ill Patients

Participants
Anna Gong, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To provide an overview of imaging findings of vascular complications in critically ill COVID-19 patients using CT Angiography.2. Discuss the incidence of these complications and the importance of early radiological detection and the role of imaging in the management of these critically ill patients.

TABLE OF CONTENTS/OUTLINE

Introduction The COVID-19 pandemic caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is a multiorgan systemic illness. Anticoagulation strategy and thrombotic and bleeding complications in patients with COVID-19 are complex and can be clinically silent or obscure in presentation. Imaging plays an active role for appropriate diagnosis, which could potentially alter management.Thrombus Venous complications: • Deep vein thrombosis Arterial complications: • Pulmonary Artery • Aorta • Mesenteric ischemia • Renal vasculature • Peripheral vasculatureHemorrhage: • Lung • Mediastinal • Gastrointestinal • Genitourinary • Retroperitoneal • Peritoneum • Intramuscular hematomas chest, abdomen and extremityInfarcts • Renal • Hepatic • Colon • Spleen • PulmonaryVascular access-related complications: • Arterial dissections • Pseudoaneurysms • Catheter-related thrombosis

VAEE-31   Spectral Doppler Ultrasound: Simple Tools To Tackle Complex Pathology

Participants
Alexander Clinkenbeard, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

Ultrasound directly visualizes vessels using grayscale and color Doppler imaging but can also indirectly assess vasculature's hemodynamics using spectral Doppler. Spectral Doppler assesses the velocity of red blood cells over time as well as their amplitude. A wide variety of waveforms can co-exist in physiologic and pathologic conditions. Knowledge of particular patterns provide the interpreter with the adequate tools to cinch the diagnosis and avoid pitfalls. Review spectral doppler findings from varied organs including waveforms, resistance patterns, and flow patterns to understand normal physiologic states. Review key artifacts, including aliasing and tissue vibration. Consider these factors (spectral Doppler findings and key artifacts) as a framework to approach vascular pathology.

TABLE OF CONTENTS/OUTLINE

Brief summary of arterial histology and physiology Rundown of commonly assessed organs and the normal expected spectral and color doppler findings Overview of the "indirectly" assessed components of vascular ultrasound Resistance patterns: resistive indices, high and low resistive end-organs, Waveform: velocity, mono-, bi-, and tri-phasic waveforms Flow patterns: plug, laminar and turbulent flow Artifacts: aliasing, spectral narrowing/broadening, vibration 4. Pathology: stenosis, arteriovenous fistula, pseudoaneurysm

VAEE-32   Multimodality Approach In Evaluation Of Vascular Pathologies In Female Pelvis

Participants
Margarita Revzin, MD, Wilton, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Familiarize radiologists with arterial and venous anatomy of female pelvis 2. Review role of imaging in evaluation of vascular pathologies in pelvis 3. Discuss characteristic appearance of various vascular pelvic pathologies 4. Provide an algorithmic approach to management of the pelvic vascular disease

TABLE OF CONTENTS/OUTLINE

1. Anatomy of pelvic vasculature: arterial system (aorta and its main branches, arterial system of the pelvis, arteriovenous system, pelvis venous plexus and main venous drainage). Hemodynamics and pathophysiology of arterial and venous systems 2. Role of imaging (ultrasound, CTA, MRA) in diagnosis and management of pelvic vascular pathologies in pelvis 3. Characteristic imaging appearance of various pelvic vascular pathologies a. Arterial: pelvic aneurysm (true and mycotic), pseudoaneurysm, AV fistula, dissection, proximal lower extremity arterial disease (LEAD) due to stenosis, occlusion, arterial rupture with and without active extravasation b. Small vessel and Capillary: Uterine AVM/AVF, pelvic AVM/AVF, rectus abdominis hemorrhage, bladder hemorrhage, hemoperitoneum, retained products of conception, placental insertion abnormality c. Venous: May-Thurner syndrome, Phlegmasia Cerulean Dolens, ovarian vein thrombosis, pelvic congestion syndrome, deep pelvic vein thrombosis, labial varices, round ligament varices 4. Algorithm of management of various vascular pathologies in the female pelvis

VAEE-33   Peripheral Arterial Doppler - From Basics To Interpreting Complex Waveforms

Participants
Carlos Padula, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

• To understand the physiology of arterial waveforms in the extremities• To understand the pathophysiology of peripheral arterial diseases.• To understand and interpret the Doppler spectra in obstructive arterial lesions, including thromboembolism, stenosis, dissection, and compartment syndrome.• To review features of the Doppler spectra in non-obstructive arterial lesions, including hyperemia, pseudoaneurysm, and arteriovenous fistula.• To understand the effects of cardiovascular support devices on arterial waveforms

TABLE OF CONTENTS/OUTLINE

1. Anatomy of peripheral (upper and lower extremity) arteries.2. Ultrasound and Doppler technique and pitfalls3. Normal color and spectral Doppler appearance of peripheral arteries4. Waveform characterization - normal and abnormal (obstructive and non obstructive)5. Case examplesa. Proximal obstruction - acute and chronicb. Distal obstruction- acute and chronicc. Stent occlusiond. Bypass graft and complicationse. Traumatic arterial injuryf. Compartment syndromeg. Arterio-venous fistulah. Aneurysm (pseudoaneurysm) and dissectioni. Cardiac diseases - reduced output, aortic regurgitation, etcj. Cystic adventitial diseasesk. Cardiovascular support devices - aortic balloon pump, LVAD, ECMO, artificial heart

VAEE-34   When Adventitia Is The Advantage. A Case-based Review Of Aortic And Visceral Pseudoaneurysms

Participants
Roberth Escarria Panesso, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the normal anatomy of arterial wall and the differences between a false and true aneurysm To learn how to identify the pathophysiological mechanism that lead to the formation of Pseudoaneurysms through a case based presentation To recognize the main characteristics of Pseudoaneurysms and the most relevant differential diagnoses on contrasted tomography To know the follow up or surgical recommendations according to the location and radiological characteristics of the Pseudoaneurysms

TABLE OF CONTENTS/OUTLINE

This educational exhibit will be presented in a case review format. Teaching points and feedback information will be highlighted in the discussion of each case. The list of cases will help the reader to learn and understand the following: Tomography technical considerations. Etiology, pathophysiological mechanisms and main location. Normal anatomy of the arterial wall and radiological characteristics of the false aneurysms. Differential diagnoses. follow up or surgical recommendations for each case os Pseudoaneurysms. Summary References.

VAEE-35   Integrating And Optimizing 4D Flow In Cardiac Imaging Practice- A Practical Guide For Problem Solving

Awards
Cum Laude

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. 4D flow is now increasingly incorporated in cardiac imaging. Technical parameters have to be optimized for the use of 4D flow2. To review the current applications of 4D flow in cardiac imaging3. To understand the key parameters required for optimization of 4D flow4. To provide practical tips and tricks for optimization of 4D flow

TABLE OF CONTENTS/OUTLINE

A. Introduction to 4D flow- Basic physicsB. Limitations of 4D flow- Long acquisition time- Long reconstruction- Long post processing- Respiratory gating and lower scan efficiency- Lower spatial resolution- limited by scan time and SNR-Lower temporal resolution- Limited by scan time and SNR, decreases accuracy- Higher noiseC. Practical tips and tricks for integrating 4D flow in practice with illustrative case examples- Intravenous contrast- Feraheme >> Multihance >> Other-Gd agents-4D flow net: reduce noise using AI based on synthetic 4D flow MRI data from computational fluid dynamics (CFD)- Slice thickness- Venc- Slightly greater than expected maximum velocity/scout- Background phase offsets, Eddy currents- Imaging planes to minimize artifacts-ECG gating- Motion-robust readouts and sorting of respiratory phases- Field of View- Acceleration - Compressed sensing, Parallel imaging- Reconstruction & post-processing- Use of AI- Artifacts

VAEE-4   Ferumoxytol MRI - Vascular Applications And Challenges

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the principles of Ferumoxytol as a contrast agent in vascular imaging2. To review the advantages of Ferumoxytol3. To illustrate the applications of Ferumoxytol in vascular imaging4. To discuss a workflow to integrate the use of Ferumoxytol in cardiovascular imaging

TABLE OF CONTENTS/OUTLINE

Principles-Ultrasmall superparamagnetic iron oxide particle-Intravascular t ½ of 14-21 hours-Cleared by macrophages-No long-term depositionAdvantages in vascular imaging- Alternative to gadolinium-based agents, no renal excretion- No concerns about timing-Can be repeated if there are artifacts- High spatial resolution with long ECG/navigator gating- Arteries & veins in the same study-High signal for 4D flowWorkflow for Ferumoxytol- Safety screening, dose, injection rate, monitoring- Imaging sequence- Steady-state imaging using MRA, IR Navigator gated SSFPLimitations-Hypersensitivity reactions- Interferes with MRI for 24 hours- Signal loss if an inappropriate dose- Caution in those unable to metabolize ironApplicationsA. Aortic disease- Aneurysm, dissection, graft, Endoleak classificationB. Pulmonary arteries- Embolism, malformationsC. Vascular compression- Popliteal artery entrapment, median arcuate ligamentD. Renovascular-Renal transplant, Renal dialysis graftE. Occlusion- SVC, IVCF. Congenital heart disease- Complex vascular anatomy, Fontan ShuntG. 4D flow applicationsH. Structural heart disease- TAVR in patients with renal dysfunction

VAEE-5   Demonstration Of Collateral Pathways To The Artery Of Adamkiewicz Using Ultra-high-resolution CT Angiography

Participants
Kunihiro Yoshioka, MD, Morioka, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. to get know the advantage of the ultra-high-resolution CT angiography in depiction of the artery of Adamkiewicz.2. to get know the anatomical characteristics of collateral pathways to the artery of Adamkiewicz. 3. to get know the clinical application of the knowledge of collateral pathways to the artery of Adamkiewicz for open and endovascular repair.

TABLE OF CONTENTS/OUTLINE

Anatomy of the artery of AdamkiewiczAdvantage of the ultra-high-resolution CT for the demonstration of the artery of Adamkiewicz Anatomical characteristics of the collateral pathways to the artery of Adamkiewicz - Collateral pathways around spinal column - Collateral pathways in thoracic wall Clinical applications of the knowledge of the collateral pathways to the artery of Adamkiewicz - Open repair - Endovascular repair

VAEE-6   Leaky Valves: What The Radiologist Needs To Know About Varicose Veins And Venous Insufficiency

Awards
Identified for RadioGraphics

Participants
Cameron Adler, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Protocol for pretreatment sonographic evaluation of varicose veins and venous insufficiency 2. Methods of treating varicose veins 3. Common pitfalls in the pretreatment sonographic evaluation of varicose veins

TABLE OF CONTENTS/OUTLINE

1. Overview 2. Review of Normal Lower Extremity Venous Anatomy 2a. Deep Veins 2b. Superficial Veins 2c. Perforator Veins 3. Pathophysiology/causes of varicosities 3a. Extremity deep venous insufficiency with perforating vein insufficiency 3b. Saphenofemoral/saphenopopliteal insufficiency 3c. Calf-muscle pump failure 3d. Pudendal/pelvic vein insufficiency 4. Methods for Surgical Treatment of Varicose Veins 4a. Invasive Treatment 4a-i. Vein Stripping 4b. Minimally Invasive Treatments 4b-i. Endovenous Ablation 4b-ii. Ambulatory Phlebectomy 4b-iii. Sclerotherapy 5. Imaging Protocol 5a. Key Elements 6. Pitfalls 6a. Missing Deep Venous Reflux 6b. Very Superficial Course of Great Superficial Veins 6c. Central Venous Obstruction 6d. Mistaking Common Femoral Vein Reflux for Significant Deep Venous Reflux in the setting of Superficial Venous Insufficiency 6e. Variant Anatomy 6f. Pudendal/pelvic vein insufficiency connecting to extremity superficial veins 7. Summary of Key Learning Points

VAEE-7   Flow Reversal In Doppler Ultrasound: What Does It Mean ?

Participants
Hsin-Kai Wang, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Partial flow reversal is a normal physiological phenomenon in the vascular system. 2. To demonstrate pathological flow reversal that may be encountered in Doppler ultrasound. 3. To explain underlying mechanisms of pathological flow reversal.

TABLE OF CONTENTS/OUTLINE

Partial flow reversal: a physiological phenomenonAffected vessels in pathological flow reversal: artery, vein, portovenous.Causes of flow reversal: diminished forward driving force, downstream occlusion/stenosis, steal. Flow reversal of the splanchnic vessels: renal artery (renal vein thrombosis), portal vein / splenic vein (portal hypertension), hepatic vein (Budd-Chiari syndrome, venous outflow obstruction), testicular vein (varicocele), ovarian vein (pelvic congestion syndrome). Flow reversal of the peripheral arteries: vertebral artery (subclavian steal syndrome), external carotid artery (common carotid artery occlusion), distal artery of dialysis arterio-venous fistula. Flow reversal of the peripheral veins: saphenous vein (superficial venous insufficiency), superficial epigastric vein (superficial venous insufficiency/deep vein thrombosis), deep vein (deep vein insufficiency), internal jugular vein (central vein stenosis/occlusion).

VAEE-8   Imaging Of Adults On Extracorporeal Membrane Oxygenation (ECMO) During The COVID-19 Pandemic- What The Radiologist Needs To Know

Awards
Certificate of Merit

Participants
Simon Ponsel, MD, Berlin, Germany (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. llustrate the different types of ECMO as well as their respective functionality and usage. 2. Discuss imaging acquisition pitfalls in ECMO patients. 3. Review common general complications. 4. Explain and display specific complications for VV and VA ECMO respectively.

TABLE OF CONTENTS/OUTLINE

1. Introduction, 1a. Usage in the COVID-19 pandemic, 1b. ECMO functionality, 1c. Altered physiology and blood flow in ECMO patients, 1d. Usage of different ECMO types. 2. Imaging acquisition pitfalls, 2a. Contrast agent application, 2b. Acquisition timing, 2c. Alterations of circulation time and vessel flow. 3. General complication, 3a. Hematoma, 3b. Thrombosis, 3c. Intracerebral bleeding, 3d Cannula malposition, 3e. Liver dysfunction. 4. Specific complications, 4a. VV ECMO, 4b. VA ECMO. 5. Miscellaneous

VAEE-9   Participants **Prevalence And Imaging Features Of Extra-coronary Arteriopathies In Patients With Spontaneous Coronary Artery Dissection. A Case Series.**

Cara Owens, MBBS,PhD, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Spontaneous coronary artery dissection (SCAD) is an infrequent diagnosis in patients presenting with acute coronary syndrome (ACS).2. There is a strong association with fibromuscular dysplasia (FMD), connective tissue diseases and systemic inflammatory diseases. 3. The American Heart Association advises vascular imaging from brain to pelvis to assess for underlying causes for patients with SCAD. 4. CT angiographic and MRI features of these underlying causes include extra-coronary artery aneurysms, dissections, beading, vessel tortuosity, stenosis and looping.

TABLE OF CONTENTS/OUTLINE

Introduction to SCAD:Prevalence, female predominance, proposed mechanism of dissection, risk factors, strong association with fibromuscular dysplasia (FMD), CT-angiographic screening of extra-coronary arteriopathies.Method:Retrospective case series of CT-angiographic findings for patients with a diagnosis of SCAD.Results: Nineteen percent of a total of 790 patients had imaging features of SCAD-associated extra-coronary arteriopathy with FMD (beading and dissection) predominating. The majority had disease in more than one vascular territory.Discussion: Results consistent with other studies with high prevalence of extra-coronary arteriopathies, particularly FMD. Supports role for CT-angiography for SCAD patients as it informs decisions about treatment, lifestyle management and surveillance.

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Abstract Archives of the RSNA, 2021

Sub-Events

IREE-1   Inferior Phrenic Artery: Anatomy And Interventional Treatment

Awards
Identified for RadioGraphics
Cum Laude

Participants
Hyo-Cheol Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

The inferior phrenic artery (IPA) is the most common extrahepatic collateral artery supplying hepatocellular carcinoma (HCC). In addition, the IPA may be treated in patients with hemoptysis or iatrogenic bleeding. Cone-beam CT can provide the detailed vascular anatomy, which can make it possible to perform radioembolization through the IPA. The purpose of this exhibit is : (1) To review the vascular anatomy of IPA with cone-beam CT. (2) To list the pathologic conditions requiring angiography of the IPA. (3) To learn how to do intra-arterial therapy via the IPA without complications.

TABLE OF CONTENTS/OUTLINE

1. Vascular anatomy of IPA : A. vascular anatomy of right and left IPA B. communication with intercostal and internal mammary artery C. pulmonary shunt by azygoesophageal branch D. accessory gastric branch2. Pathologic conditions : HCC, hemoptysis, post-operative bleeding, post-RFA bleeding, gastrointestinal bleeding3. Technical considerations : A. Proper embolic materials. B. catheterization technique depending on origin site. C. prophylactic embolization of pulmonary shunt. D. protection of normal distal branch. E. treatment through collateral pathway. F. special consideration for radioembolization

IREE-10   Thyroid Nodule Ablation: What A Radiology Trainee Needs To Know

Participants
Navpreet Khurana, MBBS, Nagpur, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Thyroid nodules are commonly seen in females and elderly, and ultrasound is imaging modality of choice for screening. Benign nodules may require treatment if they are hyperfunctioning, cause pressure symptoms, or if the patient desires it. Surgical management of such nodules carries risk of complications such as hypothyroidism, hematoma formation, damage to recurrent and superior laryngeal nerves leading to hoarseness, infection, and hypoparathyroidism. There has been an upcoming and increasingly popular role of minimally invasive procedures utilising chemical and thermal energy for destroying nodules, hence it is important for a trainee to be familiar with the same. With this exhibit, we aim to review the existing literature and use cases to-Highlight the role of ablation in the treatment of thyroid nodules.Review the importance of ultrasound evaluation and TIRADS staging.Describe the indications, clinical outcomes, and complications of ethanol ablation, radiofrequency ablation, laser thermal ablation and microwave ablation. Review pre-operative patient preparation, procedural techniques and post-procedural follow-up.

TABLE OF CONTENTS/OUTLINE

Evaluation of a thyroid nodule.Key strategies for managing benign thyroid nodules.Indications for ablation procedures.Pre-procedural imaging and investigations.Procedural techniques, outcomes, post-procedural follow-up and complicationsCase based discussion.Conclusion.

IREE-11   Hybrid CT-Angiography (Angio-CT) For Acute Traumatic And Vascular Emergencies: A Case Based Review

Participants
Karan Nijhawan, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Review features and advantages of a hybrid CT/angiography (Angio-CT) system 2) Discuss the role of Angio-CT in the management of acute trauma and vascular emergencies 3) Case based review of interventions performed at our institution using Angio-CT in the setting of acute trauma and vascular emergencies

TABLE OF CONTENTS/OUTLINE

1) Introduction to Angio-CT- history, current uses, comparison to traditional C-arm fluoroscopy, impact on operational efficiency 2) Anatomy of the Angio-CT suite- design, components, key features 3) Challenges of acute trauma and vascular emergency management that are addressed by Angio-CT including reduced treatment time, enhanced imaging quality for localization, and versatility for simplifying complex procedures 4) Pictorial review of cases using Angio-CT to manage acute trauma and vascular

emergencies within authors' institution- including technique, imaging findings, and impact of Angio-CT on the workflow and outcome of each case 5) Future applications and summary

IREE-12   Enhanced Myometrial Vascularity: Associations, Diagnosis, Management, And Role Of Uterine Artery Embolisation

Participants
Navpreet Khurana, MBBS, Nagpur, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Historically, hypervascular myometrial lesions post dilatation & curettage have been referred to as acquired arteriovenous malformations in spite of angiogram revealing little to no significant arterio-venous shunting. Coupled with increased levels of beta human chorionic gonadotropin and evidence of trophoblastic tissue found in these patients, these foci of intense vascularity with mild AV shunting are now better represented by the term 'enhanced myometrial vascularity' (EMV). EMV can be a rare but life-threatening complication. Since there are no established guidelines on its management, the role of interventional radiology is important to provide a focused case-based treatment. The aim of this exhibit is to review the existing literature regarding association, diagnosis, and management of EMV with a case-based illustration such as EMV associated with retained product of conception (RPOC) and interstitial ectopic pregnancy. It will also discuss the role of uterine artery embolisation in the management of EMV.

TABLE OF CONTENTS/OUTLINE

Enhanced myometrial vascularity: PathophysiologyClinical presentationConditions associated with development of EMVDiagnostic imaging and criteriaManagement of EMVCase discussion and comparison with existing literature reviewCase 1 - RPOC with EMVCase 2 - Interstitial ectopic pregnancy with EMVConclusion

IREE-13   An Imaging Review Of Portal Hypertension Complications, Ectopic Varices And Their Various Treatments

Participants
Jessica Yoon, MD, Providence, Rhode Island (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Pathophysiology of portal hypertension and varices 2. Classification of varices 3. Common vs ectopic varices 4. Approaches and techniques in treatment

TABLE OF CONTENTS/OUTLINE

1. Portal hypertension 1a. Demographic and background information 1b. Pathophysiology 2. Hemodynamics of varices 2a. Occlusive etiology 2b. Non-occlusive etiology 3. Common vs. ectopic varices 3a. Prevalence 3b. Anatomic differences 3c. Complications 3d. Case-based examples of ectopic varices 3di. duodenal 3dii. rectal 3diii. para-stomal 3div. gallbladder 3dv. bladder 4. Interventions: approaches and techniques 4a. Types of access 4ai. antegrade (transplenic) 4aii. retrograde (transhepatic) 4aiii. direct stick (parastomal) 4b. Decompression 4bi. TIPS 4bii. Recanalization of occluded vein 4c. Obliteration 4ci. coil embolization, sclerotherapy, glue, combinations) 5. Conclusion

IREE-14   Alert The PERT: Leveraging Artificial Intelligence To Optimize Diagnosis And Management Of Acute Pulmonary Embolism Within A Large Urban Health System

Awards
Certificate of Merit

Participants
Ricki Korff, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To present an overview of the stages of integration of artificial intelligence into a health system's pulmonary embolism (PE) diagnosis and management algorithm.2. To demonstrate the value of automated AI-generated notifications to clinical teams about concerning PE cases in a real-life clinical setting.3. To review future directions and refinement of an AI-generated PE notification system.

TABLE OF CONTENTS/OUTLINE

1. AI-assisted detection of pulmonary embolisma. Deciding which studies the PE detection algorithm should be run onb. Incorporation of AI-generated PE detection results into PACSc. Utilization of AI-generated PE detection results by radiologists2. AI-generated passive notification of radiologists about positive PE studies a. Triaging of studies3. AI-generated active notification of Pulmonary Embolism Response Team (PERT) clinicians about PEs with concerning features a. Assessment of location and extent of PEb. Integration of CT RV/LV ratio4. Overlay of relevant clinical data from the electronic medical recorda. Echo resultsb. Vitals, O2 requirementsc. Biomarkers: troponin, lactate, BNPd. Scores: PESI, sPESI, BOVA5. PERT team communication within a centralized encrypted chat environment a. HIPAA-compliant mobile application integrating imaging, clinical data, and case discussion

IREE-15   Combining Radioembolization And Immune Checkpoint Inhibitors For The Treatment Of Hepatocellular Carcinoma: Mutually Beneficial Therapies For A Challenging Disease

Participants
Suryansh Bajaj, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

Hepatocellular carcinoma remains a major cause of cancer-related mortality worldwide. While screening programs have improved early detection, many patients are diagnosed at later stages and are poor candidates for curative therapy. Therapeutic options for HCC have seen overwhelming growth within the past decade and there is multidisciplinary interest in combining therapies with potentially synergistic mechanisms. Various preclinical and clinical studies have shown promising results with the combined use of radiation and immunotherapy for multiple malignancies. With the advent of immunotherapies, there has been emerging interest in

the combined use of ICIs with transarterial Radioembolization (TARE). TARE is now a Food and Drug Administration approved therapy for HCC and, while less is known of the interaction of TARE and immunotherapy, its potential for synergism is promising.

TABLE OF CONTENTS/OUTLINE

Immune mechanisms in the pathogenesis of HCC.Role of immune checkpoint inhibitors and radiotherapy in HCC.Combination of radiotherapy and immune checkpoint inhibitors in HCC: Background of combination therapy use in different malignancies.Synergistic mechanisms and rationale for the use of combination therapy.Safety profileAbscopal effectsCurrent data and ongoing studiesLimitationsRole as bridge therapy in potential transplant recepients.Future directions: Need for reliable biomarkers, Other potential combination therapies (anti-VEGF), the prognostic significance of neutrophil : lymphocyte ratio.

IREE-16   **Safety, Quality, And Complications Of Central Venous Access Procedures**

Participants
Hiroki Horinouchi, Suita, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Central venous (CV) access devices provide reliable and stable intravenous access for patients requiring blood transfusions, chemotherapy, and parenteral nutrition. The devices relieve patients from the stress of repeated needle pricks and phlebitis over weeks, months, or even years. CV access procedures are the most common procedures performed by interventional radiologists. However, the methods vary according to the operator or hospital, and we have not been able to completely prevent the complications related to the procedures from occurring. To improve safety and quality, radiologists should know the complications of CV access procedures and optimal evidence-based methods to prevent them.This exhibition aims to instruct the participants regarding; 1) The complications of CV access procedures and their causes, 2) The methods to promptly detect and manage the complications, 3) The tips and tricks of CV access procedures.

TABLE OF CONTENTS/OUTLINE

1. What are central venous (CV) access procedures? a. Indication b. Types of CV access devices 2. How to perform CV access procedures a. Preparation b. Needle insertion c. Placement d. Fixation, Dressing 3. Complications a. Hematoma, Hemorrhage b. Pneumothorax, Hemothorax c. Thrombosis, Thrombophlebitis d. Catheter malposition e. Catheter fracture, Catheter kinking f. Infection g. Others 4. Management of complications 5. Tips and tricks to improve for safety and quality

IREE-17   **Subclavian Steal Syndrome: An Underrecognized Manifestation Of Atherosclerosis.**

Participants
Suryansh Bajaj, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

Subclavian steal syndrome (SSS) is a hemodynamic phenomenon that causes decreased perfusion in the branches of the subclavian artery and retrograde flow of blood in the vertebral artery due to decreased anterograde flow caused by an occlusive lesion in the subclavian artery. The occlusive lesion is most commonly due to significant atherosclerotic disease. An overwhelming majority of patients remain asymptomatic and those with severe occlusion can present with symptoms involving the vertebrobasilar circulation (posterior circulation symptoms like transient ischemic attacks, vertigo, and dizziness) or ipsilateral arm ischemia. Diagnosis is usually made using Doppler ultrasonography (USG), but other cross-sectional imaging modalities (CTA and MRA) have shown increased prevalence than once thought. A thorough workup for SSS and other atherosclerotic lesions should be done in all such patients. Most patients can be managed conservatively by medical management. Symptomatic patients are managed with endovascular (PTA with or without stenting) first or surgical management in select cases. This exhibit will provide a concise look at the current literature along with the latest management guidelines and therapeutic options.

TABLE OF CONTENTS/OUTLINE

Current epidemiology and prevalence of the disease. An interesting case study requiring intervention. Clinical Presentation. Latest guidelines on diagnosis: Role of Doppler USG, CTA, MRA, and conventional angiography. Management: conservative, endovascular vs surgical.

IREE-18   **Adapting A Dialysis Service For The Delivery Of Percutaneous Arteriovenous Fistulas**

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Geoffrey Lie, MBBS,BSC, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Pre-procedural planning, expertise to perform the procedure and post-procedural care are all essential to deliver an effective percutaneous arteriovenous fistula service• Pre-procedural planning: o Skilled vascular ultrasound practitioners provide an anatomical/procedural roadmap to screen patients. A proforma is mandatory to standardize record keeping o A vascular access multidisciplinary team (MDT) comprising Nephrologists, Vascular Access Surgeons, Dialysis Nurses, Anaesthetists and Interventional Radiologists (IR) to discuss the most suitable dialysis life plans for patients (as per KDOQI guidelines) and safeguard appropriate patient selection o Clinic to obtain informed patient consent, review patient co-morbidities, history of prior vascular access, and counsel for patient preference and lifestyle factors• Periprocedural: o IR team members must possess knowledge of the specific nuances related to procedure• Post-procedural care: o Ultrasound follow-up for complications and adequate fistula maturation o Dialysis nurses must be trained in needling cannulation sites specific to this fistula (eg. median cubital vein) o Established pathway for cases of non-maturation to plan for re-intervention or surgical adjunct procedures

TABLE OF CONTENTS/OUTLINE

1. Background: benefits of the percutaneous AV fistula 2. Algorithmic overview: our experience 3. Pre-procedural planning 4. Performing the procedure 5. Post-procedural care and follow up 6. Patient Case studies 7. Conclusion

IREE-19   **Interventional Radiology Management Of Complications From Iatrogenic Gastrointestinal**

Interventions

Participants
Harish Narayanan, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Gastrointestinal interventions are common and first line therapy for many gastrointestinal disorders. These therapies are safe; however, complications can occur.2. After a patient has undergone a gastrointestinal intervention and has significant abdominal pain or gastrointestinal bleeding, suspicion for complication should be high. CT angiography can be particularly useful in the diagnostic evaluation.3. Interventional radiology can manage complications from gastrointestinal interventions using various techniques.

TABLE OF CONTENTS/OUTLINE

In a case-based format, this educational exhibit will provide a pictorial review and discussion of various complications related to gastrointestinal interventions, the diagnostic imaging evaluation and the interventional radiologic management. Case 1 - Colonic Self Expanding Metal Stent (SEMS) causing left external iliac artery pseudoaneurysm Case 2 - Gastroduodenal SEMS causing aortoenteric fistula Case 3 - Lumen-apposing metal stent (LAMS) from gastrojejunostomy to excluded stomach causing pseudoaneurysm Case 4 - ERCP metallic biliary duct stent placement causing pseudoaneurysm Case 5 - Percutaneous pancreatic fluid collection/necrosis drain placement complicated by pancreatic pseudoaneurysm Case 6 - Rectus sheath hematoma after gastrostomy tube placement Case 7- Intraperitoneal abscess after gastrostomy tube placement

IREE-2   Percutaneous Drainage For Postoperative Fluid Collection After Hepato-biliary Pancreatic Surgery

Participants
Ryo Morita, MD, Sapporo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To explain the basic treatment flow of percutaneous drainage after hepato-biliary pancreatic surgery, 2. To summarize the advanced puncture technique/catheter induction, 3. To explain the treatment of anastomotic leakage with percutaneous approach

TABLE OF CONTENTS/OUTLINE

1. Basics; Treatment concepts/strategy, Diagnosis and indication, Treatment outcome and complication, Safe and effective puncture(common access route, route of single space, puncture of abscess origin), Imaging guidance(US and CT, CT fluoroscopy), Drainage technique:Trocar Seldinger technique, Catheter induction, Postdrainage management (tube replacement / removal) and catheter care.2. Developmental matters/Case presentation; Right intercostal approach:Difficulties of puncturing via the thoracic cavity, Percutaneous drainage with preexisting surgical drains, Sinus tract puncture technique, Catheter induction with Navigation Map, Anastomotic leakage/external fistula (pancreatic fistula / bile leakage), Internal fistulization/drainage for anastomotic leakage(using a jejunostomy route, creating a the jejunostomy, or rendezvous techniques).3. Technical Tips/ Equipment for reliable tube placement after puncture; Puncture kit, Tube induction system, Guidewires, Catheters.4. Important point for postoperative drainage; Confirmation and understanding of surgical procedures, Careful procedure, Troubleshooting related to the puncture(bleeding, intestinal puncture, tube falling).

IREE-21   A Review Of Heparin-induced Thrombocytopenia And Heparin-coated Intravascular Devices

Participants
Erika Ysabelle Mojica, BA, Minot, North Dakota (*Presenter*) Shareholder, Catalyst Pharmaceuticals

TEACHING POINTS

Vascular diseases, including peripheral artery disease (PAD), continue to be significant causes of morbidity and mortality worldwide. Endovascular treatments of vascular diseases are quickly replacing higher risk surgeries, in large part due to rapid advances in therapeutic interventions including the development of viable vessel substitutes. Heparinized stents and endovascular grafts are increasingly used for treatment of PAD due to superior patency rates over bare metal stents. However, cases of heparin-induced thrombocytopenia (HIT), a potentially fatal immune-mediated complication of heparin exposure, have been recorded in patients who have received heparin-coated stents and vascular grafts. Notably, the development of HIT in patients receiving heparin-coated intravascular devices may be confounded by systemic exposure to heparin during the intraoperative or postoperative period. This educational exhibit will examine the current literature on HIT in patients with heparin-coated intravascular devices.

TABLE OF CONTENTS/OUTLINE

1. Present a case of thrombocytopenia post-placement of a heparin-coated graft in the setting of aortoiliac occlusion. 2. Review the pathogenesis, presentation, diagnosis, and treatment of HIT. 3. Describe approaches to heparin bonding in intravascular devices. 4. Summarize the current literature on HIT in patients who have received heparin-coated intravascular devices. 5. Discuss recommendations for management of HIT in patients with heparin-coated intravascular stents or grafts.

IREE-22   Role Of Novel Vasculomimetic Stent Use In A High Grade Juxta-anastomotic Outflow Vein Stenosis

Participants
Shivam Kaushik, Pine Hill, New Jersey (*Presenter*) Nothing to Disclose

TEACHING POINTS

Understanding the place of arteriovenous fistula (AVF) in management of chronic kidney diseaseReviewing the complications associated with AVF leading to its failureCase based review of endovascular management strategies used for AVF failurePathophysiology of outflow vein stenosis in AVF and its management using different endovascular techniques with special

focus on vasculomimetic stents.

TABLE OF CONTENTS/OUTLINE

Anatomy of AVFsDifferent techniques of AVF creationPathophysiology of various complications leading to AVF failureEndovascular management of AVF complications-- case based reviewRole of vasculomimetic stent in management outflow vein stenosis

IREE-23   Therapeutic Ultrasound Applications In The Abdomen And Pelvis

Awards
Identified for RadioGraphics

Participants
Anne Sailer, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Discuss principles of different modes of therapeutic ultrasound.2. Examine specifications of available/in-development therapeutic ultrasound devices offering applications in the abdomen and pelvis.3. Describe diseases and organs specific to abdomen and pelvis for which therapeutic ultrasound has been utilized with examples, published evidence, current clinical trials, regulatory status and US insurance coverage.4. Review possible future abdominopelvic applications of therapeutic ultrasound.

TABLE OF CONTENTS/OUTLINE

Principles of therapeutic ultrasound - Physics of different treatment modes including Hyperthermia, Thermal Ablation (Focused versus Directional) and Mechanical (Histotripsy). Advantages and disadvantages of MRI versus Ultrasound imaging guidance. Specifications of Devices (trademarked) - Exablate, Sonalleve, TULSA-PRO, Edison, Sonablate, Ablatherm, HAIFU JC. Abdominopelvic indications of therapeutic ultrasound with US or outside US approvals - Prostate (Cancer and BPH), Uterus (Fibroids and Adenomyosis), Renal Tumors, Liver cancer and Pancreatic cancer. Brief discussion of abdominopelvic indications of therapeutic ultrasound with published human pilot trials - Endometriosis, endometrial/cervical cancer, ectopic pregnancy, biliary cancer, colorectal cancer, renal stones, hypersplenism, obesity. Future applications of therapeutic ultrasound in abdomen and pelvis - Acute kidney injury, liver fibrosis, immunologic effects, drug delivery, twin-twin transfusion syndrome.

IREE-24   Venous Anatomy And Collateral Pathways Of The Pelvis: An Angiographic Review

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Kenneth Zurcher, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

The pelvic venous collateral system is complex and demonstrates anatomic variability, however a number of predictable paths exist based on causative pathology and level of obstruction Several broad categories of collateral pathways exist, including deep, superficial/iliofemoral, intermediate/reproductive, and portosystemic pathways The ability to accurately identify common collateral patterns on multiple imaging modalities can assist in delineating underlying obstructive patterns/pathology, and in planning procedural or surgical intervention.

TABLE OF CONTENTS/OUTLINE

Provide anatomic review, causative etiologies, levels of obstruction, and clinical importance of collateral pathways as follows: Deep collateral pathway: azygos system, paraspinal and intra/extravertebral plexuses, and sacral venous plexus Superficial pathway: inferior and superficial epigastric veins, circumflex iliac vessels, iliofemoral collaterals, obturator, pudendal veins Intermediate/reproductive pathway: gonadal veins, ovarian/uterine plexuses Portosystemic pathway: inferior mesenteric vein and rectal vein collaterals, retroperitoneal collaterals

IREE-25   Interventional Radiology Management Of Liver Transplant Complications - Review And Update

Awards
Identified for RadioGraphics
Cum Laude

Participants
Sailen G. Naidu, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Interventional radiology plays a critical role in the care of liver transplant patients. Understanding post-operative anatomy and surgical technique is essential. 2. Complications generally occur at the anastomoses of the respective hepatic artery, portal vein, hepatic veins/IVC and the biliary system. 3. New techniques and perspectives have recently evolved, further enhancing the role of interventional radiology and improving overall liver transplant outcomes

TABLE OF CONTENTS/OUTLINE

Summary of surgical anatomy of liver transplantation showcasing the hepatic artery, portal vein, hepatic veins/IVC and biliary system Interventional radiology management of liver transplant complications with specific case examples and evidence-based recommendations. Hepatic artery - stenosis, thrombosis, arteriovenous fistula Portal vein - stenosis, thrombosis Hepatic vein/IVC - stenosis, thrombosis Biliary - strictures, leaks and ischemic cholangiopathy Update on Liver Transplant Interventions. This will emphasize new techniques and paradigm shifts in our understanding of liver physiology following liver transplantation Transsplenic portal vein recanalization Embolization of competing varices to increase portal flow Treatment of nonocclusive hepatic artery hyoperfusion due to portal hyperperfusion by splenic artery embolization TIPS following liver transplantation

IREE-26   Assessing Quality Of Care: A Primer For Interventional Radiologists

Participants
Helena Bentley, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

TEACHING POINTS

As modern healthcare systems become increasingly reliant on interventional radiology (IR) procedures ensuring appropriate quality of care is of utmost importance. This educational exhibit is intended to increase interventional radiologists' knowledge of foundational concepts in quality of care assessment.Upon review of this educational exhibit the reader will be better able: (1) to describe the domains of quality of care; (2) to outline the advantages and limitations of the use of each of the aforementioned domains in quality of care assessment; (3) to understand why process-based measures are most beneficial for assessing quality of care in IR; (4) to recall the construct of a quality indictor; and, (5) to identify the need for a feasible standardized approach to assessing the quality of care of patients undergoing IR procedures.

TABLE OF CONTENTS/OUTLINE

In keeping with Donabedian's historic paradigm the 3 domains of quality of care, structure, process, and outcome, shall be described and the advantages and limitations of each shall be outlined. Particular emphasis shall be placed on process-based measures of quality of care, with the benefits of assessing quality of care in IR using such measures being illustrated. Through use of illustrative cases from our high-volume, academic institution the need for a feasible standardized approach to assessing quality of care of patients undergoing IR procedures shall be formulated.

IREE-27   Percutaneous Transsplenic Portal Access: Indications And Technique.

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Mathew Smith, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Multiple diseases of the portal system require effective portal vein (PV) access for endovascular management. While percutaneous transhepatic or transjugular approaches remain the standard method of PV access, the transsplenic approach has gained recognition as an effective and safe technique in patients with contraindications to traditional approaches. 2. Treatments amenable to percutaneous transsplenic access (PTA) include recanalization of chronic PV occlusion, stenting of PV stenosis, portal vein embolization (PVE), embolization of gastric varices, or transjugular intrahepatic portosystemic shunt (TIPS) and post-liver transplant interventions 3. This educational exhibit will summarize the indications for PTA, patient work up, technique for access/closure, and common complications

TABLE OF CONTENTS/OUTLINE

1. Brief introduction to PTA 2. Indications a. Portal vein embolization b. Chronic obstruction c. Complicated transjugular intrahepatic portosystemic shunt d. Embolization and obliteration of TIPS e. Portal vein stenosis (stent placement) 3. Relevant anatomy and patient work up 4. Access 5. Closure/follow up imagining 6. Complications 7. Conclusion

IREE-28   Peripheral Arterial Disease Pre-procedure Imaging: When And How?

Participants
Dylan Later, Salisbury, North Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the physical findings of PAD and their sensitivity/specificity. 2. Understand the difference between anatomic and physiologic imaging for PAD. 3. List the advantages and disadvantages of each anatomic and physiologic imaging modality in the workup of PAD. 4. Review clinical scenarios for which each imaging modality is best suited.

TABLE OF CONTENTS/OUTLINE

Purpose: To evaluate current imaging modalities in the evaluation of peripheral artery disease (PAD): intermittent claudication (IC) and chronic limb-threatening ischemia (CLTI). Background/Materials/Methods: PAD is underdiagnosed and undertreated in the US. Amputations result in significant morbidity to the patient and tremendous cost on the health care system; however, studies demonstrate that most patients have no attempt at revascularization prior to amputation. Up to 80% of patients with non-healing ulcers have PAD. Current evaluation of PAD includes history, clinical examination, and anatomic as well as physiologic imaging. There is not one perfect test for the evaluation of PAD; work-up depends on the clinical presentation. Imaging is imperative in the diagnosis and treatment planning of PAD. Conclusion: Clinical evaluation for ischemia has a poor negative predictive value and should not be used in isolation to triage patients with non-healing ulcers. This poster will describe the role of a number of emerging modalities and their accuracy in the evaluation of PAD and CLTI.

IREE-29   Coil Embolization Of Collaterals In Arteriovenous Fistula Steal Syndrome: Physics In IR

Participants
Shivam Kaushik, Pine Hill, New Jersey (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the complications associated with arteriovenous fistulas and their evaluationUnderstand the role of access ligation and banding in management of arteriovenous steal syndromeExplore the physics behind the role of collateral embolization in arteriovenous fistula management and its current role with the help of examples.

TABLE OF CONTENTS/OUTLINE

Pathophysiology of arteriovenous steal syndromeClinical presentationPhysical examination findingsInvestigationsUltrasonographyPre-procedural DSA imaging Treatment options for arteriovenous fistulasAccess ligationBandingCoil EmbolizationCase based discussion of

IREE-3   **Radioembolization Of Hepatocellular Carcinoma With Extrahepatic Collateral Blood Supply: Anatomic And Technical Considerations**

Participants
Hyo-Cheol Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radioembolization for hepatocellular carcinoma (HCC) has exploded in recent years. HCC typically received its blood supply from the hepatic artery, however, it can recruit a parasitic blood supply from extrahepatic collateral arteries (EHC). Whereas chemoembolization has been performed through EHC without serious complications, little experiences about radioembolization though EHC have been reported. The purpose of this exhibit is: (1) To review the key anatomy of EHC by using cone-beam CT. (2) To review when we suspect the presence of EHC supplying HCC. (3) To learn how to do safe radioembolization through EHC.

TABLE OF CONTENTS/OUTLINE

1) List of treated EHC 2) Vascular anatomy of EHC by using cone-beam CT and safe point of each EHC 3) Suggestive findings of EHC on CT/MR and cone-beam CT 4) Special considerations for radioembolization through EHC: dosimetry, embolization of pulmonary shunt, protection of normal vessel, and redistribution by proximal embolization.

IREE-30   **Placement And Management Of Percutaneous Transesophageal Enteric Access: A Pictorial Review**

Participants
Jessica M. Lee, MD, Guilford, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Peritoneal carcinomatosis and lack of a safe window to the stomach confer higher risk of complication from standard gastrostomy.2. Percutaneous transesophageal gastrostomy is a safe, effective, and well-tolerated alternative to transperitoneal enteric access. 3. Percutaneous transesophageal gastrostomy allows patients to avoid the discomfort of a chronic indwelling nasoenteric tube for decompression or feeding. 4. A fluid-filled balloon positioned within the esophagus at the thoracic inlet creates a percutaneous window between the trachea and left common carotid artery and provides a target for US guided percutaneous access.5. Per oral intake is not prohibited after transesophageal gastrostomy placement.

TABLE OF CONTENTS/OUTLINE

Table of Contents/Outline:1. Abstract 2. Introduction 3. Patient selection and preprocedural evaluation 4. Review of relevant anatomy 5. PTEG insertion technique 6. Postprocedural care7. Special circumstances (left thyroid in trajectory, gastrojejunal access, catheter exit site infection, catheter dislodgement, catheter adapters, recurrent laryngeal nerve palsy)

IREE-31   **No Contrast? No Problem! A Resident Primer For C02 Angiography.**

Participants
Christine Bashour, Westlake, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

Carbon dioxide angiography is an innovative approach to angiography in patients with contraindications to traditional iodinated contrast administration. This holds especially true in those with an anaphylactoid reaction to IV contrast or those who require renal preservation in the setting of renal failure. The gas' physical properties, particularly its viscosity and buoyancy, allows for interpretation of more traditional images as well as those that cannot be visualized with other forms of angiography. Carbon dioxide angiography is not without risk, but such risks can be prevented with proper knowledge and technique. This form of imaging can be used in both the diagnostic and interventional setting; this versatility highlights the importance educating radiologists on this contrast media and its uses.

TABLE OF CONTENTS/OUTLINE

1. Mechanism and Unique Physical Propertiesa. Safetyb. Displacement of blood within the vesselc. Low viscosityd. Buoyancye. Invisibility and Compressibilityf. Digital Subtraction Angiography2. Indicationsa. Diagnostic Indicationsb. Endovascular Indications3. Contraindicationsa. Cardiopulmonary and Positioning restrictionsb. Cerebral arteriographyc. Nitrous Oxide4. Pearlsa. Lack of renal toxicity and anaphylaxis riskb. High volume, low risk administrationc. Enhanced detection of vascular abnormalities5. Pitfallsa. Risk of neurotoxicity with cerebral imagingb. Risk of coronary artery gas embolismc. Risk of "vapor lock"d. Risk of bowel ischemia6. Case examples

IREE-32   **Contemporary Management Of Acute Pulmonary Embolism: The Evolution Of Catheter-based Therapy**

Awards
Identified for RadioGraphics

Participants
Tim Carlon, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: Define massive and submassive pulmonary embolism and review risk stratification. Review different treatment options for pulmonary embolism including patient selection and procedural risks and benefits. Provide a practical approach to currently available endovascular treatment modalities for acute pulmonary embolism including large bore mechanical catheter directed thrombectomy, small bore catheter directed mechanical thrombectomy, catheter directed thrombolysis, and ultrasound-assisted catheter directed thrombolysis. Summarize the major trial results to date for endovascular treatment of pulmonary embolism and detail ongoing and upcoming endovascular clinical trials.

TABLE OF CONTENTS/OUTLINE

1. Types of Pulmonary Embolism and Clinical Coursea. Massive PEb. Sub-massive PEc. Non-massive PE2. Treatment Options for

Acute PEa. Patient selectionb. Medical managementc. Endovascular therapyd. Open surgery3. Endovascular Treatment Modalities for Acute PEa. Pulmonary angiography and pressure monitoringb. Large bore catheter directed embolectomyc. Small bore catheter directed embolectomyd. Catheter directed thrombolysise. Ultrasound-assisted catheter directed thrombolysisf. Risks and benefits of endovascular therapies4. Trial Results To-Date for Endovascular PE Intervention5. Ongoing and Upcoming Clinical Trials on PE Intervention

IREE-33   Nutcracker Syndrome: A Silent Enemy. Diagnosis, Endovascular Treatment And Its Complications.

Participants
Dario Herran de la Gala, MD, Santander, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit will: 1) Review the anatomic crossroad and anatomic variations that can lead to Nutcracker Syndrome (NCS). 2) Describe the epidemiology, frequency and risks factor related to NCS. 3) Assess NCS diagnostic criteria on US, CT and Phlebography. 4) Describe endovascular treatment options available for NCS and how interventional radiologist play a major role. 4) Describe the complications that can appear after endovascular & surgical treatment of NCS.

TABLE OF CONTENTS/OUTLINE

Nutcracker syndrome (NCS) is a vascular compression disorder which refers to the compression of the left renal vein, most commonly between the superior mesenteric artery (SMA) and abdominal aorta. It's exact prevalence is unknown and it is thought to be underdiagnosed. It usually presents as a history of chronic flank or pelvic pain, with or without hematuria. Doppler US, CT and Phlebography can be used to diagnose NCS, using different direct and indirect parameters. Phlebography alongside with a typical clinical picture gives the definitive diagnosis. There are several approaches for NCS treatment: conservative, endovascular or surgical. In the last years endovascular approach has been proven to be a valid and noninvasive treatment option in which interventional radiologist play a major role. Positioning a stent inside in the left renal vein (LRV), widening its diameter and allowing a good venous return it's the preferred endovascular approach. Graft thrombosis or stent migration are the main complications of active treatment.

IREE-34   Experimental Models For Quantitative Vascular Imaging During Hepatic Interventions: From Virtual To Reality

Participants
Joe Whitehead, BS, Madison, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

Interventional radiologists rely on their qualitative interpretation of images to determine treatment endpoints and success. Quantitative vascular imaging techniques can provide functional information such as blood velocity and flow during interventional procedures but are not yet widely used. Quantitative imaging techniques must be validated and rigorously tested prior to being translated to clinical practice and used for clinical decision making. Validation of these algorithms can be limited by an inability to 1) acquire ground truth data, 2) replicate physiological and anatomical complexity, 3) reproduce dynamic processes. This exhibit introduces techniques for quantitative vascular imaging in IR and presents an overview of virtual, experimental, and animal models available for quantitative imaging during hepatic interventions.

TABLE OF CONTENTS/OUTLINE

A) Introduction to Quantitative Imaging in IR Clinical examples of qualitative imaging, clinical applications of quantitative imaging, need for clinically realistic ground truth models. B) Virtual Phantom Models Anatomical and functional virtual phantoms, virtual imaging phantoms. C) Phantom Models: 3D printing vascular phantoms, converting anatomical to functional, clinical example of 3D printed vascular model. D) Animal Models Ideal animal model characteristics, rabbit and swine animal models, clinical translatability of animal models. E) Future Directions of Each Model. F) Quiz Questions.

IREE-35   Decreasing Morbidity And Preventing Sterilization In The Treatment Of Postpartum ComplicationsA Collection Of Uncommon Cases Amenable To Angiographic Intervention

Participants
Sean Sullivan, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. A great number of complications are known to manifest within the postpartum period, often offering a broad differential diagnosis which invariably prompts imaging evaluation. 2. While the large degree of clinical overlap accentuates the value of understanding common entities, the ability to differentiate vascular entities of the reproductive tract can correctly guide management and treatment of postpartum patients. 3. Angiographic intervention is an underutilized modality that can delay or obviate the need for surgery, offering patients a less morbid alternative which in some cases prevents sterilizing hysterectomy.

TABLE OF CONTENTS/OUTLINE

1. Review the visceral and vascular anatomy of the female reproductive tract including common variants. 2. Discuss our proposed approach to clinical and radiologic diagnosis of common postpartum complications. 3. Distinguish postpartum complications which are amenable to angiographic intervention from those that are not. 4. Case-based demonstration of successful postpartum embolizations.

IREE-36   Highlighting Vessels And Tissue Enhancement: Strengths Of Dual Energy CT For Vascular, Interventional Radiology, And Surgery Cases

Participants
Ali Erkin, DO, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Introduce the concept of Dual Energy CT.2) Present the physics which allow for Dual Energy CT acquisition.3) Educate and provide examples for clinical applications for Dual Energy CT.3) Dual Energy CT applications for interpreting CT pulmonary angiogram

studies and visualizing perfusion to the lung in the setting of acute PE.4) Dual Energy CT applications in gastrointestinal pathology. Specifically when questioning patterns of enhancement in mesenteric ischemia and delineating presence of intra-luminal iodinated contrast in acute GI bleeds.5) Dual Energy CT application in acute trauma to improve sensitivity for recognizing hematomas and improve the visualization of active extravasation.6) Dual Energy CT applications in increasing sensitivity for recognizing subtle enhancing structures in cases of acute inflammation and malignancy.

TABLE OF CONTENTS/OUTLINE

1) Dual Energy CT Technique.2) Dual Energy CT Applications, Including Metal Reduction and Iodine Mapping.3) Dual Energy CT Applications for Pulmonary Cases.4) Dual Energy CT for Gastrointestinal Cases.5) Dual Energy CT for Trauma.6) Dual Energy CT for Inflammation and Cancer.

IREE-37   Preoperative Pleural Mass Embolization: A Pictorial Review

Participants
Russ Guidry JR, MD, Hoover, Alabama (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Solitary fibrous pleural tumors are rare and account for less than 5% of pleural based tumors. 2. Surgical resection is often complicated by significant blood loss due to tumor size. 3. Pre-operative contrast enhanced computed tomography provides an accurate guide for the arterial supply: Thoracic (Mediastinal, Bronchial or intercostal arteries, subclavian branches), Extrathoracic (inferior Phrenic artery) 4. Arteriovenous fistula is frequently associated with these large solitary fibrous pleural tumor in angiography. 5. Pre-operative embolization is feasible, and safe and reduces operative blood loss. 6. Embolization is focused on tumor bed devascularization including particles, Gelfoam, coils and vascular plugs.

TABLE OF CONTENTS/OUTLINE

1. Introduction and Background: An overview of pleural masses with specific focus on solitary fibrous plural tumor will be presented with emphasis on complications arising from resection. 2. Case Series: 4 cases will be presented focusing on initial diagnostic imaging findings, angiographic findings, embolization overview, and outcome at tumor resection. 3. Discussion: Details of interventional procedure will be discussed with special attention paid to approach considerations, angiographic findings, and embolization endpoints. 4. Conclusions: Findings gleaned from the mentioned cases that may be generalizable in the context of prior literature will be listed. 5. References.

IREE-38   High Resolution Micro Computed Tomography For Translational Research In Radiology

Participants
Izzet Altun, Scottsdale, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Describe the role of micro-CT in translational research. 2. Develop a deeper understanding of the potential usage of quantitative micro-CT imaging in radiology. 3-Discuss previously used quantitative micro-CT imaging methods. 4- Demonstrate in vivo and ex vivo scanning protocols.

TABLE OF CONTENTS/OUTLINE

Micro-computed tomography (micro-CT) offers a unique, non-destructive, analytical, and three-dimensional scanning opportunity to investigate in vivo and ex vivo research samples. In our translational research laboratory, we have extensive experience in scanning biomaterials, in-vivo animals, ex-vivo tissue samples, and 3D models.- Review the usage and physics of micro-CT imaging. -Describe the role of micro-CT scanners in translational research. -Illustrate three-dimensional images of various research samples that have a unique role to explore novel minimally invasive therapies. -Discuss different scanning protocols for various samples. -Discuss the difficulties during pre- and post-scanning period. -Review the commonly seen artifacts in micro-CT imaging. -Overview the commonly used quantitative image analysis methods.

IREE-39   Outside The Box: Non-traditional Uses Of Ultrasound Contrast In Abdominal And Interventional Radiology

Awards
Identified for RadioGraphics

Participants
Eric Pepin, PhD, MD, Farmers Branch, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Contrast-enhanced ultrasound (CEUS) has applications beyond characterization of focal lesions by intravenous injection.2. Direct urinary injection can provide functional assessments of the urinary tract when fluoroscopy is inaccessible or there are radiation concerns.3. Indwelling catheters can be evaluated with CEUS at the bedside.4. Intra-procedure uses include intracavitary injection, and assessment of post-biopsy hemorrhage.5. Endovascular stents can be evaluated for patency and endoleaks in patients unsuitable for CTA.

TABLE OF CONTENTS/OUTLINE

1. Review of principles of contrast-enhanced ultrasoundA. PharmacokinetcsB. Safety profile and contraindicationsC. Supplies and imaging technique2. Case-based review of diagnostic and interventional applications, with how to, dilutions, and interpretation pitfalls:A. Non-intravenous applications:i. Genitourinary functional studiesa. Cystogramb. Voiding cystourethrogramc. Retrograde urethrogramd. Hysterosalpingogramii. Tube checksa. Percutaneous nephrostomyb. Abscess catheterc. Cholecystostomyiii. Direct injectiona. Fistulogramsb. Intra-cavitaryc. Intra-lesionalB. Vascular applications other than lesion characterization:i. Biopsy targeting to improve yieldii. Post-biopsy assessment of active extravasationiii. Assessing EVAR and FEVAR for endoleak

IREE-4   Endovascular Management Of Visceral Pseudoaneurysms: "How To Do It"

Participants
Matthew Moccia, DO, Portland, Maine (*Presenter*) Nothing to Disclose

- Pseudoaneurysms or "false" aneurysms represent collections of blood between the outer two layers of a blood vessel- Pseudoaneurysms less commonly involve the visceral arteries; however, when they do, they require rapid treatment due to the potential for rupture- We will discuss the etiology and pathophysiology of visceral artery pseudoaneurysms- When treating visceral artery pseudoaneurysms, there are many techniques at the interventionalists disposal including embolization, stent placement and thrombin injection- We will review the various endovascular strategies available to manage visceral artery pseudoaneurysms through case examples

TABLE OF CONTENTS/OUTLINE

- Introduction and Objectives- Anatomical Considerations- Pre-procedure/Diagnostic Imaging- Indications and Contraindications- Procedural Techniques (pre-procedure planning/set-up, equipment, treatment strategy)- Post-procedure Imaging- Case Example(s)- Follow-up Management- Outcomes and Complications- Conclusion- References

IREE-40   Ultrasound Guided Phrenic Nerve Block: A Tutorial

Participants
Harish Narayanan, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand how to perform an ultrasound guided phrenic nerve block and its indications/use.2. Illustrate the steps localizing the phrenic nerve and administration of nerve block under ultrasound guidance.

TABLE OF CONTENTS/OUTLINE

Introduction and rationale in the use of phrenic nerve block, including prior to CT guided procedures. Anatomy review Pre-procedure Image review Contraindications/patient assessment Procedure Localizing the phrenic nerve under ultrasound guidance. Steps performing the nerve block. Post-procedure assessment of effectiveness with examples. Complications, side effects and contraindication of performing phrenic nerve block. Case studies

IREE-41   Type II Endoleak After Abdominal/thoracic Endovascular Repair (EVAR/TEVAR); How To Diagnose And Treat It In Patients With Renal Dysfunction

Participants
Yasuhiro Ushijima, MD, Fukuoka, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the definition and hemodynamics of type II endoleak.To learn the diagnostics of type II endoleak using various and novel imaging modalities, especially under renal dysfunction.To learn the embolic procedure for type II endoleak.

TABLE OF CONTENTS/OUTLINE

1. Classification and definition of endoleak 2. Hemodynamics 3. Imaging modality: Angiography, CT (4D, dual energy), US (doppler, contrast-enhanced) 4. Embolic procedure: Transarterial approach, Percutaneous direct approach (translumbar, transabdominal, transthoracic) 5. Pitfalls

IREE-42   Novel Embolic Agents On The Horizon

Participants
Izzet Altun, Scottsdale, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review current embolization methods used by interventional radiologists. Evaluate both the benefits and limitations of current embolic agents. Examine the advantages of novel pre-clinical embolic materials. Discuss the mechanism, availability, cost, radiopacity, therapeutic effect, and the need for a special delivery system of embolic materials.

TABLE OF CONTENTS/OUTLINE

Transcatheter embolization is a minimally invasive procedure that uses embolic agents to intentionally block blood vessels for therapeutic purposes such as stopping the blood supply to the bleeding area or tumor vasculature. Currently, many types of embolic agents including metallic coils, microspheres, and liquids are available for clinical practice. Additionally, preclinical studies show promising results on novel embolic agents that can replace the currently used embolic agents. -Outline the current embolization techniques including their indications, efficacy, cost, availability, complications, drawbacks, and applicability. -Discuss the emerging novel embolic materials and the future of embolization. -Identify the main challenges to designing universal embolic material.

IREE-43   Ultrasound-guided Minimally Invasive Treatments Of Thyroid Cancer: Current Possibilities

Participants
Serena Carriero, San Donato Milanese, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

In the last decades, the incidence of thyroid cancer has been increasing globally. In Europe, the incidence is estimated as 9 and 3 cases for 100.000 person-year respectively in male and female population. The growing detection is paralleled by an increase in surgical treatments. Minimally invasive treatments (MIT) are increasingly used in the treatment of patients with thyroid cancer (TC) to reduce the invasiveness of treatment or in patients unsuitable for surgery. This exhibit will: 1. Provide a background on TC and papillary thyroid microcarcinoma (PTMC) 2. Provide an overview of main MIT techniques, particularly focusing on radiofrequency and laser ablation 3. Describe the current potential application of MIT in patients with TC, including treatment of PTMC, unresectable TC, and neck lymph-node recurrences of TC.

TABLE OF CONTENTS/OUTLINE

1. Background on TC and PTMC 2. Techniques of MIT in thyroid cancers: Thermal ablation techniques (TA) and Ethanolol ablation (EA) 3. Clinical application of MIT in patients with thyroid cancers (with clinical cases): -PTMC -Unresectable TC -Lymph node metastases from TC 4. References.

IREE-44   Retrospective Validation Of A Virtual Platform For Personalized Thermal Ablation Planning Of Liver Tumors: Microwave Ablation Vs Intravascular Plasmonic Photothermal Ablation

Participants
Mir Hadi Razeghi Kondelaji, MS,MSc, Milwaukee, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

Introduction Commercial MWA probes can effectively ablate tissue however the control of the thermal and tissue damage contours is challenging and the therapy outcome depends on the skill of radiologist placing the probe. Emerging near-infrared resonant gold nanoparticle based plasmonic thermal therapy (PTT) promises control of tumor ablation via specifically targeted nanoparticles (NP) but has not been reported clinically for liver tumor ablation. We developed an integrated finite element (FE)-based simulation framework for comparing MWA and PTT in an image guided and personalized manner. Methods Anonymized pre and post MWA DICOM images of 10 patients with liver tumors were analyzed. Ablation zones for MWA and PTT were determined by simulating EM wave and NIR light propagation coupled with bioheat transfer for both methods. For MWA an Emprint system with 15-cm probe, and 2 cm antenna was modeled to deliver about 65 W to the tumor for ~5 minutes. PTT was simulated with a cylindrical laser probe (808nm) and power delivered to the tumor was about 4 W/cm2. The computational model was validated using post MWA ablation MRI scans. Results Via a retrospective study on anonymized liver tumor MWA associated CT and MRI datasets, we demonstrate that intra-arterial laser-nanoparticle ablation can maintain sufficient temperature for ablation similar to MWA, while restricting the ablation envelope to tumors without damaging substantial amount of normal tissue.

TABLE OF CONTENTS/OUTLINE

IntroductionMethodsResults

IREE-45   Current Strategies To Identify Patients That Will Benefit From Tace Treatment And Future Directions: A Practical Step-by-step Guide

Participants
Aline Maehringer-Kunz, MD, Mainz, Germany (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Treatment of hepatocellular carcinoma (HCC) depends on the stage of disease. - In the Western Hemisphere, the Barcelona Clinic Liver Cancer classification (BCLC) is the preferred staging system.- Approximately one-third of patients initially present with intermediate-stage disease. - For these patients, transarterial chemoembolization (TACE) is the treatment of choice. - The intermediate-stage comprises a heterogeneous subgroup of patients with considerable differences in tumor burden and liver function. - Due to these differences, not all patients benefit equally from TACE. - This exhibit provides a concise practical step-by-step guide on current strategies for patient selection and decision-making before and during TACE.

TABLE OF CONTENTS/OUTLINE

1. Clinical relevance- Incidence and mortality of HCC- Special features of intermediate-stage 2. Treatment decision before and during TACE: What are the most critical time points?3. Start of TACE treatment: Which patients are optimal candidates for TACE?- Tumor-associated, patient-associated, and treatment-associated factors4. During the course of treatment: How often and when should TACE be repeated?5. Scoring systems: Appropriate support for decision-making before and during TACE treatment?6. Key points7. Future perspectives

IREE-46   Vexing Varicoceles: A Pictorial Review Of Variant Venous Drainage Of The Pampiniform Plexus

Participants
Nathan Loudon, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Varicocele refers to pathologic dilatation of the pampiniform plexus, which primarily drains into the internal spermatic (gonadal) vein. 2. Anatomic variations in the venous drainage pathways of the pampiniform plexus are relatively common. 3. Failure of surgical or endovascular therapy for varicoceles may be the result of alternate drainage pathways, which can contribute to varicocele persistence or recurrence.

TABLE OF CONTENTS/OUTLINE

1. Review of classic anatomy a. Left internal spermatic vein b. Right internal spermatic vein 2. Variant anatomy and other draining veins a. Iliocaval and renal vein variants i. Duplicated or left-sided inferior vena cava (IVC) 1. Example: Figure 1, isolated right varicocele in patient with left-sided IVC ii. Renal vein duplication, circumaortic or retroaortic renal veins 1. Example: Figure 2, circumaortic renal vein b. Parallel channels in internal spermatic vein i. Example: Figure 3, persistent varicocele due to parallel channel after surgical varicocelectomy c. Alternate draining veins i. Saphenofemoral drainage via external pudendal vein 1. Example: Figure 4, external pudendal venogram ii. External iliac vein drainage via inferior epigastric and external spermatic vein (cremasteric vein) iii. Internal iliac vein drainage via vasal vein iv. Others: Retroperitoneal, peritoneal, ureteral, splenic, colonic, etc. 1. Example: Figure 5, portosystemic shunt mimicking varicocele

IREE-47   Complications Of Locoregional Therapy In The Treatment Of Liver Malignancy: Adverse Events From Common To Rare

Participants
Travis Merritt, MD, Saline, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Increasing use of locoregional therapy (LRT) in the treatment of HCC has led to a lower prevalence of adverse events as techniques and tools are refined. However, the increased volume of LRT has resulted in an increasing incidence of uncommon or

rare adverse events- An understanding of uncommon adverse events can help radiologists recognize them when they occur, help guide appropriate therapy and aid in the application of standard processes to prevent significant morbidity and mortality in patients with HCC

TABLE OF CONTENTS/OUTLINE

1. Introduction:a. Brief overview of types of LRT b. Brief discussion of common complications after LRT for HCC (via case based examples)2. Pictorial review of rare and uncommon adverse events after LRT for HCCa. Intra-arterial (non radiation): transarterial embolization (TAE), transarterial chemoembolization (TACE) and drug eluting bead transarterial chemoembolization (DEB-TACE) b. Locoregional ablative: microwave ablation (MWA), radiofrequency ablation (RFA), and cryoablation c. External and internal radiation: stereotactic body radiotherapy (SBRT) and transarterial radioembolization (TARE)3. Provide practical techniques to avoid, recognize, and manage adverse events described

IREE-5   Not Just Renal Mass Ablation. The Role Of Interventional Radiology In Renal Cell Carcinoma Diagnosis And Management: A 2021 Update

Awards
Identified for RadioGraphics

Participants
Nathan Mickinac, MD, Mineola, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Management of advanced renal cell carcinoma (RCC) is complex.2. Interventional Radiology (IR) plays an important role in a variety of aspects of RCC treatment, including embolization and ablation of renal masses varying sizes and locations.3. More data is needed to determine the appropriateness of and best timing of and/or specific technical aspects to approaching combination therapies (such as systemic therapy with ablation and/or embolization).

TABLE OF CONTENTS/OUTLINE

-Review basic concepts in advanced renal cell carcinoma (RCC)-Highlight mechanisms of action of systemic agents used in the treatment of advanced RCC-Detail which advanced RCC patients may benefit for IR therapies-Discuss the role of trans-arterial embolization in advanced RCC-Review the role of ablation in advanced RCC-Describe unique scenarios where IR intervention may be uniquely important, including patients with multiple renal masses, inherited syndromes, and/or poor renal function-Detail the rationale behind used of combination therapies in advanced RCC, such as immunotherapy and ablation in pursuit of the abscopal effect-Highlight future directions and areas of current research

IREE-50   The Many Facets Of Pain Relief

Participants
Fernanda Babler, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review the most important anatomical concepts involved in low back pain and in spinal interventional proceduresUnderstand the indications and types of back pain injections as well as the procedures themselvesRecognize the common difficulties and possible complications of facet and epidural injections

TABLE OF CONTENTS/OUTLINE

1. INTRODUCTIONEpidemiology - and therefore the importance - of low back painMost common causesQuick review of management2. ANATOMICAL CONCEPTSLumbar vertebrae and diskFacet joint and its innervationSpinal nerve formationMeningeal spaces3. SPINAL INTERVENTIONAL PROCEDURESTypes and indications of back pain injectionsImaging guidance modalitiesPreparationTechnique4. CASE EXAMPLESSuccessful spinal interventional proceduresChallenging and not-so-successful proceduresPossible complications

IREE-51   Contrast-Enhanced Ultrasound In HCC Treatment Response Assessment After Microwave Ablation

Participants
Jeffrey Wang, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.) Successfully treated HCC will show avascularity immediately post ablation with a slow temporal reduction in size. The surrounding liver may show variable hypervascularity from ablation-induced hyperemia. 2.) Residual tumor post ablation may show greyscale and CEUS features including nodular arterial phase hypervascularity and washout, or enhancement equivalent to the original tumor. 3.) If residual tumor is detected immediately after ablation, then immediate retreatment is recommended to ensure adequate ablation. 4.) Evaluation of treated HCC after MWA should occur immediately post procedure, at 1 month, and then every 3 months post procedure.

TABLE OF CONTENTS/OUTLINE

1. Introduction i.) Paradigm of thermal ablation for HCC ii.) Treatment response (TR) assessment of HCC after thermal ablation a.) Current practice (CT/MRI follow-up) b.)Role of CEUS (ACR CEUS-LI-RADS) 2. CEUS i.) How does it work? a.) Pharmacokinetics b.) Differences compared to CT and MRI contrast ii.) HCC: CEUS findings a.) Typical features of HCC b.) Mimics of viable tumor iii.) Pros/Cons of CEUS compared to other modalities a.) Cost b.) Safety c.) Efficacy d.) Limitations/False negatives/False positives 3. Emerging data evaluating CEUS in TR assessment of HCC after thermal ablation 4. Pictorial review i.) No residual disease: Concordant findings between immediate post CEUS/CECT/CEMRI and follow-up imaging ii.) Residual disease: Concordant findings between immediate post CEUS/CECT/CEMRI and follow-up imaging 5. Conclusion and future directions

IREE-52   Interventional Management Of Acquired Lymphatic Flow Disorders

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Participants
Kenneth Huynh, BS, Orange, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To present the spectrum of acquired lymphatic flow disorders and lymphatic dysregulation secondary to associated conditions.2. To visualize the imaging features of these lymphatic disorders, with emphasis on intranodal lymphangiography.3. To demonstrate and highlight the novel techniques utilized in lymphatic intervention.

TABLE OF CONTENTS/OUTLINE

Recent advancements in lymphatic imaging techniques have allowed deeper understanding and visualization of lymphatic flow abnormalities and facilitated the emergence of lymphatic interventions. This educational exhibit will (1) present the spectrum of acquired lymphatic flow disorders and secondary lymphatic dysregulation, including chyle leak, chylous ascites, intestinal lymphangiectasia, lymphangioleiomatosis, lymphatic malformations, protein-losing enteropathy, and secondary lymphedema, (2) show the characteristic imaging features of these disorders on lymphangiography, (3) discuss the medical therapy and maintenance of these lymphatic disorders, and (4) demonstrate novel lymphatic interventional techniques used in the management of these disorders, such as thoracic duct embolization, lymphatic sclerotherapy, and thoracic duct stenting. Procedural techniques including transabdominal approach, translumbar approach, retrograde approach, transhepatic approach, and direct puncture will be reviewed. Technical considerations and post-procedural outcomes will also be discussed.

IREE-53   Splenic Artery Embolization For Blunt Splenic Injury: When And How?

Participants
Katsuhiro Kobayashi, MD, Syracuse, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Discuss the indication of splenic artery embolization (SAE) for blunt splenic injury (BSI) based on current spleen organ injury scale or MDCT findings 2) Review splenic vascular anatomy relevant to splenic artery embolization (SAE) 3) Describe technique used for SAE and pros and cons of proximal vs distal embolization

TABLE OF CONTENTS/OUTLINE

1) Overview of BSI 2) Physiology of the spleen and clinical implications of splenectomy 3) Vascular anatomy of the spleen 4) AAST spleen organ injury scale (2018 version) 5) MDCT diagnosis of BSI (parenchymal and vascular injury) 6) Current management of BSI 7) SAE technique and pros and cons of proximal vs distal embolization 8) Complications associated with SAE 9) Conclusions

IREE-54   Thyroid Ablation: Radiofrequency Ablation Of Benign And Malignant Thyroid Nodules

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Participants
Patrick Navin, MBBCh,MRCPI, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Learn indications for thyroid ablation and alternatives 2. Review relevant anatomy and structures at risk of injury during thyroid ablation. 3. Understand interventional radiologic techniques for performing thyroid ablation and review published outcomes

TABLE OF CONTENTS/OUTLINE

1. Indications for thyroid ablation and alternatives. • Discuss guidelines for thyroid ablation. • Indications: o Benign - large nodules causing compressive symptoms/cosmetic concerns o Benign - small autonomously functioning nodules o Malignant - micropapillary thyroid carcinoma • Other therapies: o Standard: surgery (in all cases), radioiodine (for autonomously functioning nodules) o Other ablative: ethanol, laser ablation, microwave ablation, focused ultrasound 2. Relevant cervical anatomy and structures at risk during thyroid ablation • Structures at risk: Recurrent laryngeal nerve, ansa cervicalis, vagus nerve, esophagus, trachea, skin, strap muscles • How to avoid injury: target selection, needle placement and visualization, hydrodissection 3. Techniques for performing thyroid ablation and published outcomes • Anesthetic, RF ablation (monopolar vs bipolar), needle approach, moving-shot vs overlapping ablations, appearance during and after ablation • Published outcomes: o benign symptomatic nodules - average volume reduction, need for retreatment, maintenance of thyroid function o autonomously functioning nodules-rate of normalization of thyroid function o micropapillary thyroid carcinoma-efficacy

IREE-55   CT-guided Celiac Plexus And Splanchnic Nerve Blocks: How We Do It

Participants
Andrew Sill, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

Celiac plexus and splanchnic nerve blocks are effective in relieving intractable abdominal pain via temporarily or permanently blocking afferent nociceptive pathways arising from the upper abdominal viscera. These blocks are most often performed for abdominal pain secondary to malignant neoplasms of the pancreas, but may also be used to treat benign sources of chronic abdominal pain. The procedure can be safely performed under CT guidance with a variety of techniques and approaches tailored to each patient's individual needs and anatomy. Variations may include unilateral and bilateral approaches, differences in patient positioning (anterior, posterior, lateral oblique), and temporary versus permanent blocks.

TABLE OF CONTENTS/OUTLINE

1. Review of relevant anatomy and pathophysiology2. Indications for celiac plexus or splanchnic nerve block3. Step-by-step overview of procedure and variations4. Mitigation and management of potential complications5. Differences between celiac ganglia and splanchnic nerve blocks6. Reported patient outcomes and future directions

IREE-56   Endoscopy Assistance In Image-guided Percutaenous Interventions: An Emerging Tool For

Challenging Cases

Participants
Pouya Entezari, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

Endoscopic guidance is a valuable tool that can be incorporated into non-vascular procedures performed by interventional radiologists (IR). Besides biliary and gallbladder pathologies, endoscopy can be integrated into the IR management of gastrointestinal, genitourinary, and gynecological diseases to achieve better outcomes.

TABLE OF CONTENTS/OUTLINE

Introduction: - Potential benefits of utilizing endoscopes. -Devices. Interventions Under Endoscopic Guidance: A) Indications and Technical Aspects 1-Biliary Interventions. 2-Lithotripsy 3-Stent Retrieval. 4-Ablations 5-Biopsies. 6-Crossing Challenging Strictures. 7-Gallbladder Interventions. 8-Biloma Drainage 9-Gastrointestinal Interventions. 10-Urologic Interventions through urostomies and trans-urethral Procedures. 11-Gynecological Interventions B)Future of Endoscopy in IR -Training Credentialing and Billing -Device Improvement. C) Case Study Atlas of Image-Guided Procedures with Endoscopic Guidance

IREE-57   Image Guided Ablation Of Lung Nodules- A Case Based Learn It Yourself Approach

Participants
Sharmila Duraisamy, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Discuss the benefits of image guided ablation, principle behind the three commonly used techniques, advantages and drawbacks.2. Patient selection, anesthesia, pre-procedural planning, intra-procedural monitoring and post procedural follow up.3.Case based discussions on ablation, complication and treatment.

TABLE OF CONTENTS/OUTLINE

1) Role of image guided ablation and ablative techniques in the management of lung nodules, patient selection including number of nodules, their location and size. 2) common ablative techniques in clinical practice, their advantages and drawbacks.3) Use of general anesthesia vs conscious sedation in appropriate clinical settings and the ablative technique used.4)Patient positioning, pre-procedural planning with CT scan, importance of MPR, immediate and late follow up scans. 5)Recognizing the immediate and delayed complications and treatment.6) Interactive case based approach in learning lung ablation including a. Typical case of nodule ablation with no complications b. Temporal evolution of an ablated nodule c. Cavitary formation in an ablated nodule with resolution d. Ablation complicated by small pneumothorax e.large pneumothorax. f. Intractable pneumothorax due to bronchopleural fistula and management g. Pulmonary hemorrhage as a complication and its management. h. Recurrence in a previously ablated lesion. i. iatrogenic pneumothorax in the ablation of sub pleural nodules. j. ablation as a palliative measure for pain control in lesions with chest wall invasion

IREE-58   Endovascular Embolization Via Deep Dorsal Venous Access For The Management Of Erectile Dysfunction Resulting From Venous Insufficiency

Participants
Navpreet Khurana, MBBS, Nagpur, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Erectile dysfunction (ED) is estimated to affect 50% of the male population, with 10% being severely affected. The pathophysiology behind the development of vascular erectile dysfunction is multifactorial and poorly understood. Veno-occlusive dysfunction (VOD) and arterial insufficiency are the main causes of vasculogenic ED. VOD occurs due to the insufficiency of venous outlet obstruction. There have been recent developments in the role of interventional radiology to treat ED resulting from VOD. Endovascular management of VOD has been successfully done by pudendal vein embolisation using transfemoral approach. More recently, deep dorsal vein approach is being utilised for pudendal vein embolisation. It is important for a radiologist to be abreast with the advancements made in the field of interventional radiology to manage erectile dysfunction resulting from VOD. This educational exhibit will discuss the risk factors, diagnostic imaging and investigations, and management of VOD. This exhibit will highlight deep dorsal vein embolisation with a case-based review.

TABLE OF CONTENTS/OUTLINE

1. Erectile Dysfunction - causes, risk factors, pathophysiology2. Doppler imaging and diagnostic criteria for vascular erectile dysfunction3. Venous insufficiency causing ED - risk factors, diagnosis and management4. Endovascular management of venous insufficiency4a. Femoral vein approach - pudendal embolisation4b. Deep dorsal vein approach - pudendal embolisation

IREE-59   Intravascular Ultrasound For Transjugular Intrahepatic Portosystemic Shunt Creation: 'Tips' And Tricks

Participants
Josi Herren, DO, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Know the indications, contraindications, and workup for TIPS placement. 2. Recognize the benefits of using IVUS during TIPS. 3. Understand the correlation of CT/fluoroscopic anatomy with IVUS imaging during TIPS placement. 4. Learn to utilize IVUS guidance in a variety of scenarios, and how to troubleshoot during challenging cases. 5. Review TIPS complications, their management, and strategies to mitigate these risks intra-procedurally.

TABLE OF CONTENTS/OUTLINE

1.1. Overview of TIPS indications, contraindications, and fluoroscopic TIPS placement. 2.1. Benefits of IVUS: reduction in

1.1. Overview of TIPS indications, contraindications, and fluoroscopic TIPS placement. 2.1. Benefits of IVUS: reduction in fluoroscopy time/dose, contrast volume and needle passes. 3.1. TIPS Imaging atlas: CT/fluoroscopic correlation with IVUS, from posterior right to lateral left segments using the IVC as a rotational axis. 3.2. Hepatic and portal vein relationships pertinent to TIPS access. 3.3. Additional relevant hepatic and biliary anatomy. 3.4. Maneuvers using IVUS for portal access: right hepatic to posterior right portal vein, right hepatic to main right portal vein, middle hepatic to right/left portal vein. 4.1 Troubleshooting with IVUS: predicting the required needle curve, targeting out-of-plane portal veins, navigating out of the posterior right portal vein, sizing, and positioning of the stent. 5.1 Post-procedure management and associated complications.

IREE-6 Endovascular AV Fistula: An Overview Of Technique, Cases, Evidence And Outlook

Participants
Surbhi Trivedi, North Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to:1) Describe endovascular arteriovenous fistula (endoAVF) creation, which is an emerging alternative to surgical fistulas for dialysis access. 2) Outline the procedural steps of endoAVF creation and the current FDA-approved systems available. 3) Review current literature regarding endoAVF patient selection, exclusion criteria, outcomes and interventions. 4) Increase awareness of nonsurgical fistulas and discuss future directions of endoAVF.

TABLE OF CONTENTS/OUTLINE

1) Chronic kidney disease epidemiology. 2) Types of dialysis access in use, including endoAVF. 3) Indications for endoAVF. 4) Patient selection and contraindications. 5) Options for dialysis cannulation sites. 6) Bard WavelinQ (TM) EndoAVF System set-up and components. 7) Pre-procedure workflow including clinic evaluation, requisite imaging, and physical exam. 8) Procedural steps. 9) Post-procedure workflow. 10) Types of post-procedure interventions including patient cases. 11) Short and long term published results of endoAVF. 12) Our experience with endoAVF and other tips. 13) Future of endoAVF.

IREE-60 Anatomical Variants In Rectal Artery Embolization - Emborrhoid Technique: A Pictorial Essay

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Participants
Julien Panneau, Marseille, France (*Presenter*) Nothing to Disclose

TEACHING POINTS

Background Hemorrhoids are recognized as a very common cause of rectal bleeding. Its treatment has evolved considerably over the past ten years. Among the new minimally invasive methods, the "Emborrhoid" technique consists into selective embolization of hemorrhoidal arteries (branches of the superior rectal arteries). The embolization is performed essentially with micro-coils and possibly with microparticles. The aim of this pictorial essay is to illustrate the pelvic vascular anatomy relevant to Emborrhoid in order to provide a practical guide that includes the most common anatomical variants. Clinical findings Angiographic findings from 200 Emborrhoid procedures were reviewed retrospectively. The hemorrhoid arterial supply was classified into five different patterns as follows: Type I: codominant right and left superior rectal artery (SRA) anterior branches with accessory posterior trunk. Type II: codominant right, left and posterior branches of the SRA. Type III: unilateral vascularization by right or left SRA anterior branch. Type IV: unilateral SRA vascularization and contralateral middle rectal artery (MRA) dominance. Type V: bilateral MRA dominance. Teaching Points Describe the anatomical variations of hemorrhoid vascular supply. Propose an angiographic anatomical classification. Discuss the clinical implication for the embolization procedure (Emborrhoid)

TABLE OF CONTENTS/OUTLINE

Introduction Inferior mesenteric arteryRectal arterial supply Type 1 Type 2 Type 3 Type 4 Type 5Conclusion

IREE-61 Percutaneous AV Fistula Creation: A Comprehensive Pictorial Review

Participants
Manuel Betancourt Torres, MD, San Juan, Puerto Rico (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Illustrate pertinent vascular anatomy and review sonographic criteria for endoAVF creation2. Review advantages and disadvantages of endoAVF creation over surgical creation including clinical parameters, technical consideration and maturation.3. Provide pictorial review of creation technique as well as pitfalls and post creation endoAVF anatomy.4. Illustrate maturation criteria and endovascular techniques to assist maturation.5. Review possible complications.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Pertinent anatomy3. Criteria and considerations for endoAVF versus surgical AVF creation4. EndoAVF creation technique5. Imaging follow-up and interventions to assist maturation6. EndoAVF in dialysis access center: expectations and guide for cannulation7. Complications8. Protocol for endoAVF creation and follow-up

IREE-62 Advanced Endoscopy: Cholangioscopic Management Of Biliary Pathology In Our Favorite Vestigial Organ (The Gallbladder)

Participants
Anne Sailer, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Familiarize a radiologist with biliary anatomy specifically as it relates to the gallbladder and the role of cholangiographic and cholangioscopic imaging, and how the use of advanced biliary cholangioscopy can guide treatment intervention, such as video assisted biopsy, laser lithotripsy and percutaneous stone extraction in patients pursuing non-operative management of biliary pathology.2. Review advanced cholangioscopy technique, imaging optimization and protocol for evaluation of biliary pathology.3. Correlation between characteristic imaging findings of various biliary tract pathologies diagnosed on cross-sectional imaging,

intraprocedural cholangiogram, to intraprocedural cholangioscopic images, focusing on stones, strictures, and tumors.

TABLE OF CONTENTS/OUTLINE

1. Gallbladder and cystic duct anatomy and an overview of biliary drainage.2. Pathophysiology of biliary pathology with imaging correlation (cholelithiasis, intrahepatic, and extrahepatic biliary pathology).3. Algorithm for cholecytostomy drain management in non-operative candidates focusing on patients with acute or chronic cholecystitis.4. Long-term management of these patients and role of imaging in post intervention assessment and surveillance.5. Review of common post procedural complications (bleeding, infection, tube retraction, dislodgment, biliary leak, dropped stones, cholangitis, etc).

IREE-63   **Real-time 3d Modeling And Volumetric Analysis Metrics From Pre- And Intra-procedural Images To Guide Tumor Ablations**

Participants
Ben Hsieh, MS, Providence, Rhode Island (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. 1. Ablations can be planned by placing 3D models of ablation antennas and expected ablation zones in models of target tumors and relevant anatomical structures constructed from pre-procedure images. 2. 2. Pre-procedure models can be registered onto intra-procedure pre-antenna images to locate tumors without IV contrast. 3. 3. Expected ablation margins can be verified after antenna placement by registering expected ablation zone models onto intra-procedure post-antenna images.

TABLE OF CONTENTS/OUTLINE

1. 1. Preparation a. Tools: i. 3D Slicer ii. MeshLab b. 3D Models of Ablation Antennae 2. 2. Pre-Procedure Planning a. Imaging requirements b. 3D Models: i. Ablation antennae and targeted ablation zones ii. Target tumor(s) iii. Target organ iv. Relevant anatomical structures c. Considerations i. Anatomical limitations ii. Heat sinks iii. Organ functions 3. 3. Intra-Procedure Planning a. Imaging requirements b. Image registration c. Model registration 4. Intra-Procedure Verification a. Imaging requirements b. Antenna placement c. Shape analyses 5. 4. Limitations a. Imaging requirements b. Registration c. Time

IREE-64   **Diagnosis And Minimally Invasive Management Of Deep Vein Thrombosis**

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Participants
Angelo Marino, DO, New Haven, Connecticut (*Presenter*) Consultant, Inari Medical, Inc;Speaker, Inari Medical, Inc

TEACHING POINTS

1. Discuss epidemiology, cases and clinical presentations of deep vein thrombosis (DVT) 2. Review role of imaging in the diagnosis of DVT 3. Briefly Describe imaging characteristics associated with different types and stages of DVT 4. Review main interventional therapies for management of DVT with emphasis on intraluminal thrombectomy

TABLE OF CONTENTS/OUTLINE

1. Anatomy and physiology of venous system 2. Imaging modalities for evaluation and characterization of DVT: Doppler ultrasound (US), CEUS Intraluminal US (IVUS), CTV, MRV, Conventional Angiogram (IR) 3. Imaging characteristics of blood clot: acute versus chronic; bland versus tumor thrombus 4. Case-based review of various techniques in management with thrombectomy acute and chronic bland and tumor thrombus

IREE-66   **Hemodynamic Measuring In Interventional Radiology: Rules Of 6**

Participants
Anne Sailer, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Familiarize a radiologist with hemodynamic measuring in Interventional Radiology.2. Review the anatomy, physiology, and key imaging findings of portal hypertension and pulmonary hypertension.3. Describe stepwise approach in the optimization and interpretation of intraprocedural hemodynamic measurements and how these guide treatments.4. Describe and briefly review the anatomy and role of imaging paramount to appropriate pressure measurements.

TABLE OF CONTENTS/OUTLINE

1. Review of relevant vascular anatomy (SCV, Right atrium, IVC, Hepatic veins, portal veins, pulmonary artery, pulmonary vein) and intervening capillary pathways 2. Physiology and hemodynamics of cirrhosis and pulmonary hypertension. Liver: Review of the subsets of portal hypertension, specifically which ones create gradients, and how these differences guide intervention: Prehepatic (portal vein thrombosis, portal veins stenosis, congenital abnormalities), Presinusoidal (hepatoportal sclerosis, granulomatous disease), Sinusoidal (cirrhosis, steatohepatitis, amyloidosisiv. Post sinusoidal: veno-occlusive disease), Post hepatic (Budd-Chiari, Cardiac failure). b.Lung: Review of pulmonary hypertensive physiology in acute, subacute and chronic pulmonary embolism.3. Review of pulmonary angiography and hepatic venography, pressure gradients, and waveforms, and how these guide intervention (thrombectomy/thrombolysis, Inari Flowtriever, TIPS, medical management).4. Pitfalls in equipment set up that affect gradient measurements.

IREE-67   **Inside Out: An Interventionalist's Guide To Intravascular Ultrasound**

Awards
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Participants
John Weaver, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

- The learner will review intravascular ultrasound (IVUS) fundamentals, including commercially available systems, equipment

specifications and compatibility- The learner will be able to identify the normal intravascular sonographic findings and commonly encountered pathology- The learner will become familiar with current evidence supporting the use of IVUS for interventional precision- The learner will review the authors' approach to using IVUS

TABLE OF CONTENTS/OUTLINE

1.IVUS Fundamentals: Phased array versus radial IVUS and applications; Equipment specifications and compatibility2. iVUS Imaging Review; Normal intravascular sonographic features; IVUS artifacts; Commonly visualized pathology3. Supporting Evidence; Transjugular Intrahepatic Portosystemic Shunts; Venous Stenting; Peripheral Arterial Disease; Endovascular Biopsy4. Pearls from the Authors ("how we do it")

IREE-68   Robotic Devices For Endovascular Interventions: Fantasy Or Reality

Participants
Izzet Altun, Scottsdale, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the studies on robotic devices for minimally invasive endovascular therapies. 2. Demonstrate the design and fabrication of nano/mili/microrobots 3. Discuss the current and potential applications, limitations and safety of nano/mili/microrobots from the viewpoint of endovascular applications. 4. Explore the future of robotic devices in minimally invasive endovascular interventions.

TABLE OF CONTENTS/OUTLINE

1. Classification of small-scale robotics: a. tethered endovascular devices b. untethered mobile robots for endovascular interventions 2. Design and fabrication of robotic devices 3. Current and potential endovascular applications 4. Challenges and safety 5. Emerging devices for minimally invasive endovascular interventions 6. Summary & Conclusion

IREE-69   NBCA Embolization: How Can We Control The Delivery Of NBCA?

Participants
Hidemasa Takao, MD, Bunkyo-ku, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To review the basics of NBCA as an embolic agent and its use in various embolization procedures2. To review the injection techniques of NBCA with an emphasis on flow control3. To discuss how to control the delivery of NBCA to achieve successful embolization and avoid complications with example cases

TABLE OF CONTENTS/OUTLINE

Basics of NBCA as an embolic agentReview of the current use of NBCA in various proceduresInjection techniques of NBCA with and without flow controlControl of the delivery of NBCA with example casesSummary

IREE-7   Life-threatening Hemoptysis: Beyond The Bronchial Arteries

Awards
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Participants
Jaime Alonso Sanchez, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- List the most common causes of life-threatening hemoptysis.- Explain the radiological management of hemoptysis.- Recognize most common findings of hemoptysis on radiological examinations.- Describe the techniques and materials used for an endovascular approach when treating bronquial and non-bronchial hemoptysis.

TABLE OF CONTENTS/OUTLINE

-Introduction-Massive hemoptisis: Definition, Causes and Diagnosis.-Radiological findings of hemoptisis.-Source of the hemoptisis: Bronchial and non-bronchial arteries.-Bronchial and non-bronchial artery embolization: technique and materials.-Pitfalls and cases: Non-bronchial hemoptysis (bleedings from intercostal arteries, internal mammary artery, thyrocervical artery trunk, lateral thoracic artery, inferior phrenic artery from our institution)

IREE-70   Complex Portomesenteric Interventions - Alternative Access For Technical Success

Participants
Shakthi Ramasamy, MBBS, Maywood, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

Transjugular intrahepatic portosystemic shunt (TIPS) is a procedure frequently used to alleviate portal hypertension and associated complications. After gaining entry through the preferred access - right internal jugular vein (IJV), a catheter is progressed to the hepatic vein and the portal system is then located by contrast. A needle is then used to gain access to the portal system and a stent is placed then ballooned up to grant a connection. The crucial step in the creation of TIPS is to puncture a suitable portal branch and then wire is guided through the main portal vein into the splenic or mesenteric veins. However, subacute/chronic portomesenteric occlusions may require alternative access sites as transjugular or transhepatic puncture for recanalization may not be technically feasible - additional access routes may be sought to achieve technical success. With this exhibit, we aim to review the existing literature and use cases to: Highlight the role of direct mesenteric venous puncture (i.e. direct SMV, IMV, and Splenic Vein) for achieving technical success with acute or chronic portomesenteric occlusions. Review the rationale for using a hybrid CT-Angiography technique Highlight the use of such techniques for complex cases Review preoperative patient preparation, procedural technique, and post-procedural follow-up

TABLE OF CONTENTS/OUTLINE

Evaluation of the two complex cases Rationale, Route and techniques for these interventions Pre-procedural imaging Outcome, and

post-procedural follow-up Case based discussion Conclusion

IREE-71   Anesthesiology Concepts For The Interventional Radiologist

Participants
Ana Beatriz Onofre Chen, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The increasing number of image guided procedures (IGP), along with the increasing concern with adequate assessment and management of pain, has reinforced the importance of Radiologists being able to provide effective and safe pain control. With the introduction of shorter-acting sedatives and opioids, reversal agents and the availability of noninvasive monitoring equipment, procedural sedation can now be safely administered in many healthcare settings. 1Provide a reference guide for radiologists who need pertinent and ready information on discomfort control. 2List the different classes of sedatives, analgesics, and anesthetics and identify in what circumstances they are most applicable to the radiologist, especially in image guided procedures. 3Consider the goals of procedural sedation, patient safety and determine if a particular patient requires pharmacological intervention. 4How to apply the techniques of IGP, such as nerve block injections during an interventional radiology procedure.

TABLE OF CONTENTS/OUTLINE

Sedation.Analgesia.Anesthesia: general, regional and local.Techniques,Preprocedural checklist,Intraprocedural monitoring of patients under sedation,Knowledge of the most common classes of sedatives and their concentration, maximum total doses, onset and duration of action. Be prepared to rescue patient from deep sedation. Know what kind of equipment and personnel are available in case of an emergency. Local anesthetic and imaging guided nerve block: anatomy, technic and complications.Postprocedure

IREE-72   PET CT-Ultrasound Fusion Biopsy: Review Of Technique And Its Value

Participants
Bryce Beutler, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review technique of PET CT-Ultrasound fusion biopsyUnderstand role of PET CT-Ultrasound fusion biopsyHighlight advantages of PET CT-Ultrasound fusion biopsy

TABLE OF CONTENTS/OUTLINE

Provide an overview of the PET CT-Ultrasound fusion biopsy techniquePresent cases of PET CT-Ultrasound fusion biopsy in the neck, chest, abdomen and pelvisDiscuss the advantages that PET CT-Ultrasound fusion biopsy offers over other biopsy techniques.

IREE-73   Prostatic Artery Embolization (PAE): A Quest To Find The Prostatic Artery And Management Of Benign Prostatic Hyperplasia

Participants
Shivam Kaushik, Pine Hill, New Jersey (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review basic prostate vascular anatomy and its impactTo learn about the anatomical angiographic classification categorizing origins of prostatic arteriesTo identify arterial variants and their clinical implicationsTo learn about the procedural steps in prostatic artery embolization (PAE)

TABLE OF CONTENTS/OUTLINE

Overview of relevant anatomy, pathophysiology and clinical presentation of benign prostatic hyperplasiaExisting management options for treating benign prostatic hyperplasiaReview of published literature on use of endovascular techniques for benign prostatic hyperplasiaRole of endovascular techniques:-Coil Embolization-Particle Embolization-Pre-procedural evaluationCone Beam CTAngiographyProcedural techniqueTreatment outcomePostprocedural follow up

IREE-74   The Role Of Intraoperative Neuromonitoring In Interventional Radiology Procedures: Preventing Permanent Nerve Damage

Participants
Anna Gong, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching Points:Intraoperative neuromonitoring (IONM) is an important component of multiple surgical procedures from parathyroidectomies to spine surgery. Still, IONM in interventional radiology has yet to be fully utilized and may prevent neural damage in a variety of IR procedures including vascular malformation embolization and tumor ablation. The purpose of this education exhibit is to:1. Reinforce the role of appropriate imaging and clinical evaluation of patients who may require neuromonitoring.• Neurosurgery and Orthopedic spine surgery started this• NeuroIR uses this for cerebrospinal AVM embolization • Embolization or ablation of soft tissue or vascular lesions with peripheral neural structures in close proximity2. Review the set-up and technical implementation of intraoperative neuromonitoring in interventional radiology• SEPs• MEPs• MNCS3. Describe how intraoperative neuromonitoring has been used to reduce neural damage• Vascular malformation - high flow• Vascular malformation - low flow• Thermal Ablation

TABLE OF CONTENTS/OUTLINE

· Assessing the appropriate use of intraoperative neuromonitoring for interventional radiology· Overview of IONM modalities and when to use each modality· The role of IONM in (1) high-flow vascular malformations (2) low-flow vascular malformations (3) tumor ablation· The role of provocative testing· Interpreting IONM findings· Conclusion

IREE-75-HC The Role Of Geniculate Artery Embolization In The Treatment Of Knee Osteoarthritis

Participants

Lynden Lee, Bronx, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Knee osteoarthritis (OA) affects millions of adults in the United States alone. The workup and management of OA accounts for billions of dollars in healthcare spending. Primary management of OA includes lifestyle modifications and medications. Invasive measures include steroid injections and knee replacements; however, these are not without increased costs and risks to the patient. Geniculate artery embolization (GAE) is becoming an increasingly popular procedure amongst interventional radiologists as it offers a minimally invasive option and has been found to effectively increase quality of life. The purpose of this exhibit is to:1. Describe the epidemiology, risk factors, and clinical features of osteoarthritis.2. Review diagnostic and traditional treatment options.3. Display previous studies supporting the use of GAE and its role in treating OA.4. Highlight key imaging necessary for GAE procedures.5. State risks and complications associated with GAE.

TABLE OF CONTENTS/OUTLINE

1. Osteoarthritis Epidemiology and Costs2. Pathophysiology and Patient Presentation3. Diagnosis, Imaging, and WOMAC Score Assessment4. Common Medical and Surgical Treatment Options5. Indications, Contraindications, and Risks associated with GAE compared to other Treatment Options6. GAE Procedure and Case Presentation7. Implications for Clinical Practice

IREE-76-HC   Sclerotherapy Of Congenital Venous Malformations (CVM) Complicated With Localized Intravascular Coagulation: A Review Of IR Management With Case Examples

Participants
Robert Weinstein, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the clinical presentation and management of CVM patients complicated with Localized Intravascular Coagulopathy (LIC) and outline a typical case presentation of an individual with LIC.

TABLE OF CONTENTS/OUTLINE

Background LIC is a coagulation disorder that has been associated with low-flow venous malformations. Diagnostic criteria for LIC includes D-dimer levels above .5mg/L, fibrinogen levels below 1g/L, and PT and PTT prolonged over 3 seconds, as well as other clinical factors. These characteristics place these patients at high risk of bleeding during interventional procedures, and therefore careful management is necessary to prevent adverse outcomes. Clinical Presentation Nine patients with a diagnosis of LIC were reviewed. These patients were between ages 9 and 73 years old, with an average age of 29. It was found that all 9 presented with elevated D-dimers, 3 with low fibrinogen, and 2 with elevated PT/aPTT. Treatment methods used for these patients included pre- and post-operative Enoxaparin, Apixaban, and Low-Molecular Weight Heparin. None of the patients experienced any adverse events during interventional procedures. Conclusion LIC is a condition which can lead to complications during interventional procedures, such as sclerotherapy. Complications include severe outcomes including Disseminated Intravascular Coagulation. Therefore, it is important for IR providers to be aware of the clinical presentation and current treatment methods for LIC while taking care of patients with low-flow vascular malformations.

IREE-8   Cystic Artery: Handball Or Dodgeball

Awards
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Participants
Hyo-Cheol Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

The cystic artery is commonly originating from the right hepatic artery. Intra-arterial therapy for hepatocellular carcinoma is usually performed beyond the origin of the cystic artery to prevent cholecystitis. When the cystic artery supplies HCCs or originates from the distal hepatic artery, interventional oncologists can not help but perform the procedure at the risk of cholecystitis. The purpose of this exhibit is : (1) To review the cystic artery anatomy and its variation. (2) To learn how to minimize the complications when the cystic artery is involved in chemoembolization or radioembolization. (3) To review the complications and their management related with the cystic artery.

TABLE OF CONTENTS/OUTLINE

A) Cystic artery. 1) its common and uncommon origin. 2) superficial and deep cystic artery. B) Cystic artery in chemoembolization.1) Embolization level : Ultraselective vs deep cystic artery vs main cystic artery.2) Lipiodol versus drug-eluting bead. 3) Additional embolization using gelatin sponge particles.C) Cystic artery in Radioembolization.1) When prophylactic embolization is needed.2) Prophylactic Embolization : permanent vs temporary.3) Selective radioembolization through the cystic artery. D) Complications and their management.1) Ischemic cholecystitis.2) Radiation cholecystitis. 3) Conservative management vs Percutaneous drainage vs surgical cholecystectomy

IREE-9   We've Got Your Back: The Proceduralist's Guide To Spinal Interventions

Participants
Jason Kim, MD, Converse, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Minimally invasive procedures have a wide range of safe and effective applications for the diagnosis and treatment of spine-related disorders. 2. Knowledge of the vertebral anatomy, procedure indications, patient selection and techniques is essential for maximizing treatment outcomes and minimizing complications.

TABLE OF CONTENTS/OUTLINE

1. Review vertebral anatomy pertinent to spinal interventions. 2. Introduce the general approach and principles for minimally invasive image-guided techniques. 3. Review the indications, contraindications, risks, preprocedure planning, techniques and

potential complications for various image-guided spinal procedures to include lumbar puncture, epidural injection, joint injection, nerve root injection, bone biopsy, disc biopsy, vertebroplasty, kyphoplasty, and thermal ablations.

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Musculoskeletal Education Exhibits</td></tr>
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Sub-Events

MKEE-1 **Making Sense Of Sacral Fractures.**

Participants
Josephina A. Vossen, MD, PhD, Richmond, Virginia (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit will review sacral anatomy, improve detection of sacral injuries, instruct on how to utilize mechanism of injury to predict the type of sacral fracture, and educate regarding treatment of sacral fractures. Improved detection of traumatic sacral injuries can prevent delay in treatment that could result in long-term disability.

TABLE OF CONTENTS/OUTLINE

This exhibit will: - Review the anatomy and biomechanics of the osseous, myotendinous and ligamentous structures associated with the sacrum. - Describe and illustrate the commonly used classification of common injuries involving the sacrum, including acute traumatic fractures, insufficiency fractures and pathologic fractures. - Discuss an approach to reporting sacral fracture findings using the commonly used classification systems and emphasize pitfalls when reviewing these cases. - Describe treatment options and their imaging appearance.

MKEE-10 **Indications, Preoperative Planning And Complications Of Shoulder Arthroplasties: What The Orthopedic Surgeons Want To Know**

Participants
Daichi Hayashi, MD,PhD, Stony Brook, New York (*Presenter*) Author with royalties, Wolters Kluwer nv

TEACHING POINTS

To describe different types of shoulder arthroplasties;To discuss required preoperative imaging and pros and cons of various imaging modalities for assessment of postoperative complications;To learn the indications, requirements, and complications of various types of shoulder arthroplasties.

TABLE OF CONTENTS/OUTLINE

1.Background - discuss demographics and epidemiological data of shoulder arthroplasties; outcomes; biomechanics.2.Different types of arthroplasty hardware: indications and contraindications - Anatomic total shoulder arthroplasty - Reverse shoulder arthroplasty - Hemiarthroplasty - Humeral head resurfacing arthroplasty.3.Preoperative imaging for surgical planning Pros and cons of imaging modalities for assessment of postoperative complications - X-ray - Ultrasound - CT - MRI - Nuclear medicine.4.Complications that are common to all types of arthroplasties: infection, stress shielding and periprosthetic fractures, humeral component loosening, heterotopic ossifications, implant failure, nerve injury.5.Complications that are specific to different types of hardware: - Anatomic total shoulder arthroplasty: glenoid component loosening, rotator cuff tear; - Reverse total shoulder arthroplasty: Instability, anterosuperior dislocation, scapular notching (Sirveaux classification), scapular spine and acromion fractures; - Hemiarthroplasty and humeral head resurfacing arthroplasty: progressive glenoid osteoarthritis requiring conversion to total shoulder arthroplasty.6.Conclusion.

MKEE-100 **Ultrasound Assessment Of Common Patterns Of Peripheral Nerve Injury: A Systematic Approach**

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Participants
Rina Patel, MD, San Francisco, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Ultrasound is critical part of the multimodality imaging approach to diagnosis of peripheral nerve disease, including identification of changes in nerve morphology, sites of compression, and adjacent anatomy and pathology. 2) Ultrasound is uniquely capable of performing a dynamic assessment of nerves and adjacent structures which can identify pathology potentially missed with other modalities. 3) A systematic approach to peripheral nerve imaging includes evaluation of extrinsic findings, intrinsic changes of the nerve, and distal muscle findings. 4) This systematic approach will aid in the identification of the most common types of peripheral nerve pathology, including extrinsic causes (ex. compressive mass or hardware), intrinsic alterations of the nerve (ex. transection or neuroma), and associated distal muscle changes (denervation edema or atrophy).

TABLE OF CONTENTS/OUTLINE

1) Normal Anatomy and Imaging Appearance. 2) Role of Imaging in Assessment of Peripheral Neuropathy. 3) 3 Step Approach to Imaging Evaluation of Peripheral Nerve Injury. 4) Common Patterns of Peripheral Nerve Injury, including the following: A. External

Compression by Hardware, Mass, and Variant Anatomy B. Anatomic Sites of Frequent Compression, such as Carpal Tunnel Syndrome C. Nerve Transection. D. Nerve Subluxation/Dislocation E. Neuroma. AND 5) Pitfalls/Limitations

MKEE-101   Triangular Fibrocartilage Complex (TFCC) Injury Made Simple

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Participants
Vitor Sato, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: 1. Illustrate and discuss the anatomy of triangular fibrocartilage complex (TFCC); 2. Describe and discuss with didactic cases different patterns of TFCC injuries, based on modified Palmer classification; 3. Show common and uncommon pitfalls that simulate TFCC injury, as well as differential diagnosis for its injury.

TABLE OF CONTENTS/OUTLINE

Introduction: general presentation of anatomy with MR imaging of TFCC, including the often-neglected complex anatomy of ulnocarpal ligaments and meniscal homolog; Present schematic cases to illustrate modified Palmer classification, as well as how to diagnosis distal radioulnar joint instability related to TFCC injury; Discuss and illustrate common and uncommon pitfalls and differential diagnosis of TFCC injury; Briefly show post-operative cases of this injuries; Bibliographical references with recent articles highlighting what's new in the topic.

MKEE-102   Chronic Kidney Disease: MSK Findings

Participants
Paulo de Tarso Perez, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: Briefly approach the pathophysiology and disorders in patients with chronic kidney disease; Review and didactically illustrate the musculoskeletal manifestations in chronic kidney disease with imaging findings on radiographs, computed tomography and magnetic resonance imaging.

TABLE OF CONTENTS/OUTLINE

Introduction: General presentation of the pathophysiology and metabolic disorders; Present a scheme with the main musculoskeletal findings; Provide didactic and illustrative cases of each disorder (hyperparathyroidism, rickets, amyloid arthropathy, avascular necrosis, infectious diseases, destructive spondyloarthropathy, crystal deposition and soft tissue calcification) Conclusions; Bibliographical references.

MKEE-103   Spinal Cord Compression: An Unusual Debut Of Frequent Systemic Diseases.

Participants
Jose Carlos Garcia-Gil Garcia, MBBCh, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To review common systemic diseases that can cause spinal cord compression (SCC) as the initial presentation.- To illustrate the imaging spectrum of spinal cord involvement on these systemic entities, outlining subtle findings that may help the radiologist.- To emphasize the paramount role of the Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) in the diagnosis and follow-up of SCC.

TABLE OF CONTENTS/OUTLINE

SCC is a medical emergency that requires prompt diagnosis and treatment to avoid irreversible spinal cord injury. Imaging tests play an essential role in the assessment of SCC confirming the clinical suspicion of SCC, grading the severity of the disease and assisting in narrowing down the differential diagnosis.The most common causes of SCC are neoplasms, especially metastasis, and degenerative disease. However, there are other systemic etiologies such as metabolic, inflammatory or infectious diseases that can be easily misdiagnosed that we must also bear in mind. In these cases, clinical-laboratory and imaging correlation is mandatory to achieve a correct diagnosis.A retrospective review was performed on all 55 patients with SCC diagnosed at our institution from January 2014 to January 2021. We present the key image findings and clinical-laboratory-pathologic correlation in several cases that illustrate SCC as the initial presentation of systemic disease and the clinical and radiologic follow-up.

MKEE-104   Simplifying Posterolateral And Posteromedial Corners Of The Knee

Participants
Camila Justino, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review with schematic drawings correlated with magnetic resonance imaging the anatomic structures of the posterolateral (PLC) and posteromedial (PMC) corners of the knee.To approach the different trauma mechanisms and clinical tests.To review the possible injuries to the structures of the PLC and PMC of the knee and the main patterns of injury, understanding the role of imaging in these injuries.

TABLE OF CONTENTS/OUTLINE

Posterolateral and posteromedial corners of the knee are responsible for stabilization of the knee. Untreated or concurrent corner injuries result in secondary osteoarthritis and rotational instability and may contribute to graft failure in anterior and posterior cruciate ligament reconstructions and poor clinical results.The radiologist's knowledge of the anatomy, the findings of the clinical tests and the understanding of the trauma mechanisms is very crucial for the radiologist to be fully aware of the spectrum of radiological appearances.The aim of this educational exhibit is to illustrate in a simple way with schematic drawings correlated with magnetic resonance imaging the anatomy of the posterolateral and posteromedial corners, trauma mechanisms and clinical tests, as

well as the identification of lesion patterns.

Radiological Assessment Of Synovial Disease

Participants
Luiza Porto, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Synovial joints are covered by the synovium, a tissue responsible forproviding nutrition and lubrication to the cartilage, which makes it essential for the functioning of the musculoskeletal system. There are several pathologies that affect the synovium, ranging from inflammatory, infectious, degenerative, traumatic, hemorrhagic, even neoplastic lesions. Due to the wide spectrum of existing synovial lesions, symptoms and clinical findings can often be nonspecific. Therefore, imaging has an essential role in the early detection of synovial diseases prior to irreversible joint damage.

TABLE OF CONTENTS/OUTLINE

Review synovial joints, their functions and histological findings.Discuss different radiological findings of synovial lesions, includinginflammatory, infectious, degenerative, traumatic, hemorrhagic, andneoplastic.Obtaining and understanding characteristic imaging findings ofsynovial diseases that enables a proper diagnosis and early treatment.Take home messages.References.

MKEE-107 **Musculoskeletal Applications Of Shear Wave Elastography: A Quantitative Ultrasound Tool**

Participants
Michael O'Bryant, DO, Hershey, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the basic concepts of shear wave elastography (SWE) as a quantitative method of ultrasound evaluation 2. Review the various applications of SWE as an adjunct diagnostic tool for musculoskeletal disease 3. Review limitations of SWE within the musculoskeletal system

TABLE OF CONTENTS/OUTLINE

1. General Principles of shear wave elastography a. Comparison of SWE with strain elastography b. Highlight QIBA findings 2. Specific uses of SWE within the musculoskeletal system and review of current literature a. Characterize MSK injuries/lesions, provide quantitative information b. Predict impending injury c. Monitor healing d. Anatomical considerations i. Tendons ii. Muscles iii. Fascia iv. Nerves v. Ligaments vi. Soft Tissue Masses 3. Limitations of SWE in the musculoskeletal system a. Anisotropy b. Positional dependence c. Activity dependence d. Strain dependence 4. Future Direction and Summary a. Will SWE provide useful diagnostic information? b. Will SWE provide a competitive advantage?

MKEE-108 **Born To Run: Imaging Evaluation Of Runners' Injuries**

Participants
Ana Laura Silva, MD, SAO PAULO, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this study is: - To review the imaging appearance of typical patterns of bone, muscle and tendon injuries in runners. - To review some of the most widely used classifications and spectrum of injuries related to running. - To discuss the role of imaging studies in the correct diagnosis and appropriate treatment of these injuries.

TABLE OF CONTENTS/OUTLINE

The types of injuries that commonly affect runners are almost exclusively related to exertion. As expected, the lower limbs are the most frequently affected segment, with injuries that include sprains, muscle tears, avulsions, stress fractures, plantar fasciitis, chronic exertional compartment syndrome and muscle hernias. Apart from ankle sprains, traumatic injuries are rare. About 60% of the causes of pain in runners are related to errors in training, leading to typical injuries. Knowledge of the common and uncommon patterns of injuries in runners will facilitate the proper recognition of these injuries in imaging studies. We will review these conditions with illustrations and several cases from our institution.

MKEE-109 **ALTR, ARMD, And Trunnionosis - Clarifying Component Related Hip Arthroplasty Complications**

Awards
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Participants
Jonelle Petscavage-Thomas, MD,MPH, Hummelstown, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Discuss special techniques utilized to maximize CT/MR resolution of hip arthroplasty• Describe appearance of complications of hip prostheses• Describe benefits of different imaging modalities for complication workup

TABLE OF CONTENTS/OUTLINE

1. Indications and goals of joint arthroplasty2. General classification based on the following: a) What type of prostheses is it b) What are the components c) What are the bearing surfaces d) How are the components fixed to the bone3. Imaging Modalities for Surveillance: a) Serial radiographs b) CT scan c) MARS - Metal Artifact Reduction Techniques d) Ultrasound4) Complications of Hip Prosthesis - Infection, Osteolysis/Radiolucent line, Dislocation, Component malpositioning, Synovitis, Polyetheylene wear-induced synovitis, Adverse local tissue reaction - Metallosis, ARMD from metal on metal hips, Trunnionosis, Component impingement, Tendonitis - iliopsoas, Gluteal, Hamstring, Aseptic loosening, Pedestal formation, Pseudobursa formation, Periprosthetic Fracture

MKEE-11 **Does This Make Me Look Fat? Fat-containing Lesions In Bone**

Participants

Eddy Zandee van Rilland, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Fat-containing osseous lesions are generally benign and nonaggressive.2. Identifying intralesional fat using CT or MRI can aid in accurate diagnosis and ensure appropriate management, often preventing unnecessary biopsies.3. This presentation will provide a review of common fat-containing osseous lesions and discuss their clinical presentation, imaging appearance, and management recommendations.

TABLE OF CONTENTS/OUTLINE

Background Accurate assessment of osseous lesions on imaging can be challenging. Intralesional fat is highly suggestive of a benign process and seen in only a few tumor types and some non-neoplastic conditions. Identifying fat within a lesion, which can be confidently performed with CT or MRI, is therefore an important step in the evaluation of all osseous lesions. This presentation will provide a case-based review of fat-containing osseous lesions including their typical clinical presentation, imaging appearance, and management options for each lesion.Case Based Reviewa. Intraosseous lipomab. Parosteal lipomac. Intraosseous hemangiomad. Bone infarct e. Focal red marrowf. Paget diseaseg. Fibrous dysplasiah. Intraosseous dermoid cysti. Intraosseous hibernomaj. Involuting simple bone cystk. Treated bone metastasis

MKEE-110 The Forgotten Joint: Pathology Of The Proximal Tibiofibular Joint

Participants
Robert Robinson, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

The proximal tibiofibular joint (PTFJ) is often overlooked during radiologic evaluation of the knee. Yet, there are important conditions involving the PTFJ that contribute to knee pain and lower extremity functional impairment.It is important to understand the normal anatomy of the PTFJ and recognize the various pathologies that can occur at this location.

TABLE OF CONTENTS/OUTLINE

Background: A deep understanding of the anatomy and recognition of common processes involving this joint is crucial when interpreting imaging studies of the knee.Imaging Considerations & Anatomical Review: The PTFJ is a synovial joint at the proximal articulation of the tibia and fibula and is the site of several tendinous/ligamentous attachments and is closely associated with the peroneal nerve. MRI, CT, and Ultrasound can play an important role when other testing is unrevealing. Primary imaging consideration involves understanding the normal anatomical components of the proximal tibiofibular joint and adjacent structures.Pathology of the Proximal Tibiofemoral Joint: Pathology of the proximal tibiofibular joint can be categorized into: Arthritis (osteoarthritis, inflammatory, synovial chondromatosis), Traumatic (fractures, dislocations, posterolateral corner injury), Neoplastic, and Neurogenic (ganglion compression of the peroneal nerve, intraneural ganglion). These conditions will be discussed, and the key imaging features and pitfalls will be highlighted.

MKEE-111 Ligament And Fibrocartilaginous Injuries Of The Fingers: The Importance Of Dynamic Maneuvers In Ultrasound Exam.

Participants
Juan Jover, Getafe, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this of this exhibit is:-To explain the mechanism of injury in ligament and fibrocartilaginous lesions of the fingers. -To emphasize the dynamic capability of ultrasound to evaluate ligament and fibrocartilaginous injuries of the fingers and correlates with MRI.

TABLE OF CONTENTS/OUTLINE

Anatomy of the finger pulley system and finger extensor hood. Mechanism of injury in ligament and fibrocartilaginous structures of the fingers. Radiological findings of ligament and fibrocartilaginous lesions of the fingers (pulley tear, collateral ligaments lesions, volar plate lesion): MRI and US. -Sample cases.

MKEE-112 Imaging Evaluation Of Long Thoracic Nerve: Correlation Between Magnetic Resonance And Neural Damages

Participants
Gabriela Camerin, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Understand the physical principles of Magnetic Resonance (MR) and its use in nerves evaluation. Comprehend clinic indications of diagnostic neurography of braquial plexus. Describe MRI limitations in nerve afecctions detection. Describe MRI neurography evaluation protocol of long thoracic nerve. Know the impact of long thoracic nerves injuries on clinical management.

TABLE OF CONTENTS/OUTLINE

INTRODUCTION Long thoracic nerve injuries and clinical findings.Epidemiology of long thoracic nerve injuries. ANATOMICAL CONCEPTS Brief description of braquial plexus anatomy. Anatomy variants. Muscle innervation. PHYSICAL CONCEPTS AND PROTOCOLO OF MR NEUROGRAPHY Neurography: image acquisition and post processing. Neural damages carachterization and additional findings MR limitations. MR NEUROGRAPHY OF DAMAGED LONG THORACIC NERVE: INTERACTIVE CASE-BASED DIDACTICS Sample MRI cases to illustrate and solidify new concepts. FUTURE DIRECTIONS

MKEE-113 Spectrum Of Injuries To The Thumb Metacarpal Joint Ulnar Collateral Ligament In American Football Players And Novel Treatment With Internal Brace Augmentation.

Participants
Kemp Knott, MD, Houston, Texas (*Presenter*) Nothing to Disclose

1. Describe the normal anatomy of the thump metacarpal (MP) ulnar collateral ligament (UCL) complex.2. Understand the spectrum of UCL injuries in American football players and significance of player position.3. Discuss the preoperative MRI classification in UCL injuries and treatment options including novel augmentation of primary repair or reconstruction with internal bracing.4. Discuss the postoperative radiographic and MRI findings in UCL injuries.

TABLE OF CONTENTS/OUTLINE

1. Normal anatomy of the thumb MP UCL complex.a. Normal anatomy, function, and imaging of the UCL proper and accessory ligament.b. Normal anatomy, function, and imaging of the dynamic stabilizers of the thumb MP.2. Spectrum of thumb MP UCL injuries in American football players with MR imaging classification.a. Partial tearb. Complete tear with <3mm retractionc. Complete tear with >3mm retractiond. Complete tear with Stener lesione. Combined UCL and RCL tear (unique to football players)f. Degenerated nonfunctioning UCL without acute tear3. Treatment options of thumb MP UCL injuriesa. Primary repairb. Tendon graft reconstructionc. Augmentation of primary repair or reconstruction with novel internal bracing using suture tape with intra-operative imaging.4. Postoperative imaging of thumb MP UCL injuriesa. Intact repairb. Failed repair5. Conclusion

MKEE-115   Postoperative Evaluation Of Tendon And Ligament Injuries In The Extremities

Awards
Certificate of Merit

Participants
Gabriela Camerin, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Comprehend clinic indications of post-operative imaging evaluation. Understand the physical principles of Magnetic Resonance (MR), Ultrasound and its use in tendons and ligaments evaluation. Understand physical principles of reduced-artifact sequences. Describe MR and Ultrasound limitations in post-operative image evaluation. Describe normal and pathological post-surgery MRI aspect of ligaments and tendons in hands and feet. Comprehend surgical indications for ligaments and tendons lesions in the extremities Understand clinical impact of surgical complications of extremities surgeries and what should be described.

TABLE OF CONTENTS/OUTLINE

INTRODUCTION Epidemiology of hands and feets soft tissue injuries. Clinical findings in main tendon and ligament extremities surgical complications and indications of post-surgical imaging. ANATOMICAL CONCEPTS Brief description of wrist and hand anatomy. Brief description of ankle and foot anatomy. PHYSICAL CONCEPTS AND PROTOCOL OF MR AND ULTRASOUND MRI: image acquisition and post processing - artifact reduction.Ultrasound physical concepts - how to avoid pittfalls. MR limitations. Ultrasound limitations. WHAT SHOULD BE DESCRIBED Normal post-opperative aspect of ligaments and tendons. Most important findings in pathological post-operative images. Structured report. DAMAGED TENDONS AND LIGAMENTS: INTERACTIVE CASE-BASED DIDACTICS Sample MRI cases to illustrate and solidify new concepts. FUTURE DIRECTIONS

MKEE-116   Whole-body Magnetic Resonance Imaging In Musculoskeletal Oncology: State Of The Art And Clinical Applications

Participants
Isabela Da Cruz, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Whole-body magnetic resonance imaging (WB-MRI) has gained importance in the field of musculoskeletal oncology over the last decades, consisting in a one-stop imaging method that allows a wide coverage assessment of both bone and soft tissue involvement. WB-MRI is valuable for diagnosis, staging and follow-up in many oncologic diseases and is especially advantageous in comparison to other imaging methods since it avoids redundant examinations and exposure to ionizing radiation in patients who often undergo long-term surveillance. The addition of diffusion-weighted sequences allows functional evaluation of neoplastic lesions, which is helpful in the assessment of viable tumor and response to treatment after neoadjuvant or adjuvant therapy. WB-MRI is an excellent alternative to FDG-PET/CT in oncologic patients, with comparable accuracy and the convenience of being radiation-free, fast to perform and available at similar cost. The development of new techniques and protocols makes WB-MRI increasingly faster, safer and more accessible, and it is important for referring physicians and radiologists to recognize the role of this imaging method in pediatric oncology.

TABLE OF CONTENTS/OUTLINE

1) Technical considerations and Protocols 2) Screening 3) Diagnosis and Staging 4) Follow-up Imaging and Treatment Response Assessment 5) Pediatric Oncology 6) Adult Oncology 7) WBMRI vs. PET-CT in Musculoskeletal Oncology 8) Future Directions

MKEE-117   Multimodality Imaging Of Synovitis In Osteoarthritis

Awards
Certificate of Merit

Participants
Eimantas Abelkis, MD, Vilnius, Lithuania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Osteoarthritis is a chronic degenerative-inflammatory joint disease and one of the major causes of disability worldwide. Low-grade inflammation and its major manifestation - synovitis - have been recently recognized as crucial factors in OA pathogenesis. Synovitis is associated with joint pain and cartilage degeneration and can potentially be target of treatment.Synovial evaluation and quantification with non-invasive imaging tools is becoming increasingly important both in clinical practice and research.Ultrasound is easily accessible and inexpensive instrument for the initial evaluation of synovitis. Different techniques can be employed such as B mode, power Doppler and CEUS. Non-contrast MRI is incapable of reliably differentiating between inflamed synovium and fluid. Hoffa synovitis and effusion-synovitis are both used as indirect markers of synovial inflammation on non-enhanced MRI. Contrast-enhanced MRI perfectly delineates inflamed synovium while intraarticular fluid remains hipointense. Dynamic contrast-enhanced MRI is a sensitive tool to investigate perfusion of inflamed synovium as well as sensitively demonstrate

radiologic response to treatment.New techniques such as molecular imaging and advanced MR sequences are being investigated in synovitis diagnostics with promising results.

TABLE OF CONTENTS/OUTLINE

Inflammation in osteoarthritis.Normal vs inflamed synovium and correlation with symptoms.US techniques.Non-enhanced MRI.Static/dynamic contrast enhanced MRI.New emerging techniques.

MKEE-118   Tarsal Coalition: Don't Let It Fall Into Oblivion

Participants
Roberto Lima, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: To improve knowledge of the different types of tarsal coalition and their imaging findings. Ilustrate the distinguishing features of tarsal coalition and pitfalls To have a clearer insight into the preoperative surgical planning

TABLE OF CONTENTS/OUTLINE

Tarsal coalitions are developmental anomalies of tarsal bones and are a cause of chronic ankle and hindfoot pain being a diagnosis often overlooked. They can be osseous, fibrous and cartilaginous in nature, most frequently encountered within the calcaneonavicular and talocalcaneal joints, although any joint can be affected. Diagnosis can often be made with conventional radiography, even when the diagnosis is not clinically suspected and advanced imaging modalities are useful for preoperative planning, identifying coalitions and degenerative changes within the foot. Rozansky et al. proposed a classification based on a 3D reconstruction by computer tomography describing 5 types of talocalcaneal coalitions which may guide through different surgical techniques including linear fibrocartilaginous, linear with posterior Hook, downward orientation with shingled talar portion, osseous, peripheral posterior. The importance of early diagnosis is in guiding definitive imaging, which assists in early management decisions.

MKEE-119   The Bleeding Joint - Haemophilic Arthropathy: A Guide For Imaging Evaluation

Participants
Eneas Cerqueira, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Haemophilic arthropathy refers to joint disease as a long-term consequence of repeated hemarthrosis. Around half of the patients with hemophilia will develop a severe arthropathy with a high morbidity. In this context, the purpose of this study is: didactically review pathophysiology of musculoskeletal manifestations of hemophilia, explaining how arthropathy develops; demonstrate with schematic illustrations and cases classical radiological findings of haemophilic arthropathy and possible complications of these patients in a multimodality approach; discuss how radiologists can assist physicians, providing information that could change clinical/surgical management of haemophilic patients.

TABLE OF CONTENTS/OUTLINE

Overview of the epidemiology, pathophysiology and clinical assessment of hemophilic patients. Demonstrate in an easy way the use of radiographic scores in predicting synovial hypertrophy. Exhibit the classical findings of haemophilic arthropathy with cases including radiographic and MRI evaluation and correlation. Present possible complications that these patients may manifest while in follow-up. Discuss the value of radiographs and MRI in prophylactic treatment. Differential diagnosis of hiposignal intra-articular masses, including intra-articular giant cell tumor, amyloidosis, inflammatory arthropathies, crystal deposit diseases, and others. Bibliographical references.

MKEE-12   Hip Arthroplasty. Normal Post-operative Appearances And Complications.

Participants
Michelle Ooi, MBBS, Wrightington, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

To identify different types of hip arthroplasties commonly used, emphasizing on key points relevant to post-operative imaging interpretation.To recognise normal/accepted findings following hip arthroplasty.To identify potential post-operative complications following hip arthroplasty on various imaging modalities including plain film, CT, MR, US and nuclear medicine studies.

TABLE OF CONTENTS/OUTLINE

1. Different types of hip arthroplasties commonly used (hemi vs. total hip replacements, unipolar vs. bipolar prosthesis)2. Different bearing surfaces in total hip replacements.3. Brief summary of CT and MRI techniques to reduce metal artefacts.4. Normal post-operative appearances of hip arthroplasties including accepted alignment and common radiological measurements used will be depicted.5. Potential post-operative complications illustrated using different modalities:-Aseptic vs septic (infection) loosening-Prosthetic dislocation, prosthetic fatigue fractures, stress reactions/periprosthetic fractures (including classification systems used for periprosthetic fractures on imaging)-Arthroplasty-related synovitis including metal-related adverse local tissue reaction (eg: metallosis, metal hypersensitivity, trunnionosis, intra-osseous pseudotumour), polyethylene wear and particle disease-Impingement syndrome (eg: iliopsoas and ischiofemoral impingement)-Abductor tendons insufficiency/tear following hip arthroplasties, heterotopic ossification-Nerve-related complications.

MKEE-120

Stuck-in-the-middle: A Radiographic Evaluation Of Impingement Syndrome

Participants
Andrea Ruiz Mojica, MS, San Juan, Puerto Rico (*Presenter*) Nothing to Disclose

TEACHING POINTS

Define Impingement Syndrome and its Pathophysiology.Anatomical Review of Impingement Syndrome in the most commonly affected joints.Provide examples of key imaging findings that are diagnostic indicators of Impingement Syndromes.

Impingement syndromes are defined as the entrapment of anatomic structures (soft tissues or bones) that result in chronic pain and limited range of motion of affected joints. The mechanical entrapment of these structures can be due to multiple etiologies, such as bony abnormalities, trauma, or chronic use. Untreated impingement syndrome can be the source of significant pain and distress in our patients, ultimately limiting their mobility and activities of daily life. The purpose of this educational exhibit is to review the characteristic imaging findings of impingement syndromes of the shoulder, hip, knee and ankle in order to provide a prompt diagnosis and prevent progression of these conditions .1. Introduction2. Objectives3. Impingement Syndromes: Pathophysiology Clinical Presentation Anatomical Overview & Classic Imaging Findings of SubtypesImpingement Syndrome of the Shoulder (Subacromial & Subcoracoid)Impingement Syndrome of the Hip (Femoroacetabular & Ischiofemoral) Impingement Syndrome of the Knee (Suprapatellar & Infrapatellar Fat Pad) Impingement Syndrome of the Ankle Intra-articular (Anterior, Posterior & Medial) Extra-articular (Talocalcaneal), Lateral Hindfoot4. Multiple cases in Quiz Format5. Conclusion

MKEE-121   Charcot Marie Tooth Disease: What The Radiologist Should Know

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Leah Waldman, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: 1. Review the clinical and radiographic features of Charcot Marie Tooth (CMT) disease 2. Describe the complex?pes cavovarus deformity of CMT and how it is assessed on weightbearing radiographs 3. Discuss surgical correction of the CMT foot

TABLE OF CONTENTS/OUTLINE

Features - history, pathophysiology, presentation, pertinent multimodality imaging findings including 3D weight-bearing CT, treatment options, and prognosis Pathology specific to patients with CMT - fifth metatarsal fractures, stress fractures/response, callus formation, ulcerations/infection - illustrated with clinically correlated imaging Pes cavovarus deformity - due to imbalance between antagonistic muscles (weak peroneus brevis and relatively strong posterior tibial; weak tibialis anterior and relatively strong peroneus longus) manifesting as hindfoot varus, midfoot adduction, foot drop, and forefoot valgus Pes cavovarus assessment - calcaneal pitch, naviculo-cuboid overlap, metatarsal stacking, talonavicular coverage, relevant angle measurements Surgery - goals; different techniques based on specific corrections necessary, correlated with intraoperative imaging; and postoperative imaging evaluation with examples of surgical complications

MKEE-122   Imaging Approach In Differentiating Bone Lesions Having Fluid Fluid Levels.

Awards
Certificate of Merit

Participants
Amar Jakure, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. presence of complete fluid-fluid levels is a classical finding of aneurysmal bone cysts; however other various bone pathologies shows fluid-fluid levels.2. Fluid-fluid levels in ABC does not have any solid component, while other lesions with fluid-fluid levels shows solid component, matrix and other features particular to that pathology.3. Differentiating fluid fluid levels seen in primary ABC and other lesions with secondary ABC can be done with help of features seen on MRI.4. ABC is an expansile lesion most commonly seen at metaphysis of long bones which shows septations within. 5. ABC has various shades of hyperintensity on T1Wimaging due to presence of various ages of blood in the vascular channels.

TABLE OF CONTENTS/OUTLINE

1. Classification of bone lesions having fluid fluid levels2. Pathophysiology and imaging characteristics of fluid-fluid levels3. Characteristics of fluid fluid levels seen in primary ABC and other lesions with secondary ABC4. Examples and image illusrations of lesions having luid fluid levels.

MKEE-123   Besides Colorful Images, What Diffusion Tractography Of Peripheral Nerve Can Add?

Participants
Jessica Gomes, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Explain what is Diffusion Tensor Imaging (DTI) and Tractography of peripheral nerves its relevance, applications and increasing clinical demand; • Simplify the physics and technical considerations behind DTI/Tractography. • Recognize the difficulties and potential artifacts of employing DTI to assess peripheral nerves and how to solve them; • Orientate how to perform image postprocessing; • Suggest an optimized acquisition protocol and its interpretation;

TABLE OF CONTENTS/OUTLINE

Introduction: What is Diffusion Tensor Imaging (DTI) and Diffusion Tractography? Peripheral nerve DTI aplications: Chronic compressive neuropathies, Traumatic injury and Neoplasms. Physics and what informations we can get from DTI: Fractional Anisotropy (FA), Axial Diffusivity (AD), Radial Diffusivity (RD), Mean Diffusivity (MD) and Tractography. Protocol suggestion and artifacts management Challenges of employing DTI to assess peripheral nerves; Potential artifacts/ biases and possible solutions; Image postprocessing: a stepwise approach Evaluation of results and sistematic interpretation FA, AD, RD, MD their meaning and electroneuromiography correlations Tractography/ DTI interpretations in the context of Chronic compressive neuropathies, Traumatic injury and Neoplasms. Conclusion and Take Home Messages

MKEE-124   We Can Go Further: The Role Of Opportunistic MRI On Bone And Muscle Quality

Participants
Lucas Silva, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Studies by magnetic resonance imaging (MRI) are common in daily practice and with the aging of the population there is an increased demand for this method. Osteoporosis and sarcopenia are common diseases in the elderly population and generate great morbidity and costs to the health care. The early diagnosis of these diseases brings great advances in the clinical management of these patients. MRI can be used as quantitative method to risk stratification for sarcopenia and osteoporosis in exams performed for other reasons, helping to reduce the cost of screening methods and the morbidity of patients. The purpose of this exhibit is: (1) To review the definition of opportunistic diagnosis and how they can be applied in routine examinations, including its advantages and limitations. (2) To demonstrate how to perform the opportunistic diagnosis by MRI. (3) To review the scientific papers available in the literature and demonstrate which are the best techniques to perform the diagnosis efficiently. (4) To demonstrate in practice how this method can be used in patients with chronic diseases and the correlation with Dual-energy X-ray absorptiometry (DXA).

TABLE OF CONTENTS/OUTLINE

(1) Definition of opportunistic MRI (2) Technical considerations (3) How to perform opportunistic MRI in routine examinations (4) Correlation of opportunistic MRI with DXA (5) Opportunistic diagnosis of osteoporosis and sarcopenia in patients with chronic diseases (6) Pittfalls (7) The future of opportunistic MRI and its implications in the daily practice of the radiologist

MKEE-125   Rethinking Hip Joint Capsule: Anatomy, Imaging Findings, Pathologies And Postoperative Changes

Participants
Henrique Santana, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The hip capsule is a fibrocartilaginous ligament complex that, along with the hip muscles and the labrum, makes the hip joint congruent, helping to stabilize and limit the multidirectional movement of this highly weight-bearing ball-socket joint. It is composed superficially by the iliofemoral, ischiofemoral and pubofemoral ligaments, and deeply by the orbicular zone ligament, delimiting a synovial cavity, with anatomical and functional association with the teres ligament and the labrum.Many pathologies may affect the hip capsule, such as inflammatory diseases, mechanical changes, systemic diseases, microcrystal deposits, and more rarely neoplasms. In light of the increasing number of surgical procedures involving the hip joint capsule such as capsulotomies and reconstructions with iliotibial band, post-operative findings and its association with biomechanical changes must be understood. Hip capsule abnormalities may result in joint instability and osteoarthritis, however its pathologies are often disregarded. In the systematic radiological assessment of the hip, the capsule should always be carefully assessed and the evaluation of its normal, abnormal and eventual post-operative findings is of high importance for the radiologists.

TABLE OF CONTENTS/OUTLINE

1. Anatomy and biomechanics 2. Normal imaging findings 3. Mechanical changes: - Degenerative changes- Instability- Trauma 4. Polymyalgia rheumatica/Adhesive capsulitis 5. Post-operative findings 6. Miscellaneous and systemic pathologies 7. Take-home message

MKEE-126   Low Back Pain Beyond The Lumbar Spine Disease.

Participants
Eduarda Bernal, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

? Know the anatomy and function of coccyx and sacroiliac joint.? Recognize causes of low back pain beyond the lumbar spine disease.? Be familiar with epidemiology, clinical presentation and causes of coccydynia and sacroiliac joint pain? Recognize the relevant imaging features in the evaluation of patients with low back pain.? Comprehend the indications of conservative and intervention management of coccydynia and sacroiliac joint pain

TABLE OF CONTENTS/OUTLINE

? INTRODUCTION- Anatomy and function of coccyx and sacroiliac joint.- Postacchini and Massobrio classification.? COCCYDYNIA AND SACROILIAC JOINT PAIN- Definition- Epidemiology- Pathology- Clinical presentation- Diagnosis? IMAGING MODALITIES- Dynamic Imaging- MR Imaging- Cases of coccydynia and sacroiliac joint pain? MANAGEMENT- Conservative management.- Injections- Radiofrequency treatment- Surgical interventions? FUTURE DIRECTIONS- Minimally invasive image-guided procedures.

MKEE-127   Image-based Approach To Synovial Masses

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Allison Khoo, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Synovial masses present as diffuse or focal thickening of the synovial lining of a joint, bursa, or tendon sheath. Knowledge of articular anatomy is important to correctly localize a mass to the synovium.2. The differential for a synovial mass includes benign synovial proliferative pathology, inflammatory and infectious arthritis, deposition disease, vascular malformation, and malignancy.3. Interpreting the MRI signal characteristics of synovial masses is essential in the characterization of synovial disease and tailors the differential diagnosis. Further incorporation of additional radiographic and MRI findings with the clinical presentation help to arrive at the appropriate diagnosis.

TABLE OF CONTENTS/OUTLINE

I. Background: Synovial anatomy: Introduction of 3 broad categories of synovial disease by MRI signalII. Case-based review1. T1

1. Background: Synovial anatomy; Introduction of 3 broad categories of synovial disease by MRI signalII. Case based review1. T1 and T2 hypointense: Calcium (synovial osteochondromatosis, synovial chondrosarcoma, intraarticular synovial sarcoma, gout); Hemosiderin (pigmented villonodular synovitis, hemophilic arthropathy); Crystalline or Protein Deposition (amyloid arthopathy, gout); Flow void (arteriovenous malformation)2. T1 and T2 hyperintense: Fat (lipoma arborescens, synovial lipoma)3. T1 intermediate and T2 hyperintense: Inflammatory or Infectious synovitis (rheumatoid arthritis, tuberculous arthritis); Cartilage (synovial chondromatosis, synovial chondrosarcoma); Other (synovial hemangioma, intraarticular synovial sarcoma, synovial lymphoma)

MKEE-128   The Sternum And Sternoclavicular Joints: Advanced Imaging Techniques, Pathologies And Procedures

Participants
Adam Michalak, MD, Manhasset, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Imaging of the anterior chest wall osseous and chondral structures has increased in frequency.• MR Imaging of the anterior chest wall requires special consideration with regards to technique, imaging planes and sequences, and differs from chest MRI indicated to assess the intrathoracic visceral structures.• MRI of the chest is susceptible to artifact of which there are techniques to minimize these artifacts.• Pathologies include fractures, infection, neoplasms- benign and malignant, inflammatory and degenerative arthritis.• Xiphoid process can mimic a palpable lesion and can vary in morphology.• It is important to assess the surrounding soft tissues, including the anterior mediastinum.

TABLE OF CONTENTS/OUTLINE

IntroductionImaging protocol for the Sternum/Manubrium/Xiphoid and Sternoclavicular Joints• Anatomy• Imaging Planes• Imaging Sequences• PositioningArtifact and reduction techniquesMore frequently encountered pathologies with imaging examples(Predominantly MRI with corresponding CT/US/Nuclear exams):• Trauma• Infection• Neoplasm• Degenerative/Inflammatory/CrystallineXiphoid morphology and variationsSoft tissue findingsProcedures

MKEE-129   Hands On Hands! Soft-Tissue And Bone Tumors Involving The Hand - Imaging Features

Participants
Guilherme Andrade, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Introduce soft-tissue and bone tumors of the hand and discuss their epidemiology, classifications, pathology and clinical aspects.2. Properly evaluate the imaging features of hand tumors and narrow the differential according to location, clinical features and presentation 3. Determine the correct diagnosis or narrow down the differential diagnosis for the requesting physician according to allimaging and clinical features.

TABLE OF CONTENTS/OUTLINE

1. Introduction.2. Review of epidemiology, classifications, pathology and clinical aspects of the hand soft-tissue and bone tumors.3. WHO Tumor Classification.4. General radiographic findings5. Cystic-appearing masses a) Ganglion cyst b) Epidermal inclusion cyst c) Synovial sarcoma6. Noncystic Masses Along Tendons and Aponeuroses a) Tenosynovial giant cell tumor b) Fibroma of tendon sheath c) Palmar fibromatosis.7. Adipocytic Tumors a) Lipoma b) Lipomatosis of nerve. 8. Vascular lesions a) Venous malformation b) Glomus tumor. 9. Nerve Tumors a) Schwannomas b) Neurofibromas.10. Bone tumors a) Chondroma b) Enchondroma c) Chondrosarcoma.11. Conclusion.

MKEE-13   Don't Get Fooled: Cartilage Variants That Can Mimic Pathology

Participants
Ryan Hoffman, DO, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the imaging manifestations of common cartilage variants that can mimic pathology.2. Compare with cartilage or osteochondral pathology that can have a similar appearance.

TABLE OF CONTENTS/OUTLINE

Introduction: Background on the importance of identifying cartilage and osteochondral variantsReview variants with case examples and corresponding true pathology (osteochondral lesions) where applicable.Cases 1. Tubercle of Assaki 2. Glenoid central bare spot 3. Capitellar Pseudodefect 4. Trochlear ridge 5. Supra-acetabular Fossa 6. Stellate Crease (acetabulum) 7. Dorsal defect of Patella 8. Notch of Harty.Conclusion.

MKEE-130   Depiction Of Bone Microstructures Using Ultra-high Resolution CT

Participants
Hiroshi Moriya, MD, Fukushima, Japan (*Presenter*) Advisor, NantWorks LLCResearch Grant, Canon Medical Systems Corporation

TEACHING POINTS

1. Clinical significance of fracture risk assessment2. Fracture risk assessment methods3. Technical advantages of ultra-high resolution CT (UHRCT)4. Trabecula visualization by UHRCT5. UHRCT findings of osteoporosis

TABLE OF CONTENTS/OUTLINE

1. Fractures severely reduce the quality of life of the elderly, so it is important to diagnose and prevent fracture risk. In particular, specific fracture prevention can be performed by identifying high-risk regions.2. Traditional fracture risk assessment method: Plain radiographs, DEXA, CT, and micro CT. CT can evaluate fracture scars, bone shape, bone cortex, trabecula. Micro CT has a spatial resolution of 0.08 to 0.16mm. Analyze of peripheral bone such as lower leg. Trabecula analysis of high-risk areas such as the femur and spine cannot be performed.3. UHRCT: In SHR mode (1024matrix, 0.25mm slice thickness, FOV 160mm), the voxel size becomes 0.15mm diameter. Any bone can be scanned using a spatial resolution comparable to that of micro CT.4. Trabecula visualization by UHRCT: Fine trabecular bones and bone structures are depicted with a small voxel. UHRCT can separate the trabecular bone in

bone marrow fat.5. UHRCT findings of osteoporosis: The trabecula is thin and sparse. The trabecular bone in the horizontal direction is decrease, and slightly thick trabecula in the vertical direction is conspicuous. Cortical bone volume, thickness, cancellous bone volume, and trabecular pattern can be analyzed.

MKEE-131   Cervical Trauma: Anatomy, Types Of Fractures, Ligaments Injury And Stable Vsunstable Lesions.

Participants
Wagner Hutterer SR, MD, Taboao da Serra, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To review anatomy and the mainly mechanism associated with cervical spinelesions.2. Correlate the different types of fracture and ligaments injury with the correspondingclinical repercussion emphasizing in differentiate stable vs unstableinjuries.3. To discuss epidemiology, criteria for requesting imaging exams4. To discuss about each type of fracture and how to diagnose it and make anaccurate assessment in a multimodality approach

TABLE OF CONTENTS/OUTLINE

1- Anatomy.2- Imaging exams indications.3- Institutional protocol (CR, CT and MRI)2- C1 fracture (Jefferson).3- Odontoid fracture.4- C2 fracture (Hangman's fracture).5- Facet dislocations.6- Interspinous ligaments injury7- Burst fracture of lower cervical spine8- Flexion and extension tear drop fracture.9- Occipital Cervical Dislocation.10- Occipital condyle fracture.

MKEE-132   Gout: Is It That Simple? Typical And Atypical Locations

Participants
Danielle Rumi, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To briefly discuss the epidemiology, pathophysiology, and clinical presentation of gout. 2. To illustrate and revisit the classic radiological findings of gout in different imaging modalities, showing common and atypical joints involved by the disease, showing how challenging gout imaging diagnosis can be. 3. We will particularly emphasize the atypical locations that have a high risk of misdiagnosis, which has a particular interest not only to radiologists but also to clinicians. When in an atypical location, gout can also have an atypical clinical presentation making the imaging study essential for correct diagnosis and treatment.

TABLE OF CONTENTS/OUTLINE

• Briefly discuss the epidemiology, pathophysiology, and clinical presentation of gout.• Briefly present the typical and atypical joints involved by the disease.• Illustrate with multiple imaging modalities (MRI, CT, XR, and US) the deposition of monosodium urate crystals.• Provide an overview of key imaging findings, tips, and illustrative cases that could help radiologists to assist the physician's decision.• Conclusions.• Bibliographical references.

MKEE-133   Musculoskeletal Infection And Mimics

Participants
Jeffrey Belair, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

After reviewing this educational exhibit, the reader will be able to:- Understand the modes of musculoskeletal contamination- Recognize the various types of musculoskeletal infection- Identify potential mimics of musculoskeletal infection and provide an appropriate differential diagnosis when applicable

TABLE OF CONTENTS/OUTLINE

1. Modes of contaminationa. Hematogenousb. Contiguous spreadc. Direct implantation2. Update on nomenclature3. Imaging techniques4. Types of infectiona. Cellulitis & abscess- Bland edema vs. devitalized tissue- Ulcers & sinus tractsb. Pyomyositisc. Infectious fasciitisd. Septic tenosynovitise. Septic bursitisf. Septic arthritis- Native joint- Prosthetic joint infection (PJI)g. Osteomyelitis- Intraosseous abscess- Pediatrics (vascularization, Brodie's abscess)- Sequestrum/cloaca/involucrum- Emphysematous osteomyelitish. Discitis-osteomyelitis5. Infection mimicsa. Inflammatory arthropathiesb. Crystalline deposition (HADD, CPPD, gout)c. Neuropathic (Charcot) arthropathyd. Tumors and tumorlike conditionse. Tissue necrosis/infarctionf. Trauma/fracture6. Reporting tips and recommendations

MKEE-134   Magnetic Resonance Imaging Of The Total Hip Arthroplasty: What Did They Cut Through?

Awards
Cum Laude

Participants
Ji Lin, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Total hip arthroplasty (THA) is one of the most commonly performed joint replacement procedures, with a variety of surgical approaches currently in common usage.- Variations in operative technique may confuse imaging evaluation of the post-THA hip for radiologists and trainees who are unfamiliar with these surgical nuances. We will demystify common MRI findings after direct anterior approach (DAA) and posterior approach (PA) THA by reviewing the different surgical techniques and relevant anatomy.- Postoperative MRI findings of THA via anterior approach is compared to posterior approach with respect to the soft tissue structures violated, including the nerves at risk.- Risk of femoral nerve injury is greater with DAA while risk of sciatic nerve injury is greater with PA.- Findings on magnetic resonance (MR) neurography for post-operative femoral nerve palsy can clarify the nature of the nerve injury in order to guide appropriate treatment.

TABLE OF CONTENTS/OUTLINE

BackgroundPros and Cons of DAA vs. PA THASurgical Anatomy of DAA vs. PA THASurgical Anatomy of PA THA- Muscle Injury-

Capsular DehiscenceNerve Injury Following THA:- Denervation effect of muscle- Abnormal nerve size and signal- Scar- Transection- Management: surgical and non-surgicalConclusion

MKEE-135   Spondylodiscitis And Its Culprits: Imaging Hallmarks Based On Etiology

Participants
Luana Concha, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To discuss the epidemiology of spondylodiscitis.To discuss the risk factors.To discuss the clinical presentation and the biochemical markers.To review the imaging hallmarks based on etiology.To review the differential diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Introduction: Review of spondylodiscitis epidemiology and risk factors. 2. Clinical standpoint and importance of MRI role on spondylodiscitis diagnosis. 3. The hallmarks to differentiating between pyogenic, tuberculous, fungal infections. 4. The differential diagnoses and features that mimic spinal infection. 5. Take home messages and teaching points.

MKEE-137   Plantar Vein Thrombosis - A Difficult And Hardly Ever Remembered Diagnosis

Participants
Vivien Bonadio, MD, Bebedouro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review the venous anatomy of the foot. 2. To approach the clinical scenario. 3. To discuss possible etiologies. 4. To correlate the plantar thrombosis through imaging findings in a multimodality approach (US, CT and MRI). 5. To approach differential diagnosis. 6. Treatment.

TABLE OF CONTENTS/OUTLINE

1. Venous anatomy of the foot. 2. Clinical scenario and possible etiologies. 3. Imaging findings in a multimodality approach (US, CT and MRI). 4. To approach differential diagnosis, including intermetatarsal bursitis, Morton neuroma, sesamoiditis, plantar fasciitis, tendon pathology, ganglion cyst and stress fracture. 5. Treatment. 6. Evolutive control.

MKEE-138   Soft Tissue Mineralization: Demystifying The Deposition

Awards
Certificate of Merit

Participants
Mohamed Elboraey, MBBCh, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- Soft tissue mineralization is commonly encountered on musculoskeletal imaging. A thorough understanding of the pathophysiology and imaging appearance of various soft tissue mineral deposits is crucial to avoid misdiagnosis and inappropriate intervention.2- Most soft tissue mineralization patterns can be distinguished on radiographs. The presence of soft tissue mineralization is often not perceived on MRI, but awareness of its presence can significantly impact the overall MRI interpretation. Therefore, comparison of any MRI exam with corresponding radiographs is essential. Even a negative radiograph provides important information in that it allows inclusion or exclusion of certain diagnostic considerations. 3- Incorporation of pertinent patient history, including clinical presentation, biochemical laboratory results, and concomitant comorbidities allows for greater confidence and accuracy in image interpretation.

TABLE OF CONTENTS/OUTLINE

1- Background on pathophysiology of soft tissue mineralization. 2- Classification of soft tissue mineralization by etiology, imaging pattern, and distribution: -Dystrophic -Vascular -Trauma -Metabolic -Neoplasm -Autoimmune -Infection 3- Illustrative examples of the most commonly encountered soft tissue mineralization deposits. 4- Special types: -Calcinosis universalis -Calcinosis cutis - Calcinosis circumscripta 5- Illustrative examples of utility of comparison radiographs during MRI interpretation.

MKEE-139   The Spectrum Of Achilles Pathology; What A Radiologist Needs To Know

Participants
Guillermo Granados Gonzalez, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

The Achilles tendon is made up of the soleus and gastrocnemius muscles, which are inserted in the posterior region of the calcaneus.In MRI, the Achilles tendon is easily visible because it is surrounded by fatty tissues, which help to define the anatomy and pathology of the Achilles tendon.Achilles tendon rupture is the most common tendon rupture, which can be complete or partial.Tendinosis is the term that should be used to refer to a non-inflammatory and degenerative process of the tendonThe term tendinitis involves an inflammatory reaction within the tendon, which leads to the development of enthesophytes.

TABLE OF CONTENTS/OUTLINE

The Spectrum of Achilles Pathology; What a a Radiologist Needs to KnowDisclosureAbbreviationsContentLearning objectivesAnatomyCinematics of the gaitImages:Routine X-raysAnatomical ClassificationPathologyAchilles tendon tear (Typical and atypical tear)ParatenonitisTendinosisInsertional tendinitisHaglund´s diseaseRetrocalcaneal bursitisRetro-Achilles bursitisTake home messagesReference

MKEE-14   A Pictorial Review Of Peri Prosthetic Fractures In Hip And Knee Replacement: A Radiologist's Guide To Key Clues In Reporting.

Participants

Javier Azpeitia Arman, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To describe the different types of Periprosthetic Fractures in hip and knee replacement.-To review the role of imaging techniques (plain radiograph, CT, MR) in the evaluation of periprosthetic fractures.-To understand usefulness and limitations of plain radiographs and CT in the evaluation of periprosthetic fractures. -To illustrate imaging findings which should be described in periprosthetic fracture reporting in different techniques (plain radiograph, CT, MR) in order to provide useful data for the orthopedic surgeon.

TABLE OF CONTENTS/OUTLINE

Periprosthetic fracture (PF) describes any fracture that occurs around an implanted orthopedic prosthesis, most commonly knee or hip arthroplasties, which may occur either intraoperatively or postoperatively. We review imaging of hip and knee replacement fractures, highlighting key concepts perceived as important variables by the surgeon and correlating images with clinical considerations and functional outcomes. We present: 1. A review of types of hip and knee replacement 2. Clinical considerations. 3. Imaging. -Imaging techniques: Plain radiographs, CT, MR. - Technique and limitations -Imaging findings. Parameters that should be evaluated. Different classifications of fractures. -Associated findings potentially obscuring fractures: metalware, loosening and osteolysis.

MKEE-140   Ultrasound Evaluation Of The Hand And Wrist: A Case-based Review

Participants
Natasha Honda, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to:1-Familiarize the radiologist with normal sonographic anatomy of the hand and wrist. 2-Review technique and image optimization for sonographic evaluation of the hand and wrist pathologies. 3-Recognize characteristic imaging findings of various traumatic and non-traumatic pathologies diagnosed on ultrasound with a case-based review, highlighting dynamic imaging abilities of ultrasound, with correlation with other modalities when pertinent (i.e. MRI and radiography). 4-Briefly describe a step-wise approach in evaluation of inflammatory arthropathies and spondyloarthropaties in the hand and wrist. 5-Discuss the role of sonography in post-operative evaluation of the hand and wrist

TABLE OF CONTENTS/OUTLINE

• Introduction with a brief description and illustrations of the hand and wrist normal anatomy• A case-based literature review of the hand and wrist spectrum of pathologies, focused in sonographic evaluation, with schematic drawings, illustrations and MRI correlation, including unusual cases• Illustrative examples to highlight dynamic imaging abilities of ultrasound• Didactic cases to consolidate the knowledge• Conclusions• Bibliographical references

MKEE-141   Clinical Challenges Of Gluteal Pain: How Can The Radiologist Help?

Participants
Thaisa Gomes, MD, Campinas, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review the anatomy of the sciatic nerve. Illustrate the anatomical structures of the subgluteal space. Expose the causes of gluteal pain related to non-discogenic sciatic.Discuss the differential diagnoses of non-neurogenic gluteal pain (sciatic-like).

TABLE OF CONTENTS/OUTLINE

Introduction:-Describe the possible conflicts of the sciatic nerve while crossing the subgluteal space.-Demonstrate non-neurogenic gluteal pain cases that can mimic sciatica.Image Techniques: Magnetic resonance images with protocols for evaluating the lumbosacral plexus, hips and pelvis.Clinical Applications:-Non-discogenic gluteal pain related to:-- tumor compressions;--piriformis syndrome;--inflammatory and infectious processes;--post-traumatic lesions;--post-surgical complications;--gynecological pathologies;--neurovascular conflicts;-Non-neurogenic gluteal pain (or sciatic-like) related to:--Sacroiliitis;--Fractures;--Hamstring enthesopathies;--;Ischiofemoral Impingement;--Bursitis;--Inflammatory and infectious processes;--Post traumatic soft tissue injuries.

MKEE-142   MRI Of Forefoot - Anatomy And Common Injuries Of Tendons, Plantar Plate And Ligaments

Participants
Vivien Bonadio, MD, Bebedouro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review anatomy of forefoot - Tendons, Plantar plate, Ligaments. 2. To correlate the anatomy of tendons, plantar plate and ligaments with MRI images. 3. To approach injuries and expected image patterns.

TABLE OF CONTENTS/OUTLINE

1. Review general anatomy of tendons, plantar plate and ligaments. 2. MRI of flexor mechanism - anatomy and injuries. 3. MRI of plantar plate - anatomy and injuries. 4. MRI of extensor mechanism - anatomy and injuries. 5. MRI of collateral ligaments - anatomy and injuries.

MKEE-143   Manage The Mess: Infections In Implants, Flaps And Grafts

Participants
Meena Nedunchelian, MBBS, Coimbatore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To describe the role of multimodality imaging in evaluating the spectrum of post-operative infections following orthopaedic implant placement.2. To highlight the key points in the differentiation of post-operative infections from expected post-operative appearances and other common as well as uncommon postoperative complications.

Imaging is often requested for diagnosis and to know the extent of infection following clinical suspicion. However, imaging can be challenging due to various complications occurring in the post-operative site which can mimic infection. A multimodality imaging approach is preferred in this scenario to evaluate bone, hardware and soft tissues since each imaging modality has a specific advantage over the other to provide definitive information regarding the above structures.It is crucial to diagnose infection at the earliest to prevent devastating complications. Apart from the early detection of infection, describing the extent of infection is of utmost importance. Soft tissue compartments and planes involved have to be adequately described for appropriate treatment. Knowledge of expected postoperative findings and common mimics of infection is essential for preventing unnecessary surgical intervention.In this exhibit, we will display the common appearances of infections in bones, joints and soft tissues following orthopaedic surgeries with implants, grafts and flaps along with a radiological checklist to be followed for diagnosis and reporting.

MKEE-144 Postoperative Foot - What The Radiologist Needs To Know

Participants
Vivien Bonadio, MD, Bebedouro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: To review the main foot orthopedic surgeries - indications, technics, expected image findings and main complications in a multimodality approach (CR, US, CT and MRI).

TABLE OF CONTENTS/OUTLINE

1. Review indications and technics of foot orthopedic surgeries. 2. Discuss which imaging modality provides the best evaluation for each kind of surgery. 3. Expected image findings and main complications in a multimodality approach (CR, CT, US and MRI). 4. The studied procedures include: Elective surgeries: - Arthrodesis; - Deformities, such as hallux valgus, varus and rigidus; - Tendon repair and transposition; - Ligament repair; - Osteochondral lesion repair. Emergency surgeries: - Ankle fracture - lateral, medial and posterior malleolus, such as tibiofibular syndesmosis injury and repair; - Talus and calcaneous fracture. 5. The complications includes: Non-union, Loosening, Disuse osteopenia, Reflex sympathetic dystrophy (Sudeck atrophy), Denervation, Infection.

MKEE-145 Oh My Hip, Again! A Multimodality Imaging Review Of Hip Arthroplasty Complications

Participants
Kaushik Chagarlamudi, MD, Cleveland, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Review of various types of hip arthroplasty orthopedic hardware.- Immediate postoperative changes with normal anatomy following total hip arthroplasty- Expected normal findings at follow up evaluation- Common and uncommon complications of total hip arthroplasty on follow up exams

TABLE OF CONTENTS/OUTLINE

? Review of Total Hip Arthroplasty Orthopedic Hardware? Normal Anatomy and Expected Postoperative Changes Following Total Hip Arthroplasty? Evaluation after initial placement¦ Alignment and positioning? Evaluation during follow-up studies¦ Checklist, pearls, and pitfalls? Complications of Total Hip Arthroplasty? Component Loosening¦ Femoral component loosening¦ Acetabular component loosening? Polyethylene Wear? Osteolysis? Adverse Local Tissue Reaction¦ Metallosis¦ Pseudotumor (solid and cystic)? Heterotopic Ossification? Periprosthetic Fracture? Infection? Prosthesis dislocation. Component malposition

MKEE-146 "Don't Get On My Nerves" - MSK Ultrasound Evaluation And Treatment Options Of Nerve Pathology

Participants
Allen Wrubel, MD, Birmingham, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review of normal sonographic appearance of nerves under ultrasound. 2. Review of anatomy of select superficial nerves with associated pathology including neuromas, scar tissue, transection, and hardware entrapment. o Review of treatment options, indications and imaging of lidocaine, steroid and phenol injections, percutaneous stimulation, radio frequency ablation, Sonex and IncobotulinumtoxinA treatments.

TABLE OF CONTENTS/OUTLINE

• Review of normal anatomic appearance of nerve tissue using MSK ultrasound. o Structure and Appearance o Differentiating nerve from surrounding muscle/tendon • Sonographic review of anatomy and pathology o Neuroma o Nerve Transection o Hardware Entrapment o Scar Tissue o Thoracic Outlet Syndrome • Review of Treatment Options o Lidocaine/Bupivacaine Injection o Steroid Injection o Phenol Injection o Methylene Blue Marking o Percutaneous Stimulation o Radiofrequency ablation o IncobotulinumtoxinA • Summary

MKEE-148 Weightbearing Imaging Of Progressive Collapsing Foot Deformity

Participants
Carlos Teixeira Lobo, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Discuss the recent recommendation to adopt the Progressive Collapsing Foot Deformity (PCFD) nomenclature in contrast to Adult Acquired Flatfoot Deformity (AAFD) and Posterior Tibial Tendon Dysfunction (PTTD); Review the new anatomical and pathological concepts involved in PCFD Discuss the previous classifications for PCFD, exposing their current limitations; Discuss the new classification for PCFD; Review the recommendations for radiographic evaluation of PCFD, with emphasis on the angular measurements necessary for the categorization of patients; Discuss the role of weightbearing computed tomography (WBCT) in the current understanding of PCFD and in the proposed new classification system; Review the findings that must be evaluated in the WBCT, unique to the method and important in the management of patients; Review the surgical reconstruction of PCFD;

TABLE OF CONTENTS/OUTLINE

Background - Overview of the new nomenclature PCFD; - Current imaging evaluation and its limitations; - Previous classification systems and current recommendation; - Anatomical aspects of PCFD; - Conventional radiographs for PCFD: recommended incidences; illustration of recommended angular measurements; - Weightbearing computed tomography: illustration of relevant findings; sagging of the medial arch; peritalar subluxation; hindfoot alignment; Foot Ankle Offset (FAO); posterior subtalar joint valgus; intrinsic valgus of the talus; - Illustrations of surgical reconstructions of PCFD

MKEE-149   Musculoskeletal Emergencies And Urgencies: An On-call Primer

Participants
Aishwarya Gulati, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

After reviewing this educational exhibit, the reader will: 1. Understand imaging findings of joint, osseous, muscle, ligament, and tendon emergencies and urgencies, both typical presentations as well as commonly missed or subtle findings, particularly on advanced imaging modalities such as MRI and US. 2. Be aware of common blind spots and learn diagnostic clues to overcome common pitfalls. 3. Understand when to recommend appropriate follow-up.

TABLE OF CONTENTS/OUTLINE

Multimodality imaging (X-ray, CT, MRI, US) focusing on optimal imaging techniques, characteristic imaging findings, and diagnostic pearls and pitfalls of: 1. Infections a. Large and small joints b. Soft tissue c. Osteomyelitis 2. Trauma a. Acute osseous, muscle, tendon, and ligament traumatic injuries b. Foreign bodies 3. Vascular injuries - traumatic and incidentally imaged 4. Non-traumatic urgencies (osseous, soft tissue) 5. Recommending appropriate follow-up a. Radiographic findings requiring further imaging or other follow-up b. Suboptimal imaging requiring re-imaging or other evaluation with alternative modalities

MKEE-15   Ultrasound-guided Musculoskeletal Intervention Of The Ankle And Foot: Kicking Pain To The Curb

Awards
Certificate of Merit

Participants
Isaiah Tan, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To recognize the clinical presentation and imaging features of musculoskeletal conditions of the ankle and foot that may warrant US-guided intervention. 2. To review the indications, contraindications, interventional methods, potential complications, and expected outcomes of US-guided interventions of the ankle and foot. 3. To discuss the technical approaches to various US-guided musculoskeletal interventions of the ankle and foot.

TABLE OF CONTENTS/OUTLINE

1. US-guided procedure overview A. Equipment and scanning B. Medication considerations C. Safety and contraindications 2. Clinical and imaging overview A. Anatomy and pathophysiology B. Clinical and imaging findings in disease C. Differential diagnosis 3. Patient positioning, injection technique, outcomes, and complications A. Ankle i. Achilles tendon interventions a. Platelet-rich plasma injection b. Dry needling/fenestration ii. Retrocalcaneal bursa injection iii. Tendon sheath injections a. Common peroneal b. Posterior tibialis iv. Nerve blocks a. Tibial b. Deep peroneal c. Baxter's nerve B. Hindfoot i. Plantar fascia interventions a. Corticosteroid injection b. Platelet-rich plasma injection ii. Sinus tarsi injection iii. Subtalar joint injection C. Mid and forefoot i. Tarsometatarsal joint injection ii. Metatarsophalangeal joint injection iii. Intermetatarsal space interventions a. Bursitis corticosteroid injection b. Morton's neuroma (1) Alcohol ablation (2) Cryoablation

MKEE-150   Striking A Cord: Review Of Normal And Variant Anatomy Of The Distal Spinal Cord And Conus With Pathologic Discussion.

Participants
Elizabeth Dobben, MD, Detroit, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review of distal spinal cord normal anatomic appearance, and variants Review of pathology involving the distal cord

TABLE OF CONTENTS/OUTLINE

Review of Distal Spinal Cord Normal Anatomic Appearance and Variants Conus normal location Borderline Conus Position Terminal/Fifth Ventricle Low Lying Conus Review of Pathology Involving the Distal Cord Syrinx of the distal cord Tethered Cord Lipoma of Filum Terminale Low Lying Conus with Lipoma Diastomatomyelia Anterior Sacral Meningocoele Summary

MKEE-151   Radiological Approach To The Acute Finger

Awards
Certificate of Merit

Participants
Anas Saeed Bamashmos, MD, Trumbull, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Elucidate osseous finger anatomy with associated biomechanics. • Recognize the spectrum of traumatic entities involving the finger. • Describe the radiologist approach in evaluating finger injury, value of different imaging modalities, and associated complications. • Present common finger injuries classification systems used by orthopedic surgeons. • Highlight the management options for finger injuries. • Discuss imaging findings of non-traumatic acute finger pathologies such as osseous and soft tissue infections, foreign bodies, and acute ischemia.

TABLE OF CONTENTS/OUTLINE

• Overview of the anatomy of the finger, with an emphasis on how this anatomy influences the types of injuries that affect the

• Overview of the anatomy of the finger, with an emphasis on how this anatomy influences the types of injuries that affect the finger and where they occur. • Review the physiological anatomy of the finger and common injury mechanisms. • Define the pathogenesis, clinical manifestations, imaging findings, management, and prognosis for finger trauma. • Review the image guided and surgical procedures utilized to manage finger injuries. • Contrast the utilization of radiography, ultrasonography, computed tomography, and magnetic resonance imaging for finger injuries. • Highlight the common non-traumatic finger pathologies.

MKEE-152 Crystal-related Arthropathy: An Imaging Overview

Participants
Tatiane Moriwaki, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: 1. Review and illustrate the most frequent and some atypical presentations of crystal arthropathies with imaging findings on radiographs, ultrasound, computed tomography and magnetic resonance, based on the type of crystal deposit; 2. Illustrate and discuss differential diagnosis with didactic and challenging cases.

TABLE OF CONTENTS/OUTLINE

Introduction: general presentation of the epidemiology, pathophysiology and clinical findings of crystal arthropathies. Present a schematic illustration with the distribution and main imaging findings in the crystal arthropathies, besides providing didactic cases of the manifestations related to each type of crystal deposit. Discuss differential diagnoses and tips to help differentiate them from crystal arthropathies and illustrate with challenging cases. Bibliographical references with recent articles highlighting and what's new in the topic.

MKEE-153 Peripheral Ulnar-Sided Tears Of The Triangular Fibrocartilage Complex (TFCC): Multiplanar Approach And Characterization Of Injury Patterns With Focus On CT Arthrography

Participants
Gonzalo Serrano, MD, Vitacura, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Introduce new concepts regarding the layered anatomy of the TFCC, demonstrate the normal appearance of these components and illustrate the varied tear patterns of the peripheral ulnar TFCC using high resolution multiplanar CT arthrography.2. Introduce a novel CT arthrography sign to distinguish tears of the deep foveal fibers from those affecting the less important superficial components.

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Details of the anatomy of the ulnar peripheral insertion of the fibrocartilage will be reviewed using high resolution multiplanar CT arthrography and illustrations. We will highlight the stratified structure of DRULs formed by superficial and deep fibers that insert in the distal ulnar in the styloid process and the fovea and their appearance on CT arthrography. Each set of fibers has volar and dorsal attachments resulting in four distinct attachment sites of these ligaments at the distal ulna. The different tear patterns that can be identified will be shown in a didactic way through illustrations and images. A new sign will also be introduced in the evaluation of foveal tears. Finally, the author's personal research data will be shown in the exhibit. We believe that accurate characterization of the various injuries seen in this area will lead to improved clinical radiological correlation and optimize patient management.

MKEE-154 The Atlanto-axial Joint. Osseous And Ligamentous Anatomy, Common And Important Clinical Cases

Participants
Susan Hesni, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

The atlantoaxial joint is a complex joint with several osseous and ligamentous components. Knowledge of this anatomy can aid in the interpretation of both traumatic and non-traumatic pathologies of the cervical spine. The following topics will be discessed.1. The atlantoaxial joint may be affected by unique pathologies such as atlantoaxial instability and basilar invagination. Often, multi-modality imaging including plain radiography, CT and MRI may be required. 2. As well as unique pathologies, the atlantoaxial joint may be affected by similar pathologies to other joints in the body including degeneration, trauma and infection. 3. Fractures involving the atlantoaxial joint are particularly important as they may give rise to instability and resultant compromise of the craniocervical junction. In addition, the pattern of the fracture can determine the likelihood of non-union.4. Fractures involving the foramen transversarium should be treated with caution and CT angiographic imaging performed to assess the vertebral arteries.

TABLE OF CONTENTS/OUTLINE

1. To outline the normal osseous and ligamentous structures of the atlantoaxial joint with the aid of imaging.2. To highlight normal anatomical variants such as os odontoidium and congenital non-fusion of the posterior arch of C1.3. To explore a variety of traumatic and non-traumatic cases involving the atlantoaxial joint such as atlantoaxial subluxation/instability, osteomyelitis and basilar invagination.

MKEE-155 A Practical Guide To The Ribs: Anatomy, Protocols And Pathologies.

Participants
Cristyano Leite, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Comprehend clinic indications for imaging evaluation.Learn the anatomic landmarks and relationships of the thoracic cage.Recognize the most useful image methods.Understand role and limitations of thoracic Magnetic Resonance imaging (MRI).Know the most frequent and relevant rib pathologies.

TABLE OF CONTENTS/OUTLINE

INTRODUCTION- Epidemiology of the rib pathologies.- Imaging methods to evaluate rib lesions.ANATOMICAL CONCEPTS- Brief

description of the thoracic cage.- Brief description of the typical and atypical ribs.- Anatomy variants.MRI PROTOCOL MRI:- Most used protocols.- Suggested weighting.MOST RELEVANT RIB PATHOLOGIES: INTERACTIVE CASE-BASED DIDACTICS- Trauma: bone rib and cartilage fractures.- Bone and chondral neoplasms.- MRI Pitfalls.FUTURE DIRECTIONS- Ultrasound evaluation of the thoracic cage.

MKEE-156   Magnetic Resonance Imaging Based Neuropathy Score- Reporting And Data System (NS-RADS)- Multi-institutional Expert Consensus Guideline

Participants
Avneesh Chhabra, MD, Flowermound, Texas (*Presenter*) Consultant, ICON plc;Consultant, Treace Medical Concepts, Inc;Author with royalties, Wolters Kluwer nv;Author with royalties, Jaypee Brothers Medical Publishers Ltd;Speaker, Siemens AG;Medical advisor,ImageBiopsy Lab;Research Grant, ImageBiopsy Lab;

TEACHING POINTS

1.Gain knowledge of MRI-based neuropathy score- reporting and data system (NS-RADS) for the standardized description and reporting of peripheral nerve disorders.2.Learn and understand the different categories of NS-RADS for description of severity scales of nerve injury (NS-RADS, I0-5), entrapment (NS-RADS, E0-3), neoplasia (NS-RADS, N0-4), diffuse nerve disorder (NS-RADS, D0-2), and post-intervention state (NS-RADS, PI-0-3).3.Discuss how to describe regional muscle abnormalities (M0-M3).4.Understand the NS-RADS-NOS (not otherwise specified) category for imaging description of peripheral nerves and muscles.

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1. Evidence-based and multi-institutional expert-consensus discussion of technical considerations and optimal parameters for MR imaging of peripheral nerves and muscles ('complete set', 'incomplete set', 'MR neurography', 'DWI/DTI').2. Discussion of coverage and billing/charges.3. Outlining of the lexicon and standardized terms to describe nerve disorder, muscle denervation, and short-segment vs. long-segment neuropathies.4. Illustration of different NS-RADS categories with relevant case examples.5. Discussion of terms to avoid during imaging descriptions and when to use NOS category.

MKEE-157   Chronic Ankle Instability And Microinstability: What You Should Know

Participants
Daisy Kase, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Chronic instability is a important cause of ankle pain with associated loss of function and limitation of movement. Ankle microinstability has been subject of studies among orthopedics, although many radiologists still haven't got familiarity with the term. In this context we aim to: Explain the concept of ankle instability and microinstability, describing didactically anatomy, mechanism of lesion and their treatments; Demonstrate with illustrations and cases the main imaging findings, possible complications and what to report; Correlate MRI findings and arthroscopy images in pre and post surgical treatment cases.

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Review current theory of instability and microinstability, including anatomy of the ankle, mechanism of lesions, clinical assessment and treatment. Describe and demonstrate with MRI examples the anatomy of the anterior talofibular ligament fascicles related to microinstability.Exhibit the main findings of instability pre and post surgical treatment and complications associated.Demonstrate and explain, with arthroscopy images, surgical ligament repair, correlating with the post-operatory MRI.Overview what to look for and how to report on these patients' exams, aiming to assist the orthopedic community.Summary.

MKEE-158   The Many Faces Of Fascial Disorders In The Musculoskeletal System

Participants
Murilo Maciel, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this study is:• Review the normal imaging appearance of the fascial system• Discuss the fascial system pathologies, their imaging patterns and clinical correlation

TABLE OF CONTENTS/OUTLINE

The fascial system is composed of connective tissue distributed in superficial and deep layers, providing protection, lubrication and contributing to force transfer during muscle contraction. The pathological conditions of the fascia can be divided into trauma, tumor, inflammatory/infectious and deposit disease. Trauma may be due to acute injury or repeated microtrauma. Acute trauma may cause direct fascia disruption or cause dissociation between the superficial interface with the hypodermis or with the deep interface with the epimysium. Repetitive microtraumas are associated with thickening of the fascia and perifascial edema, as seen in plantar fasciitis and friction syndromes. Inflammatory and infection processes can be centered in the fascia, as seen in eosinophilic fasciitis, or be an extension of muscle inflammation, as seen in inflammatory myositis. Tumor lesions range from benign circumscribed nodules to local aggressive masses/malignant tumors. The imaging appearance is not specific and depends on the cellularity and components of the lesions. Deposit diseases may also affect fascia, including hydroxyapatite crystal deposition and cerebrotendinous xanthomatosis. Knowledge of the different injuries in the fascial system helps radiologists to identify possible patterns of lesions and improve diagnostic accuracy.

MKEE-159   Runner's Stress Fractures: When Running To Reduce Stress Fails.

Participants
Daniel Ramos SR, MD,MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Stress fractures are partial or complete fractures of bone resulting from high numbers of cyclical overloading, commonly seen in runners. Since the coronavirus disease-2019 (COVID-19) pandemic began, there has been a rising number of people suffering from stress fractures after sharply transitioning from sitting at home all day to rigorously exercising, trying to be healthy or to reduce daily stress. The purpose of this exhibition is to review physiopathology, risk factors and stress fractures different subtypes: low

risk and high risk, presenting a selection of cases to illustrate.

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. Illustrated description of physiopathology. Presentation of the stress fractures risk factors and subtypes, showing their most common sites. Exhibit several cases of stress fractures and stress reaction, including: 1. Femoral neck. 2. Tibial plateau. 3. Ischiopubic ramus. 4. Calcaneus. 5. Metatarsus. Discuss stress injuries complications. Review the prognostic value of MRI grading for time to return to sports after bone stress injuries.

MKEE-16   Dynamic Ultrasound As A Problem-solving Tool: Techniques, Tips And Tricks

Awards
Cum Laude
Identified for RadioGraphics

Participants
Dyan V. Flores, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

Sonography is useful for the investigation of musculoskeletal disorders. It is cost-effective, accessible, portable, lacks ionizing radiation and allows for dynamic evaluation. A number of musculoskeletal pathologies are optimally, or even only revealed upon dynamic assessment, through muscle contraction, probe compression, change in position, or maneuvering of a patient's extremity. In this educational exhibit, we will review techniques, tips and tricks for using dynamic ultrasound as a problem-solving tool.

TABLE OF CONTENTS/OUTLINE

Technical considerations Common dynamic techniques employed• Muscle contraction• Change in position• Movement of extremity to reproduce symptoms• Probe compression Common issues/problems in static imaging • Soft tissue injury (tendon instability, ligament insufficiency)• Impingement or friction• Joint stability• Nerve dislocation/subluxation• Muscle hernias• Subclinical effusion for aspiration• Challenging anatomy for interventions• Hardware-related symptoms • Cases, techniques, tips and tricks Shoulder Impingement Proximal biceps dislocationElbow • Posterolateral rotatory instability• Distal biceps tendon tear• Ulnar nerve dislocationWrist • Scapholunate ligament injury• UCL injury and joint instability• Stener lesion• Trigger fingerPelvis and hip• Snapping• ImpingementThigh and calf Muscle herniaAnkle and foot• Tendon instability and tearIntervention• Subclinical effusions• Optimizing anatomyHardware• Hardware-related symptoms

MKEE-160   Finger Injuries: Knowledge In The Palm Of Your Hand

Participants
Alejandra Ospina Gonzalez, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this study is:To review the normal anatomy and related injuries of the hand fingers, using ultrasound and MRI.To correlate injuries with clinical images and videos.

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The fingers are composed by a complex capsuloligamentous and tendon structures which provide joint stability and control of motion. The thumb has particular anatomy that is related to this great range of motion and the unique opposable movement. The most comom finger lesions can be divide into five categories: Thumb trauma injuries, other finger traumatic injuries, trigger fingers, tumors, and arthropathies. Stener lesion is one of the most concerning finger lesions, and is characterized by the interposition of the adductor pollicis aponeurosis in a torn and retracted 1st metacarpophalangic ulnar collateral ligament. Other finger tendon and ligament injuries may also cause joint instability and can be associated with articular deformity. Trigger finger is a common lesion which occurs by repetitive microtrauma resulting in a stenosing tenosynovitis at the level of the A1 pulley. Although finger tumors are not frequent, recognition of the most common lesions is essential. Nevertheless, the fingers are synovial joints and can be affected by inflammatory arthropathies. It is important to evaluate the presence of joint effusion, synovitis, tenosynovitis, bone erosion, and osteitis. The knowledge of the normal anatomy of the fingers and their most common injuries can provide confidence to the radiologist when reporting these joints.

MKEE-161   Gluteal Aesthetic Procedures: A Practical Guide For Imaging Assessment

Participants
Vinicius Lourenco SR, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Gluteal augmentation was introduced in 1969 and is now one of the fastest-growing fields in plastic surgery. Can be performed using different techniques, such as solid silicone implant placement, autogenous fat augmentation and filler injection. The approach of this educational exhibition will be centered on the role of different imaging methods, mainly MRI, in the pre- and post-operative evaluation,the normal findings and possible complications, with the aim of creating a practical guide for a quick assessment.Implant insertion is the most frequently accepted method worldwide for buttocks augmentation. Currently, solid/semi-solid silicone implants are the only implants approved by the FDA for use in the buttocks in the USA and intramuscular placement is becoming more popular.Despite that, with the increasing demand for esthetic gluteal augmentation, we have seen an increasing number of complications from fat grafts and gluteal injections in our practice. CT and magnetic resonance imaging (MRI) are critical to document fat graft integration and volumetric variations produced in the buttocks after fat injection and to determine the level at which the foreign substance has been injected (muscle or subcutaneous fat).

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Review the basic surgical and procedural techniques of gluteus augmentationReview the normal and abnormal postprocedural findings and common types of complications of each procedure Review MRI sequences capable to assess implant integrity and differentiate the main gluteus fillers

MKEE-162   Peripheral Nerves Tumors - A Practical Guide

Participants
Lucas Rocha, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Review the anatomy of the peripheral nerves.- Recognize the most important imaging features of peripheral nerves tumors.- Acknowledge benign versus malignant imaging characteristics.- Comprehend the imaging role and techniques.

TABLE OF CONTENTS/OUTLINE

INTRODUCTION- Peripheral nerves tumors definition, epidemiology and conditions associated. ANATOMICAL CONCEPTS- Peripheral nerves anatomy.- Key anatomical landmarks demonstrated by illustrations with MRI correlation.IMAGING TECHNIQUE - MRI protocol.- Ultrasound evaluation.- The role of computed tomography (CT). IMAGING INTERPRETATION- Imaging features and systematic approach.- Benign versus malignant characteristics.- What does the referring physician expect us to report ? INTERACTIVE CASES- Sample cases to illustrate and solidify the conceptsMANAGEMENT- Treatment algorithm.

MKEE-163   MR Imaging Of Fibroblastic And Myofibroblastic Soft Tissue Tumors: A Pictorial Essay

Participants
Rafael Il Jun Yoo, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. Exhibit the various fibroblastic and myofibroblastic soft tissue tumours MRI findings according to their biological behaviour according to the latest WHO category (2020)2. Showcase relevant differential diagnosis of fibrogenic soft tissue tumors on MRI

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Fibroblastic and myofibroblastic tumors are a subset of mesenchymal neoplasms that encompass a broad spectrum of tumors. At least 30% of the benign tumors of soft tissue are fibrohistiocytic and fibrous tumors, accounting for about 12% of paediatric soft-tissue tumors, whereas fibrosarcomas account for 3.6% of all adult sarcoma.The most common locations are the extremity and trunk wall tumours, 30% being superficial and 60% deep-seated.While the etiology of most benign and malignant tumors of soft tissue is unknown, in rare cases (<10%), chemical carcinogens, radiation, viral infection and immunodeficiency and genetic susceptibility may be associated of malignant soft tissue tumors. The large majority of soft tissue sarcomas seem to arise de novo.The likelihood of misdiagnoses between similar tumor entities as well as other differential diagnosis is high, and often leads to inappropriate tumor treatment, and thus, certain MR imaging features can support the diagnosis of fibroblastic or myofibroblastic tumor.

MKEE-164   Time To Thaw The Frozen Shoulder: A Review Of Capsulitis In Various Synovial Joints

Awards
Certificate of Merit

Participants
Elise Chua, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Although most commonly reported in the shoulder, adhesive capsulitis has been described in various joints with analogous imaging features.The purpose of this exhibit is to:1) Demonstrate the capsular anatomy and non-arthrographic MRI findings of capsulitis unique to each joint. 2) Review clinical features, aetiologies and literature on diagnosis and management of capsulitis in various joints.Radiologists should consider capsulitis in patients with pain and limited range of motion to facilitate management with NSAIDS, intra-articular injections and targeted physiotherapy.

TABLE OF CONTENTS/OUTLINE

1) Adhesive capsulitis of the shoulder- Clinical stages- Histopathology- MRI: thickening of coracohumeral ligament, axillary pouch and rotator interval joint capsule2) Cases of capsulitis in various joints- Clinical presentation: chronic pain, limitation of movement variable depending on synovial recess size and intrinsic motion of different joints- MRI: Joint capsule thickening and T2 signal hyperintensity, none or small effusion corresponding to joint volume reduction, high STIR signal of capsular ligaments- Elbow associated with synovial plica syndrome- Wrist in the prestyloid recess- Hip (often associated with labral tear)- Knee (abnormal signal of fat pad and extrasynovial cruciate ligaments)- Ankle (relation to inversion sprains and impingement syndromes)3) Review of treatment options and if outcomes resemble those of shoulder adhesive capsulitis.

MKEE-165   Various Computed Tomography (CT) Findings Of Failed Fusion After Spinal Surgery

Participants
Minsu Lee, MD, Seongnam-Si, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

Spinal fusion surgeries are increasingly performed in recent decade, followed by a growing number of fusion failures. Accurate diagnosis of failed spinal fusion requires radiologist to have thorough knowledge of surgical techniques, normal findings according to the timeline, and CT findings of nonfusion. Here, we demonstrate representative cases of each imaging features of failed spinal surgery from our institution since past five years. The presented cases could be helpful in early and correct diagnosis of failed spinal fusion, avoiding adverse patient outcomes.

TABLE OF CONTENTS/OUTLINE

1. Surgical techniques and normal fusion process, A. Surgical technique; B. Normal CT findings in 3, 6, 12 and 24 months. 2. CT findings of delayed or failed fusion, A. Periscrew halo, lucency, cystic change; B. Endplate cystic change; C. Rod fracture; D. Screw fracture; E. Cage migration; F. Cage subsidence; G. Breakage of bone graft; H. Absorption of bone graft. 3. Summary and Take-home message

MKEE-166   The Ultimate Guide To High Resolution MRI Of Fingers And Nails

Participants
Thais de Souza, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

High field strength MRI scanners and optimized MRI coils has allowed detailed visualization of small structures and complex anatomy of fingers and nails. Dedicated coils provide the necessary signal to achieve the spatial resolution needed within a reasonable scanning time. In this context, high resolution MRI imaging has a new role in detecting nail apparatus disorders, such as trauma, infections, tumors and lesions in the context of systemic conditions.The purpose of this exhibit is to review finger and nail MRI protocol, including usage of ultrasound gel to improve nail analysis, and to compare imaging features between high resolution MRI and ultrasound. In didactic and illustrative way, we will review and correlate MRI and ultrasound imaging findings with sample cases.

TABLE OF CONTENTS/OUTLINE

INTRODUCTION - Clinical indications - MRI Protocol -- Loop Small coils -- The importance of ultrasound gel -- Patient positions -- MRI sequencesANATOMY CONCEPTSCOMPARISON BETWEEN HIGH RESOLUTION MRI AND ULTRASOUNDSAMPLE CASES - Retronychia - Onychomadesis - Glomus tumor - Trauma - Subungual exostosisTAKE HOME MESSAGES - Advantages of using gel ultrasound on MRI - Limitations of high resolution MRI when compared to ultrasound

MKEE-167   Radiographic Lines, Measurements, And Angles Of The Hip: A Pocket Guide

Participants
Antonio Pontes Filho, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this study is: • To review the basic radiographic anatomy of the hip in children and adults • To demonstrate the most useful lines, angles, and measurements of radiographic studies of the hip

TABLE OF CONTENTS/OUTLINE

• Introduction presenting the normal imaging pattern of hip and pelvis radiographs in children and adults, highlighting the standardized radiographic techniques and imaging views. • Objectively demonstrate the major anatomic landmarks utilized for an adequate evaluation on radiographic studies. • Demonstrate the main lines, angles and measurements of the hip, didaticly categorizing them according to the age group. In pediatric studies we will discuss acetabular index, Perkins and Hilgenreiner lines, Shenton line, Reimer migration index, grade of hip dysplasia, among others. The adult evaluation will include center-edge angle, acetabular angle, head-neck prominence and off set, alpha angle, coxa vara and coxa valga, acetabular protrusion, acetabular retroversion, among others. • Briefly correlate the measurements and lines with the most common pathologies of the hip, such as hip dysplasia and femoroacetabular impingement. • Provide didact and illustrative cases to consolidate the acquired knowledge. • Conclusions. • References.

MKEE-168   Ankle Postoperative Imaging: What The Orthopedic Surgeon Wants To Know

Participants
Vitor Sato, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: 1. Briefly approach to pre-operative imaging of fractures, deformities, arthritis (degenerative or inflammatory) and ligament, tendon and cartilage injury in the ankle; 2. Discuss the main indications of surgery procedure in this cases; 3. Review the normal post-operative imaging findings, orthopedic devices and complications of the procedures.

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Introduction: general presentation of pre-operative imaging of potentially surgical conditions affecting the ankle joint; Present a schematic illustration of the main surgical procedures and orthopedic devices, providing didactic cases of each subgroup of surgical procedure; Discuss and also illustrate the main complications of the procedures and what the orthopedic surgeons want to know to guide treatment; Bibliographical references with recent articles highlighting what's new in the topic.

MKEE-169   Many Masks Of Myeloma: Atypical Presentations Of A Common Hematologic Malignancy

Participants
Anthony Chuprin, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Present and familiarize atypical findings of multiple myeloma namely osteosclerotic lesions, extraosseous plasma cell lesions and amyloidosis. 2. Identify differential diagnoses to consider when encountering the aforementioned lesions that would be atypical for myeloma.

TABLE OF CONTENTS/OUTLINE

1. Introduction - General features of multiple myeloma. 2. Review - general features, epidemiology, clinical presentation, and special attention to musculoskeletal multimodality imaging appearance for atypical presentations of multiple myeloma including osteosclerotic lesions, extraosseous plasma cell lesions and amyloidosis. 3. Discussion - brief overview of differential diagnoses to consider when encountering atypical findings of multiple myeloma including polyneuropathy, organomegaly, endocrinopathy, monoclonal gammopathy and skin changes (POEMS) syndrome and solitary extramedullary plasmacytoma. 4. Conclusion

MKEE-17   Let's Nail It! A Simple Ultrasound Guide To Nail Diseases

Awards
Magna Cum Laude

Participants

Carolina Almeida, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) The nail performs several functions as protection and enhancement of sensations. Knowing the anatomy and embryology of the nail apparatus is important to understand the image aspect of the lesions that affect them. 2) High-frequency ultrasound is the imaging modality chosen for nail examination due to its cost and avaibility.3) Demonstrate the differences and uses of 18MHz, 24 MHz and 33MHz probes and explain the examination technique to radiology residents.4) Make a pictorial essay of the main tumor lesions and their differential diagnoses, such as glomus tumors, neuromas, melanomas and onicomatricomas.5) Demonstrate the images of inflammatory diseases (autoimmune or not) that affect the nails and may be the initial manifestation of systemic diseases.6) The nail can be affected secondarily by adjacent lesions with another source, such as synovial cysts and foreign bodies.

TABLE OF CONTENTS/OUTLINE

1) Nail anatomy; 2) High-frequency ultrasound examination technique for nail;3) Tumor and tumor-like lesions;4) Inflammatory lesions;5) Differential diagnosis.

MKEE-170   The Tale Of The Talus: Approach To Talar Bone Fractures.

Participants
Ahmad Shaban, MD, Doha, Qatar (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Elucidate the normal radiological anatomy of the talus bone. - Illustrate the unique blood supply to the talus bone and the injuries with a high risk of osteonecrosis. - Describe the most common talar fractures and their mechanism of injury with valuable learning pearls and pitfalls. - Summarize the clinically relevant classification systems for talus fractures, including the Hawkins classification. - Discuss the most common and pertinent management options for talar fractures.

TABLE OF CONTENTS/OUTLINE

- Overview of talus anatomy and biomechanics. - Epidemiology of talar injuries. - Talus fractures and their mechanism of injury. - Talar fracture classification systems. - Management options for talar injuries.

MKEE-171   Stener And Stener-like Lesions: Removing Interposed Barriers To Understanding

Participants
Joao Ricardo Barros Oliveira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review and understand the Stener lesion and different types of Stener-like lesions of other anatomical regions in imaging studies, including in the knee, fingers and foot.

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- Stener lesion corresponds to a complete tear of the distal insertion of ulnar collateral ligament (UCL) of the thumb metacarpophalangeal (MCP) joint, with interposition of the adductor pollicis aponeurosis between the retracted torn ligament and the MCP joint. This condition prevents healing and requires surgical repair1, 2. - In the MCP joints of the 2º to 5º fingers, there can be avulsion of the distal insertion of the collateral ligament (radial or ulnar) with interposition of the sagittal band between the torn ligament and the MCP joint3. - In the proximal interphalangeal (PIP) joints of the 2º to 5º fingers, the interosseous tendon can interpose between the torn collateral ligament (radial or ulnar) and the PIP joint3. - Knee's Stener-like lesion is represented by distal avulsion of the superficial medial collateral ligament (SMCL) and interposition of the pes anserinus tendons between the retracted torn ligament and its tibial insertion. That prevents healing and can prompt knee instability4. - In the hallux metatarsophalangeal (MTP) joint, there can be interposition of the extensor hood between a dislocated torn lateral collateral ligament5. - These injuries regularly require early surgical treatment1-4, due to the potential danger of ongoing instability, albeit conservative treatment can be considered in nondisplaced complete tears6.

MKEE-172   Glenohumeral Osteoarthrosis Radiological Approach, Primary Or Secondary

Participants
Cyndy Guia Yerovi, MD, Valencia, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Shoulder osteoarthritis (OA) is a common source of morbidity in the elderly population. New surgical techniques and the different types of shoulder prosthesis have opened a wide variability of treatment options for these patients. -Shoulder OA can be divided into primary or secondary, being rotator cuff massive chronic rupture the most frequent cause, other causes include fractures, avascular necrosis and chronic dysplasia. Radiological features are diagnostic. -XRAY is the main imaging technique, and it is enough for the diagnosis but for surgical planning CT/MR are essential. Xray also allows to differentiate primary and secondary OA - CT with MPR and 3D information: retroversion angle, glenoid morphology following Walch classification and bone stock. -MRI main goal is to check rotator cuff state for surgical decision on anatomical prosthesis or reverse arthroplasty. Other signs of shoulder OA can be depicted: subchondral cysts, chondral lesions, osteophytes. Massive rotator cuff arthropathy should be classified following Hamada modify classification -CONCLUSION: The knowledge of the different types of shoulder OA and the information that radiological modalities provide is essential for surgical planning. Using the same classification systems and structured report improves communication with our referral physicians.

TABLE OF CONTENTS/OUTLINE

General featuresClinical presentation Etiology Imaging findings -Plain Radiography -Computer Tomography -MRI Walch classification and measurements importance

MKEE-173   **Alterations In The Spinal Morphology And Its Relationship With Adjacent Structures That Jeopardizes Surgical Safety In Neurofibromatosis Patients With Spinal Deformity.**

Participants
Pushpa Bhari Thippeswamy, MD, MBBS, Bangalore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To demonstrate alterations in vertebral morphology by multi modality imaging in neurofibromatosis (NF) patients with scoliosis and their surgical relevance.2. To familiarize the reader with changes in the relationship of the spine with adjacent structures which can complicate the surgery or have devastating consequence when overseen.

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Scoliotic spine in NF might have several dystrophic features like vertebral scalloping and wedging, rib penciling, transverse process spindling, dysplastic pedicles, short curves with apical rotation, neural foraminal enlargement, paravertebral soft tissue mass. Presence of these features is significantly associated with rapid curve progression. However alterations in canal, pedicle and lamina are very important when surgery is indicated which is further complicated by the unique feature of body drift and vertebral rotation phenomenon. With body drift and rotation there is a possibility of rib head dislocation into the canal which can lead to cord injury during surgical manipulation. There is also a great deal of change in relationship with the spine and adjacent structures which needs special mention in the report to avoid devastating injuries during surgery. This exhibit provides detailed overview of surgically relevant findings in NF scoliosis.

MKEE-174   **Renal Osteodystrophy: Do You Know What To Find?**

Participants
Gabriela Souza, Brasilia, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review of common signs of renal osteodystrophy.Describe expected findings at radiography, MDCT and MRI. Discuss imaging approach to evaluate the various findings that may appear in renal osteodystrophy.Using examples, review a spectrum of renal osteodystrophy.

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Renal osteodystrophy is a variety of consecutive abnormalities of the musculoskeletal system because metabolic disorders of calcium and phosphate following chronic renal impairment (chronic renal insufficiency, hemodialysis, peritoneal dialysis, renal transplantation and administration of different medications).The pathophysiological and biochemical background of the disease occurs as a result of parathyroid cell hyperplasia with enlargement of the glands leading a secondary hyperparatireoidism. The hypersecretion of parathormone causes hipocalcaemia and increase of the phosphate and vitamin D, leading a extensive bone marrow fibrosis and increased osteoclastic bone resorption. The reflect of all metabolic impairment is the development of osteomalacia, rickets, deposition of calcium/phosphate compounds on soft tissues, osteopenia and osteosclerosis.With more advanced radiological techniques and early diagnosis/treatment of chronical renal disease, the management of radiological manifestations have changed and the typical features of advanced secondary hyperparathyroidism and of rickets/osteomalacia are now much less frequently revealed than previously.

MKEE-175   **Backbreaker! Imaging Review Of The Extramedullary Abnormalities Of The Adult Spine**

Participants
Hamza Alizai, MD, Valley Stream, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

The reader of this exhibit will be able to: • Provide comprehensive differential considerations for spine abnormalities not originating from the cord • Categorize spine lesions based on origin: dural coverings, vertebrae, discs and facet joints, and paraspinal tissues• Describe imaging features of each entity on radiographs, CT and MRI• Approach spine lesions using imaging characteristics such as topography, morphology, size and multiplicity

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• Dural lesions: vascular lesions (epidural venous plexus engorgement, dural arteriovenous fistula), spinal cord herniation, arachnoid cysts and dural neoplasms, dural collections• Vertebral lesions: benign tumors (hemangioma, osteoid osteoma, osteoblastoma, osteochondroma, aneurysmal bone cyst, giant cell tumor, Langerhans cell histiocytosis), malignant tumors (metastasis, multiple myeloma, lymphoma, chordoma, Ewing Sarcoma, osteosarcoma, chondrosarcoma, fibrosarcoma), trauma, metabolic (osteoporosis, gout, calcium pyrophosphate dihydrate (CPPD) and calcium hydroxyapatite crystal deposition diseases, Paget disease, renal osteodystrophy, dialysis related spondyloarthropathy), infectious (bacterial and tuberculous), inflammatory (seropositive and seronegative spondyloarthropathies)• Disc and facet joint lesions: Disc protrusions and cysts, facet joint arthropathies• Lesions of the paraspinal tissues: ligament abnormalities, peripheral nerve lesions

MKEE-177   **Thumbs Up Or Down - MR Imaging Of 1st Carpometacarpal Joint Arthroplasty - Surgical Techniques, Normal Imaging Findings And Complications**

Participants
Diego Lemos, MD, Burlington, Vermont (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To learn the normal MR imaging appearance of different techniques for arthroplasty of the 1st carpometacarpal joint, including suspensionplasty and tendon interposition with ligament reconstruction, in the setting of basilar thumb arthritis 2. To learn the MR imaging appearance of postoperative complications and patterns of failure seen with different surgical techniques in the setting of 1st carpometacarpal joint arthroplasty due to basilar thumb arthritis

TABLE OF CONTENTS/OUTLINE

1. Introduction. 2. Normal anatomy of the 1st carpometacarpal joint 3. Classification system for severity of osteoarthritis of the 1st

carpometacarpal joint 4. Different surgical techniques with artworks and drawings in the setting of basal joint arthritis including tendon interposition with ligament reconstruction and suspensionplasty 5. Normal MR imaging appearance of different types of 1st carpometacarpal arthroplasty 6. MR imaging appearance of complications and different patterns of failure 7. Conclusions 8. References

MKEE-178   Carpal Instability On Plain Radiograph: The Great Challenge

Participants
Javier Cuetos, MD, Donostia-San Sebastian, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To know the carpal bone and articular anatomy.- To know the kinematics of the carpal bones.- To become familiar with the radiological projections that should be ordered depending on the clinical suspicion.- To understand the classification of carpal instability and the dynamic and evolutionary aspect of the process.- To identify the radiological signs that suggest carpal instability

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Carpal instability is defined as an injury in which there is a loss of the normal alignment of the carpal bones and/or the radioulnar joint. The loss creates a disturbance of the normal balance of the carpal and radioulnar joints resulting in changes in range of motion. If undiagnosed, carpal instability can lead to progressive limitation of movement and later to osteoarthritis, chronic pain, and disability.In a patient with wrist pain, a plain radiograph is generally the first imaging test requested. There are various signs on plain radiography that suggest there may be carpal instability. On other occasions, these signs are not visible in routine projections but can be observed in specific projections that should be performed when suspected.This presentation aims to review both the anatomy and kinematics of the carpus in order to understand and identify which radiological signs to look for and avoid the underdiagnosis of this pathology.

MKEE-179   Multimodality Imaging Of Benign Hand Tumors And Mimics With Histopathological Correlation, Clinical And Surgical Relevance

Participants
Kanchan Dhanokar, MBBS,MD, Coimbatore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To describe the spectrum of typical and atypical benign tumors occurring in hand using multimodality imaging approach. • To highlight key imaging features for differentiating benign tumors with histopathological correlation and surgical relevance. • To demonstrate common lesions which mimic neoplasms by clinical and imaging features with histopathological correlation.

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More than 90% of the tumours occurring in hand are benign and originate from a diverse range of ectodermal & mesodermal derivatives. Histopathology gives a definitive diagnosis; however, it is not available before surgical excision in most of the scenarios, prompting for accurate radiological diagnosis. The multimodality imaging approach is therefore crucial for detecting and differentiating these tumours for optimal surgical planning. Benign tumours follow certain characteristics regards to their locations and appearance in various imaging modalities, however, the proximity of the structures of the hand creates a significant challenge for localising the epicentre and differentiating them. A further difficulty is in diagnosing a few atypical lesions that present differently both in appearance and location. We attempt to describe the key imaging features of both typical and atypical lesions in the hand with surgical relevance for each along with histopathological correlation. Tumour mimics are not uncommon and may pose a diagnostic dilemma for which radiologist should be primed. Accurate diagnosis avoids unnecessary intervention.

MKEE-18   Distal Radioulnar Joint: Anatomy, Pathologic Conditions And Imaging Findings

Awards
Identified for RadioGraphics

Participants
Dyan V. Flores, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

The distal radioulnar joint (DRUJ) is a synovial pivot-type joint between the radius and ulna that allows only one degree of motion: pronation and supination. Disorders of this joint are a common source of ulnar-sided wrist pain and can be classified into four types: (a) traumatic, (b) overuse/degenerative, (c) inflammatory and (d) neoplastic. The objectives of this educational exhibit are: 1. To discuss pertinent anatomy of the DRUJ, emphasizing the role of each structure to stability2. To understand imaging techniques in diagnosing DRUJ disorders 3. To review abnormalities of the DRUJ based on etiology

TABLE OF CONTENTS/OUTLINE

Anatomy Stabilizers Joint surfaces Joint capsule Triangular fibrocartilage complex Palmar and dorsal radioulnar ligaments Interosseous membrane Musculotendinous units - extensor carpi ulnaris and pronator quadratus Biomechanics Imaging considerations Pathology Trauma Triangular fibrocartilage complex tears Dislocation/subluxation Distal radial fractures Forearm fractures Acute and chronic instability Overuse/degenerative Ulnar impaction Ulnar impingement Osteoarthritis Inflammatory Rheumatoid arthritis Tendinitis Neoplasms Hereditary multiple exostoses Giant cell tumor

MKEE-180   Unfriendly Neighbors - Vascular Pathologies Leading To Spinal Pathology And Vice Versa.

Participants
Kanchan Dhanokar, MBBS,MD, Coimbatore, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To describe the intricate vascular anatomy in relation to the adjacent spine. • To enumerate various spinal or vascular pathologies which can mimic or affect each other by a case-based approach using multimodality imaging.

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There is a delicate relationship between the paraspinal vasculature and the adjacent spine. The pathologies affecting the spine can involve the adjacent vessel or mimic clinical features of vascular lesions. The same is also true for vascular pathologies influencing the spine. Clinical manifestations can be extremely non-specific causing missed or wrong diagnosis. Imaging plays a major role in localizing and diagnosing such pathologies hence crucial for diverting the patient to appropriate specialty & planning accurate management. We aim to present few such cases emphasizing the importance of awareness of such relationships and include these findings as a checklist in reporting format to avoid missed or wrong diagnoses. Examples include - Mycotic aortic pseudoaneurysm secondary to tubercular spondylodiscitis. Brachalgia secondary to compression by pathologies at lung apex like Pancoast tumor, thoracic isthmic aneurysm. Retroperitoneal fibrosis causing segmental IVC thrombosis leading to opening of abnormal peri vertebral venous channels with resultant epidural varices. Hypertrophic pachymeningitis associated with Takayasu arteritis causing spinal cord compression & myelopathic symptoms.

MKEE-181   Benign Bone Tumors: State Of The Art In Minimally Invasive Percutaneous Interventions- Essentials For Radiologists

Awards
Identified for RadioGraphics

Participants
Anderanik Tomasian, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Several minimally invasive, percutaneous, image-guided interventions are available to radiologists for treatment of painful benign bone tumors.Patients with benign bone tumors should be evaluated and treated in a multidisciplinary fashion.Recent advances in minimally invasive percutaneous interventions have expanded the role of radiologists in treatment of patients with benign bone tumors.Procedural protective measures may be implemented to minimize the possibility of complications.

TABLE OF CONTENTS/OUTLINE

Overview of benign bone tumorsPatient clinical evaluationPre-treatment imagingIndicationsMinimally invasive treatment options (Thermal and chemical ablation, Cementation, intra-tumoral injections)Recent advances in minimally invasive interventions and equipmentChallenging interventionsPost-treatment imagingThermal protectionComplications

MKEE-182   Ankle And Midfoot: US - MR Correlation In Evaluation Of Ligaments And Tendons.

Participants
Janette Franco Contreras, MD, San Luis Potosi, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Describe the US features of normal anatomy and main pathologic conditions of the ankle and midfoot. 2. Find the MR imaging findings that correlate with the US features. 3. Discuss the role of MR imaging as an adjunct to US in evaluation of ankle and midfoot lesions.

TABLE OF CONTENTS/OUTLINE

-Disclosure. -Introduction. -Technique and Protocol at US. -Anatomical review. Common pathologic patterns: ligament injuries and endon injuries: anterior, posterior, lateral, and medial compartments. -Discussion. -Conclusion. - References

MKEE-183   Help! Paging The Musculoskeletal Radiologist For Chest Pain!

Participants
Jay Panchal, MBBS, Wigan, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To describe costochondral, chondro-sternal and sternoclavicular joint anatomy.• To review these joints and soft tissues with the aid of multimodality imaging including radiography, ultrasound, CT, MR and nuclear medicine studies.• To highlight classical imaging features of costochondral junction fractures.• To discuss the differential diagnoses of costochondral and sternoclavicular joint pathologies including their imaging features.• To recognize the importance of costal cartilage imaging particularly in professional and amateur athletes presenting with anterior upper chest wall pain.*?aß?e ?? ???te?ts/??t???e • Introduction to the costal cartilage injuries in professional and amateur athletes• Relevant radiological anatomy of the costochondral, chondro-sternal and sternoclavicular joints.• First costochondral cartilage fracture: Epidemiology, causes, presentation and imaging findings.• Brief management pertaining to first costochondral cartilage fracture in professional athletes and sportsmen.• Other possible etiologies of anterior upper chest wall pain and its imaging findings:o Sternoclavicular joint (Sports injury, inflammatory, infective, degenerative, miscellaneous including SAPHO)o Adjoining chest wall muscleso Costal neurovascular bundles

MKEE-184   Imaging Of The Forgotten Knee Joint: Proximal Tibiofibular Joint Anatomy And Pathology

Awards
Certificate of Merit

Participants
Edward Mardakhaev, MD, Bronx, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

The proximal tibiofibular joint (PTFJ) is often under-evaluated during clinical and imaging evaluation of the knee as well as a limited number of PTFJ publications in the literature.Review imaging anatomy and pathology of proximal tibiofibular joint

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Anatomy (with imaging and illustrations)The articular facet of the fibular head and posterolateral facet of the lateral tibial condyle make up this arthrodial joint. Various morphologies are seen includingplanar trocoid or L-shaped double trocoid less frequent configurations The PTFJ participates in movements of the knee as well as the ankle. Approximately 10% of the time there is communication between the PTFJ and tibiofemoral joint capsule through the subpopliteal recess. Together with the anterior and

posterior proximal tibiofibular ligaments, the biceps femoris and fibular collateral ligament contribute to joint stability. The PTFJ can be a source of lateral knee pain and joint instability. A number of pathologies afflict the joint (with imaging): degenerative diseases, trauma, developmental disorders, inflammatory processes, infectious processes

MKEE-185   Anatomy, Imaging And Pathology Of The Pubic Symphysis

Participants
Marco Tsuno, Brasilia, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review normal anatomy of the pubic symphysis.Briefly discuss biomechanics of the and pubic symphysis related structures.Discuss traumatic and overuse pathology, treatment options and complications. Outline causes of nontraumatic pathology.Describe the main pathologies involve this site, with cases demonstrating CT and MRI aspects of each condition.

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1. Simplifying the complex anatomy and biomechanics of the pubic symphysis. 2. Pubic symphysis pathology can be divided into athletic and non-athletic pubalgia etiologies. Awareness of anatomy, common pathologies, imaging, treatment and complications are essential in meaningful evaluation of this typically neglected joint. 3. Summarize the main key points of some different diseases that affect pubic symphysis, with a focus on computed tomography and magnetic resonance findings, highlighting some pathologies like: athletic pubalgia, trauma, infection, inflammatory, tumor and tumor-like conditions.

MKEE-186   Ultrasound And MR Imaging Of Pelvic Tendon Injuries

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Dyan V. Flores, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

Assessment of injuries of the tendons about the pelvis can be performed by organizing them based on anatomic location and function. This educational exhibit will review normal anatomy and biomechanics of pelvic tendons, and discuss ultrasound and MR imaging features of common pelvic tendon injuries.

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US and MR imaging of pelvic tendon injuries: • Anterior/hip flexors Sartorius avulsion Rectus femoris avulsion injury Rectus femoris degloving injury Iliopsoas avulsion injury Psoas tendon Medial iliacus tendon Lateral iliacus muscle • Lateral/abductors and medial rotators Rotator cuff tear of the hip • Medial/adductors Athletic pubalgia or core muscle injury Rectus abdominis avulsion/stripping and muscle strain Adductor longus avulsion Aponeurotic plate injury • Posterior/extensors Hamstring tendons Tendinopathy Bone avulsion with or without retraction Myotendinous junction Intrasubstance tear

MKEE-188   Deep Learning In Spine Health Assessment

Participants
Abhinav Suri, BA, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Complications from bone diseases are highly prevalent across the world. In the United States alone, nearly 1.5 million individuals suffer fractures due to bone diseases each year, leading to decreased mobility and increased mortality. One way to prevent fractures is to assess imaging studies for vertebral deformities and overall spine health; however, the process of making measurements necessary to diagnose individuals with deformities is time-consuming, leading to under-reported rates as high as 85% among radiologists. Deep learning algorithms offer solutions that can be applied to the world of medical imaging. Some of these algorithms can detect objects, find landmarks in each object, and produce segmentation delineating the exact pixel locations and border of each object. This exhibit will focus on explaining these algorithms and showing how they can be adapted for detecting vertebral body deformities and measuring other bone quality metrics.

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At the end of this presentation, the learner should have knowledge of the following: 1. Semiquantitative method for vertebral deformity assessment (wedge, biconcave, and crush); 2. How neural networks can be used for feature detection in MR, CT, and X-Ray scans; 3. How Keypoint detection networks can be used for automated vertebral height quantification and deformity diagnoses; 4. How segmentation networks can be used to extract vertebral bodies and volumes; 5. How these automated measurements can be used for vertebral bone quality assessment

MKEE-189   Scapholunate And Lunotriquetral Instability Current. Concepts And New Diagnostic Strategies

Participants
Tomas Pascual, MMEd, Olivos, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

To describe the gross and histologic anatomy of the scapholunate and lunotriquetral ligaments.To review the different stages of carpal instability non-dissociative, integrating images into the pathological process and clinical stage to obtain relevant information for an adequate treatment.To propose a new acquisition technique in MRI and CT arthrograms for identifying ligament injuries in their initial stage (pre-dynamic instability) that may go unnoticed in conventional tests.

TABLE OF CONTENTS/OUTLINE

Scapholunate and lunotriquetral ligament injuries are the most frequent cause of carpal instability and are responsible for a considerable degree of wrist pain and dysfunction, interfering with sports and other activities.An isolated injury of these ligaments

may be the harbinger of a relentless progression to abnormal joint mechanics, cartilage wear, and degenerative changes.Imaging methods play a crucial role in the diagnosis and staging of this type of injuries which, if not treated, can lead to wrist osteoarthritisHowever, these injuries may be hard to detect in their initial stages due to their small size, even when using complex methods such as MRI and CT arthrograms.In these cases, it is important to resort to additional diagnostic techniques which allow to increase the sensitivity and specificity of the tests.

MKEE-19   Pubic Symphysis: Anatomy, Pathologic Conditions And Imaging Findings

Awards
Cum Laude
Identified for RadioGraphics

Participants
Dyan V. Flores, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

The pubic symphysis is an amphiarthrodial cartilaginous joint formed with a fibrocartilaginous disc lying between the hyaline cartilage-covered medial borders of the pubic bones. There is a wide range of abnormalities that can involve this joint, which may be traumatic, metabolic, inflammatory, infectious or neoplastic in nature. The objectives of this educational exhibit are: 1. To review osseous and soft tissue (ligament and musculotendinous) anatomy of the pubic symphysis 2. To discuss imaging techniques in diagnosing disorders of the pubic symphysis 3. To discuss abnormalities of the pubic symphysis (traumatic, metabolic, inflammatory, infectious or neoplastic)

TABLE OF CONTENTS/OUTLINE

Anatomy Osseous Developmental considerations Bladder exstrophy Physiologic variants Vacuum phenomenon Peripartum diastasis Soft tissues Ligaments Pubic ligaments Suspensory ligaments of the penis Pubocervical ligament Musculotendinous Rectus abdominis Proximal adductors Biomechanics Imaging considerations Pathology Trauma Athletic pubalgia Bones Osteitis pubis Soft tissues Capsule, proximal adductors, rectus abdominis Traumatic diastasis Insufficiency fracture Polytrauma Metabolic Hyperparathyroidism Pseudogout Inflammatory Ankylosing spondylitis Rheumatoid arthritis Infectious Osteomyelitis and septic arthritis Neoplastic Chondroid lesions

MKEE-190   A Step By Step Guide To Thoracic Outlet Ultrasound: What The Radiology Resident Needs To Know!

Participants
Antonio Jose Cueva Guerrero, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

For a very long time, the thoracic outlet ultrasound has been a place of mystery and controversy between radiologists, that until this very moment. We are about to unveil a simple guide to understanding and evaluating this insidious location, easy to reproduce. After the exhibit the reader will be able to:- Understand the thoracic outlet ultrasonographic anatomy- Create a visual standard for the normal thoracic outlet- Recognize the main etiologies for thoracic outlet syndrome- Comprehend the use of each ultrasound mode for evaluating normality- Identify and be able to report pathology, using understandable parameters

TABLE OF CONTENTS/OUTLINE

- Introduction- Anatomy- Thoracic outlet syndrome- Ultrasound protocol & technique- Abnormal findings- Conclusions

MKEE-191   Ankle Syndesmosis - Orthopedic Update!

Participants
Joshua Gu, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The distal tibiofibular syndesmosis is composed of the AITFL, PITFL, and IOL.2. Common mechanism of injury: external rotation with adduction.3. Clinical tests: external rotation stress test, squeeze test, cotton/hook test.4. Recognition of injury is paramount. Missed injuries are catastrophic. Systematic pattern review of ligaments both pre- and post-operative is imperative.5. Management: surgical and non-surgical options.6. Surgical options: screw, plate, and tightrope fixation.7. Complications: hardware and biomechanical failure, heterotopic ossification, osteolysis, tendon dysfunction.

TABLE OF CONTENTS/OUTLINE

1. Detailed review of distal tibiofibular syndesmosis anatomy using cadaveric dissections, cartoons, radiographs, and photographs.2. Demonstration of normal syndesmosis appearance on imaging studies.3. Discussion of pathophysiology/injury mechanisms of syndesmotic injury.4. Multimodal radiologic evaluation of syndesmotic injury, with examples.5. Presentation of clinical/intraoperative tests, including external rotation test, squeeze test, and cotton/hook test, using diagrams, photographs, and videos. 6. Discussion of surgical and non-surgical management options, including screw, plate, and tightrope fixation, and respective advantages and disadvantages.7. Postoperative evaluation - clinical and radiological.8. Pitfalls. 9. Summary.

MKEE-192   MR Arthrography-Techniques And Concepts. Do We Still Need It?

Participants
Kristen McClure, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Conventional MRI has limitations despite increasing field strength and dedicated extremity coils, including evaluation of small structures, small perforations or tears, and post-operative tissue.2. MR arthrography remains useful in problem solving cases by joint distention, better visualization of internal joint structures, high contrast between Gadolinium and ligaments/fibrocartilage, showing direct communication between compartments, and utilizing T1 weighted imaging with increased signal to noise ratio.3. Arthrography injection techniques are similar across joints, including joint localization, local anesthetic, image guided needle advancement into the joint, confirmation with iodinated contrast, and subsequent injection of dilute gadolinium contrast agent.4. MR arthrography allows for improved evaluation of fibrocartilage structures, ligamentous/capsular pathologies, osteochondral

lesions, intraarticular bodies, and post-operative tissues in the shoulder, elbow, wrist, hip, knee, and ankle.

TABLE OF CONTENTS/OUTLINE

1. Limitations of conventional MRI. 2. General uses/benefits of MR Arthrography. 3. Current indications of MR Arthrography. 4. Imaging techniques of shoulder, elbow, wrist, hip, knee, and ankle joint injections, and subsequent MR imaging. 5. Problem solving cases demonstrating usefulness of MR arthography in a joint-centered organization, including the shoulder, elbow, wrist, hip, knee, and ankle. 6. Summary of the relevance of MR arthrography in current musculoskeletal imaging.

MKEE-193 Ultrasound Of Gouty Arthritis: With Multimodality Correlation

Participants
Seoyun Choi, MD, Jeonju-Si, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

* What to find: Learn about specific and nonspecific US image findings of gouty arthritis. -Especially correlation with MRI will help readers to understand easily.* Where to look: Being familiar with common sites of gouty arthritis* What to consider: Being familiar with clinical manifestations of gout will help to make the right diagnosis* What to avoid: Being familiar with pitfalls of US in gouty arthritis. And being familiar with gout mimicking lesions.* The diagnosis of gouty may be difficult but possible even in the cases that have small tophi as only manifastation.

TABLE OF CONTENTS/OUTLINE

1. Strategies of US of Gouty Arthritis2. Ten clinical tips that help radiologists to make the right diagnosis3. Specific US findings of Gouty Arthritis4 Nonspecific US findings of Gouty Arthritis5. Correlation with radiograph 6. Correlation with MRI 7. Self-test cases8. Summary

MKEE-194 Vertebral Anomalies- Potential Cause For Misdiagnosis By Resident: A Multifaceted And Multimodality Imaging Review

Participants
Pradeep Roul, MBBS, Rishikesh, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

After going through this, the reviewer will learn 1.The basic embryology and normal anatomy of the vertebral body and associated anatomical structure. 2.Imaging features of various types of vertebral anomalies in common imaging modalities. 3.Clinical symptoms, associated anomalies and potential misdiagnosis associated with each individual vertebral anomaly.

TABLE OF CONTENTS/OUTLINE

The vertebral column is wide spectrum of anomalies and classified according to anatomical part involved like anatomical variants of the body, neural arch, spinous process and accessory ossicles. 1. Anatomical variants of the body: hemi, block and butterfly vertebra. 2. Anatomical variants of neural arch: arcuate foramen, congenital anomalies of the posterior atlas arch, and transitional vertebrae anomaly (cervical rib, lumbar rib, lumbarization of S1, and sacralization of L5). 3. Anatomical variants of spinous process: unfused spinous process, deviated spinous process, and bifid spinous process. 4. Accessory ossicles: accessory ossicle of the anterior arch of the atlas, oppenheimer ossicle, os odontoideum, persistent ossiculum terminale and sesamoid ossicles of the nuchal ligament. we will described various imaging features, associated other congenital anomalies, potential misdiagnosis of other pathological conditions, and associated clinical importance with each conditions. By knowing this, the young resident can not put a wrong diagnosis and will always look for other congenital anomalies during image interpretations.

MKEE-195- DCE Perfusion MRI On Spinal Tumors And Mimics
HC
Participants
Ryo Kurokawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To review the physics and parameters of Dynamic Contrast Enhanced (DCE)-MRI 2. To demonstrate the DCE-MRI imaging findings of tumors (primary tumors, secondary cancer, and secondary sarcoma) 3. To show how DCE-MRI parameters can help differentiate tumor-mimicking benign conditions from tumors

TABLE OF CONTENTS/OUTLINE

1. What is DCE-MRI perfusion?- Physics- Parameters based on Tofts model 2. DCE-MRI imaging findings of tumors- Primary vertebral tumors- Metastatic cancers- Metastatic sarcomas 3. DCE-MRI imaging findings of tumor-mimics- Radiation necrosis- Hemangiomas- Vertebral reconversion

MKEE-196 Ultra-high Resolution Magnetic Resonance Neurography: An Interactive Atlas Of The Brachial Plexus And Upper Extremity Peripheral Nerves

Participants
Philip Colucci, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Peripheral neuropathies are common and may become chronic and debilitating. Dedicated magnetic resonance imaging (MRI) of peripheral nerves, or MR neurography (MRN), is an important complement to electrodiagnostic and physical examination to guide management.Technical challenges inhibit more widespread use of MRN. State-of-the-art 3 Tesla MRI provides 1.0 mm isotropic spatial resolution in 8 minutes, which is inadequate for visualizing smaller nerves along their full course. 3D pulse sequences have longer acquisition times than comparable 2D sequences, resulting in increased susceptibility to motion artifact. Slow-flowing veins coursing alongside nerves may confound interpretation due to their similar size and signal intensity.Peripheral nerve anatomy, especially the brachial plexus, is complex. Currently available MRI atlases depict spatial relationships but are suboptimal for demonstrating peripheral nerves along their entire course. We employed prototype flexible coils, ferumoxytol for vascular suppression, and artificial intelligence-based image reconstruction with AIRTM Recon DL to achieve unprecedented spatial and

contrast resolution, creating in an in vivo, ultra-high resolution (0.4 mm isotropic) MRN atlas of the brachial plexus and upper extremity.

TABLE OF CONTENTS/OUTLINE

Monitor #1 (PowerPoint slides) - Acquisition parameters - Coil selection - Ferumoxytol - AIRTM Recon DL - Illustration of peripheral nerve anatomy - ReferencesMonitor #2 (RadStax) - Atlas of upper extremity peripheral nerve anatomy

MKEE-2   Dual X-ray Absorptiometry: What The Radiologist Needs To Know.

Participants
Dunya Imad, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Dual-energy X-ray absorptiometry (DXA) is the method of choice for assessing bone mineral density (BMD) and is used in clinical practice to identify individuals at risk for pathologic fracture. • DXA image quality may be affected due to errors at 4 different time points: indication, acquisition, analysis, and interpretation. • Visual assessment of DXA is of high clinical importance and can identify metastatic bone lesions, fractures or objects that can artificially change the BMD. • The technologist's expertise plays a crucial role in the acquisition phase. This includes correct positioning of the patient, appropriate scanning and the identification of artifacts.

TABLE OF CONTENTS/OUTLINE

1. Quality considerations in DXA acquisition and interpretation; impact on diagnosis and management.2. DXA scans and the most common errors affecting its quality and utility.3. DXA scans and the most common errors affecting its quality and utility.4. Indications for ordering a DXA scan, recommendations for the correct acquisition, analysis and interpretation. 5. Conclusions

MKEE-20   Meniscal Ramp Lesion: Clarifying Concepts.

Participants
Sara Escoda, MD, Gijon, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Meniscal ramp lesions are a special type of meniscal injury strongly associated with anterior cruciate ligament (ACL) tears that affect the periphery of the posterior horn of the medial meniscus and/or its meniscocapsular attachments.They have recently been shown to play a significant role in the stability of ACL deficient knees, so if they remain unrepaired during an ACL reconstruction, the stability of the knee may not be restored, predisposing it to meniscal and articular damage and ultimately to the failure of the ACL graft.These lesions, because of their location in a blind spot, can be unnoticed arthroscopically when using only standard anterior portals, so it is essential to identify them on preoperative MRI.Radiological findings are: vertical/oblique tears in the periphery of the posterior horn of the medial meniscus, and/or the presence of high signal in the mid-substance or in the meniscus attachments of the meniscotibial ligament and/or meniscocapsular ligament.

TABLE OF CONTENTS/OUTLINE

Concept of meniscal ramp lesion.Anatomy of the ramp zone.Epidemiology and risk factors.Implications on the biomechanics of the knee.Classification.Radiological features on MRI.

MKEE-21   "Knee-deep" In Knee Measurements On MRI And CT: What The Orthopedic Surgeon Wants To Know. A Practical Guide To Improve Diagnosis And Efficiency.

Participants
Cyrille Naim, MD, Brossard, Quebec (*Presenter*) Nothing to Disclose

TEACHING POINTS

Evaluation for superolateral Hoffa fat pad edema in knee MRIs should be part of the radiologist's checklist; it may be the only clue to symptomatic patellofemoral maltracking. Superolateral Hoffa fat pad edema should prompt a search for patella alta, trochlear dysplasia, and tibial tubercle lateralization, which are risk factors for patellofemoral joint instability. Lateral patellar tilting without subluxation in a context of anterior knee pain suggests Excessive Lateral Pressure Syndrome. For preoperative and postoperative total knee arthroplasty (TKA), multiple full-length lower limb parameters are used, notably for limb length discrepancy and genu varus malalignment. Relevant parameters to include in the radiology report can be determined with the referring orthopedic surgeons. Surgeons aim for relative external rotation of both tibial and femoral components of a TKA, to prevent patellar maltracking. Understanding measurement techniques, along with use of a universal report template for TKA component rotation, are important for accurate and efficient reporting.

TABLE OF CONTENTS/OUTLINE

1. Patellofemoral Disorders and Relevant Measurements on MRI a. Definitions b. Measurement techniques c. 3-Step approach d. Cases 2. Measurements Relevant to preoperative and postoperative TKA on full-length lower limb images 3. TKA Prosthetic Component Rotation Measurements on 2D-CT a. Femoral component rotation b. Tibial component rotation c. Cases

MKEE-22   Post-op Spine Troubles: What The Surgeon Needs To Know ?

Participants
Vishal Gaikwad, MD, Novena, Singapore (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) To review briefly the types and approaches of spinal stabilization/fusion surgeries. 2) To discuss common complications, unique to stabilization surgery. 3) To discuss what surgeons want to know in postoperative imaging of the spine.

TABLE OF CONTENTS/OUTLINE

1) Introduction. 2) Types and approaches to spinal stabilization/fusion surgeries -Decompression, fixation, stabilization and fusion,

deformity correction, and lesion excision and debridement. -Commonly used spinal implants and prostheses include screws and wires, static and extendable rods, bone grafts and biologic materials, interbody cages, and intervertebral disk prostheses. 3) Common complications unique to stabilization surgery. -Adjacent Segment Degeneration (common) -Proximal Junctional Kyphosis (only for Long segment fixation) -Non-union +/- Rod Breakage and screw loosening (Especially in smokers) -Screw Malposition (Rare with the use of Intraoperative CT in the past Decade) -Others: wrong-level surgery, dural tears/ arteriovenous fistula, epidural abscess, epidural hematoma, infection, arachnoiditis. 4) What surgeons look for in a postoperative spine. 5) Sample cases.

MKEE-23   Radiographs And CT Within Musculoskeletal MRI: Challenges, Optimization And Applications Of Zero Echo-Time Imaging

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Ustun Aydingoz, MD, Ankara, Turkey (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review technical aspects, challenges, and optimization of zero echo-time (ZTE) MR imaging that yields radiograph- or CT-like images, decreasing or even obviating the need for employing the latter imaging modalities that use ionizing radiation. 2. To describe already established and promising musculoskeletal applications of ZTE imaging. 3. To recognize pearls and pitfalls of radiograph- or CT-like images generated from MRI.

TABLE OF CONTENTS/OUTLINE

1. Technical background and optimization of zero echo-time (ZTE) imaging that yields radiograph- or CT-like images from an MRI examination. 2. Review of musculoskeletal applications of radiograph- or CT-like images thus generated from MRI. 3. Sample cases with pearls and pitfalls (e.g., glenoid bone stock estimation, glenoid on-track/off-track assessment, critical shoulder angle measurement, femoral head-neck junction morphometry, lateral center-edge angle measurement, calcific tendonitis mineral deposit load assessment, visualization of cortical encroachment of atypical cartilaginous bone lesions).

MKEE-24   Postoperative MR Imaging Of Cartilage Surgery Of The Knee

Participants
Randy Chang, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

Articular cartilage is an integral part of a healthy joint, and pathology is commonly due to trauma or degenerative processes. However, lack of vascularity within the cartilage precludes spontaneous healing after injury. Surgical repair is necessary for not only symptom relief and restoration of joint function, but also to prevent the development of early osteoarthritis. Although direct visualization by arthroscopy continues to be the gold standard to assess the cartilage repair site, magnetic resonance (MR) imaging has shown to be an additionally viable, non-invasive method. The objectives are: 1) Understand the various types of cartilage repair surgeries. 2) Learn the corresponding arthroscopic and postoperative MR imaging appearances. 3) Appreciate the emerging technique utilizing biomaterial processed allograft. 4) Quiz to assess knowledge.

TABLE OF CONTENTS/OUTLINE

A. Introduction. B. Background and anatomy. C. Types of cartilage repair surgeries. D. Expected postoperative arthroscopic and MR imaging appearances will be highlighted with discussion: 1) Bone marrow stimulation (microfracture). 2) Mosaicplasty or osteochondral autograft transfer system (OATS). 3) Osteochondral allograft transplantation surgery. 4) Minced cartilage implantation (MCI), autologous chondrocyte implantation (ACI), and matrix-assisted chondrocyte implantation (MACI). E. Biomaterial processed allograft will be discussed as an emerging technique. F. Case- and question-based assessment of knowledge. G. Summary and conclusion

MKEE-25   Skeletal Manifestations In Lymphatic Diseases: Nonenhanced Magnetic Resonance Lymphography

Awards
Certificate of Merit

Participants
Clement Cholet, MD, Paris, France (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Know the basic anatomy and physiology of the skeletal lymphatic system. - Understand the standard nonenhanced 3D magnetic resonance lymphography protocol to characterize diffuse lymphatic diseases with skeletal manifestations. - Recognize osseous lesions of lymphatic origin and know their characteristics on nonenhanced magnetic resonance lymphography. - Know the various causes of lymphatic anomaly of the bones. - Identify the associated lymphatic anomalies on nonenhanced magnetic resonance lymphography.

TABLE OF CONTENTS/OUTLINE

1. Skeletal lymphatic system. 1.i. Normal anatomy. 1.ii. Physiology. 2. Nonenhanced 3D magnetic resonance lymphography. 2.i. Protocol. 2.ii. Interpretation guide. 3. Bone lesions of lymphatic origin. 3.i. Causes. 3.ii. Imaging characteristics. 3.iii. Complications. 4. Atlas of magnetic resonance lymphography findings in lymphatic diseases with skeletal involvement. 4.i. Case presentation. 4.ii. Magnetic resonance findings.

MKEE-26   Judging A Bone By Its Cover: A Radiologist's Guide To Periosteal Pathology

Awards
Cum Laude
Identified for RadioGraphics

Participants

Nick Barnthouse, MD, Leawood, Kansas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Abnormalities of the periosteum are seen with a variety of benign and malignant conditions. 2. Periosteal pathology can derive from infectious, traumatic, metabolic, inflammatory, neoplastic, developmental, and drug-related etiologies. 3. Understanding the pathophysiology contributing to the imaging appearance of abnormal periosteum is an important skill for the radiologist and essential for detecting periosteal pathology. 4. Familiarity with the radiologic appearance of different types of periosteal reaction and knowledge of the diverse etiologies of periosteal conditions can aid the radiologist in producing a useful differential diagnosis and making appropriate clinical recommendations.

TABLE OF CONTENTS/OUTLINE

1. Normal periosteum a. Embryological development and maturation b. Periosteal geography: where it is and isn't 2. Periosteal reaction a. Pathophysiology b. Morphologic types: non-aggressive versus aggressive c. Approach to diffuse periosteal reaction 3. Case-based review of periosteal pathology a. Congenital/developmental b. Metabolic c. Drug-related d. Traumatic e. Neoplastic f. Inflammatory g. Infectious h. Vascular

MKEE-27   Multiple Faces Of Crystal Deposition Disease - Look Around That You May Find A Treasure.

Participants
Felipe A. de Oliveira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Crystal deposition disease has multiple different presentations in the musculoskeletal system. The most common deposits are calcium pyrophosphate, sodium monourate and hydroxyapatite. Although the typical presentations are, respectively, chondrocalcinosis, podagra and calcareous tendinopathy of the rotator cuff, the atypical presentations correspond to a significant number of cases and, therefore, cannot be forgotten. This relatively heterogeneous group of diseases can affect tendons, ligaments, joint capsules, hyaline cartilage, and fibrocartilages throughout the body. In acute painful cases or relapse of the symptoms, inflammatory changes tend to be exuberant, both in clinical and radiological pictures, and may mimic other pathologies of diverse etiologies, such as myopathies, infectious, rheumatological or neoplastic diseases, or even fractures, as these patients often associate some minor traumatic events with the onset of symptoms. Especially on MRI, the correct diagnosis can be challenging, as the deposits may be imperceptible or may go unnoticed due to prominent soft tissues or osseous edema. This review will focus mostly on atypical presentations.

TABLE OF CONTENTS/OUTLINE

1. Background 2. Pathophysiology 3. Clinical and laboratorial findings 4. Imaging findings 5. Radiological approach a. Radiography b. Computerized tomography (CT) c. Ultrasound d. Magnetic Resonance 6. Diagnostic flowchart 7. Take-home points

MKEE-28   Dislocations About The Knee: Three Diagnoses You Need To Be Able To Make

Awards
Certificate of Merit

Participants
Kirkland Davis, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiologists can be the first to make the diagnosis of knee dislocations and help guide treatment. Three distinct dislocation patterns about the knee—tibiofemoral, patellar, and proximal tibiofibular—demonstrate characteristic imaging findings. In tibiofemoral dislocation, two or more major ligament tears will be present on MRI. Typically resulting from high-energy trauma, these injuries are increasingly recognized in obese patients with ultra-low-velocity mechanisms. Popliteal artery injuries can make tibiofemoral dislocation a limb-threatening condition and common peroneal nerve injuries contribute to long-term pain and dysfunction. Transient patellar dislocation is the most common dislocation about the knee, yet it is suspected in less than half of cases presenting for imaging. Marrow contusions of the inferomedial patella and peripheral lateral femoral condyle are pathognomonic on MRI. Recognizing predisposing anatomy can identify patients at higher risk for recurrence. Finally, proximal tibiofibular dislocations are rare. Displacement of the tibiofibular articulation is usually subtle and must be sought in all cases of knee injury. Associated injuries include tibia fracture and peroneal nerve injury.

TABLE OF CONTENTS/OUTLINE

1. Tibiofemoral dislocation a. Key facts b. Imaging examples c. Complications & treatment 2. Transient patellar dislocation a. Key facts b. Imaging examples c. Predisposing features d. Treatment 3. Proximal tibiofibular dislocation a. Key facts b. Imaging examples c. Pitfalls d. Treatment

MKEE-29   Carpal Instability - What The Radiologist Needs To Know

Participants
Jan Grunz, MD, Wuerzburg, Germany (*Presenter*) Research Consultant, Siemens AG

TEACHING POINTS

The term "carpal instability" describes different debilitating wrist conditions, in which the carpus is unable to maintain its normal range of motion and load transfer. Depending on the etiology and location of the dysfunction, four main groups can be discerned: dissociative, non-dissociative, complex and adaptive carpal instability. Being the most common form, dissociative carpal instability can further be distinguished in dorsal or volar intercalated segment instability, mostly contingent on the afflicted interosseous ligament. Traumatic lesions of the scapholunate ligament present the most frequent cause of instability and can occur in isolated fashion or in context with other carpal injuries. Early detection and treatment is essential to prevent a carpal collapse and the onset of secondary osteoarthritis. Stress imaging and fluoroscopy facilitate the differentiation between dynamic and static forms of carpal instability, with the latter only manifesting in concomitant injury of the extrinsic ligamentous stabilizers. However, just MRI or CT/MR arthrography can visualize the true extent of ligament discontinuity.

TABLE OF CONTENTS/OUTLINE

1) Imaging modalities in carpal instability 2) Forms of carpal instability 2.1) Dissociative carpal instability 2.1.1) Scapholunate dissociation 2.1.2) Lunotriquetral dissociation 2.1.3) Scaphoid nonunion 2.2) Non-dissociative carpal instability 2.2.1) Radiocarpal instability 2.2.2) Midcarpal instability 2.3) Complex carpal instability 2.4) Adaptive carpal instability

MKEE-3   Bone Marrow Malignancies: Understanding The Biology Being Depicted By Imaging

Awards
Certificate of Merit

Participants
Roberto Garcia Figueiras, MD, PhD, Santiago De Compostela, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Bone Marrow (BM) malignancies are a heterogeneous group of tumors. Imaging phenotypes are a reflection of the interactions between tumor cells and the bone microenvironment. Conventional imaging techniques show clear limitations for tumor detection, characterization, staging and tumor response assessment in BM disorders. Advanced functional and molecular imaging techniques are changing the paradigm of imaging evaluation of the BM. The aim of this exhibit is:-To understand the main characteristics of BM microenvironment.-To discuss strengths and limitations of Imaging techniques in BM.-To review recent developments in functional and molecular imaging techniques and radiomics for the assessment of BM tumor involvement, including tumor characterization, prognosis, prediction, or response to therapy.

TABLE OF CONTENTS/OUTLINE

-BM microenvironment (the niche and the vicious cycle): tumor-bone interactions.-Biology of the BM relevant for imaging: molecular and histological explanation of imaging phenotypes of BM malignancies. -Strengths and limitations of conventional imaging techniques.-The role of advanced functional and molecular imaging techniques and multiparametric imaging in BM tumors.-How can next-generation imaging contribute to patient pathways in precision oncology?: detection and characterization of BM disease, tumor heterogeneity, prognosis, prediction, and response to therapy.-Future directions: imaging biomarkers and radiomics.

MKEE-30   Checklist For The Wrist MRI

Awards
Certificate of Merit

Participants
Asako Yamamoto, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

To provide a guide for wrist MRI from image acquisition through a proposed systematic approach for image evaluation emphasizing normal anatomy and examples of commonly encountered pathology.

TABLE OF CONTENTS/OUTLINE

1) Explanation of the optimal coil, sequences and patient positioning 2) Demonstration of normal MR anatomy of the wrist, presented by anatomic group (a) Osseous morphology and alignment (b) Intrinsic ligaments of the wrist (c) Triangular fibrocartilage complex (d) Extensor compartments (e) Carpal tunnel and Guyon's canal 3) Examples of commonly encountered pathology to contrast and compare with normal MR wrist anatomy will be provided for each anatomic region. There will be an emphasis on key MR imaging findings, best plane for visualization, and imaging sequence. The pathological conditions exhibited include the followings: dorsal and volar intercalated segment instability, ulno-carpal abutment, Kienbock's disease, osteoarthritis, Madelung deformity, triangular fibrocartilage complex injury, luno-triquetral/ scapho-lunate ligaments injuries, de Quervain tenosynovitis, intersection injuries, extensor carpi ulnaris instability, carpal tunnel syndrome, Guyon's canal syndrome.

MKEE-31   Dual-Energy CT For Bone Marrow Imaging: "How To Do It"

Participants
Bernhard Petritsch, Wuerzburg, Germany (*Presenter*) Research Consultant, Siemens AG

TEACHING POINTS

To review the indications, contraindications and limitations of dual-energy computed tomography (DECT) in bone marrow imaging. To learn about the basic physical principles of DECT imaging with emphasis on bone marrow applications. To interpret dual-energy bone marrow CT scans of healthy subjects, patients with acute fractures or malignant bone marrow infiltration, and to learn about potential pitfalls of DECT in bone marrow imaging. To highlight the potential benefits of a dual-energy investigation as a comprehensive examination of osseous morphology and additional bone marrow information.

TABLE OF CONTENTS/OUTLINE

A. Basic principles of dual-energy computed tomography. B. Technical differences in data acquisition: Single-Source (Dual-layer detector; rapid kV-switching; Twin-Beam) vs. Dual-Source scanners (differences between 1st-3rd generation dual-source scanners). C. Post-processing: Material-decomposition algorithm, creation of VNCa ("virtual non-calcium") images. D. Data acquisition: Parameter settings for dual-energy CT of the extremities, spine and pelvis. E. Current applications of DECT for the detection of acute fractures: examples in the spine, pelvis and extremities. F. Current applications of DECT for the detection of malignant bone marrow infiltrations (e.g. in multiple myeloma): examples in the spine, pelvis and extremities. G. Pitfalls of dual-energy bone marrow Imaging; limitations of DECT for bone marrow imaging; alternative imaging modalities.

MKEE-32   Is That Surgery? Orthopedic Procedures That May Mimic Disease: What Radiologists Need To Know

Participants
Andrew Liu, MD, Rochester, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Familiarize learner with a variety of common orthopedic surgical interventions. 2. Describe common imaging findings, indication, surgical approach, and/or composition of these implants.

Postoperative radiographs comprise a large portion of the musculoskeletal studies that a radiologist will encounter. As newer surgical techniques and implants have been adopted, radiologists must be able to recognize these implants on imaging and not confuse these orthopedic interventions with non-surgical bone pathology. Surgical implants such as the Cartiva® implant, Arthrex® bio-interference screw, and TightRope® implant are all radiolucent on radiographs and could be mistaken for lucent bone pathology if not recognized by the radiologist. Other procedures, like subchondroplasty, use bone substitute material to fill marrow defects or lesions and may be misinterpreted as focal sclerotic bone lesions. Bone graft harvest sites, tenodesis, and surgeries in which a bone or a portion of bone have been removed are also surgical interventions that may be confused with pathology by non-trained musculoskeletal radiologists.Our exhibit aims at presenting these orthopedic procedures by describing their imaging features, showing characteristic imaging examples, and describing the surgery and/or the composition of these implants. We hope the exhibit will familiarize the learners with these orthopedic procedures and lead to a better understanding of what to look for to avoid mistakes in post-surgical film interpretation.

MKEE-33   The Sural Nerve: Imaging Anatomy And Pathology

Participants
muhamad serhal, Beirut, Lebanon (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To highlight the imaging anatomy of the sural nerve on ultrasound and MRI. • To demonstrate the imaging technique for evaluation of the sural nerve on ultrasound and to define useful landmarks to help identify it. • To demonstrate common pathologies of the sural nerve.

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The sural nerve is a cutaneous, sensory nerve of the lower leg. It is formed by the fusion of the medial sural cutaneous nerve, a branch from the tibial nerve, and the lateral sural cutaneous nerve, a branch from the common peroneal nerve. Both nerves are superficial and fuse at the level of the mid to distal leg to form the sural nerve. The sural nerve courses along the posterolateral aspect of the leg along with the lesser saphenous vein, then along the lateral aspect of the Achilles tendon, behind the lateral malleolus and gives terminal cutaneous branches in the hindfoot. The sural nerve provides cutaneous innervation to the posterior calf and the lateral ankle and foot. Pathology of the sural nerve can be from traumatic etiologies, primary neural pathologies or secondary to surrounding soft tissue abnormalities. First, the superficial location of the nerve makes it vulnerable to iatrogenic injuries during surgeries of the ankle or Achilles tendon or during saphenous vein harvesting for a graft. Second, nerve sheath tumors can occur in the sural nerve similarly to other nerves. Third, the sural nerve can be involved by pathology of the surrounding superficial soft tissue such as a hematoma or primary lesions of the skin or subcutaneous fat.

MKEE-34   Clinical Usefulness Of Thin Slice (1mm) 2D MRI Of The Shoulder Joint Using Denoising Approach With Deep Learning-based Reconstruction (DLR) And Multiplanar Reconstruction (MPR) Images.

Awards
Certificate of Merit

Participants
Takahide Kakigi, MD, Kyoto, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

It is sometimes difficult to evaluate the structures of the shoulder joint in detail with the conventional (3mm) 2D MRI. By using DLR technology, we can obtain thin slice (1mm) 2D MRI images in clinically acceptable scan times for detailed evaluation of shoulder anatomy. By setting the resolution to 0.5 × 0.5 mm, slice thickness to 1mm, and gap to -0.3 mm, we were able to create thin MPR images from the 2D dataset, akin to 3D MRI. The purpose of this exhibit is: 1. To discuss the denoising technique by DLR. 2. To discuss the imaging techniques of thin slice 2D MRI with DLR. 3. To compare conventional (3mm) 2D MRI and thin slice (1mm) 2D MRI. 4. To review the MRI findings in patients with shoulder joint disease and learn the clinical usefulness of thin slice 2D MRI.

TABLE OF CONTENTS/OUTLINE

1. Considerations on why thin slice (1mm) 2D MRI is necessary. 2. Explanation of denoising technique by DLR. 3. Explanation of imaging techniques for thin slice (1mm) 2D MRI. 4. Review of representative cases with shoulder joint disease.

MKEE-37   Antibiotic Hip Spacers: What The MSK Radiologist Should Know

Participants
Josephina A. Vossen, MD, PhD, Richmond, Virginia (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit will review indication, imaging appearing and potential complications of antibiotic delivery devices in the hip. Increased knowledge and improved detection of complications can prevent delays in treatment that could result in long-term disability.

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- Discuss the indications and contraindications for the use of antibiotic delivery devices. - Review of the most commonly used antibiotic spacers; including molded, antibiotic coated prostheses (ACP), handmade, partial resections (cup explant only), or prefabricated. - Describe and illustrate the expected imaging appearance of antibiotic delivery devices and an approach to reporting antibiotic spacer findings. A multimodality review will include radiographs, CT, MRI and CT/MR arthrography. Evaluation of leg length and offset, spacer head size, head/neck ratio, head/acetabular ratio, and Paprosky grading will be emphasized. Extended trochanteric osteotomy (ETO), osteotomy length, femoral stem bypassing distance, and osteotomy union rate will be discussed. - Describe complications and their imaging appearance, including dislocation, periprosthetic fracture, spacer fracture.

MKEE-38   Breaking Down The Brachial Plexus: Multimodality And Case Based Review

Participants
Aaron Brumbaugh, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

1) Brachial plexus pathology can lead to variable and often unclear symptomatology, prompting imaging evaluation. The radiologist should be familiar with the normal and abnormal appearance of the brachial plexus. 2) Despite the "classic" teaching, multiple anatomic variants of the brachial plexus exist, with variable nerve root contributions. 3) Given its oblique course, understanding the spatial localization of different segments of the brachial plexus is essential to accurately evaluate the plexus and localize pathology. 4) While MRI is the gold standard modality for brachial plexus assessment, ultrasound can be used for evaluation as well. Knowledge of bony landmarks and brachial plexus anatomy is essential for US evaluation, which can be a useful adjunct in problem solving cases and is frequently used in nerve blockade.

TABLE OF CONTENTS/OUTLINE

I. Review of the classic organization of the brachial plexus and common anatomic variants. II. Review the MRI, ultrasound, and CT appearance of the normal brachial plexus. IIA. Anatomic review of the nerve roots and trunks at the interscalene space IIB. Anatomic review of the divisions and cords at the supraclavicular fossa. III. Ultrasound considerations for brachial plexus imaging: advantages and limitations. IIIA. Approach and technique of sonographic evaluation at the interscalene space. IIIB. Approach and technique of sonographic evaluation at the supraclavicular fossa. IV. Case-based review of brachial plexus trauma. V. Case-based review of oncologic pathology of the brachial plexus

MKEE-39 High-resolution Ultrasound Imaging Of Conventional And Non-conventional Structures Of Thumb Metacarpophalangeal Joint. Correlation With Illustrations And Magnetic Resonance Imaging

Participants
Jorge Diaz, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review of the thumb metacarpophalangeal joint anatomy, with emphasis in conventional and non - conventional structures that could be evaluated by ultrasound.2. List technical aspects for an optimal ultrasound evaluation of the metacarpophalangeal joint, including recommendations for static and dynamic study.3. Describe the normal appearance on ultrasound of different structures of the joint, including structures not routinely evaluated by ultrasound, and various injuries of traumatic origin.

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Details of the thumb metacarpophalangeal joint normal anatomy will be reviewed using high-resolution ultrasound images, illustrations and high-resolution Magnetic Resonance images, including structures such as: radial and ulnar collateral ligaments (proper and accessory), adductor and abductor pollicis brevis aponeurosis, volar plate-sesamoid bones complex and dorsal capsule, among others. Also, ultrasound appearence of different injuries will be shown, including: partial and total tears of collateral ligaments (including Stener lesion), injuries of the volar plate-sesamoid bones complex, in addition to the dynamic evaluation of the thumb adductor aponeurosis and ulnar collateral ligament.

MKEE-40 Shoulder And Hip Impingement Syndromes: Evolutionary And Kinematic Perspectives

Participants
Kengo Ikejima, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Impingement of the shoulder and hip joints is one of the most common orthopedic conditions.2. We review the mechanisms of impingement using kinematic MRI. 3. We also explain why some impingements occur in terms of human evolution.

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We compare the structure of the human hip and shoulder joints with those of other animals based on the evolution of bipedalism and lifestyle. 2. Next, we discuss the mechanisms of impingement in terms of the human joint structure. Hip joint - Femoroacetabular impingement - Iliopsoas impingement - Ischiofemoral impingement Shoulder joint- Subacromial impingement - Posterosuperior glenoid rim impingement - Subcoracoid impingement - Snapping scapula syndrome (scapular dyskinesis)

MKEE-42 Precision Of Bone Mineral Density Measurements In Dual Energy X-ray Absorptiometry. The Importance Of Quality Control.

Participants
Rosa M. Lorente-Ramos, MD, PhD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To review the procedure of dual-energy X-ray absorptiometry (DXA) studies in the evaluation of osteoporosis, highlighting quality control. • To analyze the most frequent operator-related mistakes and their consequences in accuracy failures. • To provide clue points to confirm in order to improve performance in DXA exams.

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Dual energy X-ray absorptiometry (DXA) is the basic tool in the diagnosis of osteoporosis, and is also useful to assess fracture risk and monitor treatment. Accurate DXA measurements require adequate image acquisition, analysis, and data interpretation.We present: • Dual-energy X-ray absorptiometry (DXA) physics and technique. • Causes of mistakes in different steps of DXA study: - Before the study: Technologist training and competence, Daily calibration, Antropometric data, Choosing regions to scan. -During the study: Patient positioning. Anatomy centered in scan field, vertical and parallel to scan axis, Image acquisition: regions of interest correctly placed, Vertebral bodies correctly numbered, Vertebral Fractures excluded. -After the study: image interpretation: Parameters. Adequate use of T-score and Z-score; Report. Detection of vertebral fractures or bone diseases (osteoarthritis, metastases, Paget's disease), soft tissue lesions, detection of artifacts-foreign bodies.

MKEE-43 Magnetic Resonance Neurography Of Upper And Lower Extremity Nerve Injuries In Athletes

Participants
Christian S. Geannette, MD, New York, New York (*Presenter*) Nothing to Disclose

Teaching points: Nerve injuries can be difficult to diagnose and require a collaborative effort, with imaging playing a crucial role. Early recognition of nerve injuries is critical, to ensure early management and treatment, preventing potentially irreversible damage. Given its excellent contrast resolution, magnetic resonance neurography (MRN) can detect nerve abnormalities that may be difficult to detect on physical examination and/or inaccessible with electrodiagnostic testing. This electronic exhibit demonstrates MRN cases of upper and lower extremity nerve injuries in athletes, as outlined in the table of contents below:

TABLE OF CONTENTS/OUTLINE

Table of contents:1. Basics of MR Neurography 2. Classification of Nerve Injuries 3. Upper Extremity Injuries a. Brachial plexus (i. "Stinger"/"Burner" ii. Thoracic Outlet Syndrome) b. Suprascapular nerve (i. Labral tear) c. Axillary nerve (i. Shoulder Dislocation) d. Ulnar nerve (i. At the level of the elbow: Valgus overload in pitchers ii. At the level of the wrist: Hamate fracture) e. Postsurgical 4. Lower Extremity Injuries a. Lumbar plexus b. Sciatic nerve (i. Hamstring avulsion) c. Femoral nerve d. Common peroneal nerve (i. ACL disruption and posterolateral corner injury) e. Superficial Peroneal Nerve (i. Muscle herniation) f. Postsurgical

MKEE-44   Meniscus Roots, Ramps, Repairs, And Repercussions

Awards
Identified for RadioGraphics
Magna Cum Laude

Participants
Hanna Tomsan, MD, Darby, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Illustrate the anatomy of meniscal roots, meniscal periphery, and meniscocapsular junction, as well as relevant associated capsular and ligamentous structures. 2. Describe the stabilizing effects of meniscal roots and meniscocapsular structures, as well as the biomechanical effects of the tears in these structures. 3. Review the MRI features and clinical repercussions of meniscal root and meniscal periphery tears that may be missed at MRI and arthroscopy. 4. Provide an interactive case-based review of the meniscal root, meniscal periphery, and meniscocapsular junction injuries in order to facilitate the correct identification of these entities.

TABLE OF CONTENTS/OUTLINE

I. Anatomy and biomechanics of the osseous and capsular attachments of the menisci. The concept of "meniscal ramp" II. Meniscus ossicles: Etiology, distribution, associations, and imaging features III. Injuries of meniscus roots, ramps, and the meniscocapsular junction: Pre-op and Post-op A. Roots of the medial meniscus: 1. Injury mechanisms and associations 2. MRI findings and arthroscopic classification (LaPrade) B. Roots of the lateral meniscus: 1. Injury mechanisms and associations 2. MRI findings C. Ramp tears at the medial meniscus periphery and meniscocapsular junction 1. Injury mechanisms and associations 2. MRI findings and arthroscopic classification (5 subtypes) D. Lateral meniscus periphery and meniscocapsular junction 1. Injury mechanisms and associations 2. MRI findings and arthroscopy - Wrisberg rip vs. pseudotear

MKEE-45   Dual-energy CT In Musculoskeletal System: Current Concept And Clinical Utility

Participants
Takeshi Fukuda, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The potential utility of dual energy CT (DECT) in musculoskeletal (MSK) system has been expanding greatly in recent years. Nowadays, monoenergetic image is not only used for metal artifact reduction but also for tendon delineation with its characteristic transition of X-ray attenuation. Virtual non-calcium image, which is well investigated for its detectability of bone marrow edema can be applied for osseous tumor detection and intervertebral disc assessment. Iodine map can be used for evaluation of inflammatory lesions in arthritis, such as synovitis and enthesitis. In addition, DECT images can readily be quantified which enables objective therapeutic assessment. This includes, automatic volume calculation of monosodium urate crystal and iodine quantification on iodine map. In this exhibition, we comprehensively review current status of DECT in MSK system, from optimal scan settings to ways of interpreting the images by reviewing clinical cases.

TABLE OF CONTENTS/OUTLINE

1 Technology of obtaining dual energy data 2 Current concept and clinical utility 2.1Virtual Monoenergetic image a)Metal artifact reduction b)Tendon image 2.2Gout 2.3Virtual non-calcium image a)Bone marrow edema b)Bone tumor c)Intervertebral disc 2.4Iodine map for Inflammatory lesions in arthritis 3 Limitations and perspectives 4 Take Home Point

MKEE-46   Knee Ultrasound: Basic Anatomy And Pathology

Participants
Cristina Iniesta, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

The diagnostic performance of musculoskeletal ultrasound of the knee. A systematic review. Assessment of normal anatomy and ultrasound's semiology. Frequent pathology and its ultrasound findings.

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Knee ultrasound is one of the most frequent radiological examinations performed on an outpatient basis, since it is an ideal technique for the study of superficial soft tissues. It allows a dynamic evaluation of the joint, as well as the comparison with the contralateral limb. It also offers the possibility of interacting with the patient and performing a short anamnesis and clinical examination, locating the exact region where the condition is referred. For its structured study, we will divide the knee into different compartments: anterior, medial, lateral and posterior. The injuries that we can find may affect the entire joint or a single element, including: traumatic pathology, degenerative, inflammatory and joint involvement such as arthritis or deposit diseases. Likewise, it is especially useful for the assessment of pain, inflammation and functional impotence in patients with knee replacement. We will review clinical cases in the adult and pediatric population. An orderly approach to the different compartments

that comprise the joint, adequate anatomical knowledge and basic notions about the main pathology, guarantee an efficient exploration, concluding with an accurate diagnosis in many pathologies and avoiding the performance of other more expensive complementary tests.

MKEE-47 Juxtacortical Lesions: Imaging Findings With Pathologic Correlation

Participants
Jennifer Levy, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Discuss the key imaging, pathologic, and clinical features of six juxtacortical lesions (2) Compare and contrast these features to aid in radiologic and clinical diagnosis

TABLE OF CONTENTS/OUTLINE

(1) Benign (a) Florid Reactive Periostitis Ossificans (FRPO) (i) Radiologic features (ii) Pathologic features (iii) Clinical features (b) Bizarre Parosteal Osteochondromatous Proliferation (BPOP) (i) Radiologic features (ii) Pathologic features (iii) Clinical features (c) Periosteal Chondroma (i) Radiologic features (ii) Pathologic features (iii) Clinical features (2) Malignant (a) Periosteal Osteosarcoma (i) Radiologic features (ii) Pathologic features (iii) Clinical features (b) Parosteal Osteosarcoma (i) Radiologic features (ii) Pathologic features (iii) Clinical features (c) Periosteal Chondrosarcoma (i) Radiologic features (ii) Pathologic features (iii) Clinical features (3) Compare & Contrast (a) Juxtacortical Osteosarcoma Subtypes (i) Periosteal osteosarcoma (ii) Parosteal osteosarcoma (b) Inflammatory/Reactive Surface Lesions (i) Bizarre Parosteal Osteochondromatous Proliferation (ii) Florid Reactive Periostitis Ossificans

MKEE-48 Evaluating The Perioperative Spine: Beyond Degenerative Disc Disease And Hardware Complications

Awards
Identified for RadioGraphics
Cum Laude

Participants
Evan Pohl, MD, Winston Salem, North Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the indications, techniques, and nomenclature for different types of cervical and lumbar spine fusions. 2. Describe a practical approach to perioperative image evaluation of the cervical and lumbar spine, emphasizing differences in early and late imaging evaluation. 3. Through case-based radiographic examples, use this approach to generate value-added reports for the spine surgeon.

TABLE OF CONTENTS/OUTLINE

Cervical spine 1. Indications for surgery. 2. Different types of cervical spine fusion, emphasizing correct nomenclature. 3. Review surgical techniques and indications. 4. Review hardware terminology. 5. How to approach preoperative and postoperative radiographic imaging. 6. How to generate a value-added report for the spine surgeon. 7. Case-based radiographic examples. Lumbar spine 1. Indications for surgery. 2. Different types of lumbar spine fusion, emphasizing correct nomenclature. 3. Review surgical techniques and indications. 4. Review hardware terminology. 5. How to approach preoperative and postoperative radiographic imaging. 6. How to generate a value-added report for the spine surgeon. 7. Case-based radiographic examples.

MKEE-49 Sacroiliac Dysfunction: Anatomy, Clinical Evaluation, Differential Diagnosis, Imaging And Surgical Fusion

Awards
Certificate of Merit

Participants
Leah Waldman, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: 1. Review sacroiliac joint (SIJ) anatomy and the spectrum of variant morphologies 2. Define Sacroiliac Dysfunction and describe its pathophysiology, differential diagnoses, and treatment options 3. Showcase pertinent multimodality pre- and postoperative imaging findings

TABLE OF CONTENTS/OUTLINE

Normal SIJ anatomy and function - Fibrous and synovial portions - Ligamentous and muscular attachments - Morphologic variations and accessory SI joints Sacroiliac Dysfunction - Etiological factors include ligamentous laxity, spinal disorders, and minor trauma - Diagnosis is primarily clinical based on motion palpation and pain provocation tests - Imaging mostly normal; primarily performed to exclude other causes of sacroiliac pain Differential diagnosis with imaging examples - Spondyloarthritis - Infection - Metabolic disorders - Trauma - Degenerative Disease - Referred pain - Tumor Treatment options - Physical therapy - Manipulation - Steroid/anesthetic injection - SI joint fusion, including triangular titanium (iFuse) implants Potential surgical complications, illustrated with cases - Loosening - Malpositioning - Peri-implant fracture or stress response - Postoperative infection

MKEE-5 Pins And Needles In Hands, Wrists, And Arms - Pictorial Review Of Upper Extremity Peripheral Neuropathies

Participants
Daichi Hayashi, MD,PhD, Stony Brook, New York (*Presenter*) Author with royalties, Wolters Kluwer nv

TEACHING POINTS

1. To describe anatomy of the upper extremity peripheral nerves.2. To identify common sites of peripheral nerve entrapment/compression and underlying predisposing factors.3. To recognize imaging features of upper extremity neuropathies and associated clinical symptoms

Upper extremity peripheral nerves can be affected by various entrapment and compression neuropathies, involving brachial plexus, musculocutaneous, axillary, suprascapular, radial, ulnar, and median nerves. MRI and ultrasound help visualize these neuropathies to narrow down differential diagnoses. Our exhibit include the following contents.1. Background;2. Aanatomy, pathomechanism, clinical features, and imaging findings of the following upper extremity nerves:a. Brachial plexus at the thoracic outlet - thoracic outlet syndrome and Parsonage-Turner syndrome;b. Shoulder - musculocutaneous nerve; axillary nerve (quadrilateral space syndrome); suprascapular nerve;c. Upper arm and elbow - proximal radial nerve at upper arm; ulnar nerve (cubital tunnel syndrome); radial nerve and posterior interosseous nerve at elbow (radial tunnel syndrome and PIN syndrome); median nerve and anterior interosseous nerve at elbow (pronator syndrome, AIN syndrome);d. Wrist - ulnar nerve (Guyon canal syndrome); median nerve (Carpal tunnel syndrome); palmar cutaneous branch of the median nerve; superficial branch of radial nerve (Wartenberg syndrome).3. Conclusion

MKEE-50 Postoperative Elbow MRI: A Guide To Surgical Techniques And Imaging Interpretation

Participants
Lawrence Lo, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

Elbow injuries are a growing problem particularly amongst overhead athletes. The goal of surgical management of elbow injuries is to restore the capsuloligamentous and osseous contributions to stability as much as possible. Postoperative MRI evaluation is difficult due to the variety of surgical techniques available, and a revision in setting of complications may be performed without imaging. The teaching points of this exhibit are the following: 1) Understanding of the different surgical techniques is essential to imaging interpretation; 2) Timing of surgery can influence MR characteristics of graft reconstruction or repair; 3) Normal postoperative findings can be very difficult to distinguish from complications due to the sensitive nature of MRI.

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A variety of surgical techniques and postoperative imaging findings of the following surgeries will be discussed: 1) Ulnar nerve decompression; 2) Capitellar osteochondral graft reconstruction; 3) Ulnar collateral ligament reconstruction; 4) Distal biceps brachii tendon repair; 5) Distal triceps tendon repair; 6) Lateral collateral ligamentous complex reconstruction; 7) Common flexor and common extensor tendon repair.

MKEE-51 A Multimodality Review Of The Musculoskeletal Manifestations Of Hyperparathyroidism And What The Radiologist Needs To Know

Awards
Certificate of Merit

Participants
Jonathan Revels, DO, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

After reviewing this educational exhibit, the learner will have an improved understanding of: The difference between primary and secondary hyperparathyroidism The clinical and radiological workup of hyperparathyroidism The musculoskeletal manifestations of hyperparathyroidism on radiography, computed tomography, and magnetic resonance imaging The role of DEXA in evaluating patients with hyperparathyroidism

TABLE OF CONTENTS/OUTLINE

Background of primary and secondary hyperparathyroidism Clinical manifestations and evaluation of hyperparathyroidism Radiologic assessment of hyperparathyroidism on US, CT, nuclear medicine and dual-energy x-ray absorptiometry Radiologic manifestations of hyperparathyroidism in a case-based format Subperiosetal bone resorption Subchondral bone resorption Subligamentous resorption Rugger jersey spine Lucent bone lesions Brown tumors Calvarial "salt-and-pepper" appearance Other radiologic manifestations of hyperparathyroidism

MKEE-52 The Dark Horse Of Cartilaginous Lesions- Literally!

Participants
Aashna Karbhari, MD, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Chondroblastomas are benign locally aggressive cartilaginous neoplasms that usually present with insidious onset bone pain.2. Chondroblastomas are predominantly epiphyseal / apophyseal tumors affecting an immature skeleton.3. Distinctive features of chondroblastomas under a microscope like chicken-wire calcification and coffee bean nuclei.4. Chondroblastomas appear as lytic lesions with a sclerotic rim on X-ray and CT, and a considerable number show conspicuous low T2 signal intensity (owing to its different histological make up as compared to other cartilaginous lesions) and significant marrow edema on MRI.5. Expected post treatment changes with focus on role of PET in assessing complete response vs residual / recurrent tumors.6. Differential diagnosis of chondroblastomas with their distinctive features on histopathology.

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• Review the pathophysiology, clinical features and management of chondroblastomas.• Elucidation of pathognomonic features of chondroblastomas on histopathology.• Illustrate the multimodality imaging features including X-ray, MRI and PET/CT of chondroblastomas at various typical and atypical locations.• Interpretation of post treatment changes in chondroblastomas and the role of PET/CT in assessing treatment response / residual disease.• Discuss various differential diagnoses with attention to their pathognomonic features on histopathology. • Review the importance of interdisciplinary coordination for improving outcomes in chondroblastoma patients.

MKEE-53 Fibrous Soft-tissue Tumors And Pseudotumors: A Comprehensive Review

Participants

María Merideno Garcia, MBBCh, Toledo, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To review the classification of fibrous soft-tissue tumors. - To illustrate the main imaging features and key findings with own-experience images. - To provide differential diagnosis clues to distinguish benign from malignant fibrous soft-tissue tumors.

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A wide variety of fibrous lesions may appear in soft tissues, whose imaging findings are often nonspecific. Ultrasound and Magnetic Resonance Imaging play an essential role in defining their size, extension, and intrinsic characteristics. In those patients (especially in pediatric age), correct diagnosis is mandatory since it leads to the decision of conservative or surgical treatment. In this educational poster, we review the classification of fibrous soft tissue tumors and pseudotumors in the adult and pediatric population. We discuss benign and malignant tumors as elastofibroma, fibroma of the tendon sheath, solitary fibrous tumor, hemangiopericytoma, or sarcomas. Their differential diagnosis includes proliferative myositis, myositis ossificans, nodular fasciitis, and fibromatoses, among others. We illustrate the main findings and propose a radiological approach based on the recognition of imaging patterns.We emphasize diagnostic pearls and pitfalls.

MKEE-54   Role Of Musculoskeletal Radiologist In Elbow Joint Dislocation.

Awards
Certificate of Merit

Participants
Varun Dhir JR, DMRD,MBBS, Delhi, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To compare the radiological features of Posterolateral rotatory instability (PLRI) vs posteromedial rotator instability (PMRI).• To understand the difference in the mechanism of injury and the pattern of ligamentous and osseous disruption in PLRI vs PMRI.• To highlight the role of the O'Driscoll and Wrightington classifications in elbow fracture-dislocation diagnosis and management.

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1. Relevant elbow joint anatomy, emphasizing the detailed anatomy of the coronoid process.2. Elbow joint stabilizing structures.3. Mechanism of injury in PLRI vs PMRI.4. Plain radiographic findings in PLRI vs PMRI, highlighting relevant radiological signs (for example, the drop sign, the double contour sign).5. The role of CT in categorizing the injury and guiding the management, according to the O'Driscoll classification of coronoid process fractures6. The different patterns of ligamentous injuries and the role of MRI in assessing these. Radiological examples highlighting different injury patterns (for example, terrible triad injuries, coronoid process fractures and posterior band ulnar collateral ligament injuries) will be included.7. The role of radiology in suggesting the diagnosis and guiding the management.8. The different surgical treatment options for PLRI and PMRI. Post-operative plain radiographs demonstrating the different treatment option will be illustrated.9. The inclusive and simplified role of the Wrightington classification in complex elbow fracture-dislocation injuries.

MKEE-55   Spine Infection Imaging: The Role Of The Radiologist In The Diagnosis And Management

Participants
Silvia Cayon Somacarrera, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

To illustrate the imaging spectrum of findings in spine infection and its relationship with different pathogens: pyogenic, granulomatous, parasitic and fungal.To show key features in X-rays, CT and MR to make the diagnosis and to differentiate it from pitfalls and mimics. To discuss indications to perform image-guided percutaneous sampling procedures.

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Spine infections are increasing in incidence due to aging population, immunosuppression and increased spinal instrumentation. In addition to this, the clinical presentation is often insidious and non-specific, thus, the ability of the radiologist to detect early or subtle imaging findings is vital to detect this pathology.In this presentation we depict several spine infections, including a wide variety of pathogens, in order to show imaging spectrum including pitfalls.Radiologists are not only important in the interpretation of radiological images, but also play a key role in the diagnostic algorithm performing image-guided percutaneous sampling procedures. Blood or urine cultures are positive in some cases but in others targeted sampling is necessary to identify the pathogen and in those cases is when the radiologist plays also an important role.

MKEE-56   The Big Nerve Problem: Imaging In Sciatic Nerve Pathologies

Participants
Aruna R. Patil, MD, FRCR, Bangalore, India (*Presenter*) Research Consultant, Koninklijke Philips NV

TEACHING POINTS

1.Radiological anatomy of Sciatic nerve - USG, CT, MRI2.Multiple focal and diffuse abnormalities of the nerve with pertinent imaging feature3.Address advances (neurography) in better depiction

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The exhibit will cover:The anatomy of the sciatic nerve (illustration) and radiological anatomy.Motor supply of the nerve.Focal lesions: Schwannoma, neurofibroma, intraneural ganglion cyst, neurofibrosarcoma, in NF-1, intraneural lipoma. Diffuse: GBS, neuritis secondary to compression (Ischiofemoral impingement), radiation neuritis, malignant extension.Trauma - neuropraxia to complete transection , posterior hip dislocation.Extrinsic compression - by tumors, osteochondroma, labral cysts. Secondary involvement - by tumors, abscess.Sciatic nerve interventions - image guided injections. Advances - MR neurography and DTI

MKEE-57   The Brachial Plexus: What Can Go Wrong And How To Identify It

Awards

Participants
Philip Wong, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the anatomy of the brachial plexus 2. Distinguish imaging and pathologic features of traumatic and non-traumatic abnormalities. 3. Provide an overview of management strategies.

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Background The brachial plexus is a complex neural network that provides motor and sensory innervation to the upper extremity and chest. A variety of pathologies including, traumatic and non-traumatic, can be seen within the brachial plexus. These entities can often be difficult to identify and characterize by clinical exam alone, thus imaging proves to be an invaluable tool. Radiologists should be aware of the different brachial plexopathies and their imaging features to identify these abnormalities. Content This exhibit will review the anatomy of the brachial plexus. Traumatic and non-traumatic plexopathies will be explored along with their imaging features, focusing on US and MRI. Non-traumatic pathologies that will be covered include tumors, postradiation plexitis, acute brachial neuritis as well as polyneuropathies such as CIDP, Charcot-Marie-Tooth, amongst others. Treatment strategies will be discussed to provide a comprehensive review of these plexopathies. Summary The brachial plexus is a complex entity in which traumatic and nontraumatic plexopathies can be identified. Radiologists should be aware of the pathologic and imaging features of these findings in the brachial plexus, as well as correct management strategies to engage in a multidisciplinary management approach to improve patient care.

MKEE-58   The Clavicle: Anatomy, Imaging And Pathology

Participants
Ami Gokli, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Review development and normal anatomy of the clavicle (with original illustrations) - Discuss the biomechanics of the joints and how it changes during development - Illustrate and discuss normal variants and pathology with grading classification - Identify rare entities involving the clavicle

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Anatomy and Development- Clavicle and associated joints, ossification centers, surrounding ligaments - Discuss developmental changes - Discuss biomechanics- original illustrationsDiagnosis - Clinical - Imaging - how to image the clavicle, imaging pitfallsPathology - Childhood variants and pitfalls (rhomboid fossa, ossification variants etc) - More common Pathology (cleidocranial dysostosis, pseudoarthrosis, physeal injury, SC joint injury, osteo, hyperparathyroid, ABC, osteochondroma, lymphoma, ewings sarcoma, LCH) - Rare pathology (Caffey Disease, Asphyxiating Thoracic Dysplasia, Osteogenesis Imperfecta, Holt-Oram syndrome, Thrombocytopenia with absent radius (TAR) syndrome, Synovitis Acne Pustulosis Hyperostosis Osteitis (SAPHO), Mucopolysaccharidoses)Conclusion

MKEE-59   Case-based Review Of The Sternum And Sternoclavicular Joints: What The Radiologist Needs To Know

Awards
Magna Cum Laude

Participants
Wilfred Manzano, MD, Palo Alto, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

[1] Knowing the radiological landmarks of the sternum and sternoclavicular joints is critical to identifying a variety of pathologies.[2] The sternum and sternoclavicular joints have a number of anatomic variants that may mimic trauma, infection, neoplasm, or other pathologies.[3] While radiographs may provide a helpful initial overview of the sternum and sternoclavicular joints, CT is the modality of choice to characterize these structures.

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[1] Overview[2] Normal Anatomy: Important Radiological Landmarks[3] Imaging Technique: Oblique Radiographs, Serendipity View, and the Importance of CT[4] Cased-based Review by Pathology[5] Congenital/Developmental Variants: Rhomboid Fossa; Episternal Ossicles; Sternal Foramen; Sternal Ossification Centers; Medial Clavicular Physis; Pectus Excavatum; Pectus Carinatum[6] Traumatic Processes: Sternoclavicular Dislocation; Costochondral Junction Fracture; Manubriosternal Subluxation; Sternal Fracture[7] Degenerative Processes: Osteoarthritis; Heterotopic Ossification[8] Infection and Inflammation: Ankylosing Spondylitis; Septic Arthritis; SAPHO[9] Neoplasm: Sclerotic Metastases; Chondrosarcoma; Radiation Osteonecrosis[10] Hardware: Sternal Dehiscence; Sternal Prosthesis[11] Conclusion

MKEE-6   Shoulder Injury Related To Vaccine Administration (SIRVA): Imaging Features Of Symptomatic Non-target Intramuscular Vaccination

Awards
Certificate of Merit

Participants
Tina Shiang, MD, Worcester, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Shoulder injury related to vaccine administration (SIRVA) is an underreported, preventable complication related to non-target vaccination. With millions of people receiving intramuscular deltoid injections under the COVID-19 vaccination program, radiologists should know the imaging features observed in the clinical setting of SIRVA as well as the appropriate vaccine injection technique and management.1. Overview of intramuscular vaccines and important considerations for vaccine administration.2. Review

consequences and show imaging findings of incorrect vaccine injection technique (i.e. SIRVA) using a case-based approach.3. Discuss the management of SIRVA with subacromial/subdeltoid bursa steroid injection.

TABLE OF CONTENTS/OUTLINE

1. Types of intramuscular vaccines, considerations for intramuscular vaccine administration and troubleshooting incorrect injection techniquesa. Injection techniqueb. Landmarks and anatomic site of injectionc. Needle size (length and gauge) and body habitus2. Vaccine injection related complications (SIRVA)a. Adhesive capsulitis (intra-articular injection)b. Subacromial/subdeltoid bursitis (intra-bursal injection)c. Periostitis or osteitis (periosteal or intra-osseous injection)d. Fat necrosis (subcutaneous injection)e. Axillary or radial nerve injury3. Case-based review of MRI findings of correct intramuscular vaccine injection and SIRVA4. Ultrasound guided steroid injection of the subacromial/subdeltoid bursa for pain management

MKEE-60   Postoperative Spine: The Imaging Hardware For The Surgeon's Sake And The Patient's Safety

Participants
Vagner Salzani, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review indications for spine surgery and the imaging assessment of the hardware used. To recognize the normal postoperative spine imaging findings, focusing on CT and MRI. To discuss the postoperative complications. To review what is essential to report from Surgeon's perspective, aiming for optimal patient management.

TABLE OF CONTENTS/OUTLINE

1. Main indications for spinal surgery: decompression, stabilization, and excision of tumors. 2. Imaging assessment of the hardware and biomaterials used in surgery. 3. Normal postoperative findings. 4. Spine surgery complications: degeneration, collections, fistulas, cerebrospinal fluid leaks, and surgical site infections. 5. Radiological report: what the Surgeon wants to know.

MKEE-61   Myeloma Mimickers - Plasma Cell Disorders Beyond Multiple Myeloma

Participants
Matthew McCann, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Imaging findings of other plasma cell disorders can mimic multiple myeloma. 2. Prognosis and treatment differ significantly between multiple myeloma and other plasma cell disorders. 3. Diagnosis relies on imaging, tissue sampling, bone marrow biopsy, and thorough evaluation of laboratories and clinical history.

TABLE OF CONTENTS/OUTLINE

1. Introduction. 2. Overview of plasma cell physiology and pathophysiology. 3. Solitary extramedullary plasmacytoma: isolated plasma cell soft tissue tumor; lack of other intramedullary or extramedullary findings. Mimic: extramedullary multiple myeloma. 4. Plasma cell leukemia: proliferation of malignant plasma cell progenitors. Extramedullary manifestations are typical. Mimic: extramedullary and skeletal involvement of multiple myeloma. 5. POEMS syndrome: paraneoplastic syndrome with underlying plasma cell dyscrasia. Polyneuropathy is a mandatory diagnostic criterion. Mimic: multiple myeloma with osteosclerotic lesions. 6. Waldenstrom macroglobulinemia: proliferation of plasma and lymphoplasmacytic cells. Mimic: skeletal involvement of multiple myeloma. 7. Immunoglobulin light chain (AL) amyloidosis: deposits of immunoglobulin fragments produced by monoclonal plasma cell population. Mimic: amyloid deposits of multiple myeloma. 8. Conclusions 9. References

MKEE-62   Uncommon Pathology Of Pubic Symphysis

Participants
Gian Luca Desi, MD, Torino, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiologists should be aware that: 1) pubic symphysis is a proper joint; 2) even though the most common inflammatory pathology is the pubic chronic osteitis of the symphysis, there are other inflammatory involvements; 4) chronic instability of pubic symphysis does exist and causes pain in the suprapubic region or at inner thighs and it has radiographic/CT proper signs.

TABLE OF CONTENTS/OUTLINE

1) the anatomical and functional structure of pubic symphysis; 2) a review of x-rays/CT/MR features of the most uncommon inflammatory pubic disorders: rheumatologic arthritis (rheumatoid arthritis, psoriatic arthritis, ankylosing spondylitis), osteomyelitis (related to pregnancy/childbirth, urologic and gynecologic surgery); 4) the subpubic cartilaginous cyst: a gelatinous degenerating tissue which arises from fibrocartilagineous component of the symphysis, causing dysuria and a palpable mass; 3) radiological signs of pubic chronic instability, which may develops after major trauma: a shift in craniocaudal displacement, sclerosis, and erosion of pubic bones, metaplastic bone formation, which may require surgery.

MKEE-63   Image-Guided Therapeutic Injections Of The Pelvic Bursae: A Pictorial Review

Participants
Antoine Azar, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The musculoskeletal anatomy of the pelvis is complex, with several naturally occurring and secondary adventitious bursae that deserve recognition by the radiologist2. These bursae can often get pathologically distended due to a variety of mechanical and inflammatory conditions3. Pain secondary to bursitis is commonly treated with image-guided steroid injection4. The aim of this exhibit is to review relevant anatomy, pathology, and image-guided injection techniques of the clinically relevant pelvic bursae

TABLE OF CONTENTS/OUTLINE

I. IntroductionII. Approach to Image-guided InterventionsIII. Iliopsoas Bursa a. Normal anatomy b. Abnormal MR appearance (bursitis) c. Image-guided steroid injection casesIV. Greater Trochanteric Bursa a. Normal anatomy b. Abnormal MR appearance

(bursitis) c. Image-guided steroid injection casesV. Ischiogluteal Bursa a. Normal anatomy b. Abnormal MR appearance (bursitis) c. Image-guided steroid injection casesVI. Ischial Bursa a. Normal anatomy b. Abnormal MR appearance (bursitis) c. Image-guided steroid injection casesVII. Ischiofemoral bursa a. Normal anatomy b. Abnormal MR appearance (bursitis) c. Image-guided steroid injection casesVIII. Conclusions

MKEE-64　Impact Factor: The Many Faces Of Ankle And Lateral Hindfoot Impingement Syndromes

Participants
Augusto Altoe, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To discuss the clinical presentation and pathophysiology of the ankle and lateral hindfoot impingement syndromes.2. To understand the anatomical basis involved in ankle impingement syndrome. 3. To describe the imaging patterns of the ankle and lateral hindfoot impingement syndromes.

TABLE OF CONTENTS/OUTLINE

1- Introduction: a. terminology, b. pathophysiology, and c. clinical presentation. 2- Classification according to the anatomic relationship of the tibiotalar joint: a. anterolateral, b. anterior, c. anteromedial, d. posteromedial, e. posterior impingement, f. extra-articular impingements. 3- Role of imaging methods for impact diagnosis: a. X-ray, b. Ultrasound, c. MR imaging, and d. MR arthrography. 4- Key Imaging features for each type of impingement, such as soft tissue or osseous abnormalities. 5- Identifying other causes of persistent ankle pain that may mimic or coexist with ankle impingement, such as occult fractures, cartilage damage, intraarticular bodies, osteochondral talar lesions, tendon abnormalities, and ankle instability. 6- Take home messages.

MKEE-65　Patellofemoral Instability: Through Patellar Maltracking To Torsional Deformities Of The Lower Limbs

Participants
Pedro Arruda, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The etiology of patellofemoral instability is multifactorial, and hip rotation, tibial tuberosity positioning, femoral groove and patellar articular facet anatomy, gait biomechanics, and imbalance of the knee extensor apparatus can all lead to poor alignment of the patella. The most sensitive and specific measurements for determining patellar instability are the trochlear groove angle, tibial tubercle-trochlear groove distance (TT-TG), patellar tilt, and patellar height. The unstable patellofemoral joint is less congruent than a stable joint throughout the range of knee movement. 10° to 20° of tibiofemoral flexion was shown to have the greatest difference in contact surface area between unstable and stable patellofemoral joints. A lateralized tibial tubercle as demonstrated by an increase in the TT-TG distance may be associated with a coexisting lower limb rotational malalignment. The effects of tibia and femur rotations on the patellofemoral joint contact pressures and areas are similar, but opposite in terms of the patellar facets affected.

TABLE OF CONTENTS/OUTLINE

1. Patellofemoral congruency a. Sulcus angle b. Patellar tilt c. Patellar deviation d. Patellar height 2. Patellar tracking a. Extension b. Flexion c. Quadriceps contraction 3. Torsional deformities a. Femoral torsion b. Tibial torsion c. Femorotibial rotation d. Cumulative torsional index 4. Translational deformities a. TT-TG b. Q angle

MKEE-66　Joints In Flame, What To Do Next? Primer For Radiology Residents On Inflammatory Arthritis

Participants
Andrea Saldana, MD, San Juan, Puerto Rico (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review the pathophysiology of Inflammatory Arthritis and its clinical presentation.Discuss the distribution pattern associated with inflammatory arthritis.Use an algorithm to aid in narrowing the differential diagnosis of Inflammatory Arthritides and its subtypes.Provide case examples for classic imaging findings of inflammatory arthritis subtypes in conventional radiography, ultrasound (US), computed tomography (CT) and magnetic resonance imaging (MRI).

TABLE OF CONTENTS/OUTLINE

Inflammatory arthritides are characterized by bone erosions and uniform joint space narrowing on conventional radiography. However, different imaging studies allow for the identification of characteristic distribution patterns (proximal vs. distal), bone proliferations, and other pathognomonic features of each subtype of arthritis. Following the identification of bone erosions, the use of an algorithm based on characteristic patterns for each subtype on multiple imaging modalities can aid in establishing an accurate diagnosis to further prevent the development of irreversible joint changes and systemic complications associated with inflammatory arthritis.1. Introduction & Objectives2. Inflammatory Arthritis Algorithm3. Inflammatory Arthritis: Why does it occur? Clinical presentationConventional radiography, US, CT and MRI Imaging Findings4. Multiple cases in quiz format5. Conclusion

MKEE-67　How To Obtain Additional Bone Mineral Density Information From The Low-dose Chest CT Examination

Participants
Xinyu Li, Xi'an, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To demonstrate the importance of measuring bone mineral density (BMD). 2. To point out the pros and cons of obtaining the BMD by using quantitative CT (QCT). 3. To propose a new no-dose-increase way to obtain the BMD using low-dose chest CT imaging.

TABLE OF CONTENTS/OUTLINE

1. The importance of measuring BMD • Osteoporosis is associated with low BMD, increasing the risk for fractures. • BMD is an independent predictor for future fracture risk and all-cause mortality. 2. The pros and cons of obtaining BMD using QCT • QCT uses

CT imaging to obtain BMD resulting in more radiation dose compared with dual energy X-ray absorptiometry (DXA). • QCT provides 3D images to measure BMD to avoid the influence of unusual structures (metal implant, osteophyte, overlying soft tissue, aortic calcifications) or pathological changes (vertebral fractures and spinal degenerative changes) for more accurate BMD than DXA. 3. A new no-dose-increase way to obtain BMD • Low-dose chest CT screening examination commonly covers the first and second lumbar vertebra. • QCT could measure the BMD of lumbar vertebra from the low-dose chest CT imaging which requires no extra radiation dose to provide volumetric BMD. • Application of low-dose chest CT screening may be extended.

MKEE-68   The State Of Art Of Hallux Valgus Deformity: An Update On Imaging Techniques And The Newest Surgical Treatments

Awards
Certificate of Merit

Participants
Lucas Silva, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Hallux valgus is a triplanar deformity comprised of a valgus deformity of the proximal phalanx, a pronation deformity of the first metatarsal, and a lateral displacement of the sesamoid apparatus. It is a slowly progressive condition that results from a series of biomechanical changes, that frequently follow several sequential steps in the pathophysiology. Although the standard imaging of HV deformity includes 2-dimensional plain radiographs, it provides limited information because of the rotational, 3-dimensional nature of the deformity. Three-dimensional, weight-bearing CT, however, does offer 3-dimensional imaging while weight bearing, and this is enabling further insight into HV. There are a large variety of surgical procedures for the correction of HV, and newer minimally invasive techniques are becoming increasingly popular. Complications may present both early and late scenarios. Early complications include fracture of the osteotomy, hematoma, infection, nerve entrapment, and avascular necrosis. Late complications include hardware failure, nonunion, malunion, persistent infection, recurrence of deformity and HV hallux varus deformity.

TABLE OF CONTENTS/OUTLINE

(1) Pathophysiology, risk factors (2) Diagnostic criteria (3) Atavism (4) Classic radiographic measurement angles (5) The role of MRI (6) Weight-bearing CT (7) What the orthopedic surgeon needs to know (8) Conventional surgical treatment (9) Minimally invasive techniques (10) Post-operative angle measurements (11) Post treatment complications

MKEE-69   Opportunistic Assessment Of Sarcopenia By Ct And Mri

Participants
Davi Romao, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Computed tomography (CT) and Magnetic Resonance Imaging (MRI) exams have been used to obtain information on body composition through its ability to quantify fat and muscle in a transverse section. This assessment of body composition has been recognized as an important prognostic factor for clinical outcomes in cancer patients or with other morbidities.We will make a brief review of opportunities to assess sarcopenia evaluation making use of routine Abdominal and Chest CT/MRI .The purpose of this exhibit is:- Point out the main software tools for CT and MRI Sarcopenia Evaluation- Describe common pitfalls in the analysis of CT / MRI sarcopenia- Show examples of how the evolution of sarcopenia can impact clinical outcomes

TABLE OF CONTENTS/OUTLINE

I. INTRODUCTION II. TOOLS FOR BODY COMPOSITION ANALYSISIII. SARCOPENIA PARAMETERS- Skeletal Muscle Index- Skeletal Muscle Attenuation (CT)- Total Body Fat Mass and Total Body Fat-Free Mass Prediction- Visceral Fat Area and Subcutaneous Fat Area- Pitfalls and LimitationsIII. CASESIV. CONCLUSION

MKEE-7   From Walkin' To Rollin': A Review Of Cervical Spine Injuries In A Level 1 Trauma Center.

Participants
Andrew Mitchell, MD, Memphis, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review epidemiology of common cervical spine injuries.2. Review cervical spine measurements suggestive of injury on CT and radiographs.3. Review cervical spine injury classification systems.4. Case examples of common cervical spine injuries and fracture types.5. Review common resident misses and pitfalls.

TABLE OF CONTENTS/OUTLINE

1. Background: Epidemiology and general overview of cervical spinal injuries.2. Review anatomy of the cervical spine and radiographic/CT measurements useful in trauma.3. Case based review of common cervical injuries and fracture classification.4. Case based review of common resident and community misses, normal variants, and pitfalls.5. Summary: Conclusions/References.

MKEE-70   Place The Correct Shoes: A Comprehensive Review Of Stress Fractures In Recreational Runners

Participants
Vagner Salzani, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review etiology and epidemiology of stress fractures;2. Discuss the most common stress fractures in recreation runners;3. Review the classifications for stress fractures in most affect sites of recreational runners, using practical cases of our service;4. Discuss the differential diagnosis of stress fracture, including benign and malign causes;5. Overview of the management of stress features in recreational runners according to their radiological features, focusing on MRI and CT.

TABLE OF CONTENTS/OUTLINE

I- Introduction: a. terminology, b. pathophysiology, and c.epidemiology. II- Imaging features of stress fractures and their

classifications: a. tibial, b. metatarsals, c. fibular, d. talar, e. navicular, f. femoral head, and g. pelvic. III- Distinguish low-risk fractures from high-risk fractures. IV-Differential diagnosis, including illustrative cases of our practice: Muscle injuries (adductor strain and piriformis syndrome), infection/osteomyelitis, and pathologic fractures. V- Key imaging features that affect the management of stress fractures.

MKEE-71   Morphologic Changes Of Vertebral Bodies: An Imaging Guidebook.

Participants
Renato Masson, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review normal anatomy of vertebral bodies. 2. To evaluate the most common morphologic changes of vertebral bodies. 3. To create a systematic approach for differential diagnosis of vertebral body changes.

TABLE OF CONTENTS/OUTLINE

1- Basic anatomy. 2- Congenital: • Limbus vertebra. • Klippel-Feil. • NF1. • MPS. • Hemivertebra. 3- Inflammatory: • Ankylosing spondylitis. • Spondylodiscitis. • Chronic recurrent multifocal osteomyelitis. 4- Metabolic. • Sickle cell anemia. • Renal osteodystrophy. • Osteopetrosis. • Paget. 5- Neoplastic: • Enostosis. • Hemangioma. • Metastasis. • Langerhans cell histiocytosis. 6- Traumatic: • Compression fracture. • Burst fracture. • Insufficiency fracture. • Malignant fracture.

MKEE-72   Imaging Aspects Of Proximal Humerus Fractures And Post-operative Evolution With Emphasis On Reviewing Neer's Classification

Participants
Pedro Arruda, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching points: 1. Fractures of the proximal humerus are frequent in women of advanced age, osteoporosis and after falling. 2. The displaced fracture segments follow the orientation of the force vectors exercised by the muscles that stabilize them. 3. Neer's classification is important for therapeutic planning, in addition to estimate the prognosis and predict complications. 4. Fractures of the proximal humerus, even if comminuted, without misalignment> 1.0 cm or without angulation = 45, are classified as "one part". 5. Anatomical neck fractures are more related to osteonecrosis of the humeral head, especially when the medial metaphyseal segment is displaced more than 2 mm or shorter than 8 mm. 6. The surgical and conservative treatments vary according to the degree of the Neer`s classification and fragments involved.

TABLE OF CONTENTS/OUTLINE

1. Knowledge of the anatomy and mechanism of trauma. 2. Understand the role of imaging exams in fractures of the proximal humerus and displacement. 3. Application of Neer's classification. 4. Understand the postsurgical findings according to each type of fracture.

MKEE-73   Plantar Plate: A Tiny Structure With Huge Importance - From Its Function And Anatomy To Its Tears

Participants
Sharon Rosemberg, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the anatomy of plantar plate complex of hallux and second to fifth toes. 2. To review MRI findings of plantar plate tears and turf toe/sand toe. 3. MRI findings of normal and altered plantar plates will be demonstrated by presenting cases of our department. 4. In this poster we intend to keep radiologists familiarized with the anatomy of these complex regions by using MR imaging and schematic drawings.

TABLE OF CONTENTS/OUTLINE

1.Plantar plate normal anatomy 2.MRI protocols 3.Plantar plate tears including : a. initial alteration - with no tearing b. partial thickness plantar plate tears c. complete plantar plate tear 4. Turf toe tears including: a. mild sprains b. partial tears c. full thickness tears.

MKEE-74   Imaging Evaluation Of Femoroacetabular Impingement. Our Experience With The Lisbon Agreement

Participants
Renato Masson, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review types and biomechanics of femoroacetabular impingement. 2. To show a suggested imaging protocol and why it is important. 3. To create a systematic approach for evaluating femoroacetabular impingement

TABLE OF CONTENTS/OUTLINE

1- The nature of impingement: a. Pincer-type, cam-type, and mixed-type. b. Normal and abnormal anatomy. c. Biomechanics. 2- Imaging evaluation: a. Radiography. b. The role of CT. c. MRI: why and how to perform it? 3- MRI evaluation: a. Labral injuries. b. Cartilage injuries. c. Bone morphology. d. Findings suggesting bad post-operative prognosis.

MKEE-75   Transforaminal Percutaneous Endoscopic Surgery. Radiologic Manipulation Signs Of A Microinvasive Spine Procedure

Participants
Pedro Arruda, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Transforaminal percutaneous endoscopic surgery for the lumbar spine under local anesthesia was recently initiated. In the

beginning, the procedure was used only for discectomy regarding soft disc herniation, with benefits that include minimal tissue traumatization and early recovery. It is expected high signal intensity of residual disc herniation in immediate postoperative MRI, which reduces at a short-term period. After some years, the procedure has also included foraminoplasty (foraminal decompression) and ventral facetectomy (lateral recess decompression) as additional steps. Regarding the foraminoplasty procedure, surgical decompression of stenotic lumbar foramina requires partial resection of the osteophytes, hypertrophic superior articulate process, and superior margin of the adjacent caudal pedicle which forms the borders of lumbar foramen. Our objective is to demonstrate the imaging surgical planning and postoperative findings regarding this microinvasive procedure.

TABLE OF CONTENTS/OUTLINE

1. Lumbar foraminal stenosis criteria a. Degree of stenosis b. Measurement done by radiographs c. Measurement done by CT and MRI 2. Types of percutaneous endoscopic surgery a. Discectomy b. Foraminoplasty c. Ventral facetectomy 3. Procedure steps a. Extraforaminal landing b. Endoscopic foraminal unroofing c. Full-scale foraminal decompression d. Optional discectomy 4. Postoperative image findings a. CT and radiography b. MRI 5. Procedure complications

MKEE-76 Pre And Postoperative Carpal Tunnel Release Parameters Analysis Associated With Open And Endoscopic Intraoperative Images

Participants
Pedro Arruda, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The onset of carpal tunnel syndrome is blamed on space-occupying lesions or pathological processes which narrow the space of the carpal tunnel. The median nerve flattening ratio is usually higher at the hook of the hamate bone level in patients with carpal tunnel syndrome. Also, the mean volar bowing of the retinaculum is increased in the pisiform level as well as in the hook of the hamate level. Surgical release of the median nerve is frequently needed when conservative treatment has failed. However, after surgical release, some patients continue to have symptoms, because failure of nerve decompression has numerous causes, Troublesome persistent or recurrent symptoms occur after the release in as many as 20% of patients, and approximately 10% of patients need reexploration. Endoscopic surgeries are now widely performed, with lower rates of syndrome recurrence. MRI depicts signs of nerve dysfunction but cannot replace electrophysiologic tests. MRI can be performed in association with EMG for patients with pain after carpal tunnel release.

TABLE OF CONTENTS/OUTLINE

1. Causes of recurrent carpal tunnel syndrome and anatomic parameters. 2. Carpal tunnel release procedure steps a. Open procedure b. Endoscopic procedure 3. Pre and post procedure evaluated parameters a. Median nerve cross-sectional area b. Median nerve caliber ratio c. Median nerve flattening ratio d. Median nerve signal intensity e. Palmar retinaculum bowing f. Carpal tunnel cross-sectional area g. Flexor retinaculum gap 4. Signs of recurrent carpal tunnel syndrome

MKEE-77 Extraarticular MRI Knee

Participants
Travis Smoot, MD, Columbia, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

The clinical diagnosis of intraarticular and extraarticular knee pathology often overlaps. The diagnosis of extraarticular findings of MRI knee depends on the specific anatomic location and signal characteristics. Differentiating extraarticular knee pathology is important because of the broad spectrum of severity and therefore differences in management. The appropriate diagnosis is pivotal in providing high quality care while reducing unnecessary follow-up and procedures.

TABLE OF CONTENTS/OUTLINE

Extraarticular MRI KneeDifferential-Based Approach: Background, Etiology, Imaging Features, and Differential Diagnosis. Cyst and Cyst-Like Lesions: Bursitis (Prepatellar, Pes Anserine), Morel-Lavallee Lesions, Popliteal (Baker's) Cyst, Ganglion Cyst (Proximal tibiofibular joint with compression of the peroneal nerve), Iliotibial (IT) Band Syndrome, Tophaceous Gout (Bilateral patellar intratendinous gout), and Synovial Sarcoma.Vascular: Deep Venous Thrombosis (DVT) and Popliteal Artery Aneurysm.

MKEE-78 What Joins The Groins: A Review Of Anatomy And Pathology Of The Pubic Symphysis

Awards
Identified for RadioGraphics

Participants
Lillian Niakan, MD,MBA, Temple, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review anatomy of the pubic symphyseal joint, pubic ligaments, and surrounding myotendinous attachments which contribute to anterior pelvic stability. 2. Illustrate various pathology of the pubic symphysis and surrounding soft tissues with different imaging modalities. 3. Emphasize that unrecognized pathology of the pubic symphysis can cause inguinal pain and can lead to anterior pelvic instability.

TABLE OF CONTENTS/OUTLINE

1. Types of joints a. Structural classification: fibrous, cartilaginous, synovial b. Functional classification: synarthroses, amphiarthroses, diarthroses 2. Anatomy of the pubic symphysis a. Bone landmarks b. Pubic symphyseal joint and fibrocartilaginous disc c. Ligaments (superior, inferior, anterior, and posterior pubic ligaments) d. Myotendinous attachments (anterior abdominal wall and thigh adductor musculature) 3. Pathology of the pubic symphysis on different imaging modalities a. Acute trauma (pubic diastasis) b. Parasymphyseal insufficiency fractures c. Postpartum symphyseal injury d. Athletic pubalgia e. Osteitis pubis f. Osteomyelitis g. Degenerative disease h. Spondyloarthropathy i. Parasymphyseal tumors 4. Treatment considerations

MKEE-8 Bench Press Blowout: Imaging Features Of Pectoralis Major Tears And Review Of Anatomy.

Participants

Peter Cormier, MD, Detroit, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review normal imaging anatomy and function of the pectoralis major muscle.2. Understand the types of pectoralis major tears and their imaging appearance.3. Discuss the treatment of pectoralis major tears.

TABLE OF CONTENTS/OUTLINE

A. Normal anatomic appearance and function of the pectoralis major musclea. Describe origins of the clavicular and sternal heads.b. Describe common tendon and insertion site on the bicipital groove of the humerus.c. Describe blood supply, innervation and function of the pectoralis major muscle.B. Tearsa. Illustrate types of tears with relevant examples.b. Correlate imaging appearance with clinical exam and intraoperative images.C. Treatmenta. Factors that differentiate surgical from conservative managementb. Describe operative management.c. Normal imaging appearance status post surgical repair.

MKEE-80   **Beyond Schwannomas And Neurofibromas: A Review Of Benign And Malignant Lesions That Arise In Association With Nerves**

Awards
Certificate of Merit

Participants
Marco Aru, MD, Portland, Oregon (*Presenter*) Nothing to Disclose

TEACHING POINTS

After viewing this exhibit, the learner will be able to:1. List growing number of non-traditional nerve sheath tumors2. Identify entity specific multimodality key imaging features3. Appreciate basic histopathologic findings for each lesion4. Describe entity specific clinical findings5. Understand imaging findings of benign versus malignant entities6. Recognize post-traumatic tumor-like nerve lesions as "do not touch" 7. Discuss technique, risks and benefits of image-guided biopsy of nerve lesions

TABLE OF CONTENTS/OUTLINE

Introduction/background-Brief review of schwannoma and neurofibroma-Case-based review of benign and malignant tumors that arise in association with nerves including:Benign: Nerve sheath myxoma, Morton neuroma, PTEN hamartoma, perineurioma, hybrid nerve sheath tumor, choristoma, lipoma of nerve, intraneural ganglion, vascular malformation of nerve, etc.-Clinical vignette-Key multimodality imaging features-Relevant histopathologyMalignant: Synovial sarcoma, metastases, triton tumor, lymphoma of nerve, etc.-Clinical vignette-Key multimodality imaging features-Relevant histopathology-Review of "do not touch" post-traumatic neurogenic tumor-like lesions-Spindle and terminal traumatic neuromas-Imaging of benign versus malignant entities-Technique, risks and benefits of nerve lesion image-guided biopsy Summary

MKEE-81   **DenosumabInducedChangesinGiantCellTumorofBone:SpectrumOfImagingFindings**

Participants
Guiomar Pique Rey, DIPLPHYS, Tortosa, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

To understand the mechanism of action and treatment indications of denosumab in patients with giant cell tumor of bone. To illustrate the changes of the imaging features induced by denosumab therapy in the giant cell tumor of bone.To correlate imaging and pathological findings.

TABLE OF CONTENTS/OUTLINE

We reviewed retrospectively plain radiographs, CT scans and MR images of 39 patients with denosumab-treated GCT of bone over a ten-year period. GCT of bone is commonly a benign but locally aggressive tumor that is usually seen in the ends of long bones as an osteolytic, expansile, eccentric lesion with a narrow zone of transition. Treatment options include curettage with local adjuvant and complete en-bloc resection which should be considered in case of multiple recurrent or unresectable GCTB, impossible joint salvage, extensive cortex destruction, and extensive soft tissue involvement. Denosumab has become a new treatment option in those cases where surgical removal of the tumor cannot be achieved because it is sited in an inaccessible location, is very extensive, frequently recurrent, or disseminated. On conventional radiographs and CT scans, sclerosis and reconstitution of cortical bone are the most common findings indicating response to treatment. On MR imaging, tumors with pathologically-proved response demonstrate predominantly low signal intensity on T2WI and diminished contrast enhancement. Recognising imaging features indicative of a positive response to denosumab is important for therapeutic decision-making.

MKEE-83   **Give Me A Pulley Long Enough And I Will Move The World: An Ultrasonographic Review Of The Most Frequent Pulley Pathology**

Awards
Certificate of Merit

Participants
Javier Cuetos, MD, Donostia-San Sebastian, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To understand the anatomy, function, and biomechanics of finger pulleys.- To become familiar with the normal ultrasound appearance of pulleys. - To understand the force mechanisms that cause a pulley rupture and the static and dynamic ultrasound findings of this pathology.- To know the mechanism underlying the trigger finger, its ultrasound appearance and the bases for percutaneous treatment.

TABLE OF CONTENTS/OUTLINE

Pulley pathology is becoming more prevalent in part due to rock climbing's boom in popularity over the past few decades. The two main pathologies that will be reviewed are the pulley rupture (which mainly affects young climbers) and the trigger finger (more common in patients with a history of repetitive manual work).Given the technological progress of ultrasound devices and their great

definition, pulleys have become visible and valuable anatomical structures by ultrasound.The objective of this presentation is to review the normal ultrasound appearance of the pulleys as well as the underlying mechanism of each of the pathologies and their most characteristic ultrasound findings of each of them in static and dynamic exploration.

MKEE-84   Brach-ing The Rules Of Brachial Plexus MRI: How To Get The Most Out Of Your 3D Imaging

Participants
Michael Villalba, DO, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understand the MRI limitations of assessing brachial plexus lesions.2. Discuss the benefits and limitations of 3D STIR-SPACE sequences in evaluating the brachial plexus.3. Introduce the use of gadolinium-based contrast in 3D STIR-SPACE sequences for MRI of the brachial plexus.

TABLE OF CONTENTS/OUTLINE

- Background on MR Imaging of the Brachial Plexus- Benefits and Pitfalls of 3D STIR-SPACE Sequences- 3D STIR-SPACE Sequence with and without Gadolinium Contrast- Cases: 1. Brachial plexus sarcoma 2. Parsonage-Turner syndrome 3. Evaluate for radiation-induced brachial plexopathy- Conclusion and Summary

MKEE-85   Give Me A Heads Up!: A Primer On Skull Vault Lesions For Radiology Residents On Call

Participants
Carlos Narvaez, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Skull vault lesions are frequently found incidentally during a routine Head CT. Radiology residents on call must be aware of these entities in order to be capable of distinguishing between which lesions are benign, and which are worth mentioning.-Radiology residents and radiologists need to educate others about these lesions to prevent unnecesary complementary studies.- Skull vault lesions can be classified according to their radiological pattern of bone involvement. They can behave as pseudolesions, lytic, sclerotic, or transdiploic lesions.- Meningioma, metastasis and lymphoma may behave as an intradiploic primary bone lesion, or as a transdiploic lesion originated from intracranial extra-axial soft tissues.- Metastatic lesions are the most common cause of malignant skull vault lesions found.- Recognition of some classical findings is key to assist in the differential diagnosis.

TABLE OF CONTENTS/OUTLINE

Introduction.Anatomic landmarks.Imaging Modalities and its limitations.Classification of skull vault lesions.Case-Based review.Conclusions.

MKEE-86   Pyomyositis And Mimics: Clinical And Imaging Clues To Diagnosis

Participants
Marco Tsuno, Brasilia, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review the pathophysiology, terminology, and classification of infectious myositis. 2. To revise the imaging findings of infectious myositis with different imaging modalities. 3. To discuss the differential entities that can mimic infectious myositis, focusing on pearls and potential pitfalls to make a correct diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Introduction: Terminology, etiology, pathophysiology, clinical features. 2. Classification: Primary and secondary. Invasive phase; Suppurative phase; Late stage. 3. Review of imaging findings: 3.1. Plain radiography; 3.2. US; 3.3. CT; 3.4. Conventional MRI; 3.5. Advanced MRI (Diffusion and perfusion). 4. Other differential diagnosis: 4.1. Inflammatory Myopathy; 4.2. Traumatic soft-tissue injury; Muscular contusion; Intramuscular hematoma; DOMS / Rhabdomyolysis; Myositis Ossificans.4.3. Neoplasm and post-therapy soft tissue changes; 4.4. Myonecrosis. 4.5. Pseudoaneurysm. 5. Conclusion.

MKEE-87   Fat On A Whole New Level. Secondary Findings Aiding Fracture Detection On Radiography And Ct, From Classic To Newly Described Signs.

Participants
Benjamin Comora, DO, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review classic signs aiding fracture detection. 2. Describe soft tissue, marrow and intra-articular findings of fracture on CT. 3. Discuss newly discovered secondary fracture signs on CT. 4. Review imaging findings related to traumatic injury to the marrow fat that may mimic other pathology.

TABLE OF CONTENTS/OUTLINE

1. Fat plane anatomy on radiographs and CT.2. Lipohemarthrosis. a. Technical and anatomical factors. b. Joint-specific considerations. 3. "Fat canvas" analysis to improve fracture detection on single energy (CT) in the setting of osteopenia. a. Common secondary soft tissue findings. b. Marrow analysis ("dripping blood" sign).4. Fat within the tendon sheath and bursae. a. Fat levels in the iliopsoas bursa b. Fat levels in wrist tendons ("floating fat sign"). c. Anatomic considerations and significance of fat-fluid levels in the tendons and bursae at various sites. 5. Post-traumatic fat lesions that may mimic other pathology. a. Pediatric cortical cyst-like lesions: typical clinical and radiographic findings, temporal evolution. b. Intramedullary fat globules: patients' demographics, variation of imaging appearance

MKEE-88   The Other Side Of The Wrist: Ulnar Wrist Pain.

Participants
José Prado, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

The purposes of this exhibit are: 1. To review the normal anatomy of the ulnar aspect of the wrist.2. To evaluate the biomechanics and pathology of common and not so common causes of ulnar wrist pain3. To create a systematic approach for reviewing MRI of these conditions.

TABLE OF CONTENTS/OUTLINE

1 - Basic and relevant anatomy 2 - Traumatic tear of the triangular fibrocartilage complex (TFCC) 2.1 - Traumatic 2.2 - TFC Detachment. 3 - Impingement syndromes 3.1 - Ulnocarpal impingement 3.2 - Ulnar styloid impaction 3.3 - Ulnar impingement syndrome 3.4 - Hamate-lunate impingement 3.5 - Triquetral impingement ligament tear (TILT) lesion 4 - Extensor carpi ulnaris tendon pathology 5 - Fractures 6 - Ulnar neuropathy 7 - Hypothenar hammer syndrome 8 - Ulnar-sided carpal coalition 9 - Inflammatory conditions 10 - Calcific tendinopathy 11 - Systematic approach of MRI findings in ulnar wrist pain

MKEE-89   High Frequency Ultrasound Uses In Botulinum Toxin A Injections: Guidance, Effects And Complications

Participants
Luciana Zattar, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Botulinum Toxin A (BTA) injection is the most common cosmetic procedure performed and its use continues to grow exponentially.In this context, the radiologist may be requested to recognize their usual aspects as well as to assess its possible effects.To achieve accurate and timely detection and appropriate approach of each case, High frequency ultrasound (HFUS/24-33MHz) is the most effective method since it provides optimal anatomical information of the skin and allows skin layers differentiation and changes.This study aims to discuss and illustrate the radiologist's role in the evaluation of BTA with HFUS.The purpose of this exhibit is:- To describe the pre procedure evaluation- To illustrate the anatomy of the skin and facial layers- To show and describe the main image patterns of BTA effects / skin changes- To highlight the importance of HFUS in dynamic evaluation- To propose a practical approach of skin changes in time / surveillance- To show possible complications related to the procedure

TABLE OF CONTENTS/OUTLINE

1.ANATOMY:Skin/facial layers2.PREPROCEDURE EVALUATION3.PROCEDURE4.EFFECTS/SKIN CHANGES EVALUATION AND SURVEILLANCE5.CONCLUSION

MKEE-9   Voriconazole Induced Periostitis: Pictorial Review With Multimodal Characterisation

Participants
Roland White, BMedSc,MD, Adelaide, Australia (*Presenter*) Nothing to Disclose

TEACHING POINTS

This multimodal characterisation of voriconazole induced periostitis is an important educational tool for radiologists and physicians, especially in a subset of the population who are immunosuppressed with haematological malignancy. Voriconazole causes a diffuse, and asymmetric periostitis, usually with a nodular and irregular morphology on imaging. The cognizance of voriconazole and its periosteal reaction morphology is paramount, as this pertinent information in a haematological malignancy subset may allow for differentiation between malignant infiltrate, hypertrophic pulmonary osteoarthropathy, and infection.

TABLE OF CONTENTS/OUTLINE

Voriconazole is a triflurinated azole drug, commonly used in immunosuppressed populations to treat invasive aspergillosis. Post marketing surveillance has identified a rare, painful periostitis secondary to elevated fluoride levels. Fluorine is incorporated into the extracellular matrix of bones in the form of fluroapatite, which increases osteoblastic activity and subsequent exostoses and periostitis. . This essay characterises voriconazole induced periostitis in two patients with haematological malignancy on multiple modalities - x-ray, computed tomography (CT), ultrasound (US), magnetic resonance imaging (MRI) and positron emission tomography (PET).

MKEE-90   Plantar Aponeurosis: Anatomy, Biomechanics And Radiological Spectrum Of Disorders

Awards
Certificate of Merit

Participants
Lucas Silva, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Plantar aponeurosis (PA) disorders cause pain and disability in general population, especially the plantar fasciitis. The plantar fasciitis is the most common PA injury and is estimated to induce more than 1 million patients to seek treatment annually and is usually related to chronic mechanical overload. In addition to plantar fasciitis, there are other disorders that affect the aponeurosis, such as rheumatoid arthritis, hydroxyapatite deposit, xanthoma, plantar fibromatosis, among others. The use of different available imaging methods assists in the correct diagnosis and management of the patient. The purpose of this exhibit is: (1) Review the anatomy, histology and biomechanics of the PA and demonstrate how these fundamentals are important in diagnostic imaging. (2) Demonstrate how the evaluation by different imaging methods can assist in the diagnosis of the various pathologies of the PA. (3) Systematic analysis of plantar aponeurosis injuries and a flowchart propose.

TABLE OF CONTENTS/OUTLINE

(1) Review of the anatomy and histology of the plantar aponeurosis. (2) Biomechanics (3) Physical examination and clinical findings. (4) Indirect findings of plantar fasciitis in plain radiography. (5) Ultrasound and Magnetic Resonance Imaging. (6) Imaging findings of PA injuries: plantar fasciitis, PA tear, plantar fibromatosis, xanthoma, hydroxyapatite deposition, infection and inflammatory diseases. (7) Pitfalls. (8) Systematic approach to aid radiologists in the correct diagnosis of a plantar aponeurosis disorder.

MKEE-91   **Fluroscopic Anatomy For Spine Intervention: With MR And CT Correlation**

Participants
Jee hyeon Lee, PhD, Bundang, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

Fluoroscopic image-guided spinal intervention is commonly performed in symptomatic patients to relieve the pain. Knowledge of normal anatomy is required to perform an effective procedure and to reduce possible complication. The purpose of this article is to review elemental fluoroscopic anatomy related to spinal intervention and correlate with MRI and CT to improve understanding of the relevant anatomy.

TABLE OF CONTENTS/OUTLINE

1. Pain intervention 1-1 Epidural steroid injection i. Inter-laminar epidural steroid injection ii. Transforaminal epidural steroid injection iii. Caudal injection 1-2 Intraarticular facet joint injection 1-3 Percutaneous vertebroplasty2. CSF-related procedure 2-1 CSF tapping 2-2 Epidural blood patch3. Discography

MKEE-92   **Bone Lesions: Review Of Imaging Guidelines For Evaluating Treatment Response**

Participants
Alireza Abadi, MD, Mill Creek, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Comprehensive review of different methods to assess tumor response in bone lesions.• Review guidelines for treatment response assessment in novel therapies including immunotherapy and immunoradiotherapy.• Provide case examples employing the different response criteria.• Provide an overview on the role of radiomics in assessing tumor response.

TABLE OF CONTENTS/OUTLINE

Response criterias:Provide a summary of the available treatment response criteria. Discuss the advantages and disadvantages of each criteria in assessment of tumor response. Lastly, provide imaging examples of how to use the following criteria in daily practice:• WHO criteria• RECIST 1.0 Criteria• RECIST 1.1 Criteria• Choi Criteria• Modified Choi Criteria• MDA Criteria• irRC Criteria• irRECIST Criteria• iRECIST Criteria• PERCIST Criteria• Prostate Cancer Working Group 2 CriteriaGlimpse of the Future:• Novel approaches including quantitative diffusion-weighted MRI• Dynamic contrast-enhanced MRI• Radiomics• Radiogenomics ConclusionRECIST 1.1 is the most commonly used treatment response criteria but several of its shortcomings have become more apparent in clinical practice and in radiology. This exhibit reviews the different available treatment response criteria and explores novel techniques for evaluation of tumor recurrence and response. Radiologist familiarity with these guidelines is important to help provide more accurate reporting of disease status.

MKEE-93   **It'S The Truth. It'S Actual. It'S Only Artifactual - Optimizing Extremity MRI At The Scanner**

Participants
Patricia Ojeda, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

? Review factors that influence MRI signal-to-noise ratio and acquisition time.? Identify common artifacts encountered on MRI of the extremities.? Demonstrate the modified patient positions detailed in this exhibit to optimize knee, elbow, ankle and shoulder MRI.

TABLE OF CONTENTS/OUTLINE

Outline: ? Factors Impacting MRI, SNR and Acquisition Time 1. SNR a) Small body parts can cause low signal b) Field inhomogeneity compromises signal c) Improper RF coil will lower signal 2) Acquisition Time a) Field-of-view b) Repeat sequence acquisition c) Extraneous sequences ? Common artifacts on MRI of the extremities 1) Motion 2) Magic angle artifact 3) Aliasing/wrap-around artifact 4) Susceptibility artifact ? Knee MRI a) Routine positioning 2) Limitations 3) Recommended Positioning 4) Recommended Technique 5) Benefits ? Elbow MRI a) Routine positioning 2) Limitations 3) Recommended Positioning 4) Recommended Technique 5) Benefits ? Ankle MRI a) Routine positioning 2) Limitations 3) Recommended Positioning 4) Recommended Technique 5) Benefits ? Shoulder MRI a) Routine positioning 2) Limitations 3) Recommended Positioning 4) Recommended Technique 5) Benefits ? Hand/Wrist MRI a) Routine positioning 2) Limitations 3) Recommended Positioning 4) Recommended Technique 5) Benefits ? Foot MRI a) Routine positioning 2) Limitations 3) Recommended Positioning 4) Recommended Technique 5) Benefits

MKEE-94   **Bulking Up - A Review Of Expanding Applications Of Quantitative Imaging Biomarkers Within Musculoskeletal Imaging**

Awards
Certificate of Merit

Participants
Elliot Breshears, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Review current QIBA Profile claims with musculoskeletal imaging applications. 2) Identify areas of active research and future directions for quantitative musculoskeletal imaging modalities.

TABLE OF CONTENTS/OUTLINE

1) MR-based biomarkers: a) Cartilage Composition (T1?, T2)¦ QIBA Profile claims¦ Current MSK clinical applications¦ Future directions b) Dynamic Contrast-Enhanced (DCE) Imaging¦ QIBA Profile claims¦ Current clinical applications¦ Future directions c) Diffusion-Weighted Imaging¦ QIBA Profile claims¦ Current clinical applications¦ Future directions d) Arterial Spin Labeling¦ Areas of active research e) Diffusion Tensor Imaging (DTI)¦ Areas of active research f) Proton Density Fat Fraction¦ Areas of active research 2) 18F-FDG-PET/CT-based biomarkers: a) Standardized Uptake Value (SUV)¦ QIBA Profile claims¦ Current clinical applications¦ Future directions 3) Ultrasound-based biomarkers: a) Shear Wave Elastography (SWE)¦ Areas of active research b) Pulse-Echo Quantitative Ultrasound¦ Areas of active research

MKEE-95   Soft Tissue Sarcoma: Review Of Imaging Guidelines For Evaluating Treatment Response

Participants
Mehrzad Shafiei, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Review important characteristics of soft-tissue sarcomas for treatment response • Compare the strengths and weaknesses of different treatment response criterias• Review guidelines for treatment response assessment in novel therapies including immunotherapy and immunoradiotherapy.• Provide case examples employing the different response criteria.Provide an overview on the role of radiomics in assessing tumor response

TABLE OF CONTENTS/OUTLINE

1) Review of important tumor characteristics: • Size and tumor burden • Architecture • Vascularity • Metabolic activity • Density and signal intensity 2) Response criterias: Discuss the advantages and disadvantages of the following criteria in assessment of tumor response: • WHO criteria (1981) • RECIST 1.1 criteria (2009) • Modified RECIST criteria (2010)• Choi Criteria (2007) • Modified Choi Criteria (2009)• irRC criteria (2009) • irRECIST criteria (2013) • iRECIST criteria (2017) • PERCIST criteria (2009) 3) Future Perspective: • Novel quantitative modalities like diffusion-weighted MRI and Dynamic contrast-enhanced MRI• Radiomics • Radiogenomics

MKEE-96   Post Knee Arthroplasty Complications: What A Radiologist Should Say.

Participants
Stephen Belmustakov, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To review the different types of knee arthroplasty.- To recognize the role of imaging modalities in detecting post-op complications: radiograph, CT and MRI.- To identify the most common post-op complications.- To describe what should be included on the radiologist's reporting checklist.

TABLE OF CONTENTS/OUTLINE

1- Types of knee arthroplasty: prothesis design, degree of constraint, spacer fixation, posterior cruciate ligament retention vs removal.2- Role of radiology in diagnosing post-op complications. Strategies for imaging of knee arthroplasty, including dedicated metal artifact reduction techniques for CT and MRI.3- Most common knee arthroplasty complications: polyethylene wear (25%), aseptic loosening (24%), instability (21%), periprosthetic joint infections (17%), arthrofibrosis - patellar clunk syndrome (15%), component malalignment (12%), extensor mechanism deficiency (6.6%), avascular necrosis of the patella (4.2%), periprosthetic fractures (2.8%) and recurrent hemarthrosis.Recognize the normal and abnormal imaging appearances of knee arthroplasty. Review of the image findings of the knee arthroplasty complications on different modalities (radiographs, CT and MRI).4- Radiological report. Checklist and description of normal and abnormal post operative findings in a knee arthroplasty case.

MKEE-97   An Imaging Review Of Chronic Overuse Injuries In Cycling

Participants
Elizabeth Carr, BSC,MBChB, Stevenage, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) A review of the biomechanics and risk factors for cycling overuse injuries 2) Clinical evaluation of cycling-related pathologies 3) Imaging review of common overuse pathologies associated with cycling

TABLE OF CONTENTS/OUTLINE

The popularity of cycling, both amateur and professional, has increased significantly over the past few years. This has led to a subsequent increase in the number of cycling-related injuries. Timely recognition of these pathologies is important as often a small change in bike setup can significantly improve or resolve symptoms.The knee is the most commonly affected site of cycling overuse injury. Cycling-related pathologies affecting the knee include patella tendinopathy, quadriceps tendinopathy, distal iliotibial band syndrome, pes anserine tendonitis, superolateral fat Hoffa's fat pad impingement, biceps femoris tendinopathy, and patellofemoral cartilage wear. Other sites of tendinopathy are also seen in cyclists, including proximal iliotibial band syndrome, Achilles tendinopathy, and wrist tendinopathies.Neuropathies are also seen in cyclists, predominantly of the wrist, foot, and perineum. Vascular complications such as external iliac artery endofibrosis and wrist arterial aneurysms and thrombosis have also been well documented.The aim of this educational poster is to review the imaging findings of chronic overuse injuries in cycling alongside the biomechanics and clinical presentation.

MKEE-98   Oh Yes! Your Problems Are Over! A Practical Guide: Glenohumeral Instability Before And After Surgery And Its Complications.

Participants
Renata Pucci, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this study is:To review the main anatomical structures of shoulder and mechanisms involved in glenohumeral instability.Familiarize radiologist with the common and uncommon imaging findings in shoulder exams before and after surgery to correct glenohumeral instability in different methods such as radiographs, computed tomography and magnetic resonance (MR).Describe the imaging findings in the most diverse methods of new surgical techniques to correct glenohumeral instability.To review the main imaging findings in postoperative complications.

TABLE OF CONTENTS/OUTLINE

Anatomical structures of shoulder.How to correlate anatomical and glenohumeral instability. Location.Coexisting lesions.We will be using cases from our Radiology department (Musculoskeletal Imaging Department) and digital illustrations to teach the main concepts and key imaging features of imaging correlation. Amongst other, our exhibition will contemplate:LatarjetRemplissageBankart repairBristowBristow- LatarjetEden HybinetteComplications

MKEE-99   Patellar Tracking "On The Move": Dynamic MRI And Ultrasound

Awards
Identified for RadioGraphics

Participants
Jiyoon Kim, DO, MS, FORTSON, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Patellofemoral pain is highly prevalent and may be associated with patellar maltracking. 2. Patellar maltracking is a consequence of biomechanical imbalance of static and dynamic stabilizers that may involve fixed osseous anatomy, ligamentous dysfunction, and/or dynamic musculotendinous dysfunction.3. By identifying anatomic derangements, diagnostic imaging plays a key role in directing management. Although dynamic evaluation is currently only performed clinically, dynamic MRI and ultrasound may have a role in adding additional diagnostic value.

TABLE OF CONTENTS/OUTLINE

1. ANTERIOR KNEE PAIN a. Magnitude of problem b. Demographics c. Clinical management algorithm2. NORMAL PATELLOFEMORAL TRACKING a. Anatomy - Key anatomic landmarks b. Biomechanics - Static vs. dynamic c. Key imaging metrics3. PATELLOFEMORAL MALTRACKING a. Anatomic risk factors - Common findings b. Pathomechanics - Static vs. dynamic c. Key imaging metrics4. DYNAMIC MRI - How to do it a. MRI technique & key anatomic landmarks b. MRI findings -- normal vs. abnormal5. DYNAMIC ULTRASOUND - How to do it a. Ultrasound technique & key anatomic landmarks b. Ultrasound findings -- normal vs. abnormal

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NMMIEE

Nuclear Medicine & Molecular Imaging Education Exhibits

Sub-Events

NMMIEE-1   Nuclear Medicine And Radiological Imaging Of Systemic Sarcoidosis: A Traditional Signs And Advanced Imaging

Participants
Takashi Norikane, Kita-gun, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The major teaching points of this exhibit are: 1 Knowledge of typical and atypical findings of systemic sarcoidosis on PET and other modalities will avoid misinterpretation for pathologic processes. 2 Knowledge of FDG and other PET tracer imaging provides further findings for radiologists to diagnose accurately.

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Modality: 18F-FDG PET/CT 11C-methionine PET/CT 18F-fluorothimidine PET/CT 67Ga-citrate scintigraphy 201Tl scintigraphy 123I-ß-methyliodophenyl pentadecanoic acid scintigraphy Involved organ: central nervous system, head and neck lung and thoracic lymph nodes heart abdomen muscle other

NMMIEE-10   Beware Of The Rare: Diffuse Liver Metastasis From Breast Cancer

Participants
Glaucia Oki, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Breast cancer is the second most common cancer in women after skin cancer. The most common breast cancer metastases sites are bones, lungs, brain, and liver. The pattern of liver metastasis most commonly consists of nodules. More rarely, metastatic spread can be so diffuse that it remains radiographically occult, and it should be suspected in case of acute hepatic failure. Liver biopsy has been recommended to confirm the diagnosis in these cases. We present four cases in which diffuse liver uptake of 18F-FDG correlates with hepatic diffuse metastatic disease. 18F-FDG PET/CT has the advantages of simultaneous demonstration of tomographic features, evaluation of metabolic activity, and detection of extra-hepatic lesions. Therefore, 18F-FDG PET/CT may be useful in making the differential diagnosis in cases of acute hepatic failure and may detect unusual patterns of liver metastatic disease. Although the liver is a frequent site of metastasis for many tumors, the diffuse pattern is relatively rare and have been reported in breast carcinoma, malignant melanoma, small cell carcinoma of the lung, gastric carcinoma, and Hodgkin's lymphoma. Diffuse liver metastasis has a very poor prognosis; therefore, early detection, when possible, is required.

TABLE OF CONTENTS/OUTLINE

To review epidemiological data and common sites of breast cancer metastases. To demonstrate diffuse liver metastasis from breast cancer detected by 18F-FDG PET/CT. To enumerate the differential diagnoses of diffuse liver metastasis.

NMMIEE-11   Imaging FDG In GCA, Clearer Than Ever On Digital PET

Participants
Peter George Maliha, MD, Montreal, Quebec (*Presenter*) Nothing to Disclose

TEACHING POINTS

Giant cell arteritis may present with different phenotypes: large vessel only, cranial arteries only or both. These phenotypes may be associated with different clinical outcomes.Recent technological advances have enabled PET/CT scanners to diagnose cranial disease in vessels previously too small to resolve. Previously fluorodeoxyglucose (FDG) PET/CT was only used to assess for large vessel involvement in Giant Cell Arteritis (GCA). It is now possible to diagnose cranial giant cell arteritis due to improved spatial resolution.The most visualized metabolically active cranial arteries in GCA are the vertebral, occipital, maxillary, and temporal arteries.The sensitivity of FDG PET/CT for the detection of GCA is likely decreased with immunosuppressive therapy such as corticosteroids.FDG PET/CT can detect other inflammatory pathologies associated with high ESR/CRP that clinically may present with GCA-like symptoms.

TABLE OF CONTENTS/OUTLINE

- Overview of GCA and the different phenotypes- Overview of the cranial artery anatomy- Overview of new digital PET/CT technology and improved image quality- Case reviews (3 cases) of cranial and large vessel GCA on FDG PET/CT- Overview of 7 alternative diagnoses found on FDG PET/CT when GCA was clinically suspected- Conclusion

NMMIEE-12 Reducing Misinterpretation Of Axillary Lymph Node Uptake On PET/CT Following MRNA COVID-19 Vaccine

Participants
Yael Eshet, MD, MSc, Kiryat Ono, Israel (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Recognize the substantial prevalence of radiotracer uptake on PET/CT after mRNA COVID-19 vaccine 2. Review uptake patterns more suggestive of response to vaccination rather than malignancy involvement 3. Discuss how incorporating practice guidelines can decrease misinterpretation

TABLE OF CONTENTS/OUTLINE

Avid unilateral axillary lymph node uptake has emerged as a major pitfall in patients undergoing PET/CT after receiving vaccinations (up to 45% in a recent publication). Although the lymph node uptake is likely the result of normal immune response, it can be mistaken for pathology, especially in patients referred for staging of breast cancer, melanoma and lymphoma. In this educational paper, we will emphasize methods of reducing misinterpretation, by incorporating practice guidelines and recognizing certain uptake patterns. Practice guidelines include an intake questionnaire to all patients prior to scan, including information regarding date of vaccination dose/s, side of injection, vaccine manufacturer, primary disease and use of immunosuppressive drugs. Imaging variables reducing misinterpretation include uptake in deltoid muscle, involvement of brachial or triangular intermuscular space lymph nodes, lymph node shape, and radiotracer used.

NMMIEE-13 Atlas Of Post-therapeutic Altered Physiologic Activity In 18F-FDG PET/CT Of Patients With Head And Neck Cancer

Participants
Eun Ji Han, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. With physiologic activity being altered by direct removal, compensatory hypertrophy, and muscle denervation after head and neck cancer (HNC) surgery on FDG PET/CT images, it is not easy to differentiate from recurrent tumors when encountering an unfamiliar pattern of FDG uptake in daily practice. In order to interpret post-therapeutic PET/CT accurately, it is necessary to be familiar with various findings of altered physiologic activity. 2. It is important to be familiar with the common patterns of altered physiologic activity according to the types of surgery performed in HNC. 3. Correlation with detailed treatment history and careful review of 2D multiplanar reconstruction (axial, coronal, and sagittal planes) and maximum intensity projection images of the PET/CT study are important to differentiate post-therapeutic altered physiologic activity from recurrent tumor. Precise anatomical evaluation is also needed through correlation with other imaging studies such as enhanced CT and MRI. 4. FDG PET/CT scans taken immediately after surgery have intense uptake making it difficult to detect residual tumor in most cases, although this varies depending on the anatomical location or surgical method.

TABLE OF CONTENTS/OUTLINE

1. Introduction of altered physiologic activity following various types of surgery in patients with HNC. 2. Atlas of various post-therapeutic altered physiologic activity in FDG PET/CT cases and reviews. 3. Description of key points for differentiation from recurrent tumors.

NMMIEE-14 Pictorial Review Of FDG-PET/CT Findings Of Histiocytosis

Participants
Nicola Hughes, MBBCh, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Histiocytoses are a rare group of disorders with a wide range of clinical and imaging manifestations which can affect any organ system. Knowledge of the classification groups and common imaging characteristics for each group can help guide the radiologist and narrow the differential diagnosis. Histiocytoses are often FDG-avid and there is a potential role for FDG-PET/CT to stage disease and assess treatment response.

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Histiocytoses are a rare group of hematologic disorders characterized by abnormal proliferation of macrophages, monocytes or dendritic cells. The most recent classification was proposed by the Histiocyte Society in 2016 and includes Langherans-related disorders (L group), cutaneous and myocutaneous disorders (C group), malignant histiocytoses (M group), Rosai-Dorfman disease (R group) and hemophagocytic lymphohistiocytosis and macrophage activation syndrome (H group). With a wide range of imaging findings for over 100 subtypes of histiocytosis, the diagnosis is often challenging for the radiologist. The role of FDG-PET/CT has not yet been well-defined in histiocytosis, however there is potentially a role for staging disease and assessing treatment response, as with other hematologic malignancies. The exhibit will illustrate the range of FDG-PET/CT findings seen in the major classification groups of histiocytic disorders in adults.

NMMIEE-15 The HIDA Scan: A Scintillating Review

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Julia Mario, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Indications for HIDA imaging. A comprehensive collection of HIDA cases, including acute and chronic cholecystitis, biliary leak, Sphincter of Oddi dysfunction and more. Important considerations while interpreting HIDA scans. Pitfalls in HIDA interpretation. Effects of Opioids on HIDA imaging. Utility of SPECT/CT in HIDA scanning. How to think while performing physiologic imaging.

What is a HIDA scan? Historical perspective. Physiologic basis of imaging the biliary system using the HIDA scan. Radiopharmaceuticals used in HIDA imaging. Imaging protocol for the HIDA scan. A comprehensive case-based review of HIDA imaging with correlative imaging including ultrasound, CT and Interventional Radiology imaging. Dynamic and static imaging would be used as appropriate to highlight the pathology. Demonstration of various radiographic signs on HIDA, including rim sign and cystic duct sign.

NMMIEE-16 The Utility Of 18F-FES PET In Breast Cancer.

Awards
Cum Laude

Participants
Jeremy Ong, MBBS, Melbourne, Australia (*Presenter*) Shareholder, Telix Pharmaceuticals;Shareholder, Lantheus Holdings

TEACHING POINTS

16a-18F-fluoro-17ß-estradiol (FES) is a novel PET tracer that targets estrogen receptors (ER), enabling non-invasive localisation of ER expressing breast cancer. 18F-fluorodeoxyglucose (FDG) positron emission tomography (PET) imaging targets accelerated glycolysis, a hallmark of malignancy, and is highly accurate in evaluating disease burden but provides limited characterisation about the disease phenotype beyond its presence. ER drives cell growth and proliferation in up to 75% of breast cancers. ER expression has implications for prognosis, treatment and is therefore critical in breast cancer management. Biopsy is currently required to prove ER expression, but this can be confounded by sampling error or heterogenous ER expression over time and across sites of disease.

This exhibit will outline the principles of ER based imaging with FES PET/CT and detail clinical scenarios where FES PET/CT adds value. These include biopsy targeting in recurrent/metastatic disease, problem solving findings on FDG PET/other modalities and staging of FDG negative disease, characterisation of disease heterogeneity when performed with FDG PET and evaluation of the pharmacodynamics of ER targeted treatments.

NMMIEE-17 Tumor Heterogeneity: Implications For Theranostics And Beyond

Awards
Cum Laude

Participants
Jeremy Ong, MBBS, Melbourne, Australia (*Presenter*) Shareholder, Telix Pharmaceuticals;Shareholder, Lantheus Holdings

TEACHING POINTS

Tumor heterogeneity, where one or multiple sites of disease exhibit different molecular characteristics, is a ubiquitous, under-recognised phenomenon in oncology. In current practice, treatment of metastatic disease is often based on features from a single biopsy site, which may explain relatively low response rates to targeted treatments. Positron emission tomography (PET) enables imaging of specific molecular targets. By using multiple tracers, tumor heterogeneity can be detected and characterised. Molecularly targeted treatment is possible by exchanging the imaging radioisotope for a therapeutic radioisotope and this combination is the basis of theranostics. Combined or sequential treatment approaches are more likely to be successful than single agents when tumor heterogeneity is present.

This exhibit will outline the principles of theranostics and characterisation of tumor heterogeneity with PET imaging. The implications of heterogeneity on clinical management will be detailed, with examples incorporating glycolysis, the sodium/iodide symporter, somatostatin receptors, prostate specific membrane antigen and norepinephrine transporters. Visual presentation of tumor heterogeneity on PET/CT imaging is also discussed.

NMMIEE-18 Algorithmic Approach To F18 FDG-PET Uptake Patterns In Retroperitoneal Pathologies: Imaging Findings, Pitfalls And Artifacts

Awards
Certificate of Merit

Participants
Priya Pathak, MBBS,MD, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

Highlight retroperitoneal anatomy and normal biodistribution of F18 FDG in the retroperitoneum. Review the optimum FDG-PET technique in evaluation of the retroperitoneum. Overview of the FDG uptake patterns in spectrum of benign and malignant retroperitoneal entities, and algorithmic approach to the differential diagnosis. Correlate the uptake patterns of F18-FDG PET of retroperitoneal pathologies to the anatomic imaging. Discuss imaging pitfalls and artifacts.

Introduction FDG-PET indications for retroperitoneal imaging, and its role in initial diagnosis and follow up. Technique FDG-PET technique optimization with intravenous hydration, furosemide, catherization and retrograde bladder filling; bowel cleansing with iso-osmotic solution. Review of urinary, colonic and attenuation correction artifacts. Review of pathologies Primary retroperitoneal lesions: Non-neoplastic Retroperitoneal fibrosis, Erdheim chester disease, Castleman disease, Extramedullary hematopoiesis, Amyloidosis, Lymphangioma. Neoplastic Lymphoma, Sarcomas, Neurogenic tumors, Germ cell tumors, Desmoid. Organ based secondary retroperitoneal lesions: Benign and malignant lymphadenopathy; renal cysts, angiomyolipoma, renal cell carcinoma, oncocytomas, transitional cell carcinoma; ureteric duplication, ureteritis, lymphoma, carcinoma; adrenal pathologies; pancreatitis, pseudocyst, pancreatic neoplasms; duodenal and colonic pathologies; aortitis, dissections, aneurysms, graft infections

NMMIEE-19 Gastroenteropancreatic Neuroendocrine Tumors (GEP-NETs): Case-based Pictorial Review Of The

AJCC 8th Edition Staging System

Participants
Emad Chishti, BS, Lexington, Kentucky (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review the underlying pathophysiology of GEP-NETs. Summarize recent treatment and management guidelines for GEP-NETs. Provide the audience with a case-based pictorial review of GEP-NETs applying the AJCC 8th edition staging system. Review key changes between the AJCC 7th & 8th edition staging system for GEP-NETs.

TABLE OF CONTENTS/OUTLINE

The incidence of neuroendocrine tumors (NETs), among which GEP-NETs are a significant proportion, is rising. Radiologists can benefit from developing familiarity with the staging system of these neoplasms. This educational exhibit will follow the following outline. I. Summary of the epidemiology and pathophysiology of GEP-NETs. II. Overview of anatomic (CT, MRI) and functional (PET, 68Ga-DOTADATE PET/CT, 18F-FDG PET/CT, & 111In-pentetreotide planar imaging, SPECT, SPECT/CT) imaging modalities used in the diagnosis, monitoring, and post-therapy assessment of GEP-NETs. III. Examples of AJCC 8th edition staging system application through case-based presentation of GEP-NETs of varying stages.

NMMIEE-2   Neurolymphomatosis: Insights Into A Uncommon But Important Entity (that Every Radiologist Should Know)

Participants
Sara Hunter, MD, Cleveland, Ohio (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Neurolymphomatosis is defined as direct lymphomatous involvement of cranial nerves, peripheral nerves, or nerve roots. It is considered one of the rarest subtypes of nervous system lymphoma.- The CNS international prognostic index (CNS-IPI) is a risk model which predicts the probability of nervous system relapse in diffuse large B cell lymphoma (DLBCL). Patients with DLBCL involving the adrenals, kidneys, uterus, or testis are at very high risk of nervous system relapse and require CNS prophylaxis at initial diagnosis. Patients with stage III/IV disease or more than one extranodal site of disease are also at elevated risk. - Prognosis for neurolymphomatosis is very poor, with average survival of a few months. Treatment consists of intrathecal methotrexate, systemic chemotherapy, and possibly radiation therapy.

TABLE OF CONTENTS/OUTLINE

- Brief overview of nervous system lymphoma - Neurolymphomatosis definition - Cases with cranial nerve involvement - Cases with peripheral nerve involvement - Factors which increase the risk of neurolymphomatosis - Treatment - Prognosis - Pitfalls

NMMIEE-20   Nuclear Medicine Imaging Of Side Effects And Adverse Events From Chemotherapy And Immunotherapy

Participants
Min Kong, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

. To raise the awareness and familiarity of induced scintigraphic imaging features related to chemotherapy and immunotherapy . To illustrate, through case-based evidence, the expected and unexpected side effects and adverse events of these drugs on Nuclear Medicine imaging with emphasis on PET/CT.

TABLE OF CONTENTS/OUTLINE

Case-based materials, related to chemotherapy and immunotherapy, are presented with Nuclear Medicine imaging in correlation with radiologic cross-sectional imaging. The side effects and adverse events induced by Verurafenib, Pembrolizumab, Ipilimumab, Bevacizumab, Methotrexate, Cyclophosphamide, Nivolumab, and Sunitinib, at different organ systems of the body, are illustrated and discussed. The presented drug-induced side effects and adverse events include cutaneous rash, colitis, hypophysitis, thyroiditis, pancreatitis, duodenitis, enteritis, bowel perforation, pneumonitis, cardiovascular toxicity, synovitis, sarcoid-like manifestations, bullous pemphigoid, polyalgia rheumatica, keratoacanthoma, squamous cell carcinoma, and induced-lymphoma.

NMMIEE-21   F18-fluoroestradiol (FES) PET Imaging For Patients With Estrogen Receptor Positive Breast Cancer: An Illustration Of Cases

Participants
Avanti Gulhane, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

1.F18-fluoroestradiol (FES), a radiolabeled estrogen analog, allows in vivo visualization of functional estrogen receptors (ER) with positron emission tomography (PET) in patients with breast cancer and is recently FDA approved for clinical use. 2.FES-PET can non-invasively detect ER-expressing tumors throughout the body, obviating the need for multiple invasive biopsies, accurately detect low F18-fluorodeoxyglucose (FDG) avid, poorly differentiated invasive lobular carcinoma, and minimize interpretation errors due to false-positive FDG uptake. 3.FES-PET imaging can assess true ER-positive metastatic tumor burden and guide patient selection for effective treatment with endocrine therapy in combination with CDK 4/6 inhibitors. 4.FES is often retained in the injected vein, extracted and metabolized by the liver, and excreted into the gastrointestinal tract, leading to physiologic high activity at these sites, requiring care in interpreting axillary findings and potentially limiting FES-PET evaluation of abdominal disease. 5.Physiologic FES uptake in uterus can be used as an internal control for image quality assessment.

TABLE OF CONTENTS/OUTLINE

1.Case Physiological FES uptake compared to FDG and potential limitations 2.Graph Average FES SUV in normal tissues 3.Case Higher avidity of FES than FDG in poorly differentiated invasive lobular carcinoma on PET 4.Utility of FES and FDG PET to establish tumor heterogeneity of ER-positive status 5.Case Interval imaging with FDG and FES PET for assessment of response to treatment

NMMIEE-22 18F-FDG Positron Emission Tomography (PET) Based Response Assessment In Malignancies - Current Standards And Evolving Considerations

Awards
Identified for RadioGraphics

Participants
Ashwin Parihar, MBBS, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. 5-point Deauville score is useful for response assessment on interim and end-of-treatment PET and can predict recurrence and survival-related outcomes in lymphomas. 2. PET based response assessment criteria in solid tumors (PERCIST) - provides guidance on analysis requirements for baseline and follow-up PET to ensure comparability of the change in standardized uptake values and describes their thresholds for assessing response. 3. FDG PET is superior to conventional imaging for detection of immune-related adverse events (irAE), especially those (e.g. pneumonitis, colitis, hypophysitis, adrenal insufficiency) that may require cessation of therapy. Pseudo- and hyper-progression are unique patterns that impact management and require prompt identification.

TABLE OF CONTENTS/OUTLINE

1. FDG PET-based response assessment in lymphomas a. Deauville 5PS b. Value of interim, end of treatment PET in HD and NHL c. Incremental value over conventional imaging-based response assessment (e.g. bulky disease, marrow involvement) 2. FDG PET-based response assessment in solid tumors a. Requirements, application of PERCIST 1.0, benefits over RECIST b. PET-based quantitative metrics (e.g. TLG, MTV) in response assessment, predicting outcomes, and prognostication 3. FDG PET-based response assessment in immunotherapy a. Distinct patterns of response: identifying hyper- and pseudo-progression b. Review of immune response criteria (e.g. irPERCIST, LYRIC), interpretation c. Imaging features of iRAE, identification, and significance

NMMIEE-23 18F-Fluoroestradiol (FES) PET/CT: Current Applications And Future Directions

Participants
Sophia O'Brien, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. 18F-Flouroestradiol (18F-FES) is a radiolabeled estradiol analogue PET tracer which targets the Estrogen Receptor (ER)2. In 2020 18F-FES was FDA approved for detection of ER-positive lesions in patients with recurrent or metastatic breast cancer3. Studies have shown many other potential clinical uses of 18F-FES including identifying tumor and metastatic hormone receptor heterogeneity, demonstrating effective ER blockade by ER antagonist therapy, and clarifying FDG-avid findings4. A current clinical trial is investigating the use of 18F-FES to predict response to endocrine therapy in newly diagnosed metastatic breast cancer5. This educational exhibit will detail the above teaching points with image-rich slides, reviewing normal and abnormal 18F-FES PET/CT imaging findings

TABLE OF CONTENTS/OUTLINE

Background Brief review of breast cancer including incidence, cancer deaths, ER expression, and ER-targeted therapies18F-Fluoroestradiol (FES) - Molecular structure, normal distribution, safety profile- In vivo 18F-FES-uptake correlates with in-vitro ER-positive malignancy; - Discordance may indicate non-functional ER expressionCurrent Applications - FDA approval - detection of ER-positive lesions as adjunct to biopsy in patients with recurrent or metastatic breast cancerFuture Directions - Review of in vitro and in vivo studies demonstrating multiple potential clinical applications of 18F-FES as well as its limitations - Review of ongoing clinical trial(s) of FES at the time of exhibit submission

NMMIEE-24 Theranostics In Pediatric Neuroendocrine Malignancies: An Illustrated Review.

Participants
Aeman Muneeb, MBBS, Galveston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Pathophysiology underlying neuroendocrine malignancies that are used as the basis for radionuclide imaging in children.2. Illustrate I-123 MIBG, Octreoscan, Ga-68 DOTATATE and F-18 FDG PET/CT findings in pediatric neuroendocrine tumors.3. Discuss therapeutic nuclear medicine options, including I-131 MIBG therapy and Lu-177 DOTATATE.

TABLE OF CONTENTS/OUTLINE

1. Overview of molecular mechanisms.2. SPECT imaging with MIBG and Octreoscan(Physiologic distribution, review of cases, correlative anatomic imaging)3. Ga-68 DOTATATE PET and FDG PET(Physiologic distribution, review of cases, correlative anatomic imaging)4. Therapeutic Nuclear Medicine (I-131 MIBG, Lu-177 DOTATATE)5. Future Directions (At-211 based therapies)

NMMIEE-25 Musculoskeletal Applications Of SPECT-CT In The Post-operative Patient Using A Novel 360 Degree Gamma Camera.

Participants
Robert Foley, MBBCh, Bath, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

SPECT-CT is an imaging technique that has a multitude of potential uses in the postoperative orthopedic patient. The aim of this educational exhibit is to demonstrate the clinical utility of a novel imaging technique, using a 12-headed gamma camera, in the investigation of a variety of important diagnoses in this patient population.

TABLE OF CONTENTS/OUTLINE

1. Biological and physical mechanisms of SPECT imaging.2. SPECT imaging options; radiotracer and gamma camera.3. Novel SPECT-CT gamma camera technique.4. SPECT-CT Protocol. 5. Clinical indications for SPECT-CT in the postoperative orthopedic patient.6. Pictorial review of patient cases and summary of the key evidence.

NMMIEE-26 PET/MRI Applications In Gynecologic Oncology

Awards
Certificate of Merit

Participants
Paul-Robert Derenoncourt, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

PET/MRI is becoming increasingly available and provides physiologic information from the PET with accurate localization to high soft-tissue contrast images from MRI. PET/MRI plays an important role in staging and assessing treatment response in patients with uterine and cervical cancers. PET/MRI is also useful in vulvar and vaginal malignancies since these primaries tend to be highly FDG avid. PET/MRI has limited role in ovarian malignancies but might be used as a problem solving tool in patients with indeterminate lesions, or patients with negative CT scan and persistent concern for disease recurrence.

TABLE OF CONTENTS/OUTLINE

Review of instrumentation and techniques Role of FDG PET/MRI in specific malignancies: Endometrial cancer Cervical cancer Ovarian cancer Vaginal cancer Vulvar cancer Future directions

NMMIEE-27 Hepatobiliary And Pancreatic Applications Of PET/MRI

Participants
Paul-Robert Derenoncourt, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

• PET/MRI combines physiologic information with superior soft-tissue contrast resolution from MRI.• In primary biliary pathologies, PET/MRI can assess disease severity, screen for malignancies, namely cholangiocarcinoma, delineate local tumor extent and regional spread, and assess response to treatment.• In hepatocellular carcinoma, PET/MRI can be useful in staging, as well as assessing treatment response after liver-targeted and systemic therapy.• In pancreatic tumors, PET/MRI can aid in the characterization and local staging, particularly of adenocarcinomas and neuroendocrine neoplasms, in addition to assessing spread to lymph nodes, metastatic disease in the liver, and evaluating treatment response.• In patients with colorectal and other malignancies, PET/MRI also plays a role in detecting liver metastases and evaluating response to treatment.• In patients with liver transplant, PET/MRI can be used for detecting recurrent HCC, recurrent sclerosing cholangitis, and post-transplant lymphoproliferative disorders.

TABLE OF CONTENTS/OUTLINE

• Introduction on PET/MRI techniques, clinical workflow, and reimbursement issues• Hepatobiliary and pancreatic applications of PET/MRI:o Cholanigocarcinomao Hepatocellular carcinomao Metastatic liver diseaseo Pancreatic ductal adenocarcinomao Pancreatic neuroendocrine neoplasms• Emerging tracers and applications

NMMIEE-28 Pediatric Body PET/MRI: A Pictorial Review Of The Most Common Applications

Participants
Paul-Robert Derenoncourt, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Body PET/MRI is increasingly used in oncologic and non-oncologic applications in the pediatric population.• Oncologic applications include solid tumors, hematologic malignancies and patients with high-risk lesions such as plexiform neurofibromas.• Non-oncologic applications include congenital hyperinsulinism with F-DOPA PET/MRI, infectious and inflammatory processes, and cardiac applications.

TABLE OF CONTENTS/OUTLINE

• Background with focus on special considerations and challenges of pediatric body PET/MRI• Oncologic body applications of PET/MRI in the pediatric population:-Solid tumors, with emphasis on sarcomas-Hematologic malignancies, with emphasis on lymphoma-High-risk patients with plexiform neurofibromas• Non-oncologic body applications of PET/MRI in the pediatric population:-PET/MRI for other infectious and inflammatory processes-PET/MRI in congenital hyperinsulinism using FDOPA

NMMIEE-29 Unusual Sites Of Prostate Cancer Recurrence, Incidental Second Primary Malignancies, Physiological Variants And Pitfalls On F18-fluciclovine PET/CT - A Pictorial Review.

Participants
Ahmed Ebada Salem, MBBCh,MSc, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To briefly review the role of F18-Fluciclovine in the evaluation of recurrent prostate cancer and its biologic distribution2. Discuss physiologic variants of distribution and common pitfalls3. Present a pictorial review of unusual sites of recurrence and incidental tumors identified on F18-Fluciclovine PET/CT

TABLE OF CONTENTS/OUTLINE

1. Discussion of role of F18-Fluciclovine in evaluating recurrent prostate cancer status post prostatectomy or prior radiation treatment. 2. Describe the technique of performing the F18- Fluciclovine PET/CT and normal biodistribution of the tracer. List of criteria to interpret the imaging findings will be included.3. Describe the physiologic variants of tracer distribution and common pitfalls. Uptake within the ganglia is a common pitfall on these studies. Uptake can be seen in the sacral or lumbar ganglia as well as within the celiac or superior mesenteric ganglia.4. A broad range of unusual sites of metastatic disease - either in isolation or in combination with other usual sites of metastatic disease will be presented, including metastatic disease to hilar nodes, inguinal nodes, intraluminal urinary bladder metastatic implant etc. 5. Incidental primary malignancies and other conditions identified on F18-fluciclovine PET/CT, including primary lung malignancy, meningioma, renal oncocytoma will be included.

NMMIEE-3 The Light From The Unknown - PSMA PET/MR Staging For Prostate Cancer

Participants
juana martinez, MD,MD, NEW YORK, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching points• Prostate specific membrane antigen is overexpressed in prostate cancer cells making it an ideal radiotracer. • Benefits of using PSMA PET include enhanced localization of cancer for image guided biopsy and focal therapeutic intervention• Small prostatic lesions detected by the PSMA PET are better anatomically characterized on MR than CT, which potentially would result in upstaging the patient and alter clinical management.

TABLE OF CONTENTS/OUTLINE

Table of Contents/Outline1. Background - The importance of proper staging of prostate cancer at diagnosis and biochemical recurrence. 2. Introduction - What is PSMA? Why PSMA PET/MR and not just MR or PSMA PET/CT? 3. Technique - How to read PSMA PET/MR for staging at diagnosis. Differentiating physiologic activity from pathologic activity. Staging PSMA PET/MR at biochemical recurrence. 4. Conclusions.

NMMIEE-31 State Of The Art PET Imaging In The Pediatric Nuclear Medicine Clinic. An Overview.

Participants
Mehdi Djekidel, MD, Doha, Qatar (*Presenter*) Nothing to Disclose

TEACHING POINTS

PET use is limited in pediatrics compared to adults due to a different tumor landscape and cancer biology. Developments in hardware, software and FDA radiopharmaceutical approvals are changing this paradigm. Newer scanners and novel artificial intelligence algorithms promise a lower dose. Faster scanning will also decrease the need for sedation.

TABLE OF CONTENTS/OUTLINE

Oncology: FDG-PET is established in pediatric lymphomas and is the standard of care in Hodgkin Lymphoma. Early PET response has prognostic significance and is used to modulate/deescalate therapy and reduce late side effects. FDG-PET helps in other pediatric cancers such as sarcomas, germ cell tumors, langerhans cell histiocytosis and GIST. Gallium DOTATATE and Copper DOTATATE have a high sensitivity and accuracy in neuroblastomas, neuroendocrine tumors, insulinomas and meningiomas. FDOPA PET is useful in pheochromocytomas/paragangliomas. FDG has a role in malignant disease (50% of cases in peds vs 30% in adults). FDOPA also helps in brain tumor cases to evaluate for recurrence vs radiation treatment changes. In medullary thyroid cancer; FDOPA PET is the agent of choice at delineating the extent of disease. FDG PET is prognostic. Non Oncology: FDOPA PET is the gold standard in congenital hyperinsilunism. FDG is used in fever of unknown origin, implantable device infections, systemic inflammatory conditions, medically refractory epilepsy patients and encephalitis. Ammonia and rubidium PET myocardial perfusion imaging can be used in select cases to evaluate ischemia.

NMMIEE-32 PSMA-PET For Initial Staging Of Prostate Cancer

Awards
Certificate of Merit

Participants
Daniela Ferraro, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

I. Review risk assessment, TNM staging and patterns of disease spread of prostate cancer II. Comprehend PSMA expression in primary prostate cancer and its correlation to PSMA-PET semiquantitative parameters III. Present relevant imaging information for TNM assessment IV. Discuss the potential impact of staging PSMA/PET on patient management

TABLE OF CONTENTS/OUTLINE

1. Risk assessment, TNM staging and patterns of disease spread 2. PSMA expression in prostate cancer a. PSMA-expression and Gleason score b. PSMA-negative tumours c. Semiquantitative parameters 3. Relevant PSMA-PET information for TNM assessment (initial staging) a. Local staging i. primary tumour detection and localization ii. extraprostatic extension iii. multifocal tumour b. Nodal staging i. regional nodes ii. distant nodes c. Distant metastasis i. bone metastasis ii. visceral metastasis 4. Potential impact on patient management a. Change of therapy modality iii. Local vs. systemic b. Approach of N-disease iv. Major changes: surgery vs. radiotherapy v. Minor changes: surgical approach and radiotherapy field c. Approach of M- disease vi. Oligometastatic vs. polymetastatic

NMMIEE-33 Evaluation Of Vascular Graft Infection Using FDG-PET/CT

Participants
Yoshitaka Toyama, MD, Sendai, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Vascular graft infection (VGI), although rare, carries a high risk of mortality. VGI is diagnosed by a combination of clinical, laboratory, and radiological findings. 18F-FDG PET/CT is the most valuable tool for assessing and diagnosing VGI. The methods for evaluating VGI using 18F-FDG PET/CT include assessing the intensity and pattern of uptake of FDG, and quantitative values. The combination of these methods and conventional evaluation method using CT can improve diagnostic accuracy. Unfortunately, however, 18F-FDG can also accumulate in non-infected grafts.

TABLE OF CONTENTS/OUTLINE

(1)Epidemiology of VGI (2)Current Criteria for the Diagnosis of VGI (3)Diagnosis of VGI using FDG-PET/CT (4)Pitfalls

NMMIEE-34 Practical Approach To Read A Brain FDG PET Scan In Suspected Dementia.

Participants
Magali Hovsepian, MD, Capital Federal, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To learn the normal 18F-FDG biodistribution in the healthy brain. 2. To review current indications of brain PET scan in suspected dementia. 3. To review recommendations regarding patient preparation. 4. To learn a practical step-by-step approach to read a brain FDG PET scan. 5. To recognize characteristic metabolic patterns in the most common causes of dementia.

TABLE OF CONTENTS/OUTLINE

Dementia is a devastating disease, increasingly affecting aging population. Alzheimer disease (AD) is the most common cause of dementia (50-60%), but frontotemporal dementia (FTD) and dementia with Lewy bodies (DLB) are also frequent. Clinical and psychological test are often not completely reliable, and imaging biomarkers represent an essential aspect in the workup of this patients. Our exhibit proposes a practical approach to interpret a brain FDG PET scan in suspected dementia, illustrating the normal and abnormal patterns of brain glucose metabolism, and highlighting the characteristic metabolic patterns seen in the most common causes of dementia. TABLE OF CONTENTS: 1. Before brain PET, other common neurological conditions have to be ruled out with clinical evaluation and brain MRI. 2. Patient preparation before brain PET acquisition. 3. Normal brain FDG biodistribution. Key anatomic areas to review. 4. Step-by-step approach for interpreting brain PET scan. Recognition of typical metabolic patterns of the most frequent causes of dementia.

NMMIEE-35 PSMA-RADS: Looking For The Perfect Pattern

Participants
Paula Fernandes I, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Brief review of the PET-PSMA technique and guidelines. • List the main PET-PSMA imaging findings in patients with prostate cancer (PCa). • Describe the use of PSMA-RADS in cases of PCa.

TABLE OF CONTENTS/OUTLINE

• Introduction: A brief review of the PET-PSMA indications. • PET-PSMA protocol and technique. • Description of the PSMA-RADS categories with illustrated teaching cases from our department. • Prospects and challenges of using the PSMA-RADS classification.

NMMIEE-36 Uncommon Lymph Node Metastasis Of Prostate Cancer: Who Are They?

Participants
Larissa Gloria, BMedSc, Campos Dos Goytacazes, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review epidemiological data about uncommon sites of prostate cancer (PCa) lymph node metastasis. We must show a case-based review illustrating 68Ga-PSMA findings from uncommon sites of lymph node metastasis from PCa in the post-prostatectomy follow-up during three years in a single institution.

TABLE OF CONTENTS/OUTLINE

Prostate cancer (PCa) metastasis increases the risk of cancer-specific mortality. In this context, it is well established that, beyond regional lymph nodes, the skeleton represents the most common metastatic site. However, recent observations suggest that some men with PCa might be affected by uncommon metastasis in the post-radical prostatectomy follow-up, defined as metastasis located at sites other than bone and regional lymph nodes. However, these findings were based on historical institutional series evaluating a small number of patients. Since the knowledge of the sites of metastasis is essential for therapeutic planning, our study aimed to report a series of cases in which atypical sites of PCa lymph node metastasis were detected by PET / CT with 68Ga-PSMA. Frequently some nomograms, for example, "The Briganti nomogram", and the recurrence of PCa are investigated by images of the prostate, such as computed tomography, magnetic resonance, and bone scintigraphy. However, this approach has limited sensitivity, particularly at low PSA levels. Therefore, PET / CT with 68Ga-PSMA has an effective role not only in detecting PCa metastasis but also in prognosis and treatment planning, defining an effective therapy.

NMMIEE-37 All That Glitters Is Not Gold: The Importance Of The Musculoskeletal Findings In Nuclear Medicine Imaging

Participants
Irline Cordeiro de Macedo Pontes, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Musculoskeletal alterations can be found in the different methods of nuclear imaging, from skeletal scintigraphy to Positron emission tomography-magnetic resonance imaging (PET-MRI). Therefore, the aim of this exhibit is to:1. Identify the most important nuclear imaging methods in the evaluation of the musculoskeletal system.2. Summarize the main indications of nuclear imaging in the assessment of musculoskeletal alterations.3. Correlate different imaging alterations, ranging from inflammatory and metabolic diseases to tumors in both magnetic resonance imaging (MRI) and nuclear imaging methods.4. Identify pitfalls in regard to musculoskeletal alterations in nuclear imaging.

TABLE OF CONTENTS/OUTLINE

Introduction the importance of nuclear imaging in the musculoskeletal system.Main imaging methods and their indications in musculoskeletal alterations, including- Skeletal scintigraphy.- Positron emission tomography/ magnetic resonance imaging (PET/ MRI).- 18F-FDG PET/CTCorrelation between nuclear imaging, MRI and computer tomography (CT)- Inflammatory alterations.- Metabolic diseases.- Infectious processes.- Bone tumors.Pitfalls- Physiological versus pathological uptake of the radiopharmaceuticals

NMMIEE-38 10 Real-life Radioisotope Safety Scenarios: With Great Power Comes Great Responsibility!

Participants
Harit Kapoor, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

After viewing this fun yet informative presentation, the learner will be able to (i) Identify key issues/concerns related to selected typical "real-life" radioisotope safety situations, and (ii) Describe appropriate responses/actions in keeping with updated NRC guidelines.

TABLE OF CONTENTS/OUTLINE

Table of Contents / Planned Scenarios 1. 1) Inspection by state/federal nuclear regulatory agency 2. 2) Malfunctioning dose calibrator 3. 3) Dosage threshold for required Written Directive 4. 4) Precautions related to therapeutic radioiodine administration 5. 5) Discrepancy in therapeutic radioiodine dosage compared to prescribed dosage 6. 6) Wrong radiopharmaceutical administration 7. 7) Breastfeeding patient undergoing diagnostic nuclear scan 8. 8) Radiopharmaceutical injection site extravasation 9. 9) Surgery planned after radiopharmaceutical administration 10. 10) Radiopharmaceutical spill in the "hot lab"

NMMIEE-39 Theranostic Approach In Breast Cancer

Participants
Majid Assadi, MD, Bushehr, Iran, Islamic Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To highlight potential of theranostics in the treatment of breast cancer 2. To review potential biological targets that can be used for a theranostic approach in breast cancers 3. To review recent advancements in new theranostic pairs for a theranostic approach in breast cancer

TABLE OF CONTENTS/OUTLINE

1. Overview of potential biological targets for a radiotheranostic approach for treating breast cancer 2. Overview and highlight the usefulness of Human Epidermal Growth Factor Receptor type two (HER-2) for theranostic oncology using 177Lu-trastuzumab 3. Overview and highlight the usefulness of Somatostatin receptors (SSTR) for theranostic oncology using 177Lu-DOTATATE. 4. Overview and highlight usefulness of fibroblast activation protein inhibitors (FAPIs) for theranostic oncology using 177Lu-FAPI

NMMIEE-4 Imaging Workup Of Primary Megaureter In Infants: With Focus On Renal Scintigraphy

Participants
Hedieh Khalatbari, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Ureteral dilatation. A descriptive term for ureters with a luminal diameter of =7 mm. In well-hydrated neonates, normal ureters up to 3-4 mm may be seen transiently on ultrasound due to peristalsis. Ureteral dilatation may be due to intrinsic or extrinsic ureteral abnormalities that result in primary or secondary megaureter (MU) respectively. A primary MU is diagnosed once etiologies of a secondary MU have been excluded.2) Primary MU classification. a) An obstructive MU is usually due to an aperistaltic juxtravesical segment of ureter. b) A refluxing MU is due to a short intravesical course of the distal ureter resulting in vesicoureteral reflux; this is typically present with higher grades of vesicoureteral reflux. c) A nonobstructive and nonrefluxing MU is postulated to be secondary to a maturational imbalance between urinary production and the caliber of the outflow tract. d) An obstructive and refluxing MU is uncommon. 3) Postnatal anatomical imaging. Ultrasound, voiding cystourethrogram, and renal scintigraphy have complementary roles in diagnosing and classifying a primary MU. Renal scintigraphy determines split renal function and drainage of the upper urinary outflow tracts.4) Management. In contradistinction to secondary obstructive MU, most patients with primary obstructive MU will not require surgical intervention.

TABLE OF CONTENTS/OUTLINE

I. Introduction II. Embryology III. Ureteral dilatation IV. Imaging evaluation a. Ultrasoundb. Voiding cystourethrographyc. Renal scintigraphy V. Management VI. Conclusion

NMMIEE-40 A Multisystem Case-Based Review Of Immunotherapy-Related Adverse Events On 18F-FDG PET-CT

Participants
Mark Ehrhart, MD, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

The Increasing use of immunotherapy in oncology necessitates an understanding of immunotherapy-related adverse events (irAEs). Oncologic imagers can play a pivotal role in early identification of irAEs, which allows for prompt treatment of these adverse events or other necessary modifications to the oncologic therapy regimen. After reviewing this presentation, the learner will have an improved understanding of the: 1) Most commonly used checkpoint inhibitors. 2) More commonly encountered irAE in cases of PD1 inhibitors. 3) More commonly encountered irAE in cases CTLA-4 inhibitors.

TABLE OF CONTENTS/OUTLINE

Background including immunotherapy medication mechanisms of action, and common terminology criteria for adverse events Multisystem case-based review of irAE on 18F-FDG PET/CT including neurological, pulmonary, cardiovascular, abdominopelvic, endocrinological, musculoskeletal, etc.

NMMIEE-41 Motion Correction And Data-Driven Gating In PET/CT

Participants
Allan Thomas, PhD, Spring, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Respiratory motion and misregistration are well-established issues in PET/CT. Both problems can lead to poor PET quantitation and limited diagnostic confidence. Both external device and data-driven gating (DDG) techniques are available to minimize the effects of motion and improve the utility of PET/CT. This exhibit shows how motion and misregistration can impact the clinical value of PET/CT. It explains how data-driven gated PET/CT, which utilizes appropriate gating methods and related analysis of PET and CT data, can provide for motion correction and improved PET/CT registration. The benefits to the clinical applications of PET/CT for improved diagnostic confidence and PET quantitation are also highlighted. Finally, guidance is provided on how to implement advanced PET/CT protocols that include gating with minimal impact on clinical workflows.

TABLE OF CONTENTS/OUTLINE

Slide 1: Clinical examples of motion-induced issues in PET/CTSlide 2: Explanation of gating techniques, specifically DDG methods for PET and CTSlide 3: Clinical examples of improvements from average CTSlide 4: Clinical examples of improvements from DDG PET/CTSlide 5: Flowchart comparing clinical workflows to address PET/CT misregistration; clinical data showing benefits and impact of using average CT and DDG PET/CT to address motion issues

NMMIEE-42 Amino Acid PET-MRI In Gliomas: A Review From Molecular Principles To Clinical Applications

Participants
Hossein Shooli, MD, Bushehr, Iran, Islamic Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the role of amino acids in intracellular metabolism.2. To review and compare transport mechanisms of natural and radiolabeled aminoacids for transport across the blood brain barrier (BBB).3. To review and compare different amino acid PET tracers for imaging gliomas. Toreview clinical indications for PET imaging in patients with glioma.4. To highlight usefulness of amino acid PET/MRI in clinical settings throughreviewing case series of glioma patients.5. To review recommended cutoffs for amino acid PET tracers in glioma imagingaccording to joint EANM/EANO/RANO/SNMMI recommendations.6. To review diagnostic performance of amino acid PET tracers for clinicalapplications using meta-analyses.

TABLE OF CONTENTS/OUTLINE

I. Overview and comparison of transport, uptake, and metabolism between naturaland radiolabeled amino acids.II. Overview of transport principles for natural and radiolabeled amino acids acrossthe BBB and their uptake/efflux mechanisms via cells.III. Overview of indications for PET scan in glioma imaging according to jointEANM/EANO/RANO/SNMMI recommendations.IV. Highlighting the usefulness of amino acid PET/MR in different clinical settingthrough reviewing some case series.V. Overview of recommended cutoffs for amino acid PET tracers in glioma imagingaccording to joint EANM/EANO/RANO/SNMMI recommendations.VI. Overview of diagnostic performance of amino acid PET tracers in differentclinical applications using available meta-analyses.

NMMIEE-43 Incidental Benign And Malignant Male Breast Pathology Detectable On Multi-Tracer Positron Emission Tomography/Computed Tomography (PET/CT): A Pictorial Review.

Participants
Sonya Khan, MD, Fullerton, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Familiarity with incidental male breast findings detectable on positron emission tomography/computed tomography (PET/CT) is key, particularly in determining which findings require additional work-up and which do not. This understanding is increasingly complicated by the emergence of newer, FDA-approved PET agents, which, in addition to F-18 fluorodeoxyglucose (FDG), localize to both benign and malignant male breast pathology.2. Benign gynecomastia, an increasingly common finding in pediatric and adult male patients, has a highly variable appearance and degree of tracer uptake on PET/CT—capable of mimicking or masking malignancy.3. Misinterpretation of PET radiotracer uptake in the male breast can result in inappropriate recommendations (including loss of patient/referring-provider confidence and poor resource utilization) or missed cancers.

TABLE OF CONTENTS/OUTLINE

1. Case-based review of incidental adult and pediatric male breast pathologies detectable on PET imaging performed at three teaching institutions with various agents, including:a. Rb-82;b. F-18 DCFPyL PSMA;c. NaF-18;d. FDG.2. Presentation of multimodality imaging correlates (SPECT, PET, MRI, ultrasound, CT, mammography) for each reviewed pathology.3. Evidence-based management, as relates to each pathology, including genetic and syndromic considerations, outlining appropriate patient-centered recommendations for the interpreting physician to make following accurate imaging interpretation.

NMMIEE-44 Troublesome Musculoskeletal Findings In The Workup Of Oncologic Patients Using Nuclear Medicine Studies

Participants
Fabiano N. Cardoso, MD, Miami, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: 1. Present a pictorial review of common and uncommon musculoskeletal benign pathologies that can mimic metastases on nuclear medicine studies and lead to unnecessary invasive procedures.2. Illustrate normal musculoskeletal variants that can be encountered in the routine evaluation of oncologic patients that could lead to misinterpretation by a general radiologist or a nuclear medicine physician.

TABLE OF CONTENTS/OUTLINE

• Introduction: Brief description about the increasing relevance and clinical utility of nuclear medicine studies in the workup of the oncologic patient. Provide a general overview about the normal pattern of uptake and distribution of the most commonly used radiopharmaceuticals in bone scintigraphy, SPECT/CT or PET/CT studies of oncologic patients. Present an illustrative review of the imaging findings of normal musculoskeletal variants and benign musculoskeletal disorders on bone scintigraphy, SPECT/CT, and

PET/CT studies, and how correlate them with other commonly available radiology exams, in order to avoid unnecessary procedures or further redundant, and costly, studies. Discussion with key points and take-home messages about frequently encountered musculoskeletal pitfalls and how to avoid mistake them for metastases. • Conclusions. • Bibliographical references.

NMMIEE-45 Neurological PET-CT Findings In Diseases Related To COVID-19

Participants
Milena Ouchar Sabino, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Describe neurological PET - CT imaging findings in patients after COVID-19 disease.- Describe the metabolic features of COVID-19 related diseases in FDG-positron-emission tomography (PET) / computed tomography (CT) imaging.

TABLE OF CONTENTS/OUTLINE

- Briefly describe normal uptake of FDG on encephalic structures.- Discuss the FDG uptake pattern in metabolic abnormalities on brain PET/CT: cases of encephalitis, memory loss, dementia associated with psychotic delirium and decreased level of consciousness, intraparenchymal cerebral hemorrhage, fever of unknown origin.- Atypical imaging appearance: pitiful and red flags on differential diagnosis.

NMMIEE-46 PSMA PET/MR For The Detection And Initial Staging Of Prostate Cancer And Its Impact To Patient Management

Awards
Magna Cum Laude

Participants
Adriano Basso Dias, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

Understand the role of PSMA PET/MR in the detection and local staging of clinically significant prostate cancerAssess the impact of PET/MR in the staging of nodal and distant metastatic diseaseRecognize the importance of PET/MR in the evaluation of disease burden (oligometastatic vs extensive disease)Highlight the implications of PET/MR on patient management

TABLE OF CONTENTS/OUTLINE

Principles in PSMA imaging Clinical indications for PSMA PET based on current guidelines Reporting systems proposed for prostate cancer staging (Prostate Cancer Molecular Imaging Standardized Evaluation - PROMISE) and lesion characterization (PSMA Reporting and Data System - PSMA-RADS)Impact of PET as an adjunct to multiparametric MRI on primary tumor detection and local staging PSMA PET/MR in primary staging of nodal and distant metastatic disease and for assessment of disease burden in comparison with conventional imagingImplications of PET/MR on disease management (locoregional vs systemic treatment vs targeted ablative metastasis-directed therapies) Therapeutic opportunities in the oligometastatic disease setting (targeted metastasis-directed ablative therapies). Case-based review with emphasis on changed management after PSMA PET/MR

NMMIEE-47 Pheochromocytoma And Paraganglioma: The Latest On This "Hot" Theranostic Topic

Awards
Certificate of Merit

Participants
Laszlo Szidonya, MD, PhD, Portland, Oregon (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Recognize the multiple germline mutations associated with pheochromocytomas and paragangliomas (PPGLs), and the known associated imaging phenotypes.2. Discuss the radiotracers used for functional imaging of PPGLs, and the role of each.3. Discuss the available radionuclide therapy options for non-resectable or metastatic PPGLs.

TABLE OF CONTENTS/OUTLINE

1. The three clusters of germline mutations associated with PPGL:a. Pseudohypoxia: including SDHx, VHL mutationsb. Kinase signaling: including NF1, HRAS, RET mutationsc. Wnt signaling2. Functional imaging:a. Indicationsb. Radiotracers used, and how the imaging phenotype is affected by the mutations detailed abovei. Tracers of the catecholamine pathways (focus on 123I-MIBG)ii. Tracers targeting somatostatin receptors (68Ga/64Cu -DOTATATE)iii. Metabolic imaging (18F-FDG)iv. Proposed imaging algorithm based on the germline mutation and tumor location3. Available radionuclide therapies, with a personalized medicine approach:a. How to decide on the most appropriate therapyb. Available therapies:i. 131I-MIBG (Azedra ®), FDA approved for non-resectable or metastatic PPGLsii. 177Lu-DOTATATE (Luthatera ®), FDA approved for gastro-entero-pancreatic neuroendocrine tumors, is an off-label therapeutic optionc. For each therapy:i. Patient eligibilityii. Pre-therapy dosimetry /dose determination (unique for 131I-MIBG)iii. Therapy administrationiv. Side effects and potential complications

NMMIEE-48 PET CT Simply Makes It Accurate: PSMA What You Need To Know, Pearls And Pitfalls

Participants
Aaron Perez Segovia, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

To identify the physiological distribution of 68Ga-PSMA-11 and 18F-PSMA-1007To know the indications of PSMA PET CT in prostate cancerTo review examples of prostate cancer imaging in PET CTTo identify benign and malignant conditions that exhibit PSMA uptakeTo know what to do in dedifferentiate or PSMA negative prostate tumorTo recognize the Pitfalls in PSMA PET CT prostate imaging

TABLE OF CONTENTS/OUTLINE

IntroductionPSMA PET CT biodistribution (68Ga-PSMA-11 and 18F-PSMA-1007)PSMA PET CT indications and imaging in prostate

cancerBenign and malignant conditions that exhibit PSMA uptakeDedifferentiated and PSMA negative prostate tumors PSMA PET CT pitfallsConclusion

NMMIEE-49   Fluorine-18 Dihydroxyphenylalanine (18-F-DOPA) As An Advanced Tracer For Imaging In Pediatric Neuroblastoma: Clinical Role, Normal Patterns, Pearls And Pitfalls

Participants
Michal Eifer, MD, Ramat Gan, Israel (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Familiarize with physiological biodistribution of 18-F-DOPA 2. Appreciate the use of 18-F-DOPA for detection, staging and response assessment of neuroblastoma 3. Recognize typical imaging features, pearls and pitfalls

TABLE OF CONTENTS/OUTLINE

18-F-DOPA, a precursor of dopamine and catecholamines, has emerged as an advanced tracer for pediatric neuroblastoma, enabling the transformation from SPECT imaging with 123-I-MIBG to PET. In this educational paper, we will familiarize the reader with the tracer and its physiological biodistribution and potential pitfalls; introduce its role in detection of the primary lesion and metastasis, and its ability to assess response to treatment; show imaging features of typical clinical accompanying syndromes; compare with 123-I-MIBG; and show 18-F-DOPA imaging in other neoroblastic tumors.

NMMIEE-5   18F-FDG PET/CT Evaluation Of Thymomas And Histological Classification.

Participants
Vanessa Murad, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Based on 2015 WHO classification, thymic epithelial tumors can be grouped into 3 large subgroups: low-risk thymomas (types A, AB, and B1), high-risk thymomas (types B2 and B3), and thymic carcinoma. 2. All thymomas, regardless of their histological grade, show some degree of FDG uptake, which tends to increase with the grade of malignancy. 3. Low-risk thymomas usually are non-invasive lesions with low metabolic activity, although type B1 can present a more aggressive behavior. High-risk thymomas are metabolically more active and have higher proliferation rates, so their FDG uptake is higher. 4. As tumor size and grade increase, the presence of necrosis also may increase, and therefore large low-risk tumors can present heterogeneous uptake patterns as well as high-risk tumors with necrosis; this finding should be interpreted in conjunction with others.

TABLE OF CONTENTS/OUTLINE

1. Thymomas and WHO classification: The most recent WHO classification divides thymomas into two main groups according to the morphology of the neoplastic epithelial cells and their nuclei. Depending on the epithelial component and cell atypia, they are also subdivided into specific subtypes. Each subtype has a different behavior, prognosis, and imaging features. 2. FDG PETCT imaging of thymomas: Even imaging findings can overlap among subtypes, there are certain characteristics that can be combined to make an accurate diagnosis based on findings. These characteristics are described in deep with demonstrative cases.

NMMIEE-50   Molecular Imaging In The Assessment Of Autoimmune, Infectious, And Post-infectious Encephalopathies: Insights On Differential Diagnosis And How Could PET Add Value To MRI

Awards
Certificate of Merit

Participants
Priscila Parro, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

i. Discuss current and emerging roles of PET and PET/MRI in autoimmune and infectious/post-infectious encephalopathy, focusing on [18F]FDG and neuroinflammation tracers. ii. Highlight the role of PET in paraneoplastic encephalopathies, addressing brain findings and the role of whole-body FDG-PET. iii. Discuss how integrating PET and MRI aids in the differential diagnosis with oncologic and neuroinflammatory conditions. iv. Recognize the importance of PET for assessing response to therapy and sequelae.

TABLE OF CONTENTS/OUTLINE

I. When and why to use the different PET tracers to evaluate autoimmune and infectious/post-infectious encephalopathies. Clinical setting: FDG-PET. Possible role of TSPO-PET in neuroinflammation. II. Specific FDG-PET and MRI findings of autoimmune and infectious/post-infectious encephalopathies: Autoimmune encephalopathy with cell-surface antibodies, onconeural antibodies and paraneoplastic syndromes: brain PET/MR and whole-body FDG-PET. Acute and subacute infectious encephalopathies. The emerging role of PET in long COVID-19. III. Treatment response and sequelae. IV. PET in the prediction of response to immunotherapy. V. Differential diagnosis: integrated PET/MRI in neurodegenerative, oncologic, other neuroinflammatory and idiopathic diseases.

NMMIEE-51   PET Imaging After Neoadjuvant Chemoradiation Therapy (NCRT): Tumor Response And Therapy-related Changes

Participants
Anne Gomes, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Discuss the current indications of neoadjuvant chemoradiation therapy in oncology assessed by PET imaging. Recognize the role of PET imaging with CT (PET/CT) and with MRI (PET/MRI) in therapy response assessment after neoadjuvant chemoradiation. Identify the expected side effects and unexpected complications of chemoradiation treatment according to the body region.

TABLE OF CONTENTS/OUTLINE

Neoadjuvant chemoradiation in oncology: which tumors benefit from PET assessment? ? Head and neck squamous cell carcinoma (HNSCC)? Non-small cells lung cancer (NSCLC)? Esophageal cancer? Gastric adenocarcinoma? Pancreatic adenocarcinoma? Rectal

adenocarcinoma? Sarcomas2. Assessment of tumor response to neoadjuvant chemoradiation? Patterns of disease response by PET? Complete and partial response? Stable disease? Progressive disease? How PET can guide the next treatment?3.Post treatment imaging of therapy-related changes? Expected side effects and unexpected complications? Head and Neck, e.g. mucositis and osteoradionecrosis? Thorax , e.g. pneumonitis? Abdomen and pelvis, e.g. fistulas? Musculoskeletal, e.g. insufficiency fracture? How to differentiate therapy-related changes from tumor by PET?4.Take-home messages

NMMIEE-53 From Beginning To End: The Multifaceted Role Of Radiology And Nuclear Medicine In The Diagnosis, Management, And Treatment Of Thyroid Malignancies

Participants
Justin Peacock, MD,PhD, San Antonio, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Global approach to imaging and radiopharmaceutical therapy in thyroid malignancies: 1. Demonstrate the role of US in evaluating thyroid nodules, utilizing ATA and/or TIRADS guidelines, as well as regional lymph nodes 2. Show the primary roles of CT and MRI: a. Staging local thyroid malignancy b. Identifying nodal metastases c. Evaluation for therapeutic response or progression of disease 3. Highlight the theragnostic roles of Nuclear Medicine: a. Use of radioiodines in the diagnosis and treatment of well-differentiated, thyroid cancer, including nodal/distant metastasis b. Assessing extent of non-radioiodine avid thyroid malignancies with 18F-FDG PET/CT c. Highlight the capabilities of somatostatin receptor theragnostics with 68Ga-DOTATATE PET/CT and Lu177-DOTATATE (Lutathera) therapy in medullary thyroid carcinoma and radioiodine-refractory thyroid carcinoma

TABLE OF CONTENTS/OUTLINE

I. Thyroid cancer overview II. Ultrasound applications in thyroid cancer imaging a. ATA guidelines b. TIRADS guidelines c. Thyroid nodule cases d. Evaluation of cervical lymph nodes III. CT and MR applications in thyroid cancer imaging a. Anatomic extent of disease b. Local and distant metastases c. Posttreatment follow-up IV. Nuclear Medicine theragnostics in thyroid cancer a. Radioiodine theragnostics b. 18F-FDG PET/CT diagnostics c. Somatostatin receptor theragnostics

NMMIEE-54 Cardiac Amyloidosis: The Nuclear Option

Awards
Certificate of Merit

Participants
Molly Roseland, MD, Northville, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Previously considered an incidental finding on bone scintigraphy, nuclear medicine bone-localizing radiopharmaceuticals are now routinely used to aid in the diagnosis of ATTR cardiac amyloidosis.2. Both quantitative and semi-quantitative visual guidelines exist to suggest the presence of cardiac amyloidosis.3. PET amyloid agents may have a role in cardiac amyloidosis, with a greater detectability of AL amyloidosis.

TABLE OF CONTENTS/OUTLINE

I. IntroductionII. Cardiac amyloidosis A. Pathophysiology and Amyloid Subtypes B. Symptoms C. Diagnosis D. Treatment and PrognosisIII. Nuclear amyloid imaging A. Radiopharmaceuticals 1. 99mTc-PYP 2. 99mTc DPD/MHDP/HDP B. Imaging protocol 1. Planar/SPECT 2. 1 hour with optional 3 hour 3. Patient selectionIV. Interpretation A. Quantitative - H/CL ratio B. Semi-quantitative visual score C. Incidental findingsV. Other agents A. PET agents - possible use in AL amyloidosis 1. 11C PiB 2. 18F amyloid tagging agents B. Advantages and disadvantages of various agentsVI. Conclusion

NMMIEE-55 Incidental Emergencies On PET/CT Scan

Participants
Hina Shah, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Describe various incidental emergent findings observed on PET/CT scans performed for unrelated reason. Follow-up details would be provided wherever available These are usually sequela of the malignancy or related to the treatment. But in some cases are unrelated and are related to either known prior medical or surgical conditions. It is important to recognize these and alert the clinician so appropriate timely management can be provided.

TABLE OF CONTENTS/OUTLINE

Different case based presentation using multimodality images and videos would be used to highlight the incidental emergency findings in patient undergoing PET/CT scan for unrelated reasons.The organs/ cases would include (incomplete list)1. Brain metastasis2. Vascular abnormalities include thromboembolic phenomenon3. abdominal abnormalities like intestinal obstruction, pneumatosis, obstructive renal calculi

NMMIEE-56 Dense Breast. To Have Cancer Or Not, That´s The Question. Breast PET As An Invaluable Tool To Diagnose New Breast Cancer Lesions

Participants
Gisela Estrada, MD,PhD, Cancun, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

Recognize the incidence of new breast cancer lesions in patients with dense breast, using mammography and compared it with breast PET and the fusion of PET with mammography. To review the incidence of bilateral lesions and the added benefits in patients with implants.

TABLE OF CONTENTS/OUTLINE

METHODS. We review all the patients in the data base from 2016 to 2019. We include only patients with breast mammography in

order to perform the fusion with the breast PET. A total of 105 patients with dense breast were included. RESULTS. From the 105 patients with dense breast, 29 had density type D and 76 had density type C. 40 right, 59 left and 6 bilateral lesions. Invasive ductal breast cancer was the most common. 6 patients, all with breast density type D, had bilateral lesions, not suspected in the mammography. 16 patients with suspected lesions in the mammography were negative with breast PET, 5 of them with density type D. From the 8 patients with implants, the breast PET was positive in 5 patients. 16 patients had multifocal disease, 15 had multicentric disease, 16 had intraductal disease. In 34 patients the breast PET contributed with more information than the mammography. CONCLUSIONS. Breast PET is not affected by breast density or by hormonal status. In the patients with implants the breast PET was very useful. Breast PET can show multifocal or multicentric disease and intraductal involvement. In 30.8% of cases the breast PET contributed with more information than the mammography.

NMMIEE-6 Anatomic And Functional Imaging Of IgG4-Related Disease And Its Mimics

Awards
Identified for RadioGraphics

Participants
Kenneth Huynh, BS, Orange, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the spectrum of IgG4-related disease with a case-based review of associated mimicking entities.2. To review the multi-modality imaging of the IgG4-related disease spectrum, with emphasis on the importance of whole-body PET/CT in diagnosing IgG4-related diseases and evaluating therapeutic response.

TABLE OF CONTENTS/OUTLINE

IgG4-related disease (IgG4-RD) is a systemic sclerosing disease with lesions affecting nearly any organ. Common sites of involvement including the pancreas, biliary tree, salivary glands, periorbital tissue, lungs, kidneys, lymph nodes, aorta and retroperitoneum, and thyroid gland will be reviewed. Importantly, IgG4-RD is responsive to corticosteroids and rituximab therapy; prompt diagnosis is paramount to avoid delay in treatment and unnecessary pharmacologic/surgical intervention. Functional whole-body imaging with PET/CT is a useful adjunct for targeting extrapancreatic biopsy sites, monitoring therapy, and demonstrating disease relapse. This educational exhibit will (1) review the imaging features of the IgG4-RD spectrum and its associated mimics and (2) emphasize the role of PET/CT in localizing organ involvement and therapeutic surveillance of IgG4-RD.

NMMIEE-7 Not Just Donuts! A Refresher In Cardiac SPECT Perfusion

Participants
Heather Cole, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Coronary artery disease (CAD) is the leading cause of death for men and women in the US. One person dies every 36 seconds in the US from cardiovascular ischemic events. Therefore, high-risk CAD patients benefit from early coronary revascularization based on the extent of myocardial ischemia. It is widely accepted that single photon emission computed tomography (SPECT) has improved assessments of myocardial perfusion and has been utilized to identify revascularization candidates. Sestamibi and Tetrofosmin are the radiotracers most commonly used in myocardial perfusion imaging. These lipophilic agents passively diffuse across cell membranes and localize in the mitochondria. Not only are these radiotracers essential for identifying life threatening cardiac events, the ability of these agents to localize in metabolically active tissue allows for identification of non-cardiac pathology having a profound effect on a patient's outcome. Along these lines, we have collected an arsenal of case studies highlighting the incidental findings from cardiac SPECT imaging including malignancy, metabolic diseases, and chronic pathologies. The purpose of this presentation is to not only provide a refresher course for cardiac perfusion imaging, but also convey the significance of reviewing ALL the data provided by SPECT, not just the "donuts".

TABLE OF CONTENTS/OUTLINE

Imaging methodologies of SPECT. Identification of CAD. Exercise v pharmacologic stress. Anatomy. Single photon radiotracers overview. Case examples of non-cardiac pathology

NMMIEE-8 Applications Of PET/MRI In Peripheral Nerve Disorders

Awards
Certificate of Merit

Participants
Joshua Olson, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

Integrated PET/MRI imaging allows for morphologic evaluation, tissue characterization, and provides quantitative information about molecular and physiologic changes that precede structural changes and help guide biopsy. PET and MRI play a complementary role in distinguishing benign and malignant peripheral nerve sheath tumors. PET/MRI can assist in the diagnosis of B-cell neurolymphomatosis, often an isolated site of disease presenting after disease progression or recurrence. Brachial and lumbosacral plexus PET/MRI is helpful in identifying perineural metastasis from breast, lung, and prostate carcinoma, with important tumor staging implications.

TABLE OF CONTENTS/OUTLINE

Review of integrated PET/MRI protocols and inherent strengths of each modality. PET radiotracers will include 18F-FDG, 11C-choline, and 18F-florbetapir Pictorial review of PET/MR applications in peripheral nerve pathologies, including: Peripheral nerve sheath tumors, including neurofibroma, schwannoma, perineurioma, neuromuscular choristoma, and hybrid nerve sheath tumors. Malignant peripheral nerve sheath tumors. Differentiating radiation change from perineural tumor spread. Perineural metastasis from lung, breast, and prostate primaries with a discussion on staging and treatment implications. Neurolymphomatosis, a rare condition characterized by lymphomatous involvement of the peripheral nerves. Peripheral nerve amyloidosis.

NMMIEE-9 18F-Fluoroestradiol PET/CT Utility For Breast Cancer Imaging

Participants
Matthew Covington, MD, Salt Lake City, Utah (*Presenter*) Consultant, inviCRO, LLC

TEACHING POINTS

1. 18F-Fluoroestradiol (FES)-PET/CT images radiolabeled estradiol bound to estrogen receptors (ERs), allowing systemic imaging of ERs at sites of breast cancer. 2. FES-PET/CT was FDA approved in 2020 for use in patients with recurrent or metastatic breast cancer as an adjunct to biopsy. 3. FES-PET/CT allows imaging of ER status for the entire tumor volume, thereby allowing body-wide assessment of tumor heterogeneity that may exist between the primary site and metastases or between various sites of metastatic disease. 4. FES-PET/CT may confirm sites of ER positive metastatic disease at sites of the body that are difficult to biopsy, such as within the brain or bones. 5. By depicting sites of ER+ disease, FES-PET/CT may be particularly well suited for evaluation of invasive lobular carcinoma (ILC), given the high rate of ER positivity with ILC, and known false negative examinations when imaging ILC with 18F-Fluorodeoxyglucose-PET/CT. 6. FES-PET/CT uptake may also predict subsequent response to hormonal therapies and act as an imaging test to confirm effective dosing of ER targeted therapies.

TABLE OF CONTENTS/OUTLINE

Introduction to FES-PET/CTMechanism of actionNormal distribution of uptakePotential indicationsEvaluation of systemic ER+ disease burdenAdjunct to biopsy for breast cancer evaluation.Utility at sites difficult to biopsy such as bone and brainInvasive lobular carcinoma stagingImaging to guide effective dosing of ER-targeted therapiesImaging case presentationComparison between FDG- and FES-PET/CTFuture directions

Abstract Archives of the RSNA, 2021

GIEE
Gastrointestinal Education Exhibits

Sub-Events

GIEE-1   **Imaging Update For Hereditary Abdominopelvic Neuroendocrine Tumors**

Awards
Certificate of Merit

Participants
Hanna Ferreira Dalla Pria, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Updates in diagnostic criteria, treatment options, and classification of neuroendocrine tumors (NETs) have led to a better understanding of their physiopathology, and many of these have been linked to characteristic genetic alterations or familial/hereditary syndromes. Up to 25% of abdominopelvic NETs are related to hereditary syndromes. The updates in imaging, diagnosis, management, and surveillance strategies for hereditary neuroendocrine tumor syndromes allow for early detection and prolonged survival. Combinations of imaging and genetic/molecular evaluation approaches have improved the diagnostic and screening capabilities for hereditary NETs.

TABLE OF CONTENTS/OUTLINE

A brief review of abdominopelvic neuroendocrine tumors, highlighting the clinical and molecular pathology features that can be helpful in diagnosis and management.Imaging-based approach with teaching points for diagnosis and/or work-up of equivocal cases of several hereditary Gastroenteropancreatic and Genitourinary NETs on anatomic (CT/MRI) and functional (PET/CT and PET MRI) cross-sectional imaging.Evaluation of the primary hereditary NET, therapeutic response, and recurrence in these cases.Current guidelines for surveillance of hereditary NETs.Limitations of current imaging methods and new directions.Take-home messages.

GIEE-10   **Good Things Come To Those Who Wait!**

Participants
Aashna Karbhari, MD, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Wait and watch protocol for rectal cancer can be applied to select group of patients for organ preservation and improving patients' quality of life.2. More intensive surveillance protocol is needed for rectal cancer patients with complete clinical response post neoadjuvant chemoradiation (NACRT). 3. Patterns of complete response on MRI post NACRT in rectal cancer patients.4. Role of the radiologist in identifying tumor recurrence / residual tumor.5. Multidisciplinary approach and good communication are the key to success.

TABLE OF CONTENTS/OUTLINE

• Historical perspective: Emergence of Wait and Watch policy• Inclusion and exclusion criteria for patients eligible for wait and watch policy in the management of rectal cancer• Assessment of complete clinical response (radiology, clinical examination and endoscopic findings)• Surveillance protocol for watchful waiting post neoadjuvant chemoradiation therapy after complete clinical response, and further clinical management in cases of recurrence.• Illustrate the various patterns of complete response, residual tumor and disease recurrence post NACRT on rectal MRI.• Role of diffusion imaging weighted in assessing tumor viability • Role of intrarectal brachytherapy boost in select patients for potential wait and watch• Role of the tumor board in joint decision making• Overall outcomes in patients on wait and watch protocol

GIEE-100   **Distal Ileum And Appendiceal Endometriosis: A "Where's Waldo"-like Disease**

Participants
Joao Stern, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Endometriosis is a common disease affecting 5-10% of women of reproductive age, frequently multifocal with intra and extra-pelvic dissemination, as such the evaluation and mapping of disease can beneficiate of systematic interpretation and structured reporting, stimulating the reader to search for foci of endometriosis in all the compartments and visible structures, including base of cecum, distal ileum and appendix.- Although the bowel is the most common site of extragenital endometriosis, the ileum and appendix involvement are rare in comparison with the rectosigmoid junction and sigmoid colon, and as such are often overlooked in MR images.- Intestinal endometriosis can present as acute intestinal obstruction, thus the importance of early diagnosis and recognition in emergency contexts to improve surgical outcomes.- Appendiceal endometriosis may appear in many imaging patterns, radiologist should know the different features to recognize and diagnose appendix involvement.

TABLE OF CONTENTS/OUTLINE

Literature review.Cases demonstrating different presentations of appendiceal endometriosis and distal ileum endometriosis with and

without intestinal subocclusion/obstruction on CT and MR images.Practical tips to recognize appendix and distal ileum involvement in endometriosis.

GIEE-101   Artifacts In Contrast-enhanced Ultrasound: Don't Burst Your Bubble!

Awards
Magna Cum Laude
Identified for RadioGraphics

Participants
David Fetzer, MD, Dallas, Texas (*Presenter*) Research support, Koninklijke Philips NVResearch support, Siemens AGResearch support, GE HealthcareConsultant/Advisory Board, Philips HealthcareConsultant/Advisory Board, GE Healthcare

TEACHING POINTS

1) Similar to other imaging modalities, artifacts are encountered in contrast-enhanced ultrasound (CEUS), many of which are unique to this modality. 2) Some artifacts may simulate pathology or lead to erroneous diagnoses. 3) This education exhibit will list the various artifacts and inform the reader how to recognize and correct them to improve study quality and diagnostic confidence.

TABLE OF CONTENTS/OUTLINE

- Introduction: a. Briefly review microbubble formulation and pharmacokinetics; b. Discuss imaging techniques that optimize CEUS image quality;c. Review technical factors affecting study quality. - Artifacts with case examples and helpful tips for each: a. CEUS-specific Artifacts i. Non-linear artifacts: 1. Highly echogenic interfaces; 2. Incomplete subtraction of tissues; 3. Pseudo-enhancement; ii. Bubble Destruction: 1. Near-field signal loss; 2. In-plane signal loss; 3. Pseudo-washout; iii. Effects of Microbubbles: 1. Signal saturation; 2. Attenuation and shadowing; 3. Color Doppler enhancement; 4. Pulse-wave Doppler signal degradation. b. Non-specific US Artifacts i. Through-transmission and shadowing; ii. Poor acoustic penetration; iii. Refraction and reflection; iv. Reverberation

GIEE-102   Optional MRI Sequences for LI-RADS : Why, What, and How

Participants
Omar Kamal, MBChB, Portland, Oregon (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Diffusion-weighted imaging, subtraction imaging and the hepatobiliary phase with gadobenate contrast are optional sequences according to the liver imaging reporting and data system (LI-RADS) technical recommendations.2) These optional sequences are often crucial for the characterization of hepatic observations.3) Optimal scanning technique enables good image quality and eliminates common artifacts.4) Knowledge of common associated pitfalls allows for accurate interpretation.

TABLE OF CONTENTS/OUTLINE

1)Background and overview Overview of LI-RADS MRI technical recommendations. 2)Diffusion weighted imaging Sequence description. Reasons for Optional Status. Added value: Diffusion restriction: an ancillary feature of malignancy in general, non-targetoid LR-M feature, helps differentiate true lesion vs perfusional changes, detect additional lesions, help identify parenchymal lesion when postcontrast identification is limited (tumor thrombus, infiltrative HCC), treatment response. Common artifacts/pitfalls. 3)Subtraction images Sequence description, reasons for Optional Status. Added value: In intrinsic high T1 signal observations: Confirm true arterial hyperenhancement and true washout. Common artifacts/pitfalls. 4)Hepatobiliary phase with gadobenate/gadoxetate: Sequence description. Reasons for Optional Status. Added value: Improved lesion conspicuity, prognostic information. Common artifacts/pitfalls: Focal hepatic parenchymal defects and impaired hepatobiliary function.

GIEE-103   Pancreas Adenocarcinoma: Using MRI For Staging To Surveillance With A Surgeon'S Perspective

Awards
Certificate of Merit

Participants
Mudassir Syed, DO, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

CT is the accepted modality for pancreas cancer staging and surveillance; however, at our institution MRI is the preferred modality. MRI provides superior contrast resolution, is as effective as CT for local staging and is more sensitive in detecting liver metastases and peritoneal implants. It is important for the radiologist to be familiar with staging and monitoring of pancreatic cancer and to recognize when MRI may offer an advantage. Additionally, understanding the surgeon's needs are vital as surgery offers the only potential cure in this disease with a typically dismal prognosis.The objectives of this exhibit include: * Discussion of imaging modalities for pancreas adenocarcinoma * Review of "need to know" findings for the surgeon * Analysis of imaging after neoadjuvant therapy * Assessment of findings during surveillance

TABLE OF CONTENTS/OUTLINE

1. Background 2. Imaging modalities a. CT b. MR c. PET 3. Imaging features of pancreas adenocarcinoma on MR 4. Differential diagnoses with case examples 5. Staging and Surgeon "need to know" 6. Imaging after neoadjuvant therapy 7. Surveillance imaging

GIEE-104   Ensuring Your LI-RADS Reporting Is In MiNT Condition - A Pneumonic For The Often Overlooked LI-RADS Decision Tree.

Participants
Deborah Kennedy, DO, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

[1] Have a basic understanding of LI-RADS reporting, which includes understanding the difference between the LI-RADS decision tree and the LI-RADS chart. [2] The LI-RADS criteria begins with the often overlooked decision tree, which is comprised of categories such as LR-M, LR-NC, and LR-TIV, all of which must be excluded before moving onto the well known LI-RADS chart. [3]

These categories can be easily remembered with the pneumonic MiNT (LR-M, LR-NC, and LR-TIV). [4] Finally, the LR-M category is comprised of multiple subcategories, which can be remembered with the alliteration LR-M for "Margin" (targeted lesions); "Mottled" appearance (infiltrative lesion), and "Marked" (Marked restricted diffusion).

TABLE OF CONTENTS/OUTLINE

[1] Background on when to apply LI-RADS criteria and the difference between the LI-RADS decision tree and table. [2] Emphasize the importance of proper characterization by initially utilizing the decision tree and subsequently applying the LI-RADS table. [3] Introduce the MiNT pneumonic for remembering the decision tree categories. [4] Examples will be given of each MiNT category to better recognize and accurately report them. These examples include images and diagrams to help solidify the pneumonic. [5] Introduce the "M" alliteration for remembering the subcategories of LR-M. [6] Additionally, examples will be given of the main LR-M subgroups. [7] Proper characterization leads to consistency and reproducibility in imaging reports, which in turn, leads to proper staging and management recommendations for HCC.

GIEE-105   Bag Of Tricks: Role Of Contrast-Enhanced Ultrasound In Evaluation Of Gallbaldder Pathology

Participants
Kanupriya Vijay, MBBS, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Conventional grayscale ultrasound (US) is very useful in identifying various gallbladder disease; however, assessment of microvascularity is needed to distinguish many benign from malignant disease processes.2. Contrast enhanced ultrasound (CEUS) is a straightforward and effective modality to differentiate such pathologies as tumefactive sludge from gallbladder cancer. 3. CEUS may be useful in differentiating benign wall thickening from chronic cholecystitis and gallbladder cancer. 4. CEUS can accurately demonstrate the microvascularity used to differentiate adherent biliary precipitate from polyps, and can help identify features of malignancy; Cholecystectomy tube injection of ultrasound contrast can be used to determine cystic duct patency and identify leak.

TABLE OF CONTENTS/OUTLINE

1. Introduction: a. Briefly review microbubble formulation and pharmacokinetics;b. Discuss imaging techniques with CEUS to optimize image quality;2. Case guided review of various gallbladder pathologies a. Benign i. Stones ii. Adenomyomatosis iii. Polyps iv. Chronic cholecystitis v. Tumefactive sludgeb. Malignant i. Gallbladder carcinoma ii. Malignant polyps3. Role of CEUS in interventions • Image guided biopsy• Evaluation of cholecystostomy tube for cystic duct patency and leaks4. Pitfalls

GIEE-106   Case Based Review: MRI Assessment Of Rectal Carcinoma After Neoadjuvant Chemoradiation Therapy

Awards
Certificate of Merit

Participants
Alon Slutzky, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Discuss the treatment pathway of rectal carcinomas, including the potential of non-operative management. Review the MRI imaging protocol utilized in the evaluation of rectal carcinoma.Provide a pictorial representation of the MRI tumor response grading system.Practice assigning Tumor Response Grades utilizing cases from our large multicenter database.

TABLE OF CONTENTS/OUTLINE

Accurately assessing the response of rectal carcinoma following neoadjuvant chemoradiation therapy (CRT) is essential for restaging, prognostication and treatment planning. Although not universally adopted, the utilization of the five-point MRI Tumor Response Grading System allows for a standardized language that can be easily understood by colorectal surgeons, oncologists and patients. Knowledge of the varied imaging features of post-treatment rectal carcinomas will aid radiologists in diagnosing tumor response and identifying patients that may benefit from nonoperative management. • TNM staging of rectal carcinoma • Rectal carcinoma treatment options (TME, APE, LAR, Watch and Wait) • Imaging features of rectal carcinoma before and after neoadjuvant chemoradiation therapy • Case based review of each MR tumor response grade (1-5) • Review numerous cases and assign the appropriate mrTRG

GIEE-107   Help From Below: Gastric, Jejunal And Colon Interposition.

Participants
Bethsabel Rodriguez Encinas, MD, Tlalpan, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Explaining the anatomy by fluoroscopy of gastric and intestinal interposition as esophageal replacement.- Indications for gastric and intestinal interposition.- Getting to know the protocol to adequately assess the transit of the bolus through gastric and intestinal interposition.- Identifying the different alterations found in postsurgical gastric and intestinal interposition patients.- Recognising the immediate complications of gastric and intestinal interposition.

TABLE OF CONTENTS/OUTLINE

1. Introduction to bolus swallow through intestinal interposition in postsurgical patients.a. Review of normal anatomy.b. Review of postsurgical anatomy.c. Fluoroscopy protocol.2. Bolus swallow protocol in intestinal interposition.a. Normal transit of the bolus under intestinal interposition conditions.b. Discerning different techniques of gastric and intestinal interposition.3. Alterations of the bolus transit under gastric and intestinal interposition conditions.a. Post-surgical complications.4. Summary.a. Pearls.

GIEE-108   Contrast-Enhanced Ultrasound To The Rescue: Leveraging CEUS To Resolve Indeterminate Findings At CT/MRI LI-RADS

Participants
David Fetzer, MD, Dallas, Texas (*Presenter*) Research support, Koninklijke Philips NVResearch support, Siemens AGResearch support, GE HealthcareConsultant/Advisory Board, Philips HealthcareConsultant/Advisory Board, GE Healthcare

- American College of Radiology Liver Imaging, Reporting and Data System (ACR LI-RADS) includes several integrated algorithms, including CT/MRI LI-RADS and Contrast-Enhanced Ultrasound (CEUS) LI-RADS for the diagnosis of hepatocellular carcinoma (HCC); - Technical and patient factors, confounders, and indeterminate imaging features may prevent definitive characterization of liver observation; - Emerging data suggest CEUS may demonstrate major features of HCC, such as arterial-phase hyperenhancement (APHE) and washout (WO) when not present at CT or MRI ; - CEUS helps differentiate HCC from non-HCC malignancies. - CEUS may be helpful in assessing treatment response when CT or MRI are contraindicated or indeterminate; - CEUS may guide procedures such as biopsies and targeted therapies.

TABLE OF CONTENTS/OUTLINE

- Briefly review ACR LI-RADS system, and the CT/MRI and CEUS diagnostic algorithms, focusing on key similarities and differences; - Emphasize benefits of CEUS that improve detection of APHE: contrast sensitivity; continuous imaging; ability to reinject contrast; - Describe the value of CEUS in patients with renal failure or contraindications to iodine or gadolinium contrast; - Discuss differences of contrast pharmacokinetics and impact on imaging technique: pure blood pool agent; rapid clearance; dynamic bubble stimulation and destruction;- Provide case examples of indeterminate CT and MRI findings clarified by CEUS; - Highlight the use of CEUS in procedure guidance and treatment response.

GIEE-109 Don't Trust Your Gut: Diagnostic Pearls In Eosinophilic And Other Autoimmune Entities Of The GI Luminal Tract

Participants
Miriana Mariussi, MD, Pilar, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Reviewing the regulatory mechanism of the intestinal immune system • Identifying the autoimmune entities of the GI luminal tract • Presenting frequent cases and complications • Correlating the radiological features with endoscopic/colonoscopic and histologic findings • Providing key diagnostic findings

TABLE OF CONTENTS/OUTLINE

• Introduction • Autoimmune entities of the GI luminal tract explained: Eosinophilic esophagitis, Eosinophilic gastroenteritis, Celiac Disease, Microscopic Colitis (Collagenous colitis and Lymphocytic colitis), Inflammatory Bowel Disease (Crohn's disease and Ulcerative Colitis), Nodular Lymphoid Hyperplasia and Autoimmune Enteropathy. • Case-based approach with radiologic correlation • Imaging findings with endoscopic/colonoscopic and histologic correlations • Differential Diagnosis • Conclusion

GIEE-11 Fluoroscopy Of The Bile Ducts: Anatomic Variants, Stones Versus Air Bubbles, Benign And Malignant Pathologies And Bile Duct Leaks

Participants
William Thompson, MD, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

Fluoroscopic Cholangiography includes the procedures which use the injection of contrast agents into the biliary system. These procedures are performed by Radiologists, Surgeons and Gastroenterologists. The studies include ERCPs, Intraoperative and T-tube cholangiograms and percutaneous transhepatic cholangiograms. For appropriate patient management, Radiologists should have knowledge of normal biliary anatomy, anatomic variations and pathologic conditions of the bile ducts. After reviewing this exhibit radiologists will: 1. Understand how each study is performed, 2. Know the important anatomic variations and 3. Be able to recognize bile duct abnormalities.

TABLE OF CONTENTS/OUTLINE

Introduction. Test cases. Definition of each procedure. Normal bile duct anatomy. Anatomic variations. Stones versus air bubbles. Strictures. Non-strictured abnormalities. Bile duct leaks. Take Home Points

GIEE-110 Imaging Of Sinusoidal Obstruction Syndrome: Current Status And Emerging Role In Early Diagnosis.

Participants
Deepashri Basavalingu, MBBS, Seattle, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Sinusoidal obstruction syndrome/ Veno- occlusive disease (SOS/ VOD) results due to damage to the endothelium of hepatic sinusoids, often recognized in the clinical setting of stem cell transplantation. 2. Diagnosis of SOS/ VOD is done using clinical (for example, EBMT criteria) and imaging criteria (for example, Lassau criteria).3. In addition to liver ultrasound and doppler, elastography has an increasing role in sonographic evaluation of SOS/ VOD.4. Other imaging modalities such as CT and MRI may be useful in problem solving in complex cases with suspected SOS/VOD.

TABLE OF CONTENTS/OUTLINE

1. Background- what's in a name- sinusoidal obstruction syndrome/ veno- occlusive disease (SOS/VOD). 2. Pathophysiology of SOS/VOD. 3. Clinical presentation and clinical criteria used in the diagnosis of SOS/VOD in children and adults. 4. Overview of how early diagnosis can save lives and improve clinical outcomes.5. Grayscale, color and spectral doppler ultrasound findings in diagnosis of SOS/ VOD. 6. A review of imaging criteria in the diagnosis of SOS/VOD. 7. Can we catch it early- role of ultrasound elastography in children and adults and how we do it. 8. Monitoring and severity grading of SOS/VOD. 9. Role of other imaging modalities in the evaluation of suspected SOS/ VOD. 10.Imaging differentials for consideration and key findings. 11. Treatment and prognosis of SOS/ VOD.

GIEE-112 Advanced Applications Of Gadoxetic Acid-enhanced Magnetic Resonance Imaging: What To Expect?

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Sandra Baleato Gonzalez, MD, PhD, Santiago de Compostela, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Gadoxetic acid is a gadolinium-based liver-specific MRI contrast agent that distributes into the vascular and extravascular spaces and progressively into the hepatocytes and bile ducts during the hepatobiliary phase. This information is particularly relevant for the detection characterization of focal liver lesions, but also has potential indications for the functional assessment of the liver and the biliary system.The aim of this exhibit is: To know physiopathology and imaging protocol for using this contrast.To establish main clinical applications.To describe tips, tricks, and pitfalls of its use.To review advanced applications for liver function assessment, staging of fibrosis and cirrhosis, tumor response, prediction of liver transplant graft survival, and risk assessment of liver failure after major resection.

TABLE OF CONTENTS/OUTLINE

1.Technique (sequences, injection).2. Work-flow and abbreviated protocols. 3. Clinical uses: 3.1. Focal Liver lesion: characterization.3.2. Treatment decision-making and follow-up in metastatic disease and hepatocellular carcinoma: staging, assessment of oncologic and functional resectability and use with international diagnostic guidelines and LI-RADS.3.3. Diffuse liver disease.3.4. Liver transplant assessment.3.5. Biliary tree.3.6. Pitfalls. 4. Multiparametric functional and molecular liver MRI including gadoxetic acid: a one stop shop tool.5. Biomarker: Prognostic and predictive value and response assessment.6. Future: Radiomics

GIEE-113   Mri Of Rectal Cancer: Challenges And Opportunities

Participants
Adam Wetzel, MD, Chambersburg, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The rate at which people are diagnosed with colorectal cancer in the US is dropping among people 65 and older but rising in younger age groups.2. MRI plays an important role in the initial staging of rectal cancer as it helps determine the need for neoadjuvant treatment and surgical planning. 3. MRI after neoadjuvant chemotherapy can help identify suitable candidates for active surveillance when combined with endoscopic findings.4. Growing body of evidence suggests that computer extracted features (i.e. radiomics) from MR images can help identify patients who may or may not benefit from neoadjuvant treatment.

TABLE OF CONTENTS/OUTLINE

1. Introduction; 2. Rectal MRI technical considerations; 3. Initial Staging- T and N stage;- Imaging Biomarkers; 4. Restaging- MRI criteria; - Endoscopic Considerations. 5. Active Surveillance; 6. Role of Radiomics; 7. Conclusion

GIEE-114   Imaging Roadmap For Colorectal Liver Metastasis Assessment (CRLM)

Participants
Cairo Mendes JR, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Over one-half of patients with colorectal cancer develop liver metastases at some point and surgical resection associated with other regional treatments offers a chance of cure and long-term survival. Therefore, the aim of this study is to outline imaging appearances, the surgical rationale for patients with CRLM, and the imaging criteria used to determine which tumors are potentially resectable.To review radiological findings of CRLM;To exhibit a roadmap for the radiology report;To show the relevant informations to aid in surgical planning;To help the postoperative evaluation.

TABLE OF CONTENTS/OUTLINE

Preoperative evaluation with CT and MRI, including hepatobiliary specific agents;How to report?- anatomical variations- number, location, size and margins of lesions- relationship with adjacent structures- possible future liver remnantPostoperative evaluation.Specific surgical techniques: portal vein embolization, partial hepatectomy, ALPPS (Associating Liver Partition and Portal vein ligation), radiofrequency ablation and radioembolization.

GIEE-115   Roles Of MRI Evaluation Of Pelvic Recurrence In Patients With Rectal Cancer

Awards
Certificate of Merit

Participants
Patricia Dantas I, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:1. To review the most relevant risk factors for local recurrence in patients with rectal cancer in regard to MRI preoperative staging and histopathological results after surgery.2. To discuss the roles of follow-up imaging and endoscopic examinations.3.To illustrate imaging patterns and pitfalls of locally recurrent rectal cancer detected during imaging surveillance.4. To clarify significant MRI staging information to guide treatment options for pelvic recurrence.5. To propose a structured proforma to ascertain meaningful information to radiology reports.

TABLE OF CONTENTS/OUTLINE

- Review on the main imaging and histopathological findings related to increased risk of local recurrence.- Recognition of patterns of local recurrence imaging findings during follow-up (anastomotic recurrence; lateral recurrence; radial recurrence; peritoneal recurrence).- Pitfalls.- Illustrative key points during pelvic recurrence staging (bone invasion; vascular invasion; pelvic organs invasion; bowel invasion; pelvic wall invasion).- Discussion on resectability and unresectability criteria.- Checklist of information that aid surgical decisions.

GIEE-116   Optimizing CT/MR Imaging In The Cirrhotic Patient From Start To Finish

Participants

Anuradha Shenoy-Bhangle, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Highlight commonly encountered reasons for degradation of cross-sectional image quality in cirrhotic patients and discuss proactive measures to counter these reasons.2. Discuss preventative strategies to improve image quality and strategies to interpret the study despite the artifact.

TABLE OF CONTENTS/OUTLINE

1. Review commonly encountered patient-related reasons for quality degradation with cross-sectional imaging in cirrhotic patientsa. Claustrophobiab. Poor breath hold capabilityc. Pain/Discomfortd. Poor communication 2. Workflow solutions to address patient-related reasons to improve image quality a. Claustrophobia: -Opt for CT rather than MRIb. Poor breath hold capacity: -Abbreviated MRI where possible -Free breathing protocols 3. Identify artifacts and enumerate strategies to accurately interpret the study despite the artifact. Artifacts and strategies to be discussed include CT: -Improper contrast bolus timing-High BMI with suboptimal radiation dose -Beam hardening artefacts -Intrinsic hyperdense hepatic nodules limiting optimal evaluation of enhancement MRI: -Susceptibility artefact -Conductive and dielectric effects -Misregistration artefact -Diffusion and ADC mismatch -Hemorrhage causing false-positive restricted diffusion-Intrinsic T1-hyperintense signal causing false-positive arterial phase enhancement -False-positive washout appearance

GIEE-117   A Call To Action: Review Of Knowledge Gaps In The LI-RADS Treatment Response Algorithm (LR-TRA) Version 2017.

Participants
Anuradha Shenoy-Bhangle, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. LR-TRA is a standardized system for assessing and reporting hepatic observations following liver directed locoregional therapy (LRT) in patients with hepatocellular carcinoma (HCC).2. Familiarity with pitfalls associated with the LR-TRA, version 2017 is important for correct application of the algorithm. 3. Gaps in knowledge related to LR-TRA need to be addressed for future refinement and improvement of the algorithm.

TABLE OF CONTENTS/OUTLINE

Knowledge Gaps: 1. Can the LR-TRA accurately predict complete pathologic necrosis when applied to various types of locoregional therapies?2. Role of contrast-enhanced ultrasound (CEUS) in LRT assessment? 3. Can LR-TRA be accurately applied after radiation-based LRT?4. Inter-modality agreement between CT and MR for category assignment in LR-TRA for the same treated observation?5. Role of ancillary features in the LR-TRA?6. What is the most accurate approach to measure residual disease in cases of LR-TR Viable?7. Significance of the LR-TR equivocal category?

GIEE-118   Functional Gastrointestinal Disorders: Spectrum Of Multimodality Imaging Findings

Participants
Mohamed Badawy, BMBCh, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Pathophysiology and etiology of functional gastrointestinal (GI) disorders • Multi-modality imaging features of functional GI disorders from the pharynx down to the anorectal region • Algorithmic approach to the differential diagnosis of findings in each affected organ • Functional changes related to aging, radiation therapy, and different medications • Potential pitfalls in imaging diagnosis

TABLE OF CONTENTS/OUTLINE

Introduction Pathophysiology of functional gastrointestinal disorders Etiology (organ-related): i Pharynx: swallowing disorders, bulbar palsy, cricopharyngeal muscle dysfunction i Esophagus: gastroesophageal reflux disease (GERD), diffuse esophageal spasm, achalasia, scleroderma, esophagogastric outflow obstruction, poor contractility, nutcracker esophagus) i Gastroduodenal: gastroparesis, functional dyspepsia i Intestine: irritable bowel syndrome, intestinal pseudo-obstruction i Gall bladder and biliary: gallbladder and sphincter of Oddi dysfunction i Pancreatic functional disorders i Anorectal functional disorder i Functional abdominal pain in children i Functional changes in elderly, functional GI disorders and medication use (proton pump inhibitors, antidepressants, and narcotics), and radiotherapy related abnormalities Optimization imaging techniques Organ-specific imaging findings and differential considerations Effect of imaging findings on management options Conclusion

GIEE-119   Budd Chiari SyndromeFrom Diagnosis To Management;#8211; A Clinico;#8211;Radiological Perspective.

Participants
Poorvi Malik, MBBS, Ajmer, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To familiarize with etiopathogenesis and regional differences of different types of Budd Chiari Syndrome(BSC). 2. Imaging checklist in suspected cases of BCS. 3. To emphasize on the pitfalls and clues to diagnosis of differential diagnosis. 4. Optimizing patient selection for endovascular treatment. 5. Follow up imaging protocol. 6. Case based approach of Budd Chiari Syndrome and its management.

TABLE OF CONTENTS/OUTLINE

Background - Etiopathogenesis Regional differences between Asian and Western population • Imaging Checklist for suspected cases and role of imaging • Mimics • Management algorithm• Case based approach to diagnosis

GIEE-12   MDCT Evaluation Of Gastroduodenal Ulcer: Imaging Features With Endoscopic And Surgical Correlation

Participants

Dario Herran de la Gala, MD, Santander, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit will: 1) Review the normal anatomy of the stomach and duodenum and the different causes of gastroduodenal ulcer. 2) Describe an appropriate CT protocol for the assessment of gastroduodenal ulcers. 3) To illustrate the spectrum of MDCT findings encountered in uncomplicated & complicated gastroduodenal ulcer with surgical and endoscopic correlation. 4) To establish a differential diagnosis of pathologies that can simulate peptic ulcer disease

TABLE OF CONTENTS/OUTLINE

Incidental diagnosis of Peptic Ulcer Disease (PUD) in patients undergoing MDCT is more common than we think. Albeit not the diagnostic technique of choice, MDCT can diagnose both complicated and uncomplicated PUD. Knowing the particular anatomy of the duodenum helps to better understand the possible complications of PUD and its differential diagnosis. Knowledge of radiological findings of uncomplicated PUD helps to prevent dangerous complications. Pneumoperitoneum around the hepatic hilum and hypoattenuation of the gastroduodenal wall are the main signs to look for in the setting of complicated PUD.

GIEE-121   The Power Of Diffusion Compels You: Importance Of Diffusion In The Interpretation Of Body Mri

Participants
Haresh Naringrekar, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

Diffusion is often underutilized, sub-optimally acquired, or not even obtained. Diffusion can help identify findings that may be otherwise subtle on MRI due to its super dynamic range. Optimize diffusion for body MRI application: Optimal b-values to obtain, Optimizing signal to noise, Reducing patient motion artifact, Increasing NSA, Newer techniques (simultaneous multi-slice acquisition)Use diffusion to help identify abnormalities that are subtle on other sequences due to its superb dynamic range Find normal anatomic structures, Infectious and inflammatory causes, MalignancyPitfalls T2 Shine through, Normal structures that may mimic pathology, Poor technique

TABLE OF CONTENTS/OUTLINE

Optimizing diffusion sequences Signal to noise, Reducing patient motion, TE, NSA, Voxel size/FOV, Optimal B valueUsing diffusion to identify normal structures Endometrium, Ovaries in postmenopausal women, Adrenal glands, Bile ductsUsing diffusion to identify infectious/inflammatory findings Collections ,Cholecystitis, Appendicitis, Abscess, Enteritis/colitis, Infectious peritonitis, Inflammatory bowel diseaseUse diffusion to identify malignancy: Occult malignancy (especially bowel malignancies), Peritoneal spread of tumor, Pancreatic/renal primary neoplasms and metastases, Extent of disease especially in liver where it may be underestimatedPitfalls T2 shine through, Poor technique, Collapsed bowel, Iron Overload, Renal pathology

GIEE-122   Quantitative Imaging With Dual-energy CT In Abdomen

Participants
Nisanard Pisuchpen, MD, Bangkok, Thailand (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Dual-energy CT is an advanced imaging technique, allowing for several quantitative approaches for abdominal imaging. 2. Subjective imaging interpretation alone may be inadequate for disease evaluation, so quantification is essential as an objective tool for accurate information. 3. Combined anatomical and functional information by dual-energy abdominal CT enhances treatment planning and patient management. 4. Developing the standardized or validated criteria for different types of dual-energy CT scanners regarding quantification in abdominal imaging is needed.

TABLE OF CONTENTS/OUTLINE

1. Describe the principle and basic concepts of dual-energy CT. 2. Describe quantitative techniques from dual-energy CT that are currently applied in clinical practice for abdominal imaging. 3. Describe roles of dual-energy CT quantification for abdominal imaging in the diagnosis, guiding medical and surgical treatment, and assessing response to treatment and monitoring disease. 4. Provide pictorial examples for various clinical applications of quantitative imaging by dual-energy CT in abdominal imaging. 5. Discuss limitations, challenges, and future roles for developing quantification by dual-energy CT in abdominal imaging.

GIEE-123   3D Reconstructions In The Treatment Of Liver Malignancies: How Can Imaging Help Clinical Decision

Participants
Giovanna Torre, Sao paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

I.Recognize the most important imaging features to report in a preoperative planningII.Discuss the application on 3D reconstruction in hepatectomies III.Discuss the future directions of virtual reality technology and intraoperative navigation

TABLE OF CONTENTS/OUTLINE

INTRODUCTION• Cross-sectional imaging and the use of liver volumetrics and tridimensional reconstructions• Understand the benefit of 3D reconstructions for a safe surgeryLIVER ANATOMY CONCEPTS• Review the main landmarks of the segmental anatomy of the liver and discuss differences of segmentation based on portal perfusionLIVER SURGERIES• Main types of surgical approaches in hepatic lesions• What information the surgeon needs to know in preoperative planning for liver surgeries with metastatic disease• Calculation of the remaining liver volumeIMAGING TECHNIQUE• Preparation• CT protocol and software managementIMAGING EVALUATION• Didactic case-based approach for 3D reconstruction in liver surgeriesFUTURE DIRECTIONS• What's on the horizon for 3D liver reconstruction for liver surgeries

GIEE-124   Postoperative Biliary Complications: What The Radiologist Needs To Know

Participants
Alexandre Minoda, BMedSc, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

The aim of this exhibit is:- To conduct a brief review of the biliary tree anatomy and its common variants and the utility of preoperative imaging.- To describe the imaging appearances of normal postoperative changes after hepatobiliary surgery.- To list the postcholecystectomy and post liver transplant biliary complications.- To describe the CT, MR imaging and MR cholangiographic imaging features of the major biliary complications after cholecystectomy and liver transplant.

TABLE OF CONTENTS/OUTLINE

INTRODUCTIONAnatomy of the biliary tree and the most common anatomic variants.Biliary variants: implications for surgery-Evaluation before cholecystectomy- Evaluation before liver transplantation MRCHOLANGIOGRAPHIC TECHNIQUE AND UPPER ABDOMEN MRI PROTOCOLSNORMAL POSTOPERATIVE FINDINGS- After cholecystectomy- After liver transplantationIMAGING PATTERNS OF MOST COMMON POSTCHOLECYSTECTOMY BILIARY COMPLICATIONS- Biliary strictures- Biliary transection- Biloma-Hemobilia- Cholangitis- Cholangitic abscess- Fistulas- Cystic Duct Remnant Mucocele- Luschka duct lesionsIMAGING PATTERNS OF MOST COMMON POST LIVER TRANSPLANT BILIARY COMPLICATIONS- Biliary Cast Syndrome- Biloma- Anastomotic Stricture- Non Anastomotic stricture- Ischemic cholangitis- Donor-to-recipient common bile duct disproportion

GIEE-125 What Is New About Pancreatic Cancer Resectability: A Radiological Correlation Of The Nakao Mesenteric Approach

Participants
Helena de Souza, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Pancreatic cancer has a high mortality rate, due to its late diagnosis. Adenocarcinoma represents about 90% of diagnosed cases and mainly affects the head of the pancreas. Radiologists play an essential role in the diagnosis and evaluation of its treatment and prognosis rate. Surgery is the standard treatment, but it's constantly under debate for updates;-The radiological criteria for resectability consider the relationship between the tumor and the surrounding vessels, categorizing the lesions as "RESECTABLE", "BORDERLINE" and "IRRESECABLE". To help the surgeon's decision, the borderline classification is divided into two categories and predicts the chances of resectability;- New surgical techniques are being established. The surgical technique indicated as ideal is pancreatoduodenectomy (PD) isolated. A new mesenteric approach (Nakao's technique) can be considered a safer procedure than other conventional approaches to PD. Radiologists need to get familiar to that.- The objectives of this exhibit are to review the vascular anatomy of pancreas and the radiological criteria for resectability of pancreatic head cancer, with a radiological correlation of the new surgical technique (Nakao mesenteric approach) and the best report to help the surgeon's decision.

TABLE OF CONTENTS/OUTLINE

-Vascular anatomy of the pancreas;-Radiological criteria for resectability of pancreatic head cancer;-Radiological correlation with the new Nakao's surgical technique.

GIEE-126 The Many Faces Of The Fat Liver: A Guide To Recognize All Patterns Of Non-alcoholic Fatty Liver Disease (NAFLD) On Multiparametric Hepatic MRI

Participants
Kalinka Dolcan, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Review the burden of non-alcoholic fatty liver disease (NAFLD)- Definition and classification of NAFLD- Suggestion of Multiparametric hepatic MRI protocol for non-invasive evaluation NAFLD- Imaging patterns on Multiparametric Hepatic MRI of different stages NAFLD

TABLE OF CONTENTS/OUTLINE

INTRODUCTION- Epidemiology of NAFLD- Risk factors- Natural course of the diseaseDEFINITION AND CLASSIFICATION OF NAFLD-Non-Alcoholic Fatty Liver (NAFL)- Non-Alcoholic Steatohepatitis (NASH)- Diagnosis criteria for steatosis and fibrosisDIAGNOSIS METHODS AND LIMITATION- Biopsy- Ultrasound- CT- MRI- ElastographyDIAGNOSING AND STAGING- Multiparametric hepatic MRIMULTIPARAMETRIC HEPATIC MRI PROTOCOL- MR imaging techniqueNORMAL LIVER FINDINGS- Normal images of the liver, correlating didactic illustrations.IMAGING PATTERNS OF DIFFERENT STAGES OF NAFLD- Mild, moderate and marked NAFL- NASH with mild inflammation/fibrosis and advanced inflammation/fibrosis- Cirrhosis with and without steatosisFUTURE DIRECTIONS- Incorporate Multiparametric hepatic MRI as a diagnostic method for the diagnosis of NAFLD- Changing the natural course of the disease and its progression

GIEE-127 Beyond Pancreatic Adenocarcinoma: CT Findings For Rare Malignant Pancreatic Neoplasms

Participants
Marycarmen Flores Duenas, MD, Lima, Peru (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this poster is to show the findings on CT of the rare malignant neoplasms of the pancreas.Introduction: Pancreatic tumors can be primary or metastatic. The primary ones are divided into epithelial and non-epithelial. The epithelial ones are the most frequent and are subdivided into exocrine and endocrine, the most representative of the endocrine ones is adenocarcinoma with a frequency of 90-95%. Pancreatoblastoma: is a very rare malignant epithelial neoplasm, the majority has been detected in children, for more rarely can occur in adults, and the prognosis is worse. Pancreatic lymphoma: represents 1% of extranodal lymphomas and 0.5% of malignant pancreatic tumors. the 80% is represented by diffuse large B-cell lymphoma. Usually between 35-75 years of age and is predominantly male. Pancreatic sarcoma: is a Follicular dendritic cell sarcoma that predominantly occurs in the lymph glands and the extranodal pancreatic localization is very rare. Metastases to the pancreas, represents 2%-4% of pancreatic masses, they typically present as solitary masses, diffuse pancreatic involvement or enlargement, or multiple discrete lesions. Conclusion: It is important to take into account the variety of malignant tumors of the pancreas, and the radiological characteristics of the rarer lesions, to help in the final diagnostic orientation for multidisciplinary management.

TABLE OF CONTENTS/OUTLINE

Pancreatoblastoma.Pancreatic lymphoma.Pancreatic sarcoma.Metastases to the pancreas.

GIEE-129   Non-lithiasic Dilatation Of The Bile Duct: Now What?

Participants
María Loyola, Santiago, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching points:Recognize the different differential diagnoses in patients with non-lithiasic dilatation of the bile duct. Describe the main imaging appearances of non-lithiasic dilatation of the bile duct in the different modalities.Recognize the importance of multidisciplinary management for optimal diagnosis and managementPropose a diagnostic approach for clinical scenarios.

TABLE OF CONTENTS/OUTLINE

Learning objetivesIntroductionObstructive Neoplasm Cholangiocarcinoma Gallbladder adenocarcinoma Pancreatic adenocarcinoma Metastasis -nflammatory AIDS cholangiopathy Biliary parasites Primary sclerosing cholangitis Post inflammatory Post pancreatitis Post radiation or chemotherapyNon obstructive Congenital Caroli disease Primary sclerosing cholangitis Choledochal cyst Infectious Recurrent pyogenic cholangitis Isquemic Post transplant Non transplantSchematic diagnostic approach

GIEE-13   Squeeze And Push! A, B, C...Defecography

Awards
Identified for RadioGraphics

Participants
Jonathan Revels, DO, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review the indications for a defecography exam Understand the techniques and protocols for fluoroscopic and MR defecography Step by step approach on how to perform and interpret fluoroscopic and MR defecography exams Compare fluoroscopy and MR defecography in evaluation of pelvic floor pathologies

TABLE OF CONTENTS/OUTLINE

Background Anatomy of pelvic floor Landmarks and normal measurements on fluoroscopy and MR Common clinical indications for pelvic floor imaging Overview the protocols and techniques (anatomic and functional evaluation) Case-based approach to pathologies: fluoroscopy and MR defecography Anterior compartment Cystocele Urethral hypermobility Middle compartment Prolapse of vaginal apex, uterus or cervix Posterior compartment • Enterocele/Sigmoidocele/Peritoneocele • Rectocele (with and without obstructed defecation) • Rectal Intussusception • Rectal/Anal Incontinence • Anismus/Dyssynergia

GIEE-130   Multimodality Approach Of Metabolic Syndrome

Participants
Fernanda Velloni, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To contextualize the metabolic syndrome as a complex disease and a public health problem; To address the main topics related to metabolic syndrome including epidemiology, physiopathology, diagnosis, treatment and post-treatment evaluation;To discuss the multimodality approach emphasizing the use of new techniques such as: big data analytics for the comprehension of the whole scenario; artificial intelligence for opportunistic diagnosis; and abbreviated MRI protocols for non-invasive longitudinal follow-up;

TABLE OF CONTENTS/OUTLINE

Epidemiological features of metabolic syndrome by using big data analytics resources;Review of the physiopathology through the correlation of laboratory, pathology and imaging findings;Discussion of the diagnostic role of imaging in this context, including the advantages and disadvantages of each technique (US, CT and MRI);Demonstration of the opportunistic detection of biomarkers during unrelated abdominal CTs, which can be potentialized by the use of artificial intelligence algorithms;Discussion of the surgical and clinical treatment options as well as the expected and unexpected results;Presentation of the abbreviated MRI protocols as a tool for non-invasive longitudinal follow-up;Review the usefulness and future perspectives of a multimodality approach for the management of these patients, especially in the current context of precision medicine;

GIEE-131   Layered Detector Dual-energy CT In Abdominal Oncology: A Convincing Pictorial Review!

Awards
Certificate of Merit

Participants
Olivier Lucidarme, MD, Paris, France (*Presenter*) Speaker, Bracco Group;Speaker, F. Hoffmann-La Roche Ltd;Expert Witness, Bayer AG

TEACHING POINTS

With a layered detector, the spectral separation of the X-ray source is realized at the detector level, which allows perfect temporal registration and spatial registration with an excellent management of the noise. This system always acquires in DECT mode, allowing a retrospective spectral evaluation for all scans . Experience is still limited using this technology compared with other DECT techniques. Our purpose is to illustrate with numerous examples of the utility of this technology in abdominal oncology imaging, based on a two-year experience in a large oncology imaging department (over 10,000 CT scans).

TABLE OF CONTENTS/OUTLINE

We will: - Present the workflow enabled by the ability to perform retrospective spectral evaluation for all CT scans, including the reduction of the amount of iodinated contrast medium. - To illustrate the clinical added value of monochromatic virtual images at 40 kev compared to polychromatic images on a variety of hyperenhancing or hypoenhancing abdominal tumors (esophagus, stomach, liver, pancreas, biliary tract, kidney, urinary tract, small and large bowel, rectum and bladder). In our experience, these

monochromatic images should be the new standard in oncologic imaging. -Discuss and illustrate the place of other standard and advanced DECT reconstructions and the Basis material decomposition: the virtual non-contrast, the iodine map, the other monochromatic images, the Z effective map, the electron density map. -Discuss the impact on the place of this technique compared to MRI in our institution.

GIEE-132 Revisiting Response Assessment Of Colorectal Liver Metastases: Lessons Learned And Opportunities For Improvement

Participants
Sireesha Yedururi, MBBS, Sugar Land, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

High-quality baseline studies are crucial for accurate response assessment The combined use of size and morphologic criteria is mandatory for accurate evaluation and both need to be included in the radiology report Optimal morphologic response predicts greater overall survival; yet is underutilized as a surrogate therapeutic endpoint. Criteria are easy to learn with established good inter-observer agreement

TABLE OF CONTENTS/OUTLINE

Introduction. Basic requirements for accurate response assessment. General principles of response assessment with a focus on morphologic response. Limitations of size based criteria. Impact on medical and surgical manag ement- Illustrative case review. Role of PET/CT and MRI. Conclusion

GIEE-133 Imaging and Radiomics in Hepatocellular Carcinoma (HCC): Current Update and Future Perspectives

Awards
Certificate of Merit

Participants
Natally Horvat, MD, PhD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

? Discuss the definition and general concepts of radiomics, textural analysis, radiogenomics, machine learning, and deep learning? Illustrate steps (pipeline) involved in radiomics research? List the most relevant applications of radiomics in HCC? Describe the limitations and challenges to be overcome before its implementation into clinical practice

TABLE OF CONTENTS/OUTLINE

? INTRODUCTION- Definition of textural analysis, radiomics and radiogenomics- General concepts of machine learning and deep learning? STEP BY STEP WORKFLOW INVOLVED IN RADIOMICS-? HCC RADIOMICS? Applications of radiomics in HCCo Histological findings (such as microvascular invasion, pathological grade, differentiating HCC from other mimicking malignancies)o Treatment response (eg. locoregional therapy - TACE, TARE; and immunotherapy - immune score)o Genomic signatureo Local recurrenceo Survivalo Post-surgical complications (eg. post-hepatectomy liver failure)? CHALLENGES, PITFALLS AND HOW TO OVERCOME THEMo Repeatability and reproducibilityo Segmentationo Overfittingo HCC endpoint and ground trutho Integration of genomics, radiomics and data from clinical endpoints? DATA INTERPRETATION- Systematic approach to evaluate the results of published studies in the literature and to conduct meaningful HCC radiomics research? FUTURE DIRECTIONS- What's on the horizon to improve its clinical applicability and acceptance

GIEE-134 Rectal Cancer After Neoadjuvant Therapy, When We Are Wrong

Awards
Cum Laude
Identified for RadioGraphics

Participants
Muhammad Awiwi, MD, Houston, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

- To review the rates of false positive and false negative results on post-neoadjuvant chemoradiotherapy MRI.- To illustrate the most common pitfalls in the interpretation of post-neoadjuvant chemoradiotherapy MRI.- To review possible interventions that can be taken to avoid these common pitfalls.

TABLE OF CONTENTS/OUTLINE

- General introduction - Expected imaging findings of complete radiological response on post-neoadjuvant chemoradiotherapy MRI. - Common pitfalls in the interpretation of post-neoadjuvant chemoradiotherapy MRI. - Interventions to improve MRI quality before the exam. - Adjustments to imaging protocol to eliminate artefacts on post-neoadjuvant chemoradiotherapy MRI.

GIEE-135 Testicular Lesions And Contrast Enhanced Ultrasound: A Pictorial Review

Participants
Jonathan Gabriel, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching Points:1.To review the principles of contrast-enhanced ultrasound (CEUS) in the assessment of focal testicular lesions. 2.To review a selection of benign and malignant testicular pathologies with a view to increasing familiarity of the appearances during CEUS. 3.To demonstrate histopathological correlation with CEUS findings. 4.To show interesting cases and pitfalls.

TABLE OF CONTENTS/OUTLINE

Outline:At our institution the use of contrast enhanced ultrasound has increased over the past 20 years and we have acquired a number of interesting cases of educational benefit. The cases reviewed in out exhibit have pathological correlation following

orchidectomy and where possible will be reviewed with histopathological images. The exhibit will be structured as follows:- Summary of learning objectives/teaching points- Review of common testicular lesions and their pathological classification- Summary of the common appearances of testicular lesions on B-mode and colour Doppler ultrasound- Pictorial case review: Germ cell tumours - Seminomas- Pictorial case review: Germ cell tumours - Non-seminomatous GCTs- Pictorial case review: Sex cord stromal tumours - Leydig cell tumours- Pictorial case review: Sex cord stromal tumours - Sertoli cell tumours- Pictorial case review: lymphoma- Pictorial case review: Pitfalls and Tumour mimics- Pictorial case review: interesting cases

GIEE-136 Rectal Adenocarcinoma After Neoadjuvant Therapy: Practical Guide And How To Avoid Common Mistakes

Participants
Natally Horvat, MD, PhD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Understand the current indications and types of neoadjuvant therapy (NAT), including total neoadjuvant therapy• Know patient assessment after NAT• Comprehend rectal MRI technique, common difficulties, and how to overcome them• Know the role and limitations of restaging rectal MRI - when we are wrong• Recognize pelvic anatomy and key anatomical landmarks for surgical planning• Be familiar with future directions in rectal cancer after NAT

TABLE OF CONTENTS/OUTLINE

• INTRODUCTIONo General overview and definitions• NEOADJUVANT THERAPYo Indication and types of NAT• MANAGEMENT AFTER NATo Surgical techniqueso Interval reassessmento Watch-and-wait• MRI TECHNIQUEo Preparationo MRI protocolo Difficulties and how to overcome them• IMAGING INTERPRETATIONo Step-by-step approach to evaluate restaging MRIo What multidisciplinary team needs to knowo Template reporting system• CHALLENGING SCENARIOS - WHEN WE ARE WRONGo Post treatment changes within the tumor bedo Mucinous tumoro Mucin (or colloid) degenerationo Viable tumor within fibrotic scaro Magnetic resonance Tumor Regression Grade (ymriTRG)o DWI (artifacts, T2 shine-through, T2 dark-through)o Lateral pelvic lymph nodeso Tumor regrowth in patients on watch-and-wait• WHAT'S ON THE HORIZON TO ASSESS TREATMENT RESPONSEo PET/MRIo Radiomicso Novel MRI techniques: magnetization transfer ratio, lymph node contrast agentso Confocal laser endomicroscopyo Multi-omics and artificial intelligence in combined prediction models• INTERACTIVE CASE-BASED DIDACTICS

GIEE-137 Ultra-high-resolution CT With 1024-matrix Using A Novel Deep Learning Reconstruction Technique: How To Use It For Abdominal Imaging

Participants
Masatoshi Hori, MD, Kobe, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation

TEACHING POINTS

1. Understanding characteristics of the ultra-high-resolution CT with 1024-Matrix.2. Understanding the basics and applications of a novel deep learning reconstruction technique for ultra-high-resolution CT imaging.3. Understanding how radiologists can use ultra-high-spatial-resolution CT with the latest deep learning reconstruction technique for abdominal imaging.4. Understanding the prospect of the ultra-high-resolution CT for improvement in pre-treatment evaluations of tumors in the abdomen.

TABLE OF CONTENTS/OUTLINE

A. IntroductionB. Basic characteristics of an ultra-high-resolution CT with 1024-Matrix: Pros and ConsB-1. Spatial resolution: Matrix and slice thicknessB-2. Image noiseB-3. Radiation doseC. Deep learning reconstruction techniques for ultra-high-resolution CT with 1024-matrixC-1. Basics of deep learning reconstruction techniquesC-2. Comparison between the previous and the latest version of deep learning reconstructionC-3. Deep learning reconstruction techniques can significantly improve image qualityD. Clinical impact of the ultra-high-resolution CT with 1024-matrix using a novel deep learning reconstruction technique for abdominal imagingD-1. Pancreatic tumors can be better visualized and evaluated by ultra-high-resolution CTD-2. Liver tumors: Are there some benefits to use ultra-high-resolution CT?D-3. Vascular structuresD-4. OthersE. Conclusion

GIEE-138 Principles And Clinical Utility Of A Novel Contrast Enhancement Boost Technique For Abdominal CT

Participants
Masatoshi Hori, MD, Kobe, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation

TEACHING POINTS

1. Understanding principles of a novel postprocessing technique (contrast enhancement boost; CE Boost) for increasing the degree of contrast enhancement.2. Understanding the role of advanced 3-dimensional subtraction with non-rigid registration.3. Understanding the role of denoising process.4. Understanding the potential of combined use with other contrast enhancement technique such as low-keV dual energy CT or low-kVp imaging.5. Understanding the advantages and disadvantages of the technique by reviewing some clinical applications in abdominal imaging.6. Understanding how radiologists can use this technique for detecting and characterizing lesions in the abdomen.

TABLE OF CONTENTS/OUTLINE

A. Introduction ? Increasing the degree of contrast enhancement by postprocessingB. Principles of contrast enhancement boost (CE Boost) techniqueB1. Advanced 3D subtraction with non-rigid registration ? the core of the techniqueB2. Selection of image pair ? various images can be produced depending on the selectionB3. DenoisingB4. Number of summations ? an important parameterB5. Combined use of CE-boost and dual-energy low-keV CT can further increase the degree of contrast enhancementC. Applications of CE Boost technique for abdominal CTC1. Liver ? tumors can be better detected and characterizedC2. PancreasC3. Vascular structuresC4. Radiation dose reduction / OthersD. Conclusion

GIEE-139 To Be Viable Hcc Or Not To Be? That'S The Question

Participants
Jéssica Marques Silva, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Hepatocellular carcinoma is the most common primary liver malignancy. Treatment strategies involve tumor resection or liver

transplantation. Despite the fact that many patients have advanced disease or multifocal tumors, it is contraindicating radical treatment. Locoregional therapies may be used as a bridge for liver transplantation or in advanced tumors and/or when radical treatment is contraindicated. Locoregional therapies include radiofrequency ablation, percutaneous ablation with ethanol, cryoablation, microwave ablation, transarterial embolization or chemoembolization, chemoembolization with doxorubicin granules, transarterial radioembolization and external beam radiotherapy. Imaging assessment of the CHC response to locoregional therapy requires assessing the size of the tumor, the tumor margins, the presence of tumor necrosis, as well as the early detection of a viable tumor. The aim of this study is to demonstrate the types of locoregional treatment for liver injuries and the interpretations of the post-treatment image examination. The data were obtained through computed tomography and magnetic resonance images of patients admitted to an oncology reference service in Rio de Janeiro.

TABLE OF CONTENTS/OUTLINE

1) Signs of viability vs. tumor non-viability 2) Locoregional therapies 3) Take home message

GIEE-14 Perianal Fistula In Crohn's Disease: Imaging As A Therapeutic Guidance

Participants
Jérémy Dana, MD, Clichy, France (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Magnetic Resonance Imaging is the reference modality in perianal fistula to aid diagnosis and to guide surgical treatment.- Imaging report should be structured, standardized and should respond to specific problematics at the successive steps of surgical treatment: should the fistula be drained? Is the drainage complete? Should closure of the fistula be considered? How can imaging impact the choice of the closure technique? - Artificial Intelligence is revolutionizing imaging and can provide images with increased signal-to-noise ratio in a shorten acquisition time using the Deep Learning Reconstruction.

TABLE OF CONTENTS/OUTLINE

- Introduction to perianal fistula in Crohn's Disease: definition, epidemiology, physiopathology, modalities of treatment- Magnetic Resonance Imaging as a reference standard: an update in technical acquisition (Deep Learning Reconstruction)- Endorectal Ultrasound as a complementary tool to MRI- Drainage of the fistula: when and how?- Drainage of the fistula: complete, incomplete or failure?- Imaging keys to guide the next steps in therapeutic management including the choice of the modality of closure.

GIEE-140 Patterns Of Relapse And Complications Of Immunoglobulin G4-related Disease (IgG4-RD) In The Abdomen: Role Of Imaging

Participants
Jie-Ying Kowa, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To familiarise radiologists with the relapse patterns detected on imaging surveillance of patients with IgG4-RD2. To show the long-term morphologic changes and complications of the affected abdominal organs in IgG4-RD

TABLE OF CONTENTS/OUTLINE

IgG4-RD is a multisystem, idiopathic fibroinflammatory disorder that can affect various abdominal organs such as the pancreas, liver, and kidneys. IgG4-RD is a highly treatable condition and, along with the clinical improvement and monitoring of IgG4 concentrations, imaging allows for documenting morphologic changes in the affected organs and response to therapy. The relapsing-remitting nature is well recognized in this condition with relapses occur in 46-90% of patients within three years from diagnosis in the same affected organ or at a different anatomical site. Therefore, imaging surveillance can play a particularly important role in detecting relapse and guiding clinical management. If left untreated or in patients who don't respond to therapy, IgG4-RD may progress to irreversible organ damage which can be identified on imaging as organ atrophy or specific morphological changes such as cirrhosis.In our exhibit, you will: 1. Know the expected post-therapeutic morphologic changes of IgG4-RD in the abdomen 2. Recognize the patterns of IgG4-RD relapse in the abdomen 3. Be familiar with the abdominal imaging findings related to irreversible organ damage and long-term complications of IgG4-RD

GIEE-142 Standardized CT Protocols For The Study Of The Abdomen: A Refreshing Update

Participants
Davide Ippolito, MD, Monza, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

To refresh the most important CT protocols, focusing on the main pathological findings in abdominal imaging, regarding standardized CT protocols.

TABLE OF CONTENTS/OUTLINE

The clinical indication for CT examination is considered the most important issue to determine which protocol should be employed, and, accordingly, the number of enhancing phases. The unenhanced phase can help to detect some pathological features (i.e. fat deposition, calcifications, blood products, and fluid collection) while the intravenous contrast media can help increasing diagnostic accuracy. In a standardized CT protocol, the arterial phase, starting about 35' from the bolus injection, is useful to identify hypervascular lesions (HCC, metastasis, hemangioma), to study the pancreatic parenchyma, and to identify bowel ischemia. Second, the portal venous phase, by obtaining a homogenous opacification and attenuation of abdominal organs about 80' from the bolus injection, helps to detect hypovascular lesions (metastasis, cysts, abscess), to better characterize different hepatic lesions (HCC, hemangioma), and the patency of venous system. Finally, the delayed phase (acquired at least 140' after injection) can help to depict fibrotic or stromal tissue (cholangiocarcinoma, fibrotic metastasis), and characterize adrenal lesions. By knowing the patient's history, previous CT examinations, and principal pathological pathways, the radiologist should acquire a tailored protocol to correctly answer to clinical issues, without losing diagnostic accuracy.

GIEE-143 Can I Finally Eat Again? MR Findings, Standardized Terminology, And Management Guidelines Of Crohn's Disease

Awards
Cum Laude

Participants
Elissandra Lima, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the epidemiology, pathophysiology and classificationTo illustrate the spectrum of MRI features of Crohn's diseaseTo discuss recent consensus recommendations for imaging interpretation and clinical management

TABLE OF CONTENTS/OUTLINE

BackgroundPhysiopathology Phenotypes Imaging protocol CTE or MRE? How to choose Consensus recommendations (SAR/AGA)Extra-intestinal manifestationsUpdated glossary of terms for Crohn's disease evaluationDrug response, therapy exchange, and urgent surgical interventionTake-home messages

GIEE-145 Abdominal And Inguinal Hernias: A Hole In The Wall.

Participants
Carlos Riquelme, MD, Providencia, Chile (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Ultrasound is the imaging modality of choice for the characterization of hernias of the abdominal wall and inguinal canal, allowing not only anatomical but also dynamic evaluation in real-time.2. The use of computed tomography in the evaluation of abdominal wall hernias allows the detection and characterization of complications: bowel obstruction, incarceration, strangulation, etc.3. The radiology report must contain whether or not there is a hernia, its spontaneity or relation to the Valsalva maneuver, content and presence of complications.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Techniques for evaluation of hernias: ultrasound and CT3. Anatomy of the anterolateral abdominal wall abdomen and inguinal canala. Ultrasoundb. CT4. Types of herniasa. Groin: inguinal and femoralb. Anterolateral abdomen5. What do you need to know to perform the best ultrasound examination for hernias?a. Pearl and pitfallsb. Radiology report6. Complicated hernias7. Examples8. Summary

GIEE-146 How Does AI Reconstruct 3D Intestinal Structures Of Ileus And Intestinal Obstruction Cases From 3D CT? - Toward AI-based Emergency Diagnostic Assistance Of Intestinal Diseases

Participants
Hirohisa Oda, PhD, Nagoya, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. How intestines are reconstructed and visualized in 3D using our AI system2. How to utilize AI-based emergency diagnostic assistance of intestinal diseases

TABLE OF CONTENTS/OUTLINE

1. Emergency diagnosis of intestinal obstruction and ileus- Tracking intestines on CT without fecal tagging2. AI system for intestine reconstruction- Related systems for CT colonography- Targeting both small and large intestines- Intestine segmentation with weak annotation-- 3D U-Net-based weak annotation-- Distance maps for preventing incorrect shortcuts- Path extraction by graphical representation- Visualization for intuitively understanding routes-- Coloring scheme respecting paths3. Demonstration of our AI system- 3D intestinal structure reconstruction of intestinal obstruction patients from 3D CT- Intestine tracking on visualization results- Obstruction point findings

GIEE-147 The Man Behind The Basc: The Many Faces Of Cecal Bascule And Volvulus

Participants
Daniel Howard, DO, Rochester, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Cecal bascule and volvulus are infrequently encountered causes of acute abdominal pain, requiring urgent surgical intervention. These can have a variety of appearances on CT, which can make accurate diagnosis challenging. A review of surgically confirmed cases from our institution reveal three basic patterns: the cecal flip, the cecal fold, and the cecal twist. Recognizing these signs can aid in swift and accurate diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Review of normal cecal anatomy. 2. Schematic review of bascule/volvulus appearance on CT 3. Case examples illustrating: 3a. The cecal flip 3b. The cecal fold 3c. The cecal twist 4. Review of clinical management and outcomes. 5. Pearls and pitfalls of accurate diagnosis

GIEE-148-HC Advances In Radiological Methods For The Assessment Of Body Composition: Application To Predict The Clinical Outcomes In Solid Organ Transplantation

Participants
Omid Shafaat, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

Using body composition in solid organ transplantation (e.g., liver and kidney) is rapidly expanding. Sarcopenia, which is defined as

loss of muscle mass that subsequently decreases muscle function, is strongly associated with the prediction of survival, post-surgical complications, and hospitalization. On the other hand, myosteatosis, which is the infiltration of fat into muscle and decreased muscle radiodensity, is also related to decreasing overall survival. In this educational exhibit, we will highlight the advances in radiological methods and application of body composition with emphasis on CT scans to predict the clinical outcomes of solid organ transplantations.

TABLE OF CONTENTS/OUTLINE

1)Definition 2) Pathophysiology and clinical impact 3) Different imaging techniques on body composition a. Dual-energy X-ray absorptiometry: Method b. CT scan i. Segmentation methods and tools ii. Selecting appropriate cross-sectional anatomical landmark iii. Quantification of subcutaneous adipose tissue (SAT) iv. Quantification of visceral adipose tissue (VAT) v. Quantification of abdominal muscle vi. Sarcopenic obesity vii. VAT/SAT ratio viii. Impact of contrast and slice thickening and the number of appropriate slice and reader ix. Challenges and pitfalls c. MRI: Method d. Ultrasonography: methods 4) Sarcopenia/Myosteatosis 5) Application of body composition in different solid organ transplantations 6) Application of artificial intelligence and machine learning in body composition of solid organ transplantation

GIEE-149-HC   Hepatic Steatosis And Fibrosis With Ultrasound Elastography And Fat Quantification: What Every Radiologist Needs To Know

Participants
Maria Lucia Brun, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To describe a "step-by-step" guideline for radiologist in how to perform an ultrasound liver elastography.• To explain the physical principles of ultrasound elastography.• To outline the clinical indications and uses of liver ultrasound elastography and fat quantification.• To review the cut-off values to determine liver fibrosis and liver steatosis and how to analyze them.• To exemplify through representatives cases the utility of liver ultrasound elastography and fat quantification.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Physical principles of US elastography3. Types of elastography4. Liver applications: indications and when to excluded5. How to perform an elastography?6. How to analyze the obtained data?7. Dispersion and attenuation imaging in steatosis and necroinflammatory changes8. Illustrative clinical cases9. Summary and conclusions10. References

GIEE-15   Embryology And Anatomy Of The Omentum, Mesentery And Peritoneum, Oh My!

Participants
Katherine Chung, MD, Stony Brook, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

The peritoneum, much like the pleura in the thoracic cavity, is a serous membrane consisting of a single layer of mesothelial cells. The specialized folds of the peritoneum are the mesentery and omentum: the mesentery suspends loops of bowel to the posterior abdominal wall, and the omentum extends from the stomach and connects it to adjacent organs. Despite these differences, the terms "mesentery" and "omentum" are often used interchangeably by radiologists, creating confusion for referring clinicians. In contrast to the lobes of lung, which are clearly distinguished by the double folds of visceral pleura, the compartments of the intraperitoneal cavity are less discernable. However, clearly differentiating omentum from mesentery has considerable implications for clinical and surgical management. The goal of this presentation is to differentiate the peritoneum from the mesentery and omentum with emphasis on anatomic and embryologic development of these structures while providing examples of pathologies that may affect the omentum and mesentery.

TABLE OF CONTENTS/OUTLINE

Introduction, Embryology of the gut, peritoneum, and its structures, Anatomy of the peritoneum, omentum, and mesentery, Greater and Lesser Omentum, Small bowel mesentery, Transverse mesocolon, Sigmoid mesocolon, Mesorectum, Mesoappendix, Clinical and Surgical Significance, Summary, Acknowledgements, References and Suggested Readings

GIEE-16   Systematic Assessment Of Obstructive Acute Abdomen: A Step-by-step Guide For Residents

Participants
Daniel Montel, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Evaluate the presence of intestinal obstruction, with a systematic approach, from categorizing the bowel dilatation to evaluating the obstruction etiology.- Recognize the level of intestinal obstruction, with tips on how to follow the dilated loops; - Identify complications and signs of severity in obstructive acute abdomen;

TABLE OF CONTENTS/OUTLINE

- Introduction; - How to identify an intestinal obstruction; - Tips on how to follow the dilated small bowel; - Patterns of bowel changes leading to obstruction and its main causes; - Sings of severity; - Take home messages.

GIEE-17   Pulp Fiction: An Interactive Guide To Splenic Lesions

Awards
Certificate of Merit

Participants
Matthew Nazarian, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

The spleen is a challenging organ to evaluate. While the vast majority of masses encountered in the spleen are benign, there is significant overlap in the imaging appearance of malignant pathologies. The characterization challenge is further exacerbated by the

fact that the majority of splenic lesions never undergo pathologic confirmation. This presentation will provide an interactive review of splenic abnormalities encountered in clinical practice. We will provide a framework to narrow the differential diagnosis utilizing an algorithm that includes whether the lesion is solid or cystic, single or multiple, vascular or nonvascular, and hemosiderin or non-hemosiderin containing. The presentation will include reference to the ACR White Paper on incidental splenic findings. Relevant anatomic and/or radiologic-pathologic correlation will be provided to assist in understanding the various disease processes.

TABLE OF CONTENTS/OUTLINE

1. Brief discussion of splenic anatomy & embryology2. Quiz-style case based review of cystic splenic lesions3. Quiz-style case based review of solid splenic lesions (single & multiple)4. "Anatomy/Pathology Corners" where relevant images will be displayed to provide a deeper understanding of the underlying pathophysiology5. Proposed algorithm for narrowing differential of splenic lesions

GIEE-18   Imaging Of Esophageal Cancer That Radiologists Need To Know: Preoperative Anatomical Variations, Surgical Techniques, And Postoperative Complications

Participants
Fumiko Yagi, MD, Shinjuku-ku, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Understanding anatomical variations about esophageal cancer surgery(2) Understanding surgical techniques for esophageal cancer(3) Learning about postoperative complications of esophageal cancer

TABLE OF CONTENTS/OUTLINE

I. IntroductionII. Anatomical variations-Variations of bronchial arteries-Variations of celiac and left gastric arteries-Variations of thoracic duct-Aberrant right subclavian artery-Azygos continuation of the inferior vena cava-OthersIII. Operation-Surgical techniques (Ivor Lewis esophagectomy, McKeown esophagectomy, left thoracoabdominal approach, transhiatal esophagectomy, others)-Bowel InterpositionIV. Postoperative complicationsAcute complications-Chylothorax-Iatrogenic bleeding (bleeding from the right gastroepiploic artery)-Thrombus/infarction (azygos vein thrombus, pulmonary embolism/deep vein thrombosis, peri-catheter thrombus, splenic infarction)-Pneumonia-Anastomotic leak, abscess/pyothorax-Lymphocele-OthersLate complications-Diaphragmatic hiatal hernia-Anastomotic stricture-Fistula-Recurrent nerve paralysis-Functional gastric emptying disorders-Reflux esophagitis-Local recurrence-Distant metastasis-Dissemination-Others

GIEE-19   Fundamentals Of Small Bowel Imaging: What A Resident Should Know

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Anup Shetty, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose

TEACHING POINTS

For the radiologist-in-training, assessment of the small bowel can be challenging, in large part due to the overlapping imaging features of many small bowel pathologies. This case-based, pictorial, educational exhibit will:1. Identify and review the imaging characteristics of small bowel entities using multiple modalities, including fluoroscopy, CT, and MR.2. Provide an interpretive approach for the disease processes involving the small bowel, highlighting important imaging pearls and pitfalls.3. Discuss the interplay between clinical and imaging findings that aid in the correct diagnosis of small bowel entities to guide appropriate management.

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Benign Diseases: Diverticulitis, malabsorption (celiac sprue, lymphangiectasia), inflammatory (Crohns, scleroderma, amyloidosis, infection)Trauma and Hemorrhage: blunt, penetrating, luminal bleeding, intramural hemorrhageVascular diseases: mesenteric ischemia (arterial, venous, non-occlusive, shock bowel), vasculitides (Henoch-Schonlein purpura/IgA vasculitis, polyarteritis, systemic lupus erythematosus)Obstruction: mechanical, closed loop, volvulusTreatment-related: graft versus host disease, radiation enteritis, NSAID enteropathy, ACE-inhibitor angioedemaBenign tumors: sporadic, polyposis-relatedMalignant tumors: adenocarcinoma, lymphoma, carcinoid, gastrointestinal stromal tumor, metastases

GIEE-2   All About Diffuse Pancreas Lesions: What Radiologists Should Know.

Participants
Shigeaki Umeoka, MD, Wakayama City, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Diffuse pancreas lesion is a diagnostic challenge for radiologists and can be caused by a variety of benign and malignant disorders, including inflammation, hematologic diseases, and malignant tumors. Although it is important to differentiate between benign and malignant lesions in order to avoid unnecessary additional examination or treatment or to select the best treatment option, radiological diagnosis may be sometimes difficult. However, in some typical cases, clinical information and/or imaging characteristics may help narrow the differential diagnosis. The goal of this exhibit is 1. To illustrate with several examples, the imaging findings of diffuse pancreas abnormalities. 2. To simplify the diagnosis of diffuse pancreas lesions on the basis of imaging findings and clinical settings.

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1.) Inflammation: Acute Pancreatitis, Chronic Pancreatitis, Autoimmune Pancreatitis, Drug-induced Pancreatitis, Traumatic Pancreatitis, 2.) Fat Replacement, 3.) Hematologic Disorders: Amyloidosis, Malignant Lymphoma, Leukemia, Hemochromatosis/Hemosiderosis, 4.) Malignant Tumors: Diffuse Pancreatic Adenocarcinoma, Islet Cell Carcinoma, Diffuse Metastasis 5.) Others: Sarcoidosis, Hypovolemic Shock

GIEE-20   How To GIST: Imaging Management Of Gastrointestinal Stromal Tumors

Awards

Participants
Salama Chaker, MD, Secane, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. In 2020, the NCCN created separate guidelines for management of GISTs, distinct from other soft tissue sarcomas, because of their unique sensitivity to molecular targeted therapies. 2. Contrast-enhanced CT is the workhorse for initial evaluation and imaging follow up. 3. Contrast-enhanced MRI is preferred for evaluation of rectal/duodenal GISTs and for suspected liver metastases. 4. PET/CT may be useful in cases where earlier assessment of response is important. 5. The imaging appearance of GISTs following therapy is variable and includes changes in size, density, wall thickness, and intra-tumoral soft tissue.6. Models for assessing treatment response of GISTs have evolved. Currently, the Choi criteria is the most widely utilized. 7. The NCCN specifies in their recommendations the type and timing intervals of imaging GISTs during and following treatment. These should be incorporated into the radiology report.

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1. Review GIST markers, mutations, and immunotherapy.2. Synopsize different imaging modalities and their use in GISTs. 3. Illustrate imaging findings seen in response to therapy and review established response criteria. 4. Summarize the 2020 NCCN Guideline recommendations for imaging evaluation, follow-up intervals, and surveillance of GISTs. 5. Through case-based applications, demonstrate incorporation of these recommendations into radiology reports.

GIEE-21   MR Image Reconstruction Using Machine Learning: Early Use Examples In Abdominal Imaging And Future Directions.

Awards
Certificate of Merit

Participants
John Kirby, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

Although MRI is a well-established tool for many clinical imaging applications, there are substantial limitations to clinical use, including long scan times, relatively low spatial resolution in comparison to CT, and limited signal to noise ration (SNR) in larger patients. Newer FDA-cleared image reconstruction techniques show great promise in overcoming some of these limitations in clinical practice.

TABLE OF CONTENTS/OUTLINE

Introduction/background: We will briefly review the general concepts of machine learning/deep learning (ML/DL) as a subset of artificial intelligence (AI), providing definitions and general concepts aimed towards the general radiologist and radiology resident. Use examples: We will review current clinical applications and benefits of ML image reconstruction for reducing scan time and improving SNR, resulting in better patient experiences, improved efficiency, and reduced cost. We will provide specific examples from our institution focusing mainly on clinical applications in abdominal imaging. Potential pitfalls: We will also review the caveats and potential pitfalls including concerns with a specific focus on hallucination in image creation and fragility of translating between different patient populations/data sets. Future directions: Finally, we will explore the potential directions of ML image reconstruction with an emphasis on the need for large volume data sets and clinical validation.

GIEE-22   Easy To Miss: Eosinophilic Gastrointestinal Disease - Tips And Tricks To Make The Diagnosis

Awards
Certificate of Merit

Participants
Camila Vendrami, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Review the pathophysiology of eosinophilic gastrointestinal diseases (EGIDs) • Describe imaging and endoscopic findings of EGIDs • Differentiate EGIDs from common mimickers

TABLE OF CONTENTS/OUTLINE

EGIDs are characterized by dense infiltration of eosinophils in gastrointestinal tissues, leading to morphological and functional abnormalities. Clinical symptoms can be vague and overlap with other GI disorders. Histopathology is the gold standard for diagnosis, however, recognition of imaging features of these disorders aids in early diagnosis and therapy. 1. Introduction: overview a. Esophagitis b. Gastritis and enteritis c. Colitis d. Hepatitis e. Pancreaticobiliary disease 2. Classification 3. Imaging features a. Fluoroscopy: rings, strictures, furrowing, small caliber, barium tablet retention b. CT: Mucosal thickening, intestinal wall thickening, ascites, bowel obstruction/ intussusception c. MRI: Inflammatory bowel changes, heterogeneous appearance of the liver, biliary dilatation, and pancreatitis 4. Endoscopic features of Eosinophilic Esophagitis a. Inflammatory changes: longitudinal furrowing, esophageal edema/loss of vascular markings, exudates, friability b. Chronic fibrostenotic changes: small caliber, rings, strictures c. Review of EOE Endoscopic Reference Score (EREFS) 5. Differential diagnosis and mimickers of EGID 6. Limitations of imaging and endoscopy a. Imaging- Findings can be subtle or nonspecific. b. EGD- decreased esophageal caliber can be challenging to diagnose. 7. Conclusions

GIEE-23   Acute Gastrointestinal Bleeding Above And Below The Ligament Of Treitz - Differential Diagnosis And Role Of Imaging

Participants
Martin Halicek, PhD, Augusta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To discuss causes of acute gastrointestinal bleeding melena vs hematochezia. 2. To describe diagnostic approach according to

clinical presentation. 3. To describe role of different imaging modalities in the setting of acute GI bleeding and pitfalls.

TABLE OF CONTENTS/OUTLINE

GI bleeding is a common clinical condition frequently requiring hospitalization and intervention with significant morbidity and mortality. The etiology of acute GI bleeding above and below the ligament of Treitz will be discussed. Upper GI bleeding pathologies, including: gastric ulcer, gastritis, varices, gastric cancer, and aortoenteric fistula. Lower GI bleeding pathologies, including: diverticular disease, angiodysplasia, colorectal cancer, inflammatory bowel disease, Meckel's diverticulum, pseudomembranous colitis, and traumatic causes. The use of different imaging modalities in the diagnosis of GI bleeding and the role of interventional radiology in the treatment will also be discussed.

GIEE-24   The LI-RADS CT/MRI Lexicon, What Every Radiologist Should Know

Participants
Jennifer Foley, MD, San Diego, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Describe the development and purpose of the American College of Radiology Liver Imaging-Reporting and Data System (LI-RADS) Lexicon for CT and MR. 2. Define key imaging findings of hepatocellular carcinoma (HCC) and other Lexicon terms with visual correlation using high quality CT and MR examples. 3. Elaborate on term definitions with specific scenarios and examples, synonyms (if applicable), the type of term and what modality it is to be used with. 4. Review common pitfalls and clinical implications of Lexicon usage

TABLE OF CONTENTS/OUTLINE

1. Background & LI-RADS Lexicon Development 2. Case Based Review of the Lexicon Terms & Definitions , with pitfalls and clinical implications. Term categories: - Major findings of HCC - Phases of contrast- Key LI-RADS terms- Ancillary features favoring HCC in particular- Ancillary features favoring malignancy, not HCC in particular- Terms associated with ancillary findings and benign findings in patients at risk for HCC- Terms associated with LI-RADS-M and LI-RADS-TIV

GIEE-25   The Acute Abdomen In Pregnancy: Radiological Decision-making Tool And The Role Of MRI

Participants
Saigeet Eleti, MA,MBBCHIR, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Acute abdominal pain in pregnancy poses a diagnostic challenge. The differential is wide, clinical assessment is difficult, and delays to diagnosis can cause maternal and fetal harm. Modalities not involve ionizing radiation are preferred. • Appendicitis is the most common cause of acute abdominal pain requiring emergent surgery. Competing causes include other gastrointestinal pathologies such as bowel obstruction; genitourinary pathologies such as ovarian torsion; and hepatobiliary pathologies such as gallstone-related disease • We present a radiological decision-making tool to guide imaging choices and best establish the underlying diagnosis in the acute pregnant abdomen. • Sonography remains first line, however anatomical visualisation can be limited due to displacement of adjacent structures by the gravid uterus. • MRI provides excellent cross-sectional soft tissue assessment of the abdomen and pelvis and is currently considered safe at any gestation as per the American College of Radiology Manual on MR Safety, 2020. With a limited protocol of sequences, a broad spectrum of pathologies can be evaluated. At our institution we have found diffusion weighted imaging of particular use to screen and highlight disease. • CT carries the highest exposure of ionizing radiation to the fetus, but may be necessary, particularly in cases of trauma. • Risks to the patient/fetus must be clearly explained.

TABLE OF CONTENTS/OUTLINE

1.Introduction 2.Radiological decision-making tool 3.US 4.MRI 5.CT 6.Explaining risk to the patient 7.Summary

GIEE-27   Imaging Of Rare Histologic Types Of Pancreatic Cancer

Participants
Mayumi Higashi, Ube, Yamaguchi, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The accurate diagnosis of rare malignant solid epithelial tumors of the pancreas remains difficult because of their overlapping imaging features or limited information on their imaging findings. However, since the tumors have different tumor behavior and prognosis, it is important for the radiologists to be familiar with their imaging characteristics for optimal patient management and therapeutic planning. The purpose of this exhibit is: 1. To describe the WHO classification and clinical features of malignant solid epithelial tumors of the pancreas other than invasive ductal adenocarcinoma. 2. To review characteristic imaging findings on CT, MRI and SPECT/CT. 3. To highlight key differential diagnostic points of imaging findings.

TABLE OF CONTENTS/OUTLINE

This exhibit includes seven rare malignant solid epithelial tumors of the pancreas. · Characteristic clinical and imaging findings of 1. Exocrine neoplasms · Invasive ductal carcinomas (adenosquamous carcinoma, undifferentiated carcinoma, colloid carcinoma) · Acinar cell carcinoma 2. Neuroendocrine neoplasms (neuroendocrine tumor, neuroendocrine carcinoma) 3. Solid pseudopapillary neoplasm · Key imaging findings for the differential diagnosis, especially from invasive ductal adenocarcinoma

GIEE-28   Fluoroscopic Guided Contrast Examinations Of The Rectum And Colon: Essential Contributions To Clinical Decision-making.

Participants
Alberto Carbo, MD, Shreveport, Louisiana (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: • Review the fluoroscopic guided contrast techniques of the colon and rectum including double and single contrast examinations, pediatric studies, pre and postsurgical evaluations and functional defecography. • Debate the

evolution of the indications of fluoroscopic guided contrast examinations (FCE) since the development of colonoscopy and cross sectional imaging and their consequences on patient care. • Validate with sample cases the essential contributions of FCE in the diagnosis of controversial cases and clinical decision-making. • Discuss some roadblocks to performing these techniques, including operator expertise, lack of interest of young radiologists, radiation exposure, and lengthy consuming time for the low-revenue.

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Present indications of FCE of colon and rectum: • Evaluation of the proximal colon in patients with incomplete colonoscopy and non diagnostic computed tomography. • Anatomic road map before surgery. • Diagnosis of rectal and colonic fistulas and perforations. • Detection of early and late postoperative complications. • Evaluation of distal and ostomy segments before ostomy take down. • Diagnosis of rectal and colonic strictures in newborn and pediatric patients. • Intussusception reduction. • Defecography for evaluation of anorectal syndromes and pelvic floor.

GIEE-29   Gallbladder And Biliary Tract Disease: Computed Tomography And Magnetic Resonance Imaging Features With Histopathologic Correlation

Participants
Hidemitsu Sotozono, MD, Kurashiki, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this study is1) To demonstrate the computed tomography (CT) and magnetic resonance (MR) imaging findings of the gallbladder and biliary tract diseases2) To illustrate the radiologic-pathologic correlation of gallbladder and biliary tract disease.

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1) Image findings of gallbladder diseaseA) Inflammatory- Acute cholecystitis- Acute acalculous cholecystitis- Gangrenous cholecystitis- Emphysematous cholecystitis- Chronic cholecystitis- Xanthogranulomatous cholecystitis- Gallbladder tuberculosis- Gallbladder torsionB) Tumor-like (hyperplastic)- Gallbladder adenomyomatosis- Gallbladder polypC) Neoplastic- Gallbladder cancer- Metastatic tumor- Intracystic papillary neoplasm2) Image findings of biliary tract diseaseA) Inflammatory- Acute cholangitis- Acute obstructive suppurative cholangitis- IgG4-related cholangitis- Primary sclerosing cholangitis- Primary biliary cholangitis- Anti-Programmed cell death-1 immunotherapy-related secondary sclerosing cholangitisB) Neoplastic- Extrahepatic and Intrahepatic cholangiocarcinoma- Cholangiolocellular carcinoma- Intraductal papillary neoplasm of the bile ductC) Anomaly- Pancreatobiliary maljunction- Anatomical variations of the cystic duct

GIEE-3   A Review Of Esophageal Pathology In Barium Esophagram: The Aunt Minnie Approach.

Participants
Javier Azpeitia Arman, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Describe normal anatomy of the esophagus. - Review normal imaging appearances of the esophagus in barium esophagram. - Illustrate typical appearances of frequent and uncommon esophageal entities. CT and esophagoscopy correlates will also be shown.

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Barium studies play an important role in evaluating the esophagus, Certain appearances of esophageal pathology in barium esophagram are pathognomonic. An illustrative case-based quiz will present a range of usual and unusual esophageal pathology highlighting key imaging findings. We present: - Study protocol. - Normal anatomy of the esophagus. - Imaging findings: Normal esophagus: physiological Impressions (aortic arch, left main bronchus, heart), "normal images" ("Glycogenic acantosis", "feline esophagus"). • Extrinsic compression: goiter, left atrial enlargement, abnormal vessels, osteophytes. • Indentations: esophageal web, cricopharyngeal bar. • Strictures: peptic, idiopatic eosinophilic esophagitis, caustic substance ingestion, radiation esophagitis. • Diverticula: Zenker's, epiphrenic, Killian-Jamieson. Motility disorders: achalasia (primary and secondary), presbyesophagus, difusse esophageal spasm. • Wall lesions: esophageal varices, esophageal intramural pseudodiverticulosis, leiomyoma, squamous cell carcinoma. • Surgery: antireflux techniques.

GIEE-30   Autoimmune Diseases Of The Gastrointestinal Tract: Review Of The Radiological Appearances

Participants
Pankaj Gupta, MD, Chandigarh, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The gastrointestinal tract (GIT) may be involved in primary and systemic autoimmune diseases. 2. The primary autoimmune diseases of the bowel include eosinophilic gastroenteritis (EGE), Celiac disease, specific inflammatory diseases [ulcerative colitis (UC) and Crohn's disease (CD)], non-specific inflammatory diseases. 3. EGE is a rare inflammatory disorder of the GIT that predominantly involves the stomach and the small intestine. Imaging findings are diffuse mucosal fold thickening, mural thickening, layered appearance of bowel wall, and ascites. 4. The characteristics imaging findings of celiac disease are related to alteration of the small bowel fold pattern, including jejunoileal fold pattern reversal, mural thickening, hypotonia and jejunal dilatation, and intussusception. Celiac disease may be complicated by small bowel malignancy. 5. UC and CD have different imaging findings and clinical course. 6. Bowel may be involved as a part of collagen vascular diseases (systemic lupus erythematosus, rheumatoid arthritis, systemic sclerosis) and systemic vasculitides (polyarteritis nodosa, granulomatosis with polyangiitis).

TABLE OF CONTENTS/OUTLINE

1. Pathogenesis of autoimmune diseases of the GIT 2. Classification 3. Clinical features 4. Radiological and endoscopic modalities for evaluation 5. Spectrum of radiological appearances 6. Imaging appearances in specific diseases 7. Imaging appearances of extraintestinal manifestations 8. Differential diagnosis

GIEE-31   Imaging Of Luminal Gastrointestinal Tract Immunotherapy-related Adverse Events

Participants
Michael S. Gee, MD, PhD, Boston, Massachusetts (*Presenter*) Research Grant, Takeda Pharmaceutical Company Limited;Researcher, General Electric Company ;Researcher, Siemens AG

Luminal gastrointestinal (GI) immunotherapy-related adverse events (irAEs) are common and most are diagnosed by imaging.Any location in the GI tract can be affected.Early diagnosis is necessary to avert patient morbidity and requires that radiologists recognize the imaging features.Dual-energy CT (DECT) can increase conspicuity of pertinent findings.

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Immune checkpoint inhibitors (ICIs) stimulate anti-tumor T cell activity against cancer cells and are associated with a unique spectrum of irAEs. Early diagnosis of irAEs is necessary to institute therapy and potentially discontinue immunotherapy treatment. Thus, it is important for radiologists to recognize the imaging features of irAEs. We review the mechanism of immunotherapy agents and associated irAEs, spectrum of luminal GI tract irAEs, illustrate case examples throughout the GI tract, and present imaging mimics. CT plays a key role in diagnosing irAEs including routine CT or PET-CT surveillance, CT angiography, and CT enterography. Dual-energy CT (DECT) examples are emphasized.Immunotherapeutic agentsImmune checkpoint Inhibitors (ICIs)Chimeric antigen receptor T-cell (CAR-T) therapyGI tract irAEsGastritisEnteritisColitisGI bleedingDiagnostic workupManagementMimicsIn conclusion, as ICI therapy gains wider use, irAEs will be increasingly encountered. Luminal GI tract irAEs can be life-threatening, so radiologists should be familiar with the imaging manifestations to facilitate diagnosis and treatment.

GIEE-32   Molecular Biomarkers Of Common Malignancies Of The Digestive System In Adults: A Primer For Radiologists

Awards
Certificate of Merit

Participants
Daniel Vargas-Zapata, MD, San Antonio, Texas (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review genetics/oncological pathways related to molecular biomarkers of common malignancies of the digestive system in adults Discuss clinical implications of molecular biomarkers, including prognostic/predictive values & therapeutics targeted Describe the role of imaging in predicting biomarkers in select malignancies & in follow-up and surveillance

TABLE OF CONTENTS/OUTLINE

Introduction Esophageal Cancers: Mismatch repair (MMR), (MLH1, MSH2, MSH6, PMS2), microsatellite instability (MSI). PD-L1 IHC, HER2 (ERBB2) amplificationsGastric Adenocarcinoma: MMR IHC & MSIs on new diagnoses. PD-L1 & HER2 (ERBB2) IHC. EBV-associated GC. Genomically-stable tumor: Diffuse gastric cancer morphology & CDH1 mutations.Gastrointestinal Stromal Tumor: KIT or PDGFRA mutations; NF1, SDH genes, BRAF and NTRK alterations if KIT/PDGFRA negative. Colorectal Carcinoma: MMR, MSI on all new diagnoses. BRAF p.V600E mutation & MLH1 promoter methylation, KRAS and NRAS oncogenic mutations & HER2 (ERBB2) & NTRK Hepatocellular carcinoma NTRK IHC. DNAJB1: PRKACA fusion seen in fibrolamellar carcinoma. Hepatocellular adenomas: Inflammatory, HFN1a inactivated & B-catenin mutated Cholangiocarcinoma: FGFR2 fusions, MSI, NTRK fusions, BRAF p.V600E or IDH1/IDH2 mutations Pancreatic ductal adenocarcinoma: ALK, NRG1, NTRK, ROS1 fusions, BRAF, BRCA1/2, ERBB2(HER2), KRAS, PALB2 mutations, MMR deficiency. Pancreatic Neuroendocrine Carcinomas ATRX/DAXX with ALT-positive phenotype Imaging findings that correlate with biomarkers Conclusion

GIEE-33   Evaluation Of Hepatic Steatosis, Inflammation And Fibrosis In NAFLD By Imaging: An Overview

Participants
Jong Yeong Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

• The purposes of this review are1. To explain the principal, clinical application, pros/cons and limitations of imaging techniques for hepatic steatosis, fibrosis and hepatitis2. To review the recently developed machine-learning based evaluations (computer aided diagnosis and radiomics) of conventional US, CT and MR images for the measurement of intrahepatic fat and fibrosis3. To discuss the future of these techniques, the possibility for wider clinical applications and roles in clinical trials for the treatment of diffuse liver disease

TABLE OF CONTENTS/OUTLINE

• Background• Hepatic steatosis1. US based techniques: 1) Gray scale imaging, 2) Controlled attenuation parameter 3) Attenuation imaging2. Unenhanced CT3. MRI based techniques: 1) Two point DIXON, 2) MR spectroscopy, 3) MRI-PDFF• Differentiation of NASH from simple steatosis1. Shear wave dispersion imaging2. Multiparametric MRI• Hepatic fibrosis1. US based techniques: 1) Transient elastography, 2) Shear wave-based elastography: Point SWE, ARFI, Supersonic shearwave2. MRI based techniques: 1) Diffusion weighted imaging, 2) Hepatocyte-specific contrast agent enhanced imaging, 3) MR elastography• Machine learning based evaluation of hepatic steatosis and fibrosis with US, CT, MR images• Can we replace liver biopsy by imaging studies for hepatic steatosis or fibrosis?• Conclusion

GIEE-34   The Role Of Cinematic Rendering In The Detection And Evaluation Of Suspected Hepatic Tumors: How We Do It

Participants
Elliot Fishman, MD, Owings Mills, Maryland (*Presenter*) Co-founder, HipGraphics, Inc;Stockholder, HipGraphics, Inc;Institutional Grant Support, Siemens AG;Institutional Grant Support, General Electric Company

TEACHING POINTS

This exhibit will focus on the incremental value of Cinematic Rendering (CR) for the evaluation of known or suspected liver tumors. We will review some of the basics of CR as it applies to the liver including the optimization of scan protocols, the role and use of CR presets to optimize workflow and lesion detection, as well as the role of CR in lesion characterization and staging. We will define the potential advantages of CR in lesion characterization and help define the "fingerprints" of various liver tumor. The role of CR in vascular mapping for tumor staging and potential therapy will also be addressed. Finally future directions lincuding augmented reality with HoloLens will be discussed and preliminary observations illustrated. The user in the end will have a fuller understanding of the role of CR in the evaluation of liver masses.

the presentation will include;1. principles of CR s directed toward the liver ad liver masses2. optimizing CT data acquisition for CR imaging3. how to create optimal CR images for a range of liver tumors as well as how to create vascular maps for these tumors4. review of the "fingerprints" for various benign (hemangioma, FNH)and malignant (hepatoma, cholangiocarcinoma, hepatic adenoma, metastases) hepatic masses.5. how to create a effecient workflow for CR imaging6. role of CR and MIP and VRT in the evaluation of complex hepatic pathology7. potential improvements in image visualization using augmented reality (HoloLens)8. future directions including the role of AI

GIEE-35 Omg: Omentum, Mesentery, And A Gamut Of Their Diseases

Participants
Katherine Chung, MD, Stony Brook, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Primary diseases involving the mesentery and omentum are rare and thus easily overlooked. Due to their proximity to many upper abdominal and pelvic organs, the mesentery and omentum are often victim of inflammation, edema, hemorrhage, and neoplasm; less frequently, they are the origin of these processes. However, mesenteric and omental diseases often have nonspecific and overlapping imaging features, posing a diagnostic challenge to radiologists and necessitating reliance on clinical information. In addition, the terms "peritoneum", "mesentery", and "omentum" are often used interchangeably, although these structures are not the same. Effective treatment relies on both diagnostic and anatomical accuracy. The goal is to review a gamut of diseases involving the mesentery and omentum with an emphasis on their anatomic location.

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Introduction, Definitions and Anatomy, Mesentery diseases, Sclerosing mesenteritis and its spectrum of diseases, Mesenteric abscess secondary to foreign body, Mesenteric cyst, Lymphangioma, Mesothelial cyst, Mature Cystic Teratoma, Peritoneal carcinomatosis, Peritoneal Gliomatosis, Pseudomyxoma peritonei, Mesenteric adenopathy, and Lymphoma, Mimickers of peritoneal diseases, Summary, Acknowledgments, References and Suggested Readings

GIEE-36 Dual-energy CT Evaluation Of Gastrointestinal Bleeding: Pearls And Pitfalls

Participants
Bari Dane, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

Virtual noncontrast (VNC) images created from a contrast-enhanced data acquisition can reduce radiation dose and afford accurate diagnosis.VNC images can assist with the differentiation of active bleeding, hyperdense enteric contents, hematoma, and enhancing masses.Low keV virtual monoenergetic images can increase the conspicuity of subtle gastrointestinal bleeding (GIB) and bowel abnormalities, improving diagnostic confidence. GIB can be diagnosed on single-phase dual-energy CT (DECT) scans by using VNC, low keV virtual monoenergetic reconstructions and iodine maps.

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Accurate diagnosis of GIB with conventional CT typically requires multiple phases, including a noncontrast acquisition. DECT offers the unique ability to eliminate the noncontrast acquisition, affording significant radiation dose reduction. Additional post-processing techniques can increase the conspicuity of contrast extravasation and potentially minimize artifacts. In this exhibit, we provide a practical guide for utilizing and optimizing DECT for GIB. DECT GIB techniqueCTA protocolCTE protocolVNC instead of true noncontrastMinimum IV contrast dose for DECT versus standard CTDECT Post-ProcessingVNCVirtual monoenergetic: low and high KeVIodine overlaySeries to send to PACSDECT InterpretationEfficient interpretationLower quality (reduced IV contrast, motion) or single-phase examsActive GIBHyperdense enteric contentsEnhancing massDECT pitfalls and limitationsObese patientsField of viewImaging artifacts

GIEE-37 A Pictorial Review Of Classic Signs Of Hepatobiliary Radiology

Participants
Suryansh Bajaj, New Haven, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

A myriad of classic radiological signs has been described in the literature across imaging modalities over the years. The liver and the biliary system can have a wide variety of pathologies and it is important to differentiate them on imaging. The presence of classic signs and the knowledge of their pathophysiology give the radiologists much more confidence to reach a particular diagnosis. This exhibit will review and describe some classic radiological signs associated with hepatic and biliary pathologies and will discuss their underlying pathophysiology, clinical relevance, and differential diagnosis.

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1. Normal variants in liver anatomy such as Beavertail liver2. Examples of several hepatobiliary radiological signs such as Atoll sign, Bright dot sign, Cluster sign, Cottage leaf sign, Double target sign, Focal hepatic hot spot sign, Light bulb sign, Doughnut sign, Lollipop sign, Nodule in nodule appearance, Nutmeg liver, Periportal halo sign, Reverse target sign, Right posterior hepatic notch sign, Expanded gall bladder fossa sign, Snake/serpent sign, Sonographic halo sign, Starry sky appearance (USG), Turtleback sign, Water lily sign, Wheels within wheels sign, Spoke wheel sign, Interface sign, Hellmers sign, white liver sign, Scalloping sign, Patent track sign, Chiladiti sign, Flip-flop sign, Lucent liver sign, Corkscrew hepatic arteries.3. Pathophysiology, appearance, clinical relevance, and differential diagnosis of the radiologic signs will be discussed.

GIEE-38 Current Updates On Extrapancreatic Intraductal Papillary Mucinous Lesions: Horses, Zebras And The Unicorns!

Awards
Certificate of Merit

Participants

Nithin Banda, MD,BS, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Discuss morphology and histological subtypes of mass-forming intraepithelial tumors (counter parts of pancreatic IPMNs) composed of preinvasive neoplastic cells, now classified as intraductal papillary neoplasms of bile duct (IPNB), intracholecystic papillary-tubular neoplasms of gallbladder (ICPNs) and intra-ampullary papillary-tubular neoplasms (IAPNs) - Review multimodality imaging appearances of extrapancreatic papillary mucinous neoplasms. - Discuss imaging mimics of the extrapancreatic papillary mucinous lesions

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- Present the list of extrapancreatic sites of papillary mucinous lesions including bile ducts, gallbladder, cystic duct and ampulla, and review the histological subtypes in each location (bile ducts, gallbladder and duodenal ampulla) - Describe the role of imaging in evaluation of the papillary mucinous lesions and present the spectrum of imaging appearances of the extrapancreatic papillary mucinous lesions on ultrasound, CT, MR and endoscopic ultrasound. - Review the imaging appearances of mimics of extrapancreatic papillary mucinous neoplasms including gallbladder sludge/hemobilia/primary adenocarcinoma/metastases, biliary strictures/sludge/stones, and ampullary adenoma/carcinoma. - Discuss current advances in diagnosis and management of extrapancreatic papillary mucinous neoplasms including role of molecular mutations and targeted therapy of actionable mutations

GIEE-39   A Multimodality Imaging Review Of Chronic Mesenteric Ischemia: What The Radiologist Needs To Know

Participants
Jonathan Revels, DO, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

After reviewing this education exhibit, the learner will have an improved understanding of: 1- The epidemiology, etiologies, and clinical presentation of chronic mesenteric ischemia 2- Multimodality imaging approach to establishing the diagnosis of chronic mesenteric ischemia 3- Current treatment approaches of chronic mesenteric ischemia

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1- Review the background of chronic mesenteric ischemia including epidemiology, etiologies, and clinical presentation 2- Describe the role of radiologist in the diagnosis of chronic mesenteric ischemia including exclusion of alternative diagnoses 3- Demonstrate the imaging features of chronic mesenteric ischemia on CT, MRI, US, and catheter angiography 4- Review the current treatments available for chronic mesenteric ischemia

GIEE-4   Imaging Of Colonic Diverticulitis: Multimodality Approach, Controversies, And Future Directions

Participants
Victoria Tan, MD, HAMILTON, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Suspected colonic diverticulitis (CD) is usually imaged with CT. CT can be used to accurately confirm or refute the diagnosis, to search for alternative diagnoses, and to identify a spectrum of potential severity and complications. Suspected or known CD can occasionally be imaged with other cross-sectional imaging modalities, including ultrasound, DECT and MRI.2. Acute CD can be complicated by perforation, peritonitis, abscess formation, fistula formation, small and/or large bowel obstruction, urinary tract obstruction, and colonic bleeding. Rare but important complications include septic thrombophlebitis, pseudoaneurysm formation in the abdominal aorta from associated septic seeding, and adnexal/uterine involvement.3. CT can be used to identify risk factors for progression from acute uncomplicated CD to complicated CD.4.Colonic malignancy can mimic CD and vice versa but there are imaging signs which may be helpful in differentiating between these diagnoses.

TABLE OF CONTENTS/OUTLINE

1. Introduction2. Multi-modality approach to imaging (CT, DECT, US, MR)3. Modified Hinchey classification4. Predictive factors for progression from uncomplicated to complicated diverticulitis5. Potential Complications6. Differentiating diverticulitis from malignancy

GIEE-40   Pearls And Pitfalls In The Evaluation Of Large Splenic Lesions: How We Do It

Participants
Elliot Fishman, MD, Owings Mills, Maryland (*Presenter*) Co-founder, HipGraphics, Inc;Stockholder, HipGraphics, Inc;Institutional Grant Support, Siemens AG;Institutional Grant Support, General Electric Company

TEACHING POINTS

The presence of a large (>5cm) splenic mass is challenging for the radiologist. Splenic lesions can range from benign to malignant tumors as well as abscesses , infarcts and a range of uncommon lesions. The key to reaching the best diagnosis is thru analysis of findings including;1. Solitary vs multiple lesions2. Solid vs cystic mass3. Sharply defined vs ill defined masses with ill defined masses suspicious for malignancy 4. Lesion enhancement patterns are critical.5.Lesion calcification (central vs peripheral calcification)6. Lesion relationship to splenic margins including shape changes of spleen. 7. Extra splenic findings (hepatic or renal lesions, adenopathy, ascites, lung nodules or mediastinal adenopathy)

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The key findings that can be used for lesion classification include;1.Solitary lesions are often benign (cysts, hemangioma), although primary and metastatic lesions can be solitary.2. Benign lesions tend to have sharper margins than malignant lesions. angiosarcoma and lymphoma are infiltrating.3.Benign lesions can be difficult to diagnosis and be confused with a malignant mass. .4.Non-enhancement of the lesion and included in this category are splenic cysts and are usually benign 5.Hypervascular lesion-malignancies like angiosarcoma. Hemangiomas can have peripheral enhancement and can be challenging.6 Hypovascular lesion-hemangiomas are often hypovascular as are metastases as well as lymphomaCase studies illustrating this findings are provided with this exhibit..

GIEE-41   Ultrasound Quantification Of Liver Fat: Past, Present, And Future

Participants
David Fetzer, MD, Dallas, Texas (*Presenter*) Research support, Koninklijke Philips NVResearch support, Siemens AGResearch support, GE HealthcareConsultant/Advisory Board, Philips HealthcareConsultant/Advisory Board, GE Healthcare

TEACHING POINTS

- Paralleling rising obesity incidence, hepatic steatosis is remarkably common; - Ultrasound (US) is first-line modality in suspected liver disease; - Qualitative features of liver fat are widely used, however show variable performance with low sensitivity; - Semi-quantitative hepato-renal index (HRI) is useful, however suffers from confounding factors; - Fully quantitative techniques, including standardized measurement of attenuation coefficient, now clinically available; - Additional quantitative techniques, as well as multiparametric and artificial intelligence (AI)-based techniques show promise.

TABLE OF CONTENTS/OUTLINE

- Briefly review incidence of hepatic steatosis and association with: Metabolic syndrome; Heart attack/stroke; Non-alcoholic steatohepatitis, cirrhosis and hepatocellular carcinoma. - Emphasize need for liver fat assessment by US: Diagnosis (screening); Response to therapy (longitudinal follow up). - Detail widely used qualitative features of fatty liver, diagnostic performance of each and in combination; - Describe semi-quantitative HRI, benefits and drawback; - Discuss current and emerging quantitative techniques, including those currently available and those emerging as promising future tools: Attenuation and Backscatter Coefficient; Speed-of-Sound; RF analysis; Shear wave dispersion; Multiparametric and AI-based solutions. - Highlight current efforts by various organizations (AIUM; RSNA QIBA) to standardize techniques and reporting.

GIEE-42   **Precancerous Lesions Of Gastrointestinal, Hepatobiliary And Pancreatic Carcinoma: A Primer For Radiologists**

Participants
Kiyoyuki Minamiguchi, Kashihara, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of the exhibit is to recognize various cases of abdominal precancerous lesions, focusing on carcinogenesis, and to suggest a clinical significance such as early disease detection and disease-prevention.

TABLE OF CONTENTS/OUTLINE

Carcinogenesis is a multistep process in which cells accumulate multiple genetic alterations. In abdominal tumors, several different kinds of genetic alteration such as APC and KRAS mutation have been reported. Chronic infections and inflammatory diseases may contribute to the multistep carcinogenesis. The advance of radiology helps us detecting the precancerous lesions of various organs, such as villous adenoma of colon, and dysplastic nodule in the liver. Recognizing the imaging findings of precancerous lesions leads us not only to detect in early stages, but also to prevent the carcinogenesis. 1) Case presentations: We reviewed precancerous lesions in gastrointestinal and digestive system: a) Gastrointestinal tract: Villous adenoma and mucinous adenocarcinoma, Familial adenomatous polyposis and colorectal cancer. b) Liver: dysplastic nodule and hepatocellular carcinoma, bile duct adenoma and cholangiocarcinoma. c) Pancreas: PanIN and pancreatic carcinoma, IPMN and IPMC or colloid carcinoma, MCA and MCC, ITPN d) Gall bladder: ICPN In each case, we described the multimodality imaging features such as CT, MRI, US, and barium fluoroscopy. 2) Discussion: The clinical significance such as differential diagnosis, early disease detection and disease-prevention are mentioned.

GIEE-43   **Acute Appendicitis; An Update At The Light Of The 2019 Nijemegenconsensus Conference.**

Participants
Jean-Pierre Tasu, MD, PhD, Poitiers, France (*Presenter*) Speaker, Bayer AG;Consultant, Bracco Group;Research Grant, Terumo Corporation;Shareholder, TeleDiag

TEACHING POINTS

The use of clinical scores to exclude acute appendicitis (AA) and identify intermediate-risk patients needing of imaging is recommended. Ultrasonography (US) is the most appropriate first-line diagnostic tool in both adults and children. Contrast-enhanced low-dose computed tomography (CT) scan in patients with suspected AA and negative US findings is recommended. MRI is the second line examination in pregnant patients with suspected AA, after inconclusive US. Medical treatment with antibiotics is an effective alternative to surgery in children or young adult with uncomplicated AA in the absence of an appendicolith. Laparoscopic appendectomy should be the preferred approach over open appendectomy for both uncomplicated and complicated AA. Initial non-operative management with antibiotics and, if available, percutaneous drainage is recommended for complicated appendicitis with a periappendicular abscess.

TABLE OF CONTENTS/OUTLINE

The 2020 WSES (World Society of Emergency Surgery) guidelines on AA provide recommendations on diagnosis and management. This exhibit gives the key-points for radiologists. Recommendations are given according to their quality of evidence (QoE) marked as high, moderate, low, or very low and their strength (SoR) based on the level of evidence and qualified as weak or strong. Imaging patterns is given for US, CT and MRI. Two flow-chart algorithms for the diagnosis and management of acute appendicits to be used for adults and pediatric patient populations are given.

GIEE-44   **How To Use AI In Laxative-free CT Colonography For Colorectal Cancer Screening**

Participants
Hiroyuki Yoshida, PhD, Boston, Massachusetts (*Presenter*) Patent holder, Hologic, Inc;Patent holder, MEDIAN Technologies;

TEACHING POINTS

The teaching points of this exhibit are to (1) explain the role of laxative-free CT colonography in colorectal cancer screening, (2)

explain the role of artificial intelligence (AI) in realizing an effective laxative-free CT colonography examination, and (3) demonstrate how the use of AI enhances diagnostic performance in laxative-free CT colonography.

TABLE OF CONTENTS/OUTLINE

1. Introduction: The importance of colorectal cancer screening; Laxative-free CT colonography can revolutionize colorectal cancer screening; Results and implications of laxative-free CT colonography screening trials. 2. How it works: AI resolves current technical challenges of laxative-free CT colonography; How to use AI for computer-aided detection; How to use AI for electronic cleansing; How to use AI for computer-assisted diagnosis. 3. Case studies: Examples of how AI-enabled correct interpretation of a clinical laxative-free CT colonography case.

GIEE-45   **Macrovascular Invasion In Hepatocellular Carcinoma - Imaging And Pitfalls**

Participants
Roman Kloeckner, MD, Mainz, Germany (*Presenter*) Advisory Board, Guerbet SA;Speaker, Guerbet SA;Advisory Board, Bristol-Myers Squibb Company;Advisory Board, Sirtex Medical Ltd;Speaker, Sirtex Medical Ltd;Advisory Board, F. Hoffmann-La Roche Ltd;Speaker, F. Hoffmann-La Roche Ltd;Advisory Board, Boston Scientific Corporation;Speaker, Boston Scientific Corporation;Speaker, BTG International Ltd;Speaker, Siemens AG;Speaker, Eisai Co, Ltd

TEACHING POINTS

1. To understand the high clinical relevance of correct PVTT imaging2. To learn the imaging principles to identify PVTT3. To learn to differentiate PVTT against bland thrombus4. To raise awareness of the aggressive tumor behavior in patients with PVTT

TABLE OF CONTENTS/OUTLINE

1. Clinical relevance- Incidence and mortality of HCC and PVTT2. Classification of PVTT (Liver Cancer Study Group of Japan stages)3. Impact of PVTT on survival4. Differentiation of PVTT vs bland thrombus5. Case-based pictorial reviews- Bland thrombus vs PVTT- Unfavorable prognosis of PVTT with rapid progression- Concomitant hepatic vein tumor thrombus (HVTT)- Concomitant extrahepatic metastases6. Summary of important findings / teaching points

GIEE-46   **Pre-surgical Conditioning In Giant Hernias Or With Loss Of Domain; How We Do It And The Most Frequent Complications**

Participants
Almudena Gil Boronat, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To learn which patients are candidates for a pre-surgical conditioning treatment.-To explain how intramuscular injection of botulinum toxin and progressive pneumoperitoneum is carried out, as well as its benefits.-To become familiar with the main complications of conditioning techniques through a case-based review.-To emphasize that the main complications continue to be postoperative due to the high comorbidities of the patients

TABLE OF CONTENTS/OUTLINE

1. Quick review of the hernias' characteristics amenable to preconditioning treatment 2. How we perform the intramuscular eco-guided injection of botulinum toxin in our hospital 3. How we perform progressive pneumoperitoneum by CT-guided catheter insertion in our hospital. 4. We illustrate the few complications derived from both techniques through a case-based review and the main postoperative complications. 5. Conclusions 6. Bibliography

GIEE-47   **Acute Pancreatitis: A Ticking Bomb - Focusing On Its Multiple Complications.**

Participants
David Castanedo SR, MD, Santander, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the radiologic features of Acute Pancreatitis (AP). 2. To describe the wide variety of complications that may appear during the evolution of AP. 3. To focus on the diagnostic pearls for the recognition of the most lethal complications of AP.

TABLE OF CONTENTS/OUTLINE

1. Definition and standardized nomenclature of AP according to the Atlanta Revised Classification (2012). 2. Etiology of AP, diagnostic criteria and severity classification. 3. Interstitial Edematous Pancreatitis and Necrotizing Pancreatitis. 4. Severe complications of AP: 4.1. Fluid collections: Acute Peripancreatic Fluid Collection, Pseudocyst, Acute Postnecrotic fluid collection, Walled - off necrosis. 4.2. Superinfection. 4.3. Necrosis related complications: Infected Pancreatic Necrosis, Central Necrosis (disconnected duct syndrome) and Extra - pancreatic Fat Necrosis.4.4. Vascular related complications: Arterial pseudoaneurysm, Venous thrombosis. 4.5. Gastrointestinal complications: intestinal obstruction, intestinal perforation, ileus. 5. Conclusion. 6. References.

GIEE-48   **Digestive Stoma Complications: Key Imaging Findings**

Participants
Jesus Arenos-Abril, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Stoma-related complications are a frequent cause of morbi-mortality of post-operative patients and radiology plays a crucial role in order to diagnose major part of them.- Radiology professionals must be familiar with the different surgery techniques, the main indications of digestive stoma derivation and be aware of the main complications and its imaging findings.- There are multiple types of complications appearing in different post-operative periods.- CT and MR are the principal imaging diagnostic techniques and can be performed in emergency room.

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There has been a collaboration of Radiology and Surgery departments in order to collect different representative cases of the main

stoma complications and reflect them on this exhibit with the following structure:1. Definition of digestive stoma2. Surgery indications3. Types of derivations and surgery technique4. Normal imaging findings5. Digestive stoma complications- Skin complications- Parastomal hernias- Prolapse- Retraction- Necrosis- Stenosis- Parastomal fibrosis- Neoplastic implants- Parastomal varices and bleeding- Infection and abscess formation- Stomal inflammatory bowel disease recurrence- Stoma dehiscence6. Conclusions

GIEE-49   Complications Of Sacropexy: The Imaging Study View

Awards
Identified for RadioGraphics

Participants
Mohamed Haouari I, MD, Vanves, France (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Pelvic floor dysfunction constitutes a major public health issue. - Pelvic organ prolapse (POP) is among the manifestations of pelvic floor dysfunction. - Laparoscopic sacropexy is the reference standard treatment of symptomatic POP and produces excellent outcomes with few complications. - Although rare, complications can occur at each step of the surgical procedure, from the insertion to the removal of the trocars. - These complications raise diagnostic challenges for radiologists who are not specialized in pelvic and perineal imaging. - Complications may be specific or nonspecific and may occur early or after some time.

TABLE OF CONTENTS/OUTLINE

- Pelvic organ prolapse: definition, epidemiology, pathophysiology, and investigation modalities - Role of laparoscopic sacropexy in the treatment strategy for pelvic organ prolapse. - Description of the laparoscopic sacropexy technique - Examples of the imaging findings produced by early complications of each surgical step - Description of imaging findings in delayed complications

GIEE-5   Hepatic Metastases From Various Primaries; Organ-specific Metastasis And Imaging Features With Pathologic Correlation

Awards
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Cum Laude

Participants
Kumi Ozaki, Fukui, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Metastases are the most common malignant tumor in the liver, while the liver is one of the most affected organs to be involved with metastatic disease. The accurate detection and characterization of liver metastases are crucial since patients' management depends on it. The purposes of this presentation are; 1) to understand the basic mechanism of hepatic metastases in relation to organotropism; 2) to provide a general overview of imaging features of hepatic metastases from various primaries.

TABLE OF CONTENTS/OUTLINE

1. Introduction. 2. Knowledge of the various primaries and the frequency of hepatic metastases. 3. Organ-specific metastasis and role of tumor exosomes in the formation of pre-metastatic niche. 4. Metastasis process and epithelial-mesenchymal transition. 5. Hepatic fibrosis of chronic liver disease and it's influence to promoting pre-metastatic niche. 6. Desmoplastic reaction around the tumor and related imaging findings. 7. Key points of diagnostic imaging. 8. General overview of imaging features of hepatic metastases from various primaries. 9. Review several differential diagnoses of hepatic metastases. 10. Conclusion.

GIEE-50   Treatment Response Assessment After Radiation Therapy For Hepatocellular Carcinoma (HCC): Diagnostic Challenges

Participants
Matthew Carr, MD, San Diego, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Understanding the pathophysiology of radiation induced tumor cell death.2. Understanding the expected post-treatment imaging features after transarterial chemoembolization (TARE) and stereotactic body radiotherapy (SBRT) in the setting of hepatocellular carcinoma (HCC).3. Understanding the challenges in treatment response assessment after radiation (TARE/SBRT) therapy for HCC and common pitfalls in interpretation.

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Brief overview of mechanism of radiation induced cell death.Pictorial review: 1. Describe imaging features of HCC treated with TARE or SBRT in addition to adjacent parenchymal changes. 2. Highlight the differences in post-treatment appearances of lesions following TARE and SBRT compared to other loco-regional therapies.Case based review: 1. Applying current treatment response algorithms to radiation therapy of HCC. 2. Describe challenges involved with image interpretation when applying current treatment response algorithms. 3. Highlight imaging features that improve on conventional criteria for assessing treatment response after radiation therapy and potential pitfalls in interpretation.Additional topics 1. Case based review of multidisciplinary treatment approach for diagnostic dilemmas. 2. A review of emerging data including radiology-pathology correlation.

GIEE-51   "I (ain't) Got Rhythm": Imaging GI Tract Motility Disturbances

Awards
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Participants
Jonathan Revels, DO, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- Review common and less commonly encountered GI motility disorders 2- Review the clinical and radiological approach in the

1- Review common and less commonly encountered GI motility disorders 2- Review the clinical and radiological approach in the diagnosis of these disorders 3- Review algorithmic approach to arrive at a differential diagnosis

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1- Review the imaging features of common and uncommon GI motility disorders from esophagus to the large bowel such as achalasia, pyloric stenosis, intestinal obstruction and pseudo-obstruction, visceral myopathies and neuropathies, diverticular disease, systemic sclerosis, ileus, dumping syndrome, intestinal reflux and bacterial overgrowth, post-vagotomy motility disorders, etc. 2- Demonstrate imaging features of these conditions with correlative imaging including fluoroscopy with Cine imaging, CT, MRI, and relevant pathologic and surgical photos 3- Review clinical approach from the time suspected diagnosis, imaging, and follow up 4- Describe the role of radiologist in management of such patients 5- Algorithmic approach based on pattern of clinical and imaging findings to arrive at a differential diagnosis

GIEE-52   Transanal Total Mesorectal Excision (TaTME) In Rectal Surgery: Diffusion Tensor Tractography Can Be A Powerful Imaging Tool To Learn Anatomical Landmarks.

Participants
Yuko Someya, MD, Kyoto, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Transanal total mesorectal excision (TaTME) is a promising surgical method which could outperform conventional rectal cancer surgery in both oncological and functional preservation. Direct clear visualization of the dissection plane, even in a narrow pelvis, under endoscopy from the anus is a major benefit to select the optimized dissection layer. Since the direction of the muscle fibers is concerned as an important intraoperative landmark, recognition of characteristic anatomy via transanal approach is required and a method for visualization for training is needed for surgeons. In this presentation, we review essential anatomy of anorectum and pelvic floor along with MR images, highlighting a potential benefit of diffusion tensor imaging (DTI), which is also helpful for extending knowledge of radiologists.

TABLE OF CONTENTS/OUTLINE

1. Introduction to the TaTME procedure (Advantages of TaTME, Candidates for TaTME, Possible complications) 2. The steps of TaTME procedures (Rectal purse-string suture, Rectotomy: open the rectal wall circumferentially, Dissection: Posterior Anterior Lateral, Neurovascular bundle dissection, Specimen extraction, Mechanical coloanal anastomosis), comparing information visualized by MR images. 3. Key structures (Anococcygeal lig., Muscle fibers from levator ani to conjoined longitudinal muscle of anal canal, Puborectalis m., Rectourethralis m., Denonvilliers' fascia)

GIEE-53   Current Applications Of Dixon-quant Technique In Abdominal Pathologies: A Case Base Review

Participants
Sonsoles Junquera, MD, Santiago de Compostela, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Dixon techniques have being developed to simplify and accelerate MRI acquisition These sequences are one of the methods to suppress fat signal in MRI based on chemical shift-based techniques that use the in-phase/out-of-phase cycling of fat and water. DIXON allows us to obtain four contrast images in only one acquisition: fat-fraction, water-only, fat-only, and T2*. Fat-only images offer great potential for fat-quantification, which is useful to narrow the broad differential diagnosis of abdominal pathology since the presence of intralesional fat is typical of certain specific entities.The aim of this exhibit is -To review the technical aspects of Dixon sequences. -To discuss strengths and limitations of these sequences. -To illustrate possible pitfalls -To review main clinical applications of Dixon in abdominal disorders.

TABLE OF CONTENTS/OUTLINE

1. Technical aspects. 2. Advantages and disadvantages. 3. Applications in abdominal MRI - Liver: a) diffuse diseases (fat and iron storage) b) characterization of focal lesions- Gallbladder - Pancreas: diffuse/focal lesions- Kidneys - Adrenals - Retro and peritoneum - Bone marrow - Tumor response assessment 4. Pitfalls 5. Conclusions

GIEE-54   Long Term Course Of Crohn'S Disease: Clinical, Radiologic And Endoscopic Correlation

Awards
Certificate of Merit

Participants
Myung-Won You, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

TEACHING POINTS

In this exhibition, we aimed to categorize and review the long-term disease courses in patients with Crohn's disease.

TABLE OF CONTENTS/OUTLINE

1. Clinical disease patterns- Vienna classification- Montreal classification2. Assessment of disease acitvity- Clinical activity index: Crohn's disease acitvity index (CDAI), Harvey-Bradshaw index(HBI)- serologic biomarkers: fecal calprotectin, C-reactive protein(CRP) etc.- Imaging: CT enterography, MR enterography- Endoscopy: Crohn's disease endoscopic index of severity(CDEIS), SES-CD- Pathologic exam3. treatment planning: 'treat-to-target'4. Long term disease courses: case review1) remission2) improved and stable3) chronic refractory4) chronic relapsing5. Predictors for disease courses

GIEE-55   Update On Electronic Cleansing In Single- And Dual-energy CT Colonography

Participants
Rie Tachibana, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Electronic cleansing (EC) is used for subtracting orally tagged residual materials from CT colonography (CTC) images to improve the polyp detection sensitivity of virtual endoscopic fly-through reading. The teaching points of this exhibit are (1) to learn about the

history of EC in CTC, (2) to learn about recent progress in state-of-the-art AI solutions for EC, and (3) to demonstrate clinical outcomes of the state-of-the-art AI-based EC in single- and dual-energy CTC.

TABLE OF CONTENTS/OUTLINE

1. Introduction: Review the history of EC in CTC. 2. How EC works: Traditional EC; How does AI-based EC differ from traditional EC; State-of-the-art EC; self-supervised generative adversarial networks (GANs); How does dual-energy information improve the image quality of AI-based EC. 3. Case studies: examples of how the use of AI-based EC avoids the image artifacts of traditional EC algorithms in clinical single- and dual-energy CTC cases.

GIEE-56   Digging In: MR Imaging Of Perianal Fistulas In Patients With Crohn's Disease

Participants
Eric Ehman, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

-MRI of the pelvis is used extensively to evaluate perianal Crohn's disease-Accurate reporting of fistula type, complexity, severity, and complications guides treatment options-Response assessment varies by treatment used-Perianal severity indices may be helpful for longitudinal response assessment

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Perianal disease is commonly seen in Crohn's Disease (CD) and results in significant morbidity. Fistulas rarely resolve spontaneously and may be difficult to evaluate at physical exam. MRI of the pelvis provides a comprehensive evaluation of the perianal region and guides therapy as well as assesses treatment response.-Describe MRI technique for optimal imaging evaluation of the perianal region-Review Parks classification of perianal fistulas, and showcase complex features that portend surgical intervention-Provide a framework for clear and concise routine reporting of perianal disease-Describe currently proposed severity scoring systems for perianal disease (MAGNIFI)-Highlight therapies for perianal disease such as medications (biologics), surgical interventions (seton placement, fistulotomy, ligation, advancement flaps), and other treatments (fibrin glue injection, collagen plugs and novel stem cell impregnated plugs)-Case-based review of above treatments to illustrate healing or response to therapy

GIEE-57   Imaging Masterpieces Of Intestinal Obstruction: A Notable Collection To Unlock Your Mind

Participants
Paulo Antunes, MD, Niteroi, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Obstructive disorders of the gastrointestinal tract are common events in current medical practice. The signs and symptoms related to the multiple causes of intestinal obstruction are very similar in the majority of cases, which points out the relevance of CT evaluation in the emergency setting. Our objective is:To discuss the main imaging findings associated with the diagnosis of complex intestinal obstructions.To learn some tips and tricks to detect life-threatening complications, such as ischemia.

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We will analyze several CT scans of patients with intestinal obstruction, use multiplanar reformats and surgical images, to create an interactive quiz, which will help us to understand the patterns of obstruction and its complications. Causes of obstruction that will be on the quiz: internal hernias, adherents causing simple and complex obstructions, uncommon cases such as phytobezoar and gossypiboma, parietal hernias, post-surgical internal hernias, large bowel, and gastric volvulus. We will demonstrate signs of complicated obstruction such as closed-loop obstruction, signs of ischemia, and bowel perforation.

GIEE-58   Eosinophilic Disorders Of The Gastrointestinal Tract And Beyond

Awards
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Participants
Mariana Yalon, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

Teaching Points:• Primary eosinophilic gastrointestinal disorders (EGIDs) are characterized by abnormal eosinophilic infiltration of various layers and segments of the GI tract in the absence of systemic or secondary causes of eosinophilia.• The clinical manifestations and radiological findings are dependent on the layers of the wall and segment of the GI tract involved.• Secondary EGIDs occur with hypereosinophilic syndrome, parasitic infections, drugs, inflammatory bowel disease, vasculitis, and other autoimmune disorders.

TABLE OF CONTENTS/OUTLINE

Table of Contents/Outline:• Overview of EGIDs (Etiology, Pathology, Clinical Presentation, Imaging features and Treatment).• Describe the imaging findings with illustrative examples of primary and secondary EGIDs: - Eosinophilic esophagitis (EoE)- Eosinophilic gastritis (EG)- Eosinophilic gastroenteritis (EGE) - Eosinophilic colitis (EC) - Eosinophilic hepatitis and cholangitis- Eosinophilic pancreatitis (EP)- Hypereosinophilia associated conditions *Parasitic infections *Primary hypereosinophilia *Drug induced *Inflammatory bowel disease

GIEE-59   Post Bariatric Abdominal Pain: A Practical Imaging Guide For The Evaluation On Emergency Room.

Participants
Paulo Antunes, MD, Niteroi, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To clarify the importance of surgical anatomy knowledge, as well as the systematic evaluation of computed tomography in the context of urgency.To describe the main imaging findings in the emergency room of patients with Roux-en-Y reconstruction after bariatric surgery.To highlight the red flags that indicate surgical urgency and the small changes that are associated with less

common diagnoses in everyday life.

GIEE-6   **Imaging Assessment Of Treatment Response In Hepatocarcinoma: Is That Tumor Viable Or Not?**

Participants
Monica Munoz-Lopez, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

-To review, in a case-based presentation, expected imaging appearances of treated hepatocellular carcinoma.-To understand the pathophysiology of imaging findings after the different types of systemic and locoregional therapies.-To recognize residual or recurrent tumor requiring further treatment.-To identify the main challenges in assessment, and the utility of multimodality imaging.

GIEE-60   **Can COVID-19 Pandemics Help Us To Understand Abdominal Anatomy? A Safe Travel Through The Extraperitonal Abdominal Spaces, Guided By The Dissecting Pneumomediastinum.**

Participants
Paulo Antunes, MD, Niteroi, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To learn the anatomical pearl of the extraperitoneal abdominal spaces based on CT scans of patients with dissecting pneumomediastinum into the abdomen.To highlight the main signs that assist in the differentiation between peritoneal and extraperitoneal localization of the gas.

GIEE-62   **Catching The Wave: A Module For Performing And Interpreting MR Elastography**

Participants
Rekha Krishnasarma, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

TEACHING POINTS

Magnetic resonance (MR) elastography has been demonstrated to be a reliable noninvasive technique for detection and staging of liver fibrosis. Protocols have allowed for MR elastography to be performed quickly and effectively. Our review consists of an overview of the theory, indications, and advantages of MR elastography. We also discuss the standard protocol, steps to acquiring a successful study, obtaining measurements, and review salient cases.

GIEE-63   **Body MRI Optimization: Quantitative MRI Pitfalls And How To Avoid Them**

Participants
Justin Yu, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Quantitative MRI holds much clinical utility and is increasingly commonly utilized in practice-There are certain artifacts/pitfalls that can occur with different quantitative methods-We summarize the presentation of some of these pitfalls and ways to fix and avoid them in 4 common qMRI methods-These methods are illustrated in the liver for this abstract, but may apply to other organs as well

image swapping, gadolinium contrast, non-standardized units of measurement, iron overload, workflow-R2* mapping--Iron overload, post processing methods, sequence selection, scanner field strength, confounding medications (e.g. ferumoxytol)-T1/T2 mapping--Technical considerations (parameter selection, sequence type), patient BMI, liver iron

GIEE-64   Moving Ahead: A Review Of Gastrointestinal Motility Disorders

Awards
Identified for RadioGraphics

Participants
Avinash Nehra, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

TEACHING POINTS

Motility disorders can affect any portion of the gastrointestinal tract or combination of segments and can be primary or secondarily caused by a variety of diseases.Multiple diagnostic tests are available to evaluate for gastrointestinal motility abnormalities, each with unique advantages and limitations, including manometry, fluoroscopy, cross sectional (CT/MRI), and nuclear medicine imaging.With the development of new diagnostic technology, (ie. high resolution manometry and EndoFLIP) new motility disorders and subtypes of previous known disorders are being reported

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Gastrointestinal tract motility disorders are common and mimic other disease processes, frequently leading to extensive evaluation and delayed diagnosis. Several diagnostic tests are available to evaluate for motility disorders, each with unique advantages and limitations. Technologic advances have led to the ability to identify new disorders or subtypes of previous known disorders. This exhibit reviews the common tests used to evaluate for motility disorders for each segment of the gastrointestinal tract and describes the findings for these disorders.• Esophagus: Achalasia, Connective tissue diseases, Diffuse esophageal spasm, Jackhammer esophagus, Post-bariatric dysmotility• Stomach: Diabetic and idiopathic gastroparesis, Opioid induced gastric atony, impaired gastric accommodation• Small bowel: Pseudo-obstruction, Scleroderma, Amyloid, IBS• Colon: Megacolon, Hirschsprung's disease, Pelvic floor dyssynergy

GIEE-65   Radiogenomics In Hepatobiliary Cancers

Participants
Aman Saini, DO, Phoenix, Arizona (*Presenter*) Nothing to Disclose

TEACHING POINTS

-Review radiogenomics, radiomics, and their emerging role in personalized cancer treatment. -Discuss key studies that examine the diagnostic, prognostic, and predictive abilities of radiogenomics in hepatobiliary cancers including HCC, cholangiocarcinoma and metastases. -Highlight challenges to radiogenomics adoption, future directions, and the role radiologists will play in multidisciplinary cancer care.

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-Provide a background on hepatobiliary malignancies with a focus on HCC, Intrahepatic cholangiocarcinoma (ICC), and metastatic disease to the liver. -Discuss advances in genomics and the role of personalized therapy in cancer treatment. -Define radiogenomics and its process including imaging trait selection, genomic map creation, incorporation of clinicopathologic data, radiogenomic modeling, and model validation. -Define the related field of radiomics and review its role in the extraction of data from quantitative imaging features and how the subsequent combination of that data with clinical data can be used to monitor disease, select treatment, and predict outcomes. -Review radiogenomic/-omic literature involving HCC, ICC, and hepatic metastases. -Highlight the key findings of studies that demonstrate the diagnostic, prognostic, and predictive abilities of radiogenomics/-omics. -Discuss challenges to the adoption of radiogenomics into clinical practice. -Review future directions of the field and the role radiologists will play in multidisciplinary cancer management.

GIEE-66   Hepatic Elastography For Fibrosis And Steatosis Quantification: An Overview Of Applications, Limitations And Perspectives With Multimodality Imaging

Participants
Leonardo Marcelino, MD, SAO PAULO, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Understand how elastography techniques work and how they can beperformed.? Learn about the different imaging modalities of hepatic elastography (HE) andtheir applications, focusing on the benefits and drawbacks of ultrasound-basedtechniques.? Recognize relevant imaging features on different elastography methods,including magnetic resonance (MR) elastography.

TABLE OF CONTENTS/OUTLINE

• Introduction - HE concepts and techniques:o How elastography works: a multimodality approach.o Ultrasound elastography and MR elastography for assessingchronic liver disease.• Liver ultrasound elastography: state-of-arto How to perform: a step-by-step walkthrough.o Artifacts and pitfalls.o Current guidelines and recommendations.• Case-Based Review:o Case studies to illustrate various modalities of HE in adults and children, as well as their benefits and drawbacks, including:o Transient Elastography (TE)o Acoustic Radiation Force Impulse (ARFI)o Real-time Elastography (RT-E)o Shear-Wave Elastography (SWE)o Controlled Attenuation Parameter (CAP)o Attenuation Imaging (ATI)o Shear Wave Dispersion (SWD): investigate necroinflammatory changeso MR Elastography• Future Directions: new image modalities and next generation technologies.• Conclusion and key takeaways.

GIEE-67   Resident Primer On US And MR Elastography For Hepatic Fibrosis

Participants
Javad Azadi, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

TEACHING POINTS

US and MRI elastography can be an intimidating concept for residents. With the continued advancement in elastography techniques and applications it is imperative that residents are comfortable in understanding, interpreting and reporting both US and MRI

elastography.-US and MRI Elastography are noninvasive methods to grade liver fibrosis-With MRI Elastography, you can also determine liver fat and liver iron levels-US Elastography can be both stand-alone procedure as well as be performed as an add-on to standard ultrasound exams of the liver-MRI Elastography requires special equipment and is typically performed as a dedicated procedure

GIEE-68   **The Dark Side Of The Bright Spot: Spectrum Of Pancreatic Neuroendocrine Neoplasms.**

Participants
Fernando Martos Martins, MD, Sao Roque, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Pancreatic neuroendocrine neoplasms (pNEN) are rare neoplasms that arise in the endocrine tissues of the pancreas. Functioning pNEN can secrete a variety of peptide hormones, including insulin, gastrin, glucagon, and vasoactive intestinal peptide, resulting in a myriad of clinical syndromes. Although nonfunctioning pNENs do secrete a number of substances, such as chromogranins, neuron-specific enolase, pancreatic polypeptide, and ghrelin, they do not present clinically with a hormonal syndrome as compared with their functional counterparts. The gross appearance of well-differentiated pNENs varies with size, ranging from smaller than 1 cm to larger than 20 cm. Smaller tumors tend to be more homogeneous, whereas larger tumors more commonly are heterogeneous with areas of cystic change, necrosis, and calcification. Atypical radiologic presentations pNEN may be mistaken as several different conditions, such as pancreatic adenocarcinoma, pseudocysts, metastasis, and forms of pancreatitis.

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Discussion of the different forms of presentation of pNEN, describing the most typical radiological findings in each type. Presentation of rare imaging features found in unusual cases. Provision of a didactic approach of differential diagnoses. Easy-to-use take home messages to facilitate the handling of challenging cases.

GIEE-69   **Stuck In The Middle: A Systematic Approach For CT Assessment Of Jejunal Diseases**

Participants
Isabella Bertuol Kinoshita, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) Limitations of cross-sectional imaging in the past have once put hollow organ evaluation in an obscure place. CT technique improvements over the decades overcame most of these limitations, making small bowel findings increasingly more common in daily practice. However, still to this day, jejunal diseases are an ongoing challenge due to overlapping findings and scarce literature regarding this subject.2) Jejunal lesions are relatively rare and benign in most cases. Nonetheless, their prompt identification is crucial for patient management. They are not easily reached via endoscopic methods and accurate diagnosis may indicate or spare the patient from surgery and enterectomy.

TABLE OF CONTENTS/OUTLINE

1) Introduction: a brief review on small intestines anatomy and CT imaging protocols for jejunal evaluation.2) Case-based review of pathologic processes that develop along the jejunum. Representative cases will include intussusception, angioedema, inflammatory bowel disease, tuberculosis, adenocarcinoma, lymphoma, diverticula, GIST, metastasis, carcinoid, ectopic pancreas, benign polyps, hematoma and others.3) Flowchart-based approach for narrowing diagnostic possibilities through cross-sectional imaging.4) Take-home messages.5) References.

GIEE-7   **Everything About Complicated Cholecystitis: Survival Guide For On-call Radiologist**

Participants
Dario Herran de la Gala, MD, Santander, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit will: 1) Describe the complications acute cholecystitis can have and its pathophysiology through a pictorial review. 2) Review the different complications that acute cholecystitis can have and its main imaging findings on US, CT and MRI.

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Gallbladder pathology is the most frequent cause of right upper quadrant pain and its a common cause of acute abdomen. Its pathology ranges from simple biliary colic to acute cholecystitis and its complications. If untreated, it can lead to important mortality and morbidity rates. Acute cholecystitis and its complications requires a prompt diagnosis in which the radiologist plays a major role. If untreated, acute cholecystitis can evolve to either gangrenous cholecystitis, emphysematous cholecystitis, hemorrhagic cholecystitis, gallbladder perforation, gallstone ileus and even portal vein thrombosis (pylephlebitis). In this work we will review its key cross-sectional imaging findings helped by pictorial drawings.

GIEE-70   **Abdominal Imaging Peer Learning: Valuable Lessons Learned**

Participants
Sarah Ali, MD, Burlington, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Our subspecialized department in a tertiary medical center transitioned from a score-peer review model to Peer Learning in 2017. Between 2017-2021, 1018 body imaging cases were submitted, 374 for great calls, 316 discrepancies and 297 for

discussion.Analysis of submitted abdominal cases revealed common themes in potential blindspots for our radiologists, the majority being incidental findings on studies for other indications. These themes suggest our radiologists may not review organ systems outside our subspecialty as closely and that certain locations/organs are challenging. This transparency into our practice has given us the ability to identify where we can collectively improve and where we should amplify our accomplishments.It is our hope that by sharing these common themes, we may be able to make other radiologist cognizant of potential preventable errors.

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1.Introduction2.Themes among submissions on CT/MRI: Vascular pathology eg aneurysms, PE and DVT, Female pelvic pathology eg endometrial thickening, pelvic masses, Spinal/paraspinal, breast, gastric and pancreatic masses, Bowel findings on MRI, eg colonic masses on liver MRI, diverticulitis on pelvic MRI, Renal and adrenal masses not characterized with dual energy CT post-processing, Use of appropriate follow-up recommendations, Systems Issues eg recommending follow-up imaging for stable findings, mentioning important study details in the body but not the impression3.Future directions

GIEE-71   MRI Of Cholangitis: Simplified Interplay Between MRCP, DCE, DWI And MR Elastography

Participants
Manohar Roda, MD, Jackson, Mississippi (*Presenter*) Nothing to Disclose

TEACHING POINTS

• To review the diagnostic criteria of acute and chronic causes of cholangitis • To describe and illustrate magnetic resonance cholangiopancreatographic (MRCP) features in the spectrum of cholangitis etiologies, including ductal and parenchymal involvement • To discuss the additional value and imaging signs in DCE, DWI and MR elastography in different clinical scenarios of cholangitis

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Pathologic signs are seen in less than 40% of patients and are not pathognomonic of cholangitis; thus, the final diagnosis often relies on laboratory and imaging findings. Magnetic resonance cholangiopancreatography (MRCP) is the standard for the evaluation of morphological changes of bile ducts. Aside from biliary ductal imaging features that are diagnostic of cholangitis, liver parenchymal changes are commonly identified. In recent years, the continued advancement of magnetic resonance imaging (MRI) techniques allowed for accurate non-invasive diagnosis and surveillance of biliary ductal changes and hepatic parenchymal disease progression. Our education exhibit will focus on the MRI assessment of cholangitis including acute and chronic causes such as infectious, inflammatory, iatrogenic, malignant, congenital, ischemic, traumatic and radiation or chemotherapy-induced. We will explore MRCP features and multiple imaging techniques like diffusion imaging, post contrast imaging, MR Elastography (MRE) that assist radiologists in the correct diagnosis, etiology assessment and treatment guidance of cholangitis.

GIEE-72   Sonographic Liver Elastography: An Overview And Pathologic Correlation At A Liver Transplantation Center

Participants
Paschalis Toskas, MD, Burlington, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Acknowledge the clinical significance of hepatic fibrosis. Review fibrosis staging by pathology and elastography. Highlight imaging techniques of liver elastography. Learn basic physical principles of ultrasound elastography. Share a liver transplant institution's experience of reporting and comparing elastography results to biopsy specimen.

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Background: Hepatic cirrhosis, and its dreadful consequence of hepatocellular carcinoma, remain a significant clinical and financial burden for our society. In search of less invasive methods than biopsy, liver fibrosis staging by imaging has become an area of strong interest, leading to the emergence of various quantification techniques by ultrasonography and MRI.Exhibit Goals: This project aims to familiarize the radiologist with these modern technologies, with a focus on ultrasonography, and also to conduct a comparison between ultrasonography and pathology in terms of fibrosis staging, from a perspective of an institutional experience.The big picture: Given the invasive nature of liver biopsy and the increasing need to care for a multiplying and aging population in a world of exorbitant medical costs, highlighting the role of ultrasound elastography is more relevant than ever before, in aiding the interdisciplinary teams of radiologists, gastroenterologists, oncologists, and other specialists involved in the care of this patient population.

GIEE-73   Tropical Calcific Pancreatitis: Etio-pathology, Clinical Presentation, Imaging Features, Diagnosis And Complications

Participants
Thara Pratap, DMRD,DMD, Ernakulam, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Tropical Calcific Pancreatitis (TCP) is a unique entity which has regional predisposition in tropical countries, in young non alcoholics, associated with malnutrition and has a rapid progressive course with diabetes and increased risk of adenocarcinoma. TCP is associated with a high risk of pancreatic cancer The differentiation between inflammatory and malignant pancreatic mass is based on the enhancement characteristics and ancillary features. Early diagnosis of pancreatic cancer in a background of TCP needs increased awareness by the reporting radiologist as an early diagnosis will improve patient survival.

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Overview of TCP (Etiology, Pathology, Clinical Presentation, imaging findings and diagnosis). Describe the imaging findings in TCP and its complications, Differentiating features between benign and malignant masses, importance of early diagnosis of pancreatic cancer with images and illustrative examples. Management of TCP requires multidisciplinary approach involving radiologists, endoscopists and gastroenterologists.

GIEE-74   State-of-the-art Clinical Application Of Spectral-detector CT Technologies For Abdominal Imaging

Participants

Yasunori Nagayama, MD, Kumamoto, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Spectral-detector CT provides spectral-based imaging such as virtual non-contrast imaging (VNC), virtual monochromatic imaging (VMI), and iodine density maps for all examinations, potentially facilitating the optimal lesion assessment and management for various abdominal pathologies. This presentation aims to provide the state-of-the-art clinical applications of spectral CT technologies for abdominal imaging and discuss the potential added values and current limitations.

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1. Technical principles of spectral CT 2. Image acquisition and reconstruction process 3. Spectral-based imaging A) VNC B) VMI C) Iodine density map D) Effective Z E) Electron density F) Calcium suppression 4. Image characteristics 5. Clinical implementations A) Liver ? Hepatic tumor ? Fibrosis estimation ? Steatosis B) Biliary - Isoattenuating stones C) Pancreas ? Pancreatic tumor detection ? Diagnosis and staging with single venous phase CT ? Prognosis predictions D) Kidney ? Solid tumors ? Stones E) Adrenal gland - Adenoma diagnosis F) Intestinal tract ? Intestinal ischemia ? Active Crohn's disease ? Electronic cleansing in CT colonography G) Peritoneal - Peritoneal seeding H) Vascular ? Endoleak ? Assessments of arteries on venous phase CT I) Multiple organs - Contrast medium reduction 6. Current limitations and future directions A) Material decomposition accuracy B) Longitudinal variability in material density C) Integration with artificial intelligence technology

GIEE-75   Beyond Portal Vein: The Intra-abdominal Radiologic Venous Anatomy And Its Applicability In The Everyday Routine - Whats Every Radiologist Must Know.

Participants
Fernanda Mazzucato, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this study is to describe radiologic anatomy of the gastrointestinal venous system, without including the main portal vein, and its correlation with some abdominal pathology, such as hepatic pseudolesions, pancreatic cancer and the spreading of diseases.

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I. Anatomy and nomenclature of the intra abdominal veins and its main branchesII. Correlation between this veins with some pathologies, such as:a. Hepatic pseudolesion (focal fat, focal fat sparing and perfusion changes) due to venous drainage to the hepatic parenchyma other than portal venous blood (so-called "the third inflow"), such as aberrant right and left gastric vein and aberrant pancreaticoduodenal vein.b. Pancreatic pathologic condition causing dilatation or occlusion of the gastrocolic trunk and gastroepiploic veins. Also, talking about pancreatic neoplasm resectability, it's fundamental to study the relation between the lesion and gastrocolic trunk and first jejunal trunk.c. Rectal cancer and metastatic dissemination pathways based on its location and venous drainage.

GIEE-76   The Mysterious Mesentery: Building A Differential For Solid And Cystic Masses

Participants
Nathaniel Linna, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

A variety of primary and secondary solid lesions can arise from the mesenteries, a possible endocrine organ with various functions and histological tissue types.Many solid and cystic lesions are non-aggressive malignancies. An understanding of typical imaging characteristic on both CT and MR can help direct treatment and interventional decisions.Multi-parametric MRI scans often provide additional information for differentiating these masses, particularly the post-contrast dynamic enhancement imaging.

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A review of the embryology, anatomy, and composition of the mesenteries, to aid in building differentials.A proposed flowsheet for developing a differential diagnosis of mesenteric masses, with branch points based on imaging features.Cases that demonstrate multimodality findings for mesenteric masses and how they fit into differentials. Examples as follows:Cystic Masses: lymphangioma, cystic mesothelioma, peritoneal inclusion cyst, etc.Solid Masses: desmoid, fatty masses, metastatic disease, lymphoma, etc.Discuss clinical significance and management of cystic and solid mesenteric masses.

GIEE-77   Retroperitoneum In The Emergency - CT Findings

Participants
Marina Bustamente, MD, Buenos Aires City, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

A differential diagnosis of an acute abdomen includes a wide range of causes among which we can categorize those related to the retroperitoneal space. Medical emergencies in this space are difficult to assess clinically due to their location and scarce manifestation of signs and symptoms. They can include vascular, iatrogenic, traumatic and infectious causes. Some of these pathologies need immediate treatment while others do not need surgery. In this context, the MDCT is a useful screening tool which increases the level of diagnostic certainty. Imaging with MDCT is the most widely used procedure to scan the retroperitoneal abdominal space in order to detect diseases. It is fast, accessible, non-invasive and of space-time high resolution. Furthermore, it allows for the implementation of post processing techniques as well as angiography studies which are invaluable for abdominal emergencies.TEACHING POINTS: 1 Differentiate the anatomy of the abdominal cavity and the retroperitoneal space. 2 Review the imaging features in acute retroperitoneal pathologies. 3 Show the useful radiology signs to identify the organ of origin. 4 To describe CT key features to make an accurate diagnosis and essential diagnostic clues to treatment.

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CT usefulness in retroperitoneal emergency. CT signs to locate retroperitoneal pathologies. Anatomy. Pathology. Summary.

GIEE-79   In And Out Of The Bag: A Pictorial Review Of Gallbladder Cancer On MRI

Awards
Cum Laude

Participants
Jordan LeGout, MD, Ponte Vedra Beach, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the types, associations, and presentations of gallbladder cancer. 2. Establish an understanding of the growth patterns and patterns of spread of gallbladder cancer. 3. Review the staging of gallbladder cancer with MRI emphasis. 4. Familiarize with the appearance and management of gallbladder polyps. 5. Introduce and review the MRI features of the mimics of gallbladder cancer.

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I. Introduction a. Epidemiology b. Associations c. Presentation II. Types of gallbladder cancer a. Types and frequencies (ex. adenocarcinoma, adenosquamous, etc.) b. Metastatic disease III. Growth patterns a. Frequency by location b. Growth patterns IV. Patterns of spread a. Adjacent organ invasion b. Lymphatic spread c. Hematogenous d. Peritoneal V. Staging VI. Polyps a. Appearance b. Management VII. Treatment/Prognosis VIII. Mimics a. Acute cholecystitis b.Chronic cholecystitis i. Xanthogranulomatous c. Adenomyomatosis d. Mirrizzi syndrome

GIEE-8   Current Update On The Role Of Endoanal Ultrasound: A Primer For Radiologists.

Participants
Pankaj Nepal, MD, Bridgeport, Connecticut (*Presenter*) Nothing to Disclose

TEACHING POINTS

To understand the technique, indications and role of endoanal ultrasound. To evaluate the performance of endoanal ultrasound when compared to transperineal and transvaginal approaches in evaluation of anal/perianal pathologies. To illustrate normal anatomy of internal and external anal sphincters at proximal, mid and distal anal levels. To illustrate 3D endoanal ultrasound reconstruction images in pre-operative assessment of abscess, fistula, defects, tumors, and postoperative complications.

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Logistics: Endocavitary probe, scanning technique, simultaneous schematic and sonographic anatomy of anal sphincter. Sphincteric injury: Obstetric anal sphincter injury, trauma, iatrogenic Anal sphincteric fistula types, abscess and complications Postoperative complications: retained foreign body, sphincter atrophy, and repair of defect Anovaginal and anovulvar fistula Anorectal tumor: depth of invasion and sphincter involvement

GIEE-80   Multimodality Imaging Spectrum Of Crohn's Disease: A Pictorial Review

Participants
Alessandro Bozzato, MD, Trieste, Italy (*Presenter*) Nothing to Disclose

TEACHING POINTS

•Describe the imaging techniques and select the most appropriate modality for the assessment of each phase of Crohn's disease.
•Review the multimodality imaging patterns of Crohn's disease and its complications.

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Introduction • Crohn's disease, a type of inflammatory bowel disease (IBD), is a chronic disease characterized by phases of quiescence and activity. Endoscopy remains the gold standard for the diagnosis of Crohn's disease, nevertheless also Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and Multiparametric Ultrasound (MPUS) can be a useful tool in the assessment of mural changes and complications. Imaging techniques • Describe the imaging techniques used to evaluate Crohn's disease (MPUS, including gray-scale US, color and power Doppler, elastography, and contrast-enhanced US (CEUS),CT Enterography (CTE) and MR Enterography (MRE)). Show the application of cine-ultrasound and cine-MRI imaging in Crohn's disease. Multimodality imaging patterns • Illustrate the imaging patterns of Crohn's disease (bowel wall thickening, loss of the normal gut stratification, hyperemia, abnormal lymph nodes) and its complications (stricture, obstruction, ulceration, fistula, phlegmon and abscess).

GIEE-81   Radiomics In Pancreatic Ductal Adenocarcinoma: Is It Time?

Participants
Francesca Rigiroli, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1 Review of application of radiomics in pancreatic ductal adenocarcinoma (PDAC). 2 Analysis of the methods used for radiomics in PDAC. 3 Analysis of the challenges and limitations to research and broad applicability of radiomics. 4 Possible solutions and future development.

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1 Radiomics has been applied in PDAC for different goals: diagnosis, differential diagnosis, staging, analysis of genetics and biology, prognosis. 2 Summary of the different methods applied, including patient selection, identification of the target, segmentation, feature extraction, feature selection. 3 PDAC poses particular challenges for the use of Radiomics, including small population for machine learning applications, poor prognosis and low number of patients undergoing surgery, different chemo and radiation therapies, lack of multi-center studies. 4 Reproducibility is currently a major challenge for the applicability of radiomics analysis on PDAC. Given the location and relationship with other structures, the analysis of only intratumoral radiomic features may be limited, it is essential to look at the tumor environment and relation with other structures such as vessels. 5 Possible solutions and future development.

GIEE-82   From EDGE To TIF: A Pictorial Primer Of Advanced Endoscopic Procedures

Participants
Fernanda S. Mazzariol, MD, Bronxville, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the gamut of advanced endoscopic procedures and how they are performed. 2. Discuss the relevant anatomy and the expected post-procedural imaging findings. 3. Discuss the indications and potential complications of advanced endoscopic procedures.

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Content: Illustrated examples of the following advanced endoscopic procedures but not restricted to:1. Bariatric Procedures: Endoscopic gastric balloon, endoscopic sleeve gastroplasty, endoluminal gastric bypass revision.2. Drains and stents: Cystogastrostomy, retroperitoneal drainage for pancreatic necrosis, cholecystojejunostomy post Billroth II, EUS-guided cholecystoduodenostomy, EUS-guided cholecystogastrostomy, EUS-directed transgastric ERCP (EDGE), EUS-guided gastrojejunostomy, EUS-guided hepaticogastrostomy. 3. Myotomies and others: Peroral endoscopic myotomy (POEM), gastric peroral endoscopic myotomy (G-POEM), endoscopic cricopharyngeal myotomy, transoral incisionless fundoplication (TIF).

GIEE-83   Cystic Liver Lesions: An Update From The Radiologic Pathology Archives And Brigham And Womens Hospital

Participants
Khoschy Schawkat, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. While cysts with benign etiology dominate this category referred to as cystic liver lesions, a wide spectrum of diseases including malignant neoplasms and metastasis can present as such.2. Several imaging features including characterization of the wall and internal patterns such as septa, presence of fat, calcifications as well as contrast dynamics aid in characterizing cystic liver lesions through imaging.3. Additional clinical information such as age, sex, clinical history, and symptoms are crucial in characterization of cystic liver lesions.

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Infectious Parasitic 1. Hydatic cyst 2. Amoebic abscessNon-parasitic 1. Pyogenic abscess 2. Fungal microabscessNon-infectious Developmental 1. Hepatic cyst a. Sporadic b. Genetic i. Polycystic liver disease ii. Von Hippel Lindau iii. Tuberous sclerosis 2. Bile duct hamartoma 3. Caroli diseaseNeoplastic 1. Benign a. Hemangioma i. Classic hemangioma ii. Cystic degeneration of hemangioma iii. Giant hemangioma 2. Premalignant a. Mucinous cystic neoplasm b. Intraductal papillary neoplasm of the bile duct 3. Malignant a. Cystic hepatocellular carcinoma b. Mucinous cholangiocarcinoma c. Undifferentiated embryonal carcinoma d. Cystic metastasisMiscellaneous 1. Subcapsular/intrahepatic pseudocyst 2. Traumatic a. Hematoma b. Biloma c. Seroma

GIEE-84   Mucinous Tumours Of The Abdomen And Pelvis: More Than Just Mucin! Pearls, Pitfalls And Key Learning Points.

Awards
Certificate of Merit

Participants
Francesca Castagnoli, MD, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

• How does the pathophysiology of mucinous neoplasms of the abdomen and pelvis differ from non-mucinous tumours?• Describe the unique clinical and imaging features of mucinous tumours: why are they important and how to recognize them.• Understand how to image mucinous neoplasms of the abdomen and pelvis.• How to interpret the post-treatment appearances of mucinous tumors - is disease still present?

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• Pathology overview of Mucinous tumours and correlation with multimodality imaging. What are the characteristic appearances of Mucinous tumours of the abdomen, and why do we see them?• Where do you see Mucinous tumours of the abdomen - not just the GI tract! Case-based review of common sites such as colorectal, gastric, appendix, pancreas and less-common sites including prostate, bladder, cervix, intra-hepatic.• Imaging strategies for suspected Mucinous tumours, what modalities are most helpful?• Why is it important to recognise these on imaging? What are the implications for prognosis and treatment?• Mucinous tumours can mimic benign pathology and how to avoid this diagnostic pitfall.• Interpreting images in the post-treatment setting, is there still viable disease?

GIEE-85   Lumen-apposing Metal Stents (LAMS): Cutting Edge Applications And Their Imaging Appearance.

Participants
Inessa Goldman, MD, Bronx, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

To familiarize radiologists with main indications, applications, advantages and common adverse events of LAMS;To demonstrate various LAMS radiologic appearances draining peripancreatic collections (PPC);To present spectrum of other common and cutting edge applications of LAMS often encountered in practice.

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1) Approcved use of LAMS to drain:a. Symptomatic pseudocysts(PC)b. Symptomatic walled-off necrosis (WON)2. Characteristic of LAMSa. Dumb-bell shape and wide lumen are main advantages.3. Most common adverse events a. bleeding, migration, stent obstruction.3) Possible variations in LAMS appearance in PPC:a. Multiple LAMS to drain different portions of larger collections;i. synchronous or metachronousb. Plastic pigtail biliary stents placed through LAMS may prevent migration;3) Other common applications of LAMS:a. Drainage of postsurgical leaksb. Gastrojejunostomy via LAMS to relieve gastric or duodenal obstruction by

malignancyc. Gallbladder (GB) drainage: i. Inoperable patients for drainage of GB in acute cholecystitis/cholangitis ii. Choledochoduodenostomy via LAMS to drain obstructed bile duct due to malignancyd. Drainage of perirectal and inaccessible pericolic abscessese. Temporary LAMS placement for strictures i. Benign for peptic ulcer disease ii. Temporary for gastric cancer prior to surgeryf. Gain entry to inaccessible bowel (i.e. LAMS between gastric pouch and excluded stomach to gain endoscopic approach for ERCP)

GIEE-86 Test Yourself. Subtle Clues To Critical Findings Of Extraluminal Gas On Plain Radiographs

Awards
Certificate of Merit

Participants
Lisa Richardson, MD, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiographs are still utilized as a screening tool to triage many patients with abdominal pain, in spite of the advances in Computed Tomography, Magnetic Resonance Imaging, and Ultrasound. Any unexplained abdominal gas pattern can be a challenge for the radiologist. Often the abnormal gas pattern leads to the underlying etiology of the patient's symptoms and accurate interpretation is important for next steps management. There are many plain abdominal radiographic findings and signs of extraluminal gas and the radiologist must be familiar with them. Simple guidelines which can aid the radiologist in the interpretation of abdominal gas are gas in the wrong place as well as nonsense gas, which is usually retroperitoneal or in the abdominal wall.

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Introduction. Extraperitoneal gas/gas in the wrong place causes and outcomes. Air under the hemidiaphragms; Continuous diaphragm sign. Rigler's Sign. Intraabdominal free air signs and figures. Gas that makes no sense; Retroperitoneal gas, causes and outcomes. Gas within the abdominal wall, causes and outcomes. Test yourself and Cases. Conclusion/Take Home points.

GIEE-87 Towards Response Assessment For Crohn's Disease Small Bowel Strictures (CD-SBS): A Roadmap For Radiologists

Awards
Certificate of Merit

Participants
Joel Fletcher, MD, Rochester, Minnesota (*Presenter*) Research Grant, Siemens AG;Research Grant, Pfizer Inc;Research Grant, Takeda Pharmaceutical Company Limited;Consultant, Takeda Pharmaceutical Company Limited;Research Grant, NEXTRAST, INC;Consultant, Medtronic plc;Consultant, Johnson & Johnson;Consultant, GlaxoSmithKline plc;Consultant, Boehringer Ingelheim GmbH

TEACHING POINTS

• New treatments for CD-SBS will require reproducible methods for measuring length, obstruction, and inflammation • The Stenosis Therapy and Anti-fibrotic Research (STAR) Consortium has developed radiologist training to guide reproducible measurements and observations of CD-SBS

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Background Recent guidelines have defined Crohn's small bowel strictures as having proximal small bowel dilation = 3 cm; however, numerous ambiguities exist regarding how single vs. adjacent strictures are distinguished and measured. • A single stricture is defined by continuous inflammation (but may have varying regions of luminal narrowing) or two nearby segments with luminal narrowing • Maximum small bowel dilation ass'd with a stricture is generally proximal, but may occur within a stricture itself due to a dominant stenosing region • Post-Gd images are useful for identifying short segment strictures • Imaging findings of inflammation such as restricted diffusion and ulcerations are more challenging to identify in strictures due to heterogeneity • Strictures should be classified based on inflammation, multifocality, penetration and relationship to an enteric anastomosis Summary: A consistent approach to Crohn's disease small bowel strictures is needed to measure response to therapy in clinical and research settings.

GIEE-88 Dilemmas In Rectal Tumor Board: Simple Questions But Not So Simple Answers

Participants
Purvi Haria, DMRD, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Answer commonly asked question in rectal tumor board.• Emphasize findings that can change the treatment plan.• Highlight routinely encountered grey zones in rectal MRI reporting.• Understand what the surgeon wants to know.• Underscore the importance of multidisciplinary interaction.

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The exhibit will discuss the various questions asked in the rectal cancer multidisciplinary tumor board, and help understand the correct answers to these questions. Examples include: • What is the extent of sphincter involvement? Is sphincter preserving surgery feasible? • Is the primary disease T2 or early T3, or is it advanced? • Which lymph nodes are involved? Is it an internal iliac or obturator node? Are the nerve roots involved? • Is it mesorectal fascia involvement or anterior peritoneal reflection involvement? • Is the tumor abutting the prostate or involving it? Should we do a standard TME, Denonvilliers fascia excision, prostatic shave, or prostatectomy? • Is there EMVI or not? • Is the presacral fascia involved, and at what level? • Does the mildly enlarged inguinal node need sampling? • Is this 'incidental' bone abnormality or cystic adnexal lesion metastatic? • Is there a fistula? Is there wall dehiscence post-treatment?

GIEE-89 Don't Mess With The Pancreas: Ultrasound Findings Of Native And Transplant Pancreas Not To Miss

Participants
Mudassir Syed, DO, Jacksonville, Florida (*Presenter*) Nothing to Disclose

TEACHING POINTS

Ultrasound (US) of the native pancreas can be challenging and is not typically first line imaging when pancreatic pathology is suspected. However, meticulous scanning technique and awareness of sonographic findings of pancreatic pathology is important information for the radiologist. After pancreatic transplant, US is the first line modality for evaluating the allograft and vasculature to look for complications. After reviewing this case based exhibit, the learner will:- Understand US technique for evaluating the native and transplant pancreas- Identify normal anatomy for the native pancreas - Recognize the sonographic appearance of pathology in the native pancreas- Describe the surgical anatomy of pancreas transplants- Describe complications of pancreas transplant- Determine when additional imaging of the pancreas is needed

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1. Objectives 2. Background 3. Pancreas a. US technique with tips for visualizing the pancreas b. Normal anatomy c. Case examples (Pancreatitis 1. Acute interstitial 2. Necrotizing 3. Chronic 4. Complications) (Pancreas masses - Solid, Cystic) 4. Pancreas Transplant a. Review of surgical techniques b. Normal appearance c. Complications (Vascular, Parenchymal, Perigraft, Bowel) d. Problem solving (Contrast enhanced ultrasound to assess allograft perfusion and vascular complications, Ferumoxytol MRI to assess transplant vasculature).

GIEE-9   Molecular Subtype-based Therapy For Colorectal Cancer: An Update For Radiologists Involved In Oncology Multidisciplinary Team Meetings

Participants
Cinthia D. Ortega, MD,PhD, Sao Paulo, Brazil (*Presenter*) Speaker, Johnson & Johnson

TEACHING POINTS

Trends towards personalized medicine impact the management of patients with colorectal cancer (CRC), and molecular biomarkers now truly influence clinical decisions. Radiologists should be aware of the genetic basis for colon cancer molecular signatures and treatment options so that accurate imaging interpretation benefits patients. The purposes of this presentation are: to briefly review some oncogenic pathways in CRC; to refresh guidelines indications for both adjuvant and systemic treatments; to understand clinical and molecular (MSI (+/-), RAS & RAF mutations) tumor characteristics used as biomarkers in the clinical setting; to assess imaging response in the scenario of metastatic disease according to different systemic therapy options; to reinforce the role of radiologists to the mutidisciplinary team.

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Summary of main hypothesis of molecular pathways involved in tumorigenesis (chromosomal instability (CIN), microsatellite instability (MSI) and CpG Island Methylator Phenotype (CIMP). Explanation on relationship between molecular markers and systemic treatment. Interpretation of staging exams and possible synchronous tumors, including HNPCC (Hereditary Non polyposis Colorectal cancer) syndrome. Sample cases: clinical decisions regarding RAS status and Cetuximab, microsatellite instability and decision regarding adjuvant treatment and metastatic treatment with immunotherapy.

GIEE-90   Doppler Ultrasound Evaluation For TIPS Stent Dysfunction

Participants
Joseph Owen, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Describe the indications for Doppler US evaluation of TIPS dysfunction2. Describe the effect of angle correction on velocities measured with Doppler Ultrasound3. List and obtain the key measurements for detection of transjugular intrahepatic portosystemic shunt (TIPS) stent dysfunction

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1) Is Doppler US necessary, or is dysfunction better detected with clinical signs of portal hypertension recurrence?2) Review the concept of measuring velocity with ultrasound: a) Doppler Shift; b) Angle correction3) Discuss TIPS placement: a) Ideal placement; b) Covered vs uncovered stent use4) Review the signs of TIPS dysfunction: a) Recurrence of pathology that led to TIPS placement- i) Ascites, ii) Variceal Bleeding, iii) Pleural Effusion; b) Low main portal vein velocity; c) Low or high in-stent velocity; d) Change in velocity from prior study; e) Focal Aliasing; f) Reversal of flow in portal branches distal to the TIPS5) Compare and contrast accurate and inaccurate, or incomplete, TIPS evaluations on real cases

GIEE-91   "Nothing Likes To Live In A Cirrhotic Liver" And Other Truisms Taught By Our Mentors

Participants
Frank H. Miller, MD, Chicago, Illinois (*Presenter*) Advisory Board, Bayer AGAdvisory Board, Guerbet

TEACHING POINTS

· Review important imaging pearls taught to us by our mentors · Illustrate the common and atypical features of disease processes

TABLE OF CONTENTS/OUTLINE

This exhibit will review important pearls of wisdom taught by our most respected mentors, which have become invaluable in our daily clinical practice, many of which are not in textbooks. Main focuses will be on the hepatobiliary system and pancreas. 1. Introduction 2. "Nothing likes to live in a cirrhotic liver" a) Typical nodules associated with cirrhosis b) Nodules seen in general population (not in cirrhosis or atypical, i.e. hemangiomas) 3. Impact of fat in liver lesions and differentials: a) Fat-containing lesion in cirrhosis - consider HCC b) Hepatic steatosis- difficult to identify metastases on CT; MR/US helpful 4. Large solitary liver masses in older patients (often HCC) 5. Biliary cystic mucinous neoplasms: uncommon; usually mid-size/larger lesions (especially males) are still cysts 6. Contiguous peripheral enhancement, not nodular, usually bad - consider malignancy, atypical hemangioma 7. What is often called an "atypical hemangioma" is not in fact a hemangioma 8. Do not be swayed by the absence of biliary dilatation in peripheral intrahepatic cholangiocarcinoma 9. Pathology is not always definitive 10. Cystic hepatic lesions in setting of prior instrumentation/sphincterotomy: consider abscess 11. Abrupt terminating pancreatic duct even without discrete mass: suggests pancreatic cancer 12. Clinically unexplained pancreatitis: consider underlying cancer 13. Conclusions

GIEE-92   Value Of MR Imaging In Assessment Of Pancreatic Transplantation Complications

Participants
Emanoel Silva, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Pancreatic transplantation is a therapeutic strategy that aims to restore physiological glycemic control in diabetic patients who are difficult to control or with glomerulopathy. It is commonly performed in conjunction with cadaver donor kidney transplantation, however other techniques are possible, such as isolated pancreatic transplantation or years after kidney transplantation. The different surgical techniques have variations in vascular and enteric anastomosis, which make the interpretation of images challenging. Magnetic resonance imaging due to its excellent tissue characterization allows a detailed assessment of grafts and post-surgical complications such as hematomas and abscesses. Together with MR angiography, it also makes it possible to evaluate vascular structures, identifying abnormalities related to them. The purpose of this presentation is to make the radiologist familiar with the normal anatomy after transplantation and be able to identify abnormalities and complications with MR imaging.

TABLE OF CONTENTS/OUTLINE

? normal anatomy and pancreatic vascularization ? Post-transplant anatomy. ? Post-transplant complications: - pancreatitis; - necrosis; - seroma; - hematoma; - abscess; - Thrombosis. ? Conclusion.

GIEE-93   Post-COVID-19 Cholangiopathy: An Emerging And Challenging Diagnosis That Share Similarities With Secondary Sclerosing Cholangitis Of The Critically Ill Patient (SSC-CIP)

Participants
Irline Cordeiro de Macedo Pontes, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Discuss how to identify and diagnose irreversible hepatobiliary injury in COVID-19, as part of a broader spectrum of non-pulmonary manifestations in this disease.- Review cases of patients with no prior history of hepatobiliary disease and persistent cholestasis after cardiopulmonary and renal recovery.- Correlate imaging findings, using magnetic resonance cholangiopancreatography (MRCP) as main diagnostic method, with pathological features.- Introduce the concept that Post-COVID-19 Cholangiopathy may be a subtype or variant of SSC-CIP, both affecting patients after prolonged need of critical treatment.

TABLE OF CONTENTS/OUTLINE

Clinical scenarioPathophysiology- Biliary ischemia, toxic bile formation, cholangiocyte necrosis, microvascular changes, and other features present in this entity and also in SSC-CIP- Other particular features not previously observed in SSC-CIP, suggesting a role of direct hepatobiliary damage by the virusImaging findings- Diffuse intrahepatic biliary irregularities, strictures and dilatations- Normal or mild-damaged extrahepatic bile ducts- Biliary casts- Complications (bacterial cholangitis, ischemia and hepatic abscess)Treatment and prognosis- Clinical treatment- Biliary and abscess drainage- Secondary biliary cirrhosis- Liver transplant- Poor prognosis and death

GIEE-94   2021 Multimodality Update On Hepatic Adenomas

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Justin Tse, MD, Cerritos, California (*Presenter*) Research Grant, General Electric Company ;Research Grant, Bayer AG

TEACHING POINTS

-Clinical and histopathologic findings of hepatic adenomas (HCAs) based on Nault et al. 2017 reclassification system-Multimodality imaging findings for each subtype, with an emphasis on Gd-EOB-DTPA MRI-Emerging role of interventional radiology in locoregional treatment for hepatic adenomatosis and portal vein embolization-Implications for management and future research

TABLE OF CONTENTS/OUTLINE

1) Molecular genotype and risk factors of each HCA subtype using both the prior and new classification systems2) Potential complications of each HCA subtype and implications for clinical care3) Multimodality imaging finding of each HCA subtype, including mimics and pitfalls4) Role of interventional radiology

GIEE-95   Rectal Adenocarcinoma After Neoadjuvant Therapy: An Updated Review

Awards
Certificate of Merit

Participants
Giovanna Torre, Sao paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

I. Understand the current concepts of rectal carcinoma managementII. Comprehend the importance of restaging after CRT in the treatment planningIII. Systematic approach to the interpretation of MR images of patients with rectal cancer after chemoradiotherapy- Discuss the highlights findings on post-CRT MRI- Recognize the main pitfalls for image interpretation

TABLE OF CONTENTS/OUTLINE

MANAGEMENT OF RECTAL CANCER? Treatment guidelines? Upfront surgery X neoadjuvant therapy? Standard therapy for locally advanced rectal cancer (concurrent chemoradiotherapy followed by surgery and adjuvant chemotherapy) X Total neoadjuvant therapyINDICATIONS OF MRI IN RECTAL CANCER AFTER NEOADJUVANT THERAPY? Restaging after CRT? Selections of candidates to organ-preserving strategies such as watch-and-wait and local excision? Follow-up of complete responders? Guide surgical approach to reach for free-margin resectionIMAGING EVALUATION ON POST CRT MRI? MR tumor regression grade? Diffusion-weighted

imaging? Mucinous subtype? Lymph node assessment after CRT? Complications of radiation therapyFUTURE DIRECTIONS? Intentional complete response

GIEE-96   Imaging Assessment After Pancreaticoduodenectomy. Reconstructions Techniques: Normal Findings And Complications.

Awards
Magna Cum Laude

Participants
Lautaro Florentin, MD, Buenos Aires, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

Different surgical techniques are utilised for Pancreaticoduodenectomy reconstruction, depending on the surgeon's experienceRadiologists should be familiarized with different biliodigestive reconstruction in order to know normal postoperative findings as well as main complications related to each of themMost challenging complication diagnoses are pancreatic fistula, anastomosis stricture and tumor recurrency.

TABLE OF CONTENTS/OUTLINE

1) Introduction2)Anastomoses variations. Description and helpful tips for imaging recognitiona)Pancreatico-enteric anastomosisPancreaticojejunostomy vs. Gastrojejunostomy Duct-to-mucosaInvaginationb)Biliodigestive anastomosisHepaticojejunostomyCholedojejunostomy c)Gastrojejunostomy vs. Duodenojejunostomy. When and why?3) Intestinal reconstruction.a)Child vs. Y de Roux. Afferent and efferent limbs: Interactive imaging recognition4) Normal postoperative findings vs complications. Multimethod imaging assessmentNormal findings. How to avoid pitfalls.Complicationsi) Anastomoses-relatedPancreatic Fistula (PF). CT challenge: abscess vs PFBiliary Fistula. Clue key for diagnosis.Delayed gastric emptying. Imaging roleii) Intestinal loops relatedAfferent limb syndrome. Multimodality analysis.Intestinal obstruction.iii) GlobalStump pancreatitis. Singular CT findings Tumor recurrency. Making the diagnosis: implicance in prognosisHemorrhagePseudoaneurysmArterial and/or Venous thrombosis

GIEE-97   Pelvic Floor Disorders: A Self Guided Tour And Physical Examination Correlation

Participants
Kalinka Dolcan, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Understand the causes of dysfunctions of the pelvic floor-Comprehend the normal anatomy and measurements of pelvic floor on functional study-Recognize the pathologic findings that can involve the organs of the pelvis and its respective graduations (and correlation of physical examination findings and dynamic MR defecography)

TABLE OF CONTENTS/OUTLINE

INTRODUCTION- Epidemiology of the pelvic floor pathologies- Risk factors of dysfunctions of the pelvic floorMR IMAGING PROTOCOL- Exam preparation- MR imaging technique (rest, squeeze, strain, and defecation)NORMAL ANATOMY- Relevant anatomy of the pelveHOW TO MEASURE- Normal measurement and landmarks of pelvic floor, correlating schematic pictures and MRI imagesPATHOLOGY FINDINGS THAT INVOLVE THE ORGANS OF THE PELVIS- Findings on MRI and its respective graduation, correlating didactic MRI images.- Anterior compartmentBladder descent-Middle compartmentUterine/vaginal descent-Cul-de-sacEnterocele, peritoneocele, sigmoidocele- Posterior compartmentAnterior and posterior rectoceleIntussusceptions-Abnormal relaxationDescending perineal syndromeParadoxal puborectal contraction- Some examples of pathology involving supporting structuresFUTURE DIRECTIONS- Facilitate the reading of the functional examination of the pelvis- Suggestive structure report

GIEE-98   Targeted Radiation Therapy For Hepatic Malignancy: Indications, Techniques, And Post-treatment Appearances

Participants
Madeleine Sertic, MBBCh, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

Targeted radiation therapies have emerged as viable treatment options for unresectable or locally advanced hepatic malignancies.Image-Guided Radiation Therapy (IGRT) uses focused high-energy radiation or proton beam for targeted tumor therapy. Fiducial markers are inserted, and a planning CT creates a predictive model that maximizes tumor radiation and minimizes damage to adjacent organs. Expected post-radiation changes include a well-demarcated irradiation zone that is hyper-enhancing to the background liver and retains contrast on delayed phases. A lack of residual intra-tumoral enhancement indicates treatment response.Selective Internal Radiation Therapy (SIRT) involves intra-arterial administration of micron-sized particles containing radioisotopes, which deliver local radiotherapy. Post-SIRT changes include peritumoral edema and hemorrhage, which can result in transient increase in tumor volume. Lack of intra-tumoral enhancement indicates treatment response; peripheral enhancement may persist. Complications include atrophy of the treated lobe, hypertrophy of the untreated lobe, hepatic fibrosis, portal hypertension, ascites, and pleural effusions.

TABLE OF CONTENTS/OUTLINE

- Introduction to Targeted Radiation Therapy - Image-Guided Radiation Therapy o Indications o Technique § Stereotactic Radiotherapy § Proton Beam Radiation o Expected Post Treatment Appearance o Complications - Selective Internal Radiation Therapy o Indications o Technique o Expected Post Treatment Appearance o Complications

GIEE-99   Expected And Unexpected Jejunum In The Chest: Normal Appearance And Complications After Jejunal Interposition And Esophagojejunostomy

Participants
Sanna Herwald, MD, PhD, Menlo Park, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

The jejunum is rarely found in the chest of patients who have not undergone surgery. However, in patients who have undergone

complex gastroesophageal surgeries, the presence of jejunum within the chest is not uncommon, and may be expected. The first focus of this presentation is jejunal interposition grafting, which can be used for esophageal reconstruction status post esophagectomy. The second focus is esophagojejunostomy, which can establish continuity of the digestive tract after total gastrectomy. Fluoroscopy is a key imaging modality for evaluating the expected post-operative anatomy and possible complications of these surgeries. The indications, normal post-operative imaging appearance, and examples of post-operative complications are reviewed.

TABLE OF CONTENTS/OUTLINE

Part 1, Jejunal interposition graft: 1. Indications 2. Anatomy 3. Normal imaging appearance 4. Peri-anastomotic leak 5. Enterocutaneous fistula 6. Malignant stricture. Part 2, Esophagojejunostomy: 1. Indications 2. Anatomy 3. Normal imaging appearance 4. Peri-anastomotic leak 5. Leak from the Roux limb blind end 6. Esophago-pleural fistula 7. Peri-anastomotic stricture, treated with stenting 8. Hiatal herniation with jejunoesophageal reflux.

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HNEE

Head and Neck Education Exhibits

Sub-Events

HNEE-1 Nasopharyngeal Carcinoma: Staging, Tumor Recurrence And Post-irradiation Complications. What The Radiologist Needs To Know?

Participants
KA MAN CHU, MBChB, Hong Kong, Hong Kong (*Presenter*) Nothing to Disclose

TEACHING POINTS

Knowledge on current state of nasopharyngeal carcinoma (NPC) imaging is important for the radiologist to provide better care for patient.Basic anatomy of nasopharynx and pathology of NPC will be discussed.Update and changes on AJCC 8th edition TNM classification will be highlighted. MRI staging of primary tumor will be illustrated, with emphasis on perineural spread as well. (a) The foramina and fissures within the central skull base offer a direct extension of tumor into cranium. (b)The pterygopalatine fossa serves as an important junction for tumor extension into nasal cavity (via sphenopalatine foramen), oral cavity (via greater palatine canal), masticator space (via pterygomaxillary fissure), orbit (via inferior orbital fissure) and middle cranial fossa (via foramen rotundum). (c) Tumor involvement of vidian canal should alert the radiologist to search for perineural spread along the greater superficial petrosal nerve (GSPN).Tumor recurrence detection using MRI will be illustrated. T2 weighted sequence and diffusion weighted imaging are important for differentiation between post irradiation change and tumor recurrence. Post irradiation complications including temporal lobe necrosis, osteoradionecrosis, vascular injury such as pseudoaneurysm and carotid blow out, and radiation induced neoplasms will be illustrated.

TABLE OF CONTENTS/OUTLINE

IntroductionAnatomy and PathologyAJCC 8th edition TNM classificationMRI staging of primary tumorTumor recurrencePost irradiation complications

HNEE-10 Vascular Imaging And Interventions In The Head And Neck

Participants
Mihran Khdhir, MBChB, Beirut, Lebanon (*Presenter*) Nothing to Disclose

TEACHING POINTS

Diagnostic and interventional radiology are pivotal in diagnosis and treatment of various extracranial head and neck vascular disorders. Vascular disorders of the head and neck region compromise a heterogenous group of pathologies and are encountered in both the emergency setting and non-emergent daily practice. A detailed understanding of cross-sectional and angiographic vascular anatomy, an awareness of the various vascular based pathologies and a grasp of meticulous interventional techniques, enable radiologists to make the correct diagnosis, evaluate the extent of disease, assess for potential complications, and even provide the appropriate management. The aim of this review is to familiarize radiologist with the multimodality imaging of head and neck vascular anatomy and disorders while navigating through the various interventional treatment techniques.

TABLE OF CONTENTS/OUTLINE

1. Vascular anatomy and anomalies. 2. Vascular stenosis and aneurysms. 3. Vascular emergencies and trauma. 4. Vasculitis. 5. Vascular malformations. 6. Vascular tumors 7. Non-vascular hypervascular lesions.

HNEE-11 The Management Of Neurofibromatosis Type 2 - What A Radiologist Should Know

Participants
Kyungmin Kim, MD, Manchester, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

Neurofibromatosis type 2 (NF2) is a tumor predisposition syndrome associated with multiple schwannomas, meningiomas and ependymomas. Management options comprise active surveillance, surgery, systemic anti-angiogenic therapy (bevacizumab) and stereotactic radiosurgery (SRS). The aim is to maintain quality of life for as long as possible and management decisions are best made by a multidisciplinary team. Imaging is central and patients with NF2 require regular MR surveillance of the head and spine to assess for disease progression and complications. Most patients undergo resection of at least one NF2-related tumor in their lifetime. The reporting radiologist should be familiar with common surgical approaches to accurately assess for recurrence and post-surgical complications. Adjunctive therapies such as implanted hearing augmentation devices (e.g. cochlear and auditory brainstem implants) can help maintain quality of life. Selected NF2 patients can benefit from bevacizumab or SRS.

TABLE OF CONTENTS/OUTLINE

- Introduction - Management options for NF2 1. Active surveillance 1.1 Imaging assessment 2. Surgery 2.1 Tumor resection 2.2 Adjunctive surgical treatment options 2.2.1 Implanted hearing augmentation devices 2.2.1a Cochlear Implant 2.2.1b Auditory Brainstem Implant 2.2.2 Eyelid weights 3. Bevacizumab 4. SRS - Conclusion

HNEE-12   I See Double! Searching For The Abnormal Cranial Nerve In Diplopia

Participants
Angela Guarnizo, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

Diplopia or double vision can be binocular due to orbital or neurological disorders including abnormalities in the brain, in the brainstem, within the subarachnoid space, in the cavernous sinus and/or superior orbital fissure. Monocular diplopia is secondary to lesions in the orbit. Causes of binocular diplopia include: ischemia, tumors, infection, inflammatory and vascular abnormalities. Imaging assessment with MRI of the brain and orbits with contrast is crucial to identify pathologies involving the nuclear, cisternal, cavernous and orbital segments of these cranial nerves. Ischemia, tumors and infection are the most common pathologies involving the nuclear segment of the III, IV and VI cranial nerves. Extrinsic compression due to aneurysms, tumors or brain herniation are common causes of cranial nerve palsy involving the cisternal segment. Lesions of the cavernous sinus can cause III, IV and VI cranial nerve palsy and deficits of the V1 and V2 cranial nerves. In patients with proptosis, pain in the eye and combination of III, IV and VI cranial nerve palsies a lesion of the orbital segment must be suspected. Infection, tumors, inflammatory conditions and lesions secondary to trauma should be included in the differential.

TABLE OF CONTENTS/OUTLINE

1. Objectives2. Diplopia: definition (monocular versus binocular diplopia)3. Anatomy of cranial nerves III, IV and VI 4. Imaging diagnostic approach 5. Common and infrequent pathologies involving the nuclear, the cisternal, the cavernous and the orbital segments of CN III, IV and VI.6. Summary

HNEE-13   18F-FDG PET/CT In Head And Neck Cancer: Usefulness And Pitfalls

Participants
Masafumi Sakai, MD, Tsukuba, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

18F-FDG PET/CT (PET/CT) is useful for the staging and assessment of post-treatment response and follow-up in head and neck (H&N) cancer. Cancer staging helps detect lymph node and distant metastases, second primary malignancies (SPMs), and primary lesions of metastasis from unknown primary sites. However, there are some pitfalls when using PET/CT to assess primary tumors and metastases. The post-treatment response assessment and follow-up findings indicate a high negative predictive value. Further, PET/CT can also yield false-positive results that mimic the findings of recurrence. Immune checkpoint inhibitors (ICIs) have recently been introduced for the treatment of H&N cancer. Immune-related adverse events (irAEs) caused by ICIs may result in false-positive findings on PET/CT. Radiologists should understand the usefulness and pitfalls of PET/CT in the diagnostic imaging of H&N cancer. The purposes of this exhibit are:1. To explain the usefulness and pitfalls of PET/CT in H&N cancer staging 2. To explain the usefulness and pitfalls of PET/CT in the assessment of post-treatment response and follow-up of H&N cancer

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Usefulness and pitfalls of PET/CT in H&N cancer 1. Initial staging SPMs Unknown primary sites in cases of cervical lymph node metastasis Physiological uptake Inflammation False negatives Benign tumors Difficult-to-detect brain metastases Etc. 2. Post-treatment response assessment and follow-up Postoperative changes Postirradiation changes IrAEs Inflammation Benign tumors SPMs Etc.

HNEE-14   Head/Neck Fistulae

Participants
Maram Alafif, MD, San Diego, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) Acquired fistulae may occur due to surgical resection with symptoms mitigated by obturator/ prosthesis, or unintended fistulae as a complication of treatment, wound healing or tumor involvement. (2) Assessment of head/neck fistulae on imaging requires multi-planar tracking of the trans-spatial path and any branches. (3) Evaluation of adjacent structures is critical to evaluate for areas of osteomyelitis, bone exposure, and risk for arterial pseudoaneuysm or blow out. (4) Sampling may be necessary to exclude viable tumor, as PET imaging may not discriminate between inflammation and tumor.

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Imaging examples are presented of the following fistulae, with case notes including key findings, pre-disposing factors and treatment: (1) Nasal-Oral (without and with obturator), (2) Oral-Antral, (3) Oral-Cutaneous, (4) Salivary-Cutaneous, (5) Submandibular-Tonsillar, (6) Pharyngo-Prevertebral, (7) Phayngo-Cutaneous, (8) Orbital-Sinonasal-Oral cavity, (9) Sinonasal-Skull base, (10) CSF-Pharyngeal, (11) Tracheo-esophageal, (12) Neopharyngeal-Cutaneous, (13) Esophageal reconstruction-Cutaneous

HNEE-15   Recognizing Complications Of Head/neck Radiation

Participants
Maram Alafif, MD, San Diego, California (*Presenter*) Nothing to Disclose

TEACHING POINTS

(1) It is important to recognize expected post-radiation imaging appearance in order to differentiate between symptomatic findings vs complications or recurrence. (2) Expected radiation induced changes include edema, fibrosis, accelerated atherosclerosis, dentition changes related to xerostomia, dysphagia and bone marrow fat replacement. (3) Complications include soft tissue necrosis, ulceration and fistula formation, bone and cartilage necrosis, vascular thrombosis. (4) Recurrence may occur within or at margins of treatment field, and radiation-related tumors may present years later. (5) Sampling may be necessary to exclude recurrence.

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Comparison cases will be presented with side-by-side examples of expected post-radiation findings and complications including recurrence: (1) Mucosal: mucositis and submucosal edema, ulcer-ulceration vs tumor recurrence (2) Dentition changes vs

recurrence (3) Submandibular gland transfer vs recurrence (4) Denervation related changes vs perineural spread (5) Osteonecrosis vs tumor recurrence (6) Chondronecrosis vs tumor recurrence (7) Accelerated atherosclerosis vs pseudoaneurysm within tumor (8) Brain radiation necrosis vs tumor invasion (9) Recurrence vs new radiation-related primary tumor

HNEE-16   Desmoid Type Fibromatosis Of The Head And Neck: A Pictorial Review.

Participants
Tao Ouyang, MD, Hershey, Pennsylvania (*Presenter*) Nothing to Disclose

TEACHING POINTS

• Desmoid type or aggressive fibromatosis (DF), is an uncommon mesenchymal tumor, with a tendency for infiltrative growth and local recurrence. The tumor is rare, with 2-4 new cases per million annually. Approximately 10% of all cases occur in the head and neck. • Differential diagnosis of DF in the head and neck includes: malignant soft tissue tumors, solitary fibrous tumor, neurogenic tumor and metastases. • There is an association with familial adenomatous polyposis (FAP) and Gardner syndrome although most occur sporadically. • The management of DF includes surgery, radiation and systemic therapies (hormonal therapy, chemotherapy and more recently immunotherapy). • Cross sectional imaging features include: involvement of the prevertebral space, involvement of the submandibular and masticator spaces, elongated shape, low signal non-enhancing bands on all MRI sequences, lack of necrosis, calcification or hemorrhage, and homogeneous contrast enhancement. MRI appearance maybe somewhat variable depending on size of lesion and treatment • Effect on adjacent bony structures on CT maybe helpful to distinguish DF from other entities in the head and neck • CT and MRI are most useful for treatment planning and follow up

TABLE OF CONTENTS/OUTLINE

BackgroundDifferential diagnosis of DFImaging appearance of DF in the head and neck• Paraspinal• Submandibular• Masticator space• ScalpImaging appearance after treatment (surgery or protein kinase inhibitor)Conclusion

HNEE-17   Can You See Me Now? A Review Of Diffusion-Weighted Imaging (DWI) Of The Orbit

TEACHING POINTS

1. Provide an overview of diffusion weighted imaging (DWI) in the orbits focusing on magnetic resonance imaging (MRI) physics and clinical interpretation.2. Review state-of-the-art DWI protocols (i.e. RESOLVE) that allow for increased image quality in the orbits.3. Review anatomy of the orbit.4. Review essential DWI manifestations of orbital pathology in the context of other conventional MR imaging findings.5. Highlight distinct benefits and limitations of DWI compared to other MRI sequences when evaluating orbital pathology.

TABLE OF CONTENTS/OUTLINE

Introductiono Conventional MR protocol (i.e. T1-weighted, T2-weighted, short tau inversion recovery) versus DWIo Common DWI applications for evaluation of central nervous system pathology (CNS)o Specific limitations of DWI in evaluation of orbital pathologyReview of MRI physics concepts underpinning DWIo Concept of random movement (Brownian motion)o Significance of variables contributing to water molecule displacement distribution (i.e. duration of measurement, temperature, type of molecule)o Role of apparent diffusion coefficient (ADC) mapDWI Techniqueo Common DWI sequences (i.e. single shot echo-planar imaging)o DWI artifacts to consider during image interpretationo Modified techniques for improved image quality (i.e. RESOLVE)Anatomy of the orbitCase-guided review of orbital pathology findings focusing on DWIo Comparison with conventional MR findingso Added value of including DWI for narrowing the differential diagnosis for orbital lesions

HNEE-18   Deadly Fungi. Invasive Fungal Infections In The Head And Neck

Awards
Identified for RadioGraphics

Participants
Mariko Kurokawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The aim of this review is to summarize the imaging findings of invasive fungal sinonasal infections, which sometimes lead to devastating clinical outcomes. Teaching points:• Recognize the spectrum of sinonasal invasive fungal infections and associated clinical features.• Identify the multimodal imaging findings of invasive fungal infections in the head and neck.• Describe epidemiologic characteristics and key imaging findings to narrow the differential diagnosis of these invasive sinonasal fungal infections.

TABLE OF CONTENTS/OUTLINE

I. IntroductionWhen to consider invasive fungal infection?The spectrum and clinical features of invasive fungal infectionII. Imaging Findings - CT and MRI -Typical findings of the invasive fungal infectionThe areas to evaluate for invasionComplications; Intracranial extension, intraorbital extension, vascular invasionIII. Case based review i. Intraorbital extension: Orbital apex syndrome, Ischemic optic neuropathy ii. Intracranial extension: Cavernous or venous sinus thrombosis, Cerebritis, Intracranial abscess, Meningitis (pachymeningitis and leptomeningitis) iii. Vascular invasion: Mycotic aneurysm, Vascular obstruction including embolic strokes , Acute infarction, Septic vasculitisIV. Summary

HNEE-19   Radiological Approach For The Preoperative Prediction Of Mastoid Extensions In Middle Ear Cholesteatoma

Participants
Akira Baba, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The European Academy of Otology and Neurotology (EAONO) and the Japan Otological Society (JOS) newly proposed the STAM anatomical classification system (S1 = supratubal recess, S2 = sinus tympani, T = tympanic cavity, A = attic, and M = mastoid) as a part of the EAONO/JOS staging system for intraoperative evaluation of middle ear cholesteatoma extension. In particular, assessment of extension to the mastoid (M) in cholesteatoma is an important factor influencing the decision to perform

mastoidectomy. Therefore, it is important for radiologists to preoperatively evaluate for the presence of mastoid extensions. Although this is easy when cases are clear in preoperative imaging, there are often cases in which radiologists have difficulty assessing mastoid extensions. Therefore, radiologists need to know about a variety of radiological imaging features, including novel techniques for identifying mastoid extensions in middle ear cholesteatomas.

TABLE OF CONTENTS/OUTLINE

1. Staging of middle ear cholesteatoma 2. Radiological features of middle ear cholesteatoma 3. CT prediction of mastoid extension 4. MRI prediction of mastoid extension 5. Temporal subtraction CT prediction of mastoid extension

HNEE-2   **Where Is The Primary Tumor? Imaging Approach To Cervical Lymph Node Metastases From An Unknown Primary Tumor**

Awards
Identified for RadioGraphics
Cum Laude

Participants
Sota Masuoka, MD, kashiwa, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Cervical lymph node (LN) metastasis causes initial symptoms in patients with head and neck cancer, even if the primary tumor is not clinically evident. Appropriate further workup, including imaging, is mandatory for detecting the primary tumor and choosing the optimal treatment modality. Imaging can help in the prediction and detection of the possible site of the primary tumor and aid in the final diagnosis of the tumor, including true occult primary tumors. Therefore, radiologists should know how to estimate the primary site based on the distribution and imaging findings of LN metastases and be familiar with the detailed local imaging anatomy for detecting a small primary tumor.The aims of this exhibition are:•To discuss the approach for estimating the primary site based on imaging findings of cervical LN metastases•To discuss the detailed local anatomy and imaging findings that provide clues for the detection of primary tumors

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1. Introduction2. OverviewRole of imaging according to the ASCO and NCCN guidelinesClassification of unknown primary tumors based on AJCC, 8th editionImaging strategy for unknown primary tumors3. Case illustrationsPrediction of the primary site based on imaging findings of LN metastasis- Distribution of LN metastasis- Characteristic imaging findings of LN metastasesDetection of primary tumors- Detailed local anatomy- Imaging findings that provide clues for the detection of primary tumors4. Summary

HNEE-20   **CT And MRI Evaluation Of Head And Neck Cancer Treated With Chemoradiotherapy: Basics And State-of-the-art**

Awards
Magna Cum Laude

Participants
Akira Baba, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Chemoradiation therapy (CRT) for head and neck cancer is evolving and becoming mainstream, and may now include targeted therapy. Post-CRT imaging aims mainly to determine the response to treatment and to detect local and neck recurrence. However, interpretation of images of post-CRT can be difficult even for experienced radiologist due to image modifications such as obscuration of local and surrounding structures. Furthermore, the clinical significance of post-CRT imaging findings has not yet been well established. While CT is the standard for evaluation due to its wide-detector coverage, high examination efficiency, and time resolution, MRI has shown the potential to achieve a greater differentiation between post-treatment changes and residual/recurrent lesion compared to CT. We outline both the basics and state-of-the-art of imaging evaluation of head and neck cancer post-CRT.

TABLE OF CONTENTS/OUTLINE

1. Post-CRT imaging modality and surveillance 2. Post-CRT local recurrence and control 3. Post-CRT neck relapse and control 4. Post-CRT state-of-the-art imaging

HNEE-21   **Recent Progress Of MR Imaging Findings For Estimating The Depth Of Invasion Of The Oral Cancer**

Participants
Akira Baba, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The AJCC (8th edition) added a modification to the T categorization of the oral cavity, incorporating depth of invasion (DOI). In clinical practice, CT and MRI are widely used to depict tumor extensions and measure the radiological DOI (r-DOI) in the staging of malignant diseases of the head and neck. However, MRI and CT measurements of DOI might differ from pathological DOI (p-DOI) up to about 1 cm and in some cases are not always reliable. Lesions arising from the oral mucosa have adjacent anatomical structures, and MRI findings of invasion in such structures reflect a relatively large p-DOI. Lesions that are clinically and pathologically proven but undetectable on MRI are relatively superficial low-volume lesions and reflect a small p-DOI. Such MRI findings are easy to interpret and useful in estimatiing p-DOI.

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1. DOI - DOI measurement method. - Usefulness and limitations of radiological DOI measurement 2. MRI findings for estimation of pathological DOI. - Styloglossus and hyoglossus muscle invasion in oral tongue cancer. - Buccal muscle invasion in buccal mucosa cancer - Buccal fat pad invasion in buccal mucosa cancer 5. Usefulness of undetectability on MRI - Undetectability of oral tongue cancer - Undetectability of buccal mucosa cancer - Undetectability of floor of mouth cancer

HNEE-22   **A, B, C (Easy As 1, 2, 3!): Alphabetic Clues To Head And Neck Involvement In Tumors Of**

Hematopoietic And Lymphoid Tissues

Awards
Certificate of Merit

Participants
Caitlin Henry, MD, New York, New York (*Presenter*) Nothing to Disclose

TEACHING POINTS

This exhibit will highlight the spectrum of head and neck involvement in tumors of hematopoietic and lymphoid origin, within an emphasis on radiological manifestations of extranodal disease. The audience will gain an understanding of the WHO classification of hematopoietic and lymphoid tissue neoplasms. Case presentation of hematolymphoid tumors of the head and neck will illustrate pertinent anatomic locations to include in the radiological search pattern. Clinical Pearls will be incorporated to tie each case together and encourage an interdisciplinary approach to the diagnostic workup. Finally, the "A to Z" framework will serve as a memory tool to highlight key clinical terminology and anatomic landmarks pertaining to hematopoietic and lymphoid tumors of the head and neck.

TABLE OF CONTENTS/OUTLINE

Introduction to the WHO classification of tumors of hematopoietic and lymphoid tissues including myeloid, lymphoid, and histiocytic/dendritic cell neoplasms; Review of fundamentals in diagnostic imaging and the spectrum of typical and atypical radiological findings of these tumors; Featured multimodality cases of hematopoietic and lymphoid neoplasms in the head and neck including: orbital, oropharyngeal, sinonasal, parotid, thyroid, perineural, cutaneous, and skull-base manifestations; Summary of teaching points and clinical pearls.

HNEE-23   Metastases To The Extraocular Muscles: MR Features Of Institutional 16 Cases And A Systemic Review Of Clinical Features

Participants
Nobuo Kashiwagi, Suita, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Following a review of our institutional 16 patients with metastasis to the extraocular muscles which is the largest cohort to date, we present MR features with special attention to the number of lesions, shapes, margin characteristics, signal intensities on T1- and T2-weighted images, enhancement patterns. After a combination of patients from our institutions and from previous literature, we present clinical features including the primary tumor, presenting symptoms, affected muscles among the external ocular muscles, presence of metastasis to other organs, and presence of extra-orbital muscle metastases.

TABLE OF CONTENTS/OUTLINE

1. Summary of MR features in our 16 patients. 2. Summary of clinical features in 87 combined patients. 3. Presentation of illustrative cases. 4. Conclusions: MR features can be divided into two main patterns: a solitary and well-defined mass with the target appearance as an internal architecture and multi-muscular masses with an infiltrative nature. Regarding clinical features from the combined data, the most common primary tumors were breast cancer accounting for 30% of patients. The most common presenting symptom was proptosis and ocular symptoms were the first manifestation of malignancy in 17% of patients. Distant metastases to other organs were found in 82% of patients, but metastases to extra-orbital muscles were found in only 2 %.

HNEE-24   Cochlear Implant Atlas And Implications For The Radiologist

Awards
Certificate of Merit

Participants
Katherine Reinshagen, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

After viewing this exhibit, the reader will be able to:1) Recognize the most common types of cochlear implant leads2) Accurately assess placement of the cochlear implant lead3) Develop an approach to the challenging cochlear implant case

TABLE OF CONTENTS/OUTLINE

Introduction:1) Epidemiology related to cochlear implant placement2) Preoperative imaging and important surgical landmarks3) Common types of cochlear implants from the three vendors approved in the US (Advanced Bionics, Cochlear, and MED-EL) with review of MR compatibilityIntraoperative and Postoperative Imaging of Cochlear Implants:1) Positioning for intraoperative radiographs (modified Stenvers view)2) Acquisition/reconstruction technique for postoperative CT3) Examples, tips, and pitfalls in imaging each deviceImaging of the Challenging Cochlear Implant Case1) Intracochlear malposition based on electrode location and depth, including tip fold-over2) Extracochlear malposition (eg. vestibular placement) 3) Implantation in cochlear malformation (eg. incomplete partition type 3) 4) Implantation in cochlear neo-ossification (eg. labyrinthitis ossificans)5) Facial nerve stimulation

HNEE-25   Eye Lens Exposure Reduction Method During Head CT Scanning

Participants
Miyu Haga, RT, Fukushima, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The methods of reducing the exposure dose of the eye lens in head CT2. Gantry tilt mechanism: The gantry tilt mechanism is the technology that can reduce the exposure dose most. However, it is limited to patients who can be properly positioned. 3. Bismuth shielding: Bismuth protective shields are not recommended due to the artifacts that arise from the shield. 4. Organ-based tube current modulation (TCM): Although it is possible to reduce the tube current in the set direction, the dose reduction function operates over the entire imaging range because the imaging site cannot be limited.

TABLE OF CONTENTS/OUTLINE

How to use the new tube current modulation mechanism we devised: We will clarify the characteristics of the tube current modulation mechanism and explain the method we devised to use this mechanism properly. We used Organ Effective Modulation (OEM: Canon Medical Systems). The head phantom was scanned with and without OEM, and the SD change was compared with the dose rate. The dose rate was reduced by 49% at the setting position. SD rose 17%. The current OEM system cannot reduce exposure only within the target range. It reduces the dose over the entire scanning area. Therefore, although it is possible to reduce the exposure dose of the eye lens using OEM, it worsens the SD of the entire head. However, by using variable helical pitch scan (VHP: Canon Medical Systems) manually, OEM can be applied only to the eye lens area. By using the method we devised, it is possible to reduce the exposure dose only to the eye lens.

HNEE-27   The Dawn Of A New Era In The Diagnosis And Treatment Of Maxillofacial Tumors

Participants
Silvia Cayon Somacarrera, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

To learn about the role of the radiologist in 3D imaging analysis and planning in craniomaxillofacial surgery. To learn about the multidisciplinary management of head and neck cancer, including surgical, radiotherapy and pathological approaches.

TABLE OF CONTENTS/OUTLINE

We show six clinical cases of maxillofacial malignant tumors, that were resected using 3D analysis and planning. The cases that will be included are as follows: two maxillary sinus epidermoid carcinomas, one frontal sinus epidermoid carcinoma, one merkel cell carcinoma in the cheek, one gingival epidermoid carcinoma and one pseudolymphomatous angiosarcoma in the cheek. Clinical presentation, radiological studies, 3D planning for surgery and imaging planification for the radiotherapy treatment will be explained and illustrated with images, as well as pathological findings when relevant with regard to safety margins. The radiologist must play an active role in the diagnosis and treatment planification of these patients, being an important part of a multidisciplinary team. This implies bringing support to other colleagues in the treatment planification, especially when imaging is used to do so. Moreover, it is important for the radiologist to be familiar with all the steps followed by these patients in order to better understand the findings in the first follow-up imaging after treatment.

HNEE-28   Low-dose Head CT Using Deep Learning Reconstruction: Comparison Of Gray-white Matter Differentiation With Normal-dose Head CT

Participants
Natsumi Miura, RT, Fukushima, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

In the diagnosis of cerebral infarction by head CT, it is necessary to reduce image noise and improve the visibility of the epithelial boundary (gray-white matter differentiation). Although it is common to set the dose higher than other parts CT, a noise reduction reconstruction method using deep learning (DLR) has recently been developed. This presentation exhibits low-dose head CT images reconstructed by DLR to show clinical acceptance.

TABLE OF CONTENTS/OUTLINE

1. Usefulness and Limitations of Head CT in Diagnosis of Cerebral Infarction 2. Recommended scanning conditions 3. Overview of various noise reduction technologies 4. An example of image examination The cortical and medulla image quality characteristics of the low-dose head CT images reconstructed by DLR and the normal-dose head CT images were compared (5mm slice thickness, 512×512 pixels). The normal dose image (80mGy: Gold Standard: GS) was reconstructed by Filtered Back Projection (FBP). Low-dose images (40mGy) were reconstructed with DLR and hybrid iterative reconstruction (HIR). Cortical and medulla CT values, CT value difference (?CT), and SD values were compared (Wilcoxon matched-pair signed-rank test, P <0.05). ?CT was not significantly different in GS, HIR, and DLR. There was no significant difference in GS and DLR between cortical and medulla SD, but HIR was higher than GS and DLR. DLR has a better noise reduction effect than HIR, and it is possible to reduce the image noise of low-dose head CT as much as the GS image.

HNEE-29   Progress And Reversion In Mild Cognitive Impairment: An 8-year Follow-up MRI Study

Participants
Naoki Kodama, PhD, Niigata, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To explain the progression of patients with mild cognitive impairment to Alzheimer's disease or dementia with Lewy bodies during eight-year follow-up study. 2. To review 20 cases in mild cognitive impairment followed for longitudinal. 3. To review cases with the conversion to Alzheimer's disease or dementia with Lewy bodies from mild cognitive impairment during the study. 4. To predict the possibility of conversion to Alzheimer's disease or dementia with Lewy bodies from mild cognitive impairment.

TABLE OF CONTENTS/OUTLINE

1. Learn approach for the diagnosis of probable Alzheimer's disease or dementia with Lewy bodies. 2. Appreciate mild cognitive impairment on long-term brain MR images. 3. Relationship between cognitive function or radiomic features and gray matter atrophy on MR images. 4. Review cases with the conversion to Alzheimer's disease or dementia with Lewy bodies from mild cognitive impairment. 5. Review cases with the no progress in mild cognitive impairment after eight years. 6. Review cases with revert from mild cognitive impairment to normal cognition. 7. Relationship between MR images and radiomic features in cases with revert from mild cognitive impairment to normal cognition. 8. Summary

HNEE-3   Virtual Neck Exploration Utilizing Parathyroid 4D Computed Tomography For Double Gland/Multigland And Ectopic Parathyroid Disease: Optimization For Detection And Surgical Success

Participants
Austin Liou, BA, Atlanta, Georgia (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Double gland disease (DGD)/multi-gland disease (MGD) and ectopic hyperfunctioning parathyroid glands acount for up to 33% and 6-16% of primary hyperparathyroidism (PH) respectively. They are major contributors to failed parathyroid exploration even with preoperative localizing imaging. 2. Meticulous CT technique and interpretation including radiologist-directed workstation image analysis paralleling surgeon's bilateral neck exploration pattern, what we term virtual neck exploration (VNE), substantially increase diagnostic yield and accuracy. 3. Accurate 3-dimensional measurement and precise report of individual gland location relative to adjacent surgical landmarks with supplemental volume rendered surgical map substantially shorten operating time and increase cure rate in this surgically challenging group.

TABLE OF CONTENTS/OUTLINE

1. Embryology, anatomy and surgical techniques of parathyroids pertaining to VNE/4D-CT. 2. Parathyroid CT scanning technique. 3. VNE workstation image analysis (including 3D volume rendering technique) paralleling surgical bilateral neck exploration for systematic interrogation of potential orthotopic and ectopic parathyroid locations. 4. Illustrative cases of how VNE enhances DGD/MGD and ectopic parathyroid adenoma detection. 5. Pearls to increase VNE accuracy. 6. Table incorporating VNE findings as central component of preoperative surgical planning.

HNEE-30   Imaging In Tongue Malignancy - What The Surgeon Wants To Know.

Participants
Anu Kamalasanan, MBBS, East Renfrewshire, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Depth of invasion (DOI) is measured from the level of normal tissue at the basement membrane to deepest limit of enhancement. Radiological DOI is usually larger than the pathological DOI. In ulcerative lesions the DOI is larger than the lesion diameter and in exophytic lesions it is smaller than the lesion. - Elective neck dissection has been proven to increase overall survival and disease free survival in patients with T2 or greater tumors, even with N0 neck. Sentinel node biopsy is done in some centers if DOI is greater than 4mm.- On the sagittal plane, at least 1.5cm of normal tongue should be interposed between the tumor and vallecula for larynx preservation. - Involvement of mylohyoid or geniohyoid requires enbloc incontinuity resection of primary and neck dissection to avoid positive margin.- Involvement of hyoglossus, styloglossus, lateral pharyngeal wall and pterygomandibular raphae should be highlighted in the report as they influence surgical planning.

TABLE OF CONTENTS/OUTLINE

We aim to discuss - Normal imaging anatomy of the tongue . - TNM staging .- Imaging of tumor staging with examples.- Surgical options for treatment of tongue malignancy.- Emphasis on role of imaging in guiding surgical decision making. - Post treatment imaging.- Complications and their imaging features.

HNEE-31   Post Treatment Imaging In Head And Neck Malignancy

Participants
Maria Bobadilla Floristan, MD, Dundee, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Post surgical leak after laryngectomy commonly occurs anteriorly at the junction between base of the tongue and the neopharynx. Sagittal evaluation on fluoroscopy with coned views of the anterior neopharynx are helpful- Focal, nodular enhancing soft tissue is suspicious of recurrence. Post operative soft tissue thickening is usually linear and uniform- Tumor recurrence in the presence of a surgical flap, usually occurs at the junction between flap and native tissue- Osteoradionecrosis may be differentiated from recurrence by presence of diffuse osteosclerosis, loss of trabeculation and diffuse rather than focal soft tissue thickening

TABLE OF CONTENTS/OUTLINE

- Discuss role of various modalities, including radiography, ultrasound, CT, MRI and PET-CT in follow up imaging of head and neck malignancies - Demonstrate normal appearance of post treatment neck - post surgery, chemotherapy and radiotherapy - Illustrate immediate, late and delayed complications secondary to surgery - fluid collections, vascular complications, nerve injury (recurrent laryngeal nerve, hypoglossal nerve), intracranial complications - Discuss various types of neck dissections, indications and findings- Discuss indications for surgical flaps, types of flaps, presurgical imaging and illustrate donor and recipient site pathology, leaks and fistula - Demonstrate post oncological treatment complications - osteoradionecrosis, sarcoma, post radiation encephalopathy and myelopathy - Illustrate with examples, disease recurrence in post treatment neck

HNEE-32   Tongue In Cheek: What The Radiologist Needs To Know About Anatomy And Pathologies Of The Hypoglossal Nerve

Participants
Shea Roddy, MBChB, Dundee, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Hypoglossal nerve is a purely motor nerve and can be divided into five segments- cisternal, skull base, carotid space and sublingual segments2. Supranuclear disease causes deviation of tongue away from side of lesion, while disease at nuclear and infra nuclear levels causes deviation of tongue towards side of lesion and fasciculations3. Acute hypoglossal palsy is associated with diffuse ipsilateral oedema and mild mass effect4. Chronic hypoglossal palsy is associated with diffuse fatty infiltration and volume loss

TABLE OF CONTENTS/OUTLINE

1. Illustrate normal course of hypoglossal nerve from hypoglossal nucleus in medulla to its termination in sublingual space2. Discuss role of various imaging techniques and coverage required to evaluate hypoglossal nerve palsy3. Differentiate upper motor neuron and lower motor neuron types of hypoglossal palsy4. Features of acute and chronic hypoglossal palsy on imaging5. Discuss, with examples, various pathologies and their differential diagnosis that affect intracranial and extracranial segments of the hypoglossal nerve, causing hypoglossal nerve palsy

HNEE-33   Turn On The Lights Of Dangerousness: Emergencies And Potentially Life-threatening Conditions In The Head And Neck

Participants
Heber Colares Costa, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To demonstrate that ear, nose, and throat (ENT) emergencies include mainly infections and trauma cases, which may affect critical structures and cause severe complications. To illustrate the regions' complex anatomy, which is essential for imaging interpretation and preventing the worst outcomes. To depict relevant ENT imaging pearls in emergency settings, emphasizing the severity of the condition, vascular and airway evaluation.

TABLE OF CONTENTS/OUTLINE

1. Overview anatomy of the nose, temporal bone, and pharynx. 2. Imaging protocol for the best assessment of ENT regions. 3. ENT trauma: clinical issues and imaging assessment, emphasizing the seriousness of the condition. 4. ENT infection: clinical issues and imaging assessment, emphasizing the severity of the condition and airway evaluation. 5. Take home messages and summary.

HNEE-34   **Post Covid-19 Related HFN Mucormycosis: An Imminent Threat In Endemic Countries.**

Participants
Mansi Jantre III, MBBS,MD, Thane, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Mucormycosis in long standing moderate to severe COVID-19 pneumonia patients is a looming threat with an alarming rise in endemic countries battling the pandemic. Predisposing conditions include diabetes mellitus, unrestrained use of immunosuppressive therapy like corticosteroids, Toclizumab and systemic immune dysregulation occurring in COVID-19. Extensive angioinvasion is attributable for rapid orbital and intracranial dissemination. Cross sectional imaging plays a crucial role in evaluating extent of disease and pre surgical planning for timely intervention. MRI is the preferred modality to assess intracranial and soft tissue involvement, skull base invasion, perineural spread and vascular involvement. Diffusion weighted sequences are particularly useful for detecting secondary ischaemic optic neuropathy. Typical overlapping CT features include proptosis, orbital inflammatory fat stranding, optic nerve thickening, sinusitis with erosion of sinus walls. Awareness of fairly characteristic imaging features in a background of high index of clinical suspicion are crucial to help subsequent early management.

TABLE OF CONTENTS/OUTLINE

In this exhibit we review key CT and MRI features of cases of COVID 19 related Mucormycosis, we have come across in our institution. We have illustrated classical cases of sinonasal, rhino-orbital and orbito-cerebral stages along with intraoperative and post operative outcome of illness.

HNEE-35   **Vision Loss: A Radiologic Approach To The Visual Pathway Abnormalities**

Participants
Loai Aker, MD, Doha, Qatar (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- Review the radiological anatomy of the visual pathway. 2- Provide a simplified approach to various pathologies that may result in vision loss based on anatomical location. 3- Clinically correlate the imaging features to aid narrow the differential diagnoses. 4- Illustrate the CT and MRI features of different vision-threatening pathologies in a case-based approach.

TABLE OF CONTENTS/OUTLINE

1- Basic radiologic cross-sectional anatomy of the visual pathway. 2- Eye globe pathologies. 3- Optic nerve pathologies. 4- Retro-orbital pathologies. 5- Sellar and parasellar pathologies. 6- Optic tract, optic radiation and visual cortex pathologies.

HNEE-36   **A Multiparametric MRI Evaluation In Salivary Gland Tumors**

Awards
Certificate of Merit

Participants
Heber Colares Costa, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the primary tumor lesions of the salivary glands. To evaluate the principal characteristics by magnetic resonance imaging. To illustrate the importance of advanced MRI sequences for the differential diagnosis of injuries.

TABLE OF CONTENTS/OUTLINE

1. Main lesions of salivary gland morphology, location, contour, extension to the muscular or subcutaneous planes. 2. Signal intensity in the primary sequences T1 and T2 (mixed benign tumor, Warthin's and low, intermediate, and high-grade malignant tumors). 3. Evaluation of advanced MRI sequences (diffusion-weighted sequence with ADC and perfusion sequence with enhancement curve) in diagnosis and post-therapy follow-up.

HNEE-37   **A Sight For Sore Eyes: Imaging In Painful Ophthalmoplegia**

Awards
Certificate of Merit

Participants
Jack Garnham, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

TEACHING POINTS

The aim is to provide attendees with: A review of the anatomy of the orbit, the orbital apertures, and the cavernous sinus.A

structured discussion of the causes of painful ophthalmoplegia (POP), illustrated with a series of cases, including a selection of common causes and a smattering of rarities. A framework for planning and interpreting imaging in POP based on clinical lesion localisation. Insight into the role of neuroimaging (and supplementary body imaging) in the process of diagnosis and treatment from a multidisciplinary perspective.

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POP is characterised by hemicranial pain and dysfunction of the ocular motor muscles. The list of potential aetiologies is extensive and includes inflammatory, vascular, neoplastic, and infectious processes, which share anatomical localisation to the orbit, the orbital apertures, and the cavernous sinus. It presents a substantial challenge to the assessing neurologist and radiologist; timely diagnosis and treatment is frequently required to prevent permanent visual impairment. Imaging plays a central role in the investigation of POP. To meet the challenge of appropriately targeting and accurately interpreting imaging, we will review the relevant anatomy, explore the causes of POP, and describe the process of lesion localisation as it pertains to the neuroradiologist. This will be integrated with a series illustrative cases compiled from a tertiary neurosciences centre in London, and will include a selection of the usual suspects and a handful of rarer conditions.

HNEE-38 Looking The Beauty Inside - A Multimodality Imaging Approach Of Facial Aesthetic Procedures And Its Complications

Participants
Isabela Alves, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Facial aesthetic procedures are increasingly being performed using injectable materials, implants and grafts so it is not uncommon to observe such findings on head and neck imaging. In this context, the radiologist has been requested to recognize these procedures as well as to assess possible complications. To achieve accurate and timely detection and appropriate approach, each method has a specific importance including high frequency ultrasound (HFUS/24-33MHz), computed tomography (CT) and magnetic resonance imaging (MRI). This study aims to discuss and illustrate the radiologist's role in the evaluation of facial aesthetic procedures, their complications and how imaging can be ancillary to avoid them. The purpose of this exhibit is: - To illustrate the anatomy of the skin and facial layers - To show the main image patterns of cosmetic fillers, surgery, implants and grafts (HFUS, CT and MRI) - To list, classify and describe the facial aesthetic procedure complications

TABLE OF CONTENTS/OUTLINE

ANATOMY Skin/facial layers MULTIMODALITY IMAGING APPROACH Imaging aspects of facial fillers and facial procedures (surgery, implants and grafts) on HFUS, CT and MRI COMPLICATIONS Acute: vascular, infectious/inflammatory, Late: granuloma, post-COVID 19 infectious and others

HNEE-4 MRI Findings Of Benign Tongue Tumors And Tumor-like Diseases With Radiologic-pathologic Correlation

Participants
Taylor Wu, MD,PhD, Guangzhou, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

¦ Hemangioma and schwannoma are the two most common benign tongue tumors. Hemangioma is most common in the dorsal surface of the tongue and usually manifests as a prominent enhancement. Schwannomas typically appear as encapsulated masses with variable hyperintensity depending on the predominance of Antoni B fibers on T2-weighted images and heterogeneous enhancement.¦ Spindle cell lipoma (SCL) is most commonly located on the side of the midline of the tongue, with a clear boundary and a capsule. The MRI appearance of SLC is various depending on the distribution and ratio of fat and non-fat components. ¦ Both Epidermoid cysts and Dermoid cysts most often involve the floor of the mouth. On CT and MR imaging, the epidermoid cyst usually shows a well-defined, lobulated mass, and its attenuation or signal intensity is roughly similar to cerebrospinal fluid. Whereas imaging characteristics of dermoid cysts may have a thicker lining which can calcify and may enhance with contrast material and usually have the low negative attenuation values of contents (adipose, -60 HU to -90 HU).

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We describe the imaging findings of benign tumors or tumor-like lesions, including Epithelial Tumors (Papillomas), Non-epithelial Tumors (Lipoma), Soft Tissue and Neural Tumors/Lesions (Hemangioma, Lymphangiomas, Schwannoma. Neurofibroma, RhabdomyomaLeiomyoma, Chondroma), Teratomas (Epidermoid cyst and Dermoid cysts), Others (Venous malformations, Thyroglossal duct cysts), Intermediate (Inflammatory pseudotumor).

HNEE-40 The Different Shades Of Thyroid Carcinoma. Do You Know Them All?

Participants
Nancy Margarita Gutierrez Castaneda, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

TEACHING POINTS

To describe the general characteristics of thyroid carcinoma and the subtypes.To know the most affected organs in the thyroid carcinoma metastases.To identify the imaging studies that we must do and the radiological findings of each modality (radiography, CT scan, MRI, PET CT, SPECT CT and others).To associate the clinical presentation, the radiological studies and the histopathological result.To discuss the appropriate management of thyroid carcinoma based on recent literature guidelines and expert opinions.

TABLE OF CONTENTS/OUTLINE

Introduction.General features of thyroid carcinoma and the subtypes (Papillary, Follicular, Medullary, Anaplastic, Undifferentiated). Clinical presentation.Radiological findings of thyroid carcinoma in the different imaging modalities.Relationship between radiological and histopathological findings.Illustrative pathological cases. Conclusion

HNEE-41 The Roads To Misery: Complications Of Ear Infection.

Participants
Luiz Uchoa, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review adequate imaging protocols for evaluation of ear infection according to clinical suspicion.To demonstrate the imaging findings of ear infections, didactically divided in external ear, middle ear, inner ear and petrous apex.To illustrate complications of ear infections with CT and MR images.

TABLE OF CONTENTS/OUTLINE

Anatomical division of the ear.Visual systematization of infectious ear diseases.Illustrative cases of ear infections and their complications divided in external ear, middle ear, inner ear and petrous apex.Take home messages.

HNEE-42   Orbital Emergencies In A Blink: What The Radiologist Should Know

Participants
Eugenio Gil, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Present an overview of the anatomy and mechanism involved in orbital emergencies.2. To demonstrate the imaging appearances of typical and atypical orbital emergencies. 3. To develop a classification scheme with a list of pathologies based on the region of involvement and create a flowchart to help the radiologist avoid misinterpretations and improve diagnostic rate.

TABLE OF CONTENTS/OUTLINE

A. Introduction General Aspects Anatomic Considerations Mechanism Region of Involvement B. Evaluation Flowchart and Checklist C. Trauma Hemorrhages Retinal Detachment Choroidal Detachment Lens Dislocation Foreign Bodies Globe Rupture D. Infection Abscess Endophthalmitis E. Inflammation F. Vascular

HNEE-43   Open Your Eyes! Orbital Inflammatory And Infectious Diseases

Participants
Carolina Clementino, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Orbital inflammation is a vision-threatening condition that may be idiopathic or caused by an underlying disease. Considering continued advances in computed tomography (CT) and magnetic resonance imaging (MRI), it is of utmost importance that radiologists are able to recognize affected structures and suggest the correct etiology when feasible.The main goals of this exhibit are:Identification of normal orbital anatomy in CT and MRI.To review the morphological manifestations, the most common sites of involvement, and key imaging findings of inflammatory and infectious diseases.To apply a systematic approach to the radiologic characterization of those lesions.To show differential diagnoses that may mislead radiologists and how to identify them.

TABLE OF CONTENTS/OUTLINE

1- Anatomy review2 - Imaging findings of orbital inflammatory disease:DacryoadenitisMyositisNeuritis/PerineuritisCellulitisOrbital apicitisPeriscleritis3 - Imaging features and patterns that may suggest a specific etiology:Idiopathic orbital inflammationImmunoglobulin G4 related diseaseDysthyroid orbitopathy (Graves disease)SarcoidosisAmyloidosisGranulomatosis with polyangiitisHistiocytosisSjogren syndromeInfection (viral, bacterial, fungal, parasitic)Demyelinating disorders4 - Differential diagnosisPrimary tumorMetastasisLymphoproliferative disordersCarotid-cavernous fistulaCavernous sinus/ superior ophthalmic vein thrombosisVascular malformationIschemic neuropathy5 - Take-home messages

HNEE-44   51 Shades Of Gray-Recognizing The Evil Gray On T2 Weighted Imaging For Detection Of Recurrence In Post Surgically Treated Head And Neck Cancer

Participants
Jeevitesh Khoda, MD, Jammu, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Surgery with radiation forms the cornerstone of the management of locally advanced neck cancers. It is challenging to differentiate disease from healthy tissue in the setting of postsurgical changes. Clinicians must manage recurrence while it is still salvageable to pursue an improved survival. 2. In postsurgical subjects for cancers occurring in the oral cavity, plastic reconstruction with flaps and post-treatment trismus further impedes clinical examination. 3. Recurrent cancer and scar fibrosis resulting from post-radiation treatment changes will enhance post-contrast images. With superimposed anatomical changes induced in postsurgical settings, resulting in artifacts on diffusion sequences, the interpretation of valid tumoral restriction becomes challenging. 4. The calculation of ADC values in these artefactual regions would lead to erroneous interpretation and might lead to an increased risk of missing an early potentially salvageable recurrent cancer. Further quantitative ADC value interpretation is not carried out in routine clinical practice. ADC values when interpreted with diffusion may yield false-negative results in approximately 26%, missing cancers. 5. Recurrent tumors are described as intermediate "evil gray" T2 signal intensity on MR imaging.

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Clinical cases with pictorial depiction shows the "different shades of gray" of recurrent tumours on MR with conventional T2WI, diffusion , post contrast and 18 FDG PET-CT (when available) in post surgical cases of head and neck cancers.

HNEE-45   Sleep Apnea: What The Clinician Wants To Know

Participants
Stephanie Nagano, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1- Sleep apnea is a condition caused by cessation of breathing throughout the night. This condition may cause daytime sleepiness, headaches, chronic arterial hypertension, and in extreme cases, can lead to traffic accidents, ischemic stroke and sudden death. 2- Obstructive apnea is the commonest type. Diagnosis is made by clinical aspects and polysomnography. Imaging methods are important to determine the obstruction topography, therefore, to guide therapeutic planning. 3- Computed tomography is the imaging method of choice, because of its availability, faster acquisition and lower cost when compared with MRI. It also allows for three-dimensional reconstructions and measurement of the upper airway area. All structures that may be associated with obstructive apnea, including the tongue, soft palate, tonsils, epiglottis and the hyoid bone are well evaluated by CT. 4- Treatment is individualized and depends on the location of the obstruction and its severity. Weight loss and continuous positive airway pressure (CPAP) are the most commonly used methods, but surgery may be required in some patients.

TABLE OF CONTENTS/OUTLINE

1- Introduction. 2- Definition, types and physiopathology of sleep apnea. 3- Superior airway anatomy involved with obstructive apnea. 4- Imaging methods. 5- Main measurements. 6- Pathological examples. 7- Conclusions.

HNEE-46   Congenital Anomalies Of The Craniovertebral Junction : A Pictorial Presentation

Participants
Bhanupriya Singh, MD, Lucknow, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To outline few characteristic congenital anomalies of the CVJ in the form of a pictorial presentation 2. The Craniovertebral junction (CVJ) is a collective term that refers to the occiput, atlas, axis and supporting ligaments that enclose soft tissue structures of the cervical medullary junction. (1) 3. A variety of congenital anomalies with the potential for causing neurological deficits to occur in this region(2) 4. Computed Tomography and Magnetic Resonance Imaging are rewarding in the detailed evaluation and diagnosis of common and uncommon abnormalities of the CVJ.(1)

TABLE OF CONTENTS/OUTLINE

1. Multiplanar reconstruction in coronal & sagittal planes was done after obtaining axial CT images. 2. Craniometric measurements used in radiologic assessment of CVJ anomalies include the Chamberlain line, Wackenheim clivus baseline, Welcher basal angle, and atlantooccipital joint axis angle. 3. A pictorial representation of a few of the representative congenital anomalies of CVJ are included in this study

HNEE-47   Imaging Of Free Flaps In Head And Neck Reconstruction Surgeries

Participants
Amit K. Agarwal, MD, MBBS, Jacksonville, Florida (*Presenter*) Consultant, Authentic4D;Stockholder, Gilead Sciences, Inc

TEACHING POINTS

1. To provide basic understanding of the free flap reconstruction techniques for Head and Neck surgeries through schematic diagrams, intra-operative photos and their imaging correlate 2. To discuss the imaging findings in immediate and late complications of free-flap reconstruction surgeries 3. To discuss pertinent findings to help differentiate local recurrence from conditions which can mimic tumor

TABLE OF CONTENTS/OUTLINE

1. Reconstructive ladder in head and neck surgery2. Graft versus Flaps3. Types of Flaps-Local-Regional/Pedicle-Free flap (focus on radial free forearm flap)4. Composition of flaps and common usage5. Post-operative anatomy (CT/MR)6. Immediate postoperative complications (ischemia, infection, bleeding, and dehiscence)7. Long-term complications (infection, fistulas, hardware exposure, osteonecrosis, recurrence)8. Conditions mimicking local recurrence

HNEE-48   A Comprehensive Review Of Vertebral Artery Dissection Imaging

Participants
Heber Colares Costa, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the anatomy of vertebral arteries, the pathophysiology, and types of dissection, as well as the risk factors and clinical presentations of vertebral artery dissection. 2. To re-examine the diagnostic imaging techniques, including CT angiography, MR angiography with emphasis on vessel wall imaging (3D T1 dark blood) and Digital subtraction angiography. 3. To point out imaging findings and pitfalls in daily cases.

TABLE OF CONTENTS/OUTLINE

1. 1. Vertebral artery anatomy. 2. Pathophysiology and types of dissection. 3. Diagnostic methods including CT angiography, vessel wall imaging and MR angiography, and digital subtraction angiography. 4. Vessel wall imaging in vertebral arteries dissection assessment: importance, imaging highlights, and pitfalls. 5. Sample cases and mimics. 6. Summary

HNEE-49   Stranger Things In Head And Neck Images: Radiologic Manifestations Of Hematologic Diseases.

Participants
Adrian Candido, MD, Capital Federal, Argentina (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review relevant concepts of hematologic diseases and the way they are classified.Describe imaging findings spectrum of various hematologic diseases in multiple regions of the head and neck, specially infrequent presentations.Discuss clinical cases of our Institution and present additional Radiology and Pathology findings that guide the diagnosis.

TABLE OF CONTENTS/OUTLINE

Hematologic diseases. Classification (pathways).Clinical cases. Imaging findings and correlation with pathology.Scalp acute lymphocytic leukemia.Orbital mantle lymphoma.Orbital Burkitt´s lymphoma.Orbital granulocytic sarcoma.Orbital amyloidosis.Masticator and submandibular space granulocytic sarcoma.Masticator space plasmocitoma.Pharyngomucosal space B-cell lymphoma.Skull base granulocytic sarcoma.Perivertebral space multiple myeloma.Brachial plexus infiltration by Burkitt´s lymphoma.Summary.References.Contact.

HNEE-5   What's That Pain In My Neck? Imaging Manifestations Of Rheumatic Diseases In The Head And Neck

Awards
Certificate of Merit

Participants
Pattana Wangaryattawanich, MD, Bellevue, Washington (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Rheumatic diseases are diseases that affect joints, tendons, ligaments, bone and muscles and may involve multiple organs. They can be classified based on their pathogenesis, including: 1) autoimmune disorders such as rheumatoid arthritis; 2) autoinflammatory process such as chronic recurrent multifocal osteomyelitis; 3) metabolic causes such as gout and calcium pyrophosphate dihydrate (CPPD) crystal deposition disease and 4) degenerative joint disease. 2. Rheumatoid arthritis is the most common autoimmune-mediated inflammatory arthritides of the head and neck, most commonly affecting the atlantoaxial joint but also involving the temporomandibular and cricoarytenoid joints. 3. Crystal-induced arthropathy such as CPPD and calcium hydroxyapatite deposition disease can affect joints and soft tissues in the head and neck and cause unique imaging and clinical manifestations.

TABLE OF CONTENTS/OUTLINE

1) Introduction 2) Classification and pathogenesis of rheumatic diseases 3) Imaging manifestations of rheumatic diseases in the head and neck 4) Case-based presentation 5) Take home points

HNEE-50   Orthognathic Surgery For Radiologists: From Indications To Complications

Awards
Certificate of Merit

Participants
Carlos Alberto Coelho Neto, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:- Review concepts, techniques and indications of orthognathic surgery, with a radiologic focus. - Demonstrate complications on post-operatory radiologic exams.

TABLE OF CONTENTS/OUTLINE

1) Introduction to orthognathic surgery, with definitions and statistics demonstrating this worldwide used method. 2) Common indications, including prognathism, retrognathia, craniofacial deformities, dental malocclusion and obstructive sleep apnea syndrome (OSAS). We highlight, with schemes and cases, concepts and measurements on radiological exams, such as the angle between sella, nasion and A/B points (SNA and SNB); the Angle classification for dental malocclusion; and imaging parameters on OSAS evaluation. 3) Discuss some widely used orthognathic surgical techniques: mandibular osteotomies, maxilla advancement and mentoplasties. We highlight expected early and late radiologic features on CT, showing esthetical and functional satisfactory results and comparing pre and post-operatory exams. 4) Demonstrate early and late complications,, with a radiologic focus, including infection (osteomyelitis, bone sequestrum and soft tissue abscesses) and fixation material issues (screw displacement, plaque fractures). 5) Discuss the alveolar inferior canal and nerve, detailing their anatomy with illustration and cases. Show complications such as involvement by the osteotomies and by the screws. 6) Conclusion.

HNEE-52   Radiologic Approach To Semicircular Canals Malformations

Participants
Virginia Simonini, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Semicircular canals (SCC) are part of the inner ear (IE), a sensory organ that responds to sound, gravity and movement, related with hearing and balance. They offer sensorial information about the rotational movements of the head through the endolymph internal circulation. The three SCC are arranged at different angles, allowing the perception of head movements.They start developing between the 6th and 8th fetal week and are completely formed by the end of the 22nd week. Developmental disorders may determine malformations such as dysplasias, incomplete development or total absence of SCC. They may appear in isolation or associated with other IE anomalies, sporadically or syndromically. The objectives of this exhibit are to review the anatomy and function of the SCC and demonstrate the evaluation in imaging of their main malformations.The imaging methods used to investigate SCC malformations are computed tomography (CT) for the bony labyrinth and magnetic resonance imaging (MRI) for the membranous labyrinth and neural structures, with multiplanar reformations and 3D reconstruction. In this exhibit the authors review how to evaluate cases of common crus aplasia, dysplasia, agenesis and anomalies of the CSS associated with other malformations of the IE and more frequent syndromes.

TABLE OF CONTENTS/OUTLINE

Illustrate normal SCC anatomy. Expose didactic cases of SCC malformations and how to evaluate them, illustrating described findings to consolidate the acquired knowledge.Bibliographical references.

HNEE-53   "Which Road Do I Take?": Tips And Tricks For Perineural Tumor Spread

Participants
Luiz Pedro Dos Santos, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:- To review the skull base and cranial nerve anatomical landmarks in order to evaluate the perineural spread.- To discuss the imaging modalities strengths and weaknesses.- To describe the imaging features of neoplastic and non-neoplastic lesions with perineural spread with sample cases from our database institution, highlighting the main pathways of dissemination. - To provide practical tips and discuss common pitfalls of perineural spread, emphasizing the utility of a systematic approach for accurate evaluation.

TABLE OF CONTENTS/OUTLINE

- Introduction- Skull base and cranial nerve normal anatomy- Main perineural pathways- Imaging modalitiesDifferential diagnosis- Practical tips and pitfalls - Take-home messages

HNEE-54   Tumor Or Radionecrosis? - The Tools For Diagnosis

Awards
Certificate of Merit

Participants
Samya Alves, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Imaging examinations have a fundamental role in head and neck cancer monitoring, including primary lesion and metastatic disease, especially in the assessment of treatment response and disease progression. Radiotherapy is currently a paramount therapy, whether neoadjuvant, adjuvant or palliative, though it carries some possible unfortunate outcomes, as radiation necrosis. The post treatment head and neck imaging is hence even more challenging, as we are expected to distinguish these outcomes from persistent or recurrent tumor, not at all an easy task. This exhibition aims to Revisit the imaging features of radionecrosis; Review the assessment for recurrence in head and neck tumors through CT, PET-CT and MRI; Discuss the role of advanced imaging techniques, such as diffusion-weighted (DWI) and dynamic contrast-enhanced (DCE) MRI in the differentiation between recurrence and post radiation findings; Illustrate concepts based on didactic cases and pathology correlation.

TABLE OF CONTENTS/OUTLINE

POST RADIOTHERAPY HEAD AND NECK IMAGING: Radionecrosis and Radiotherapy. CASE-BASED DISCUSSION: Sample cases to illustrate the concepts; Imaging Assessment and Techniques - CT, PET-CT and MRI; Hints for Differentiation between Tumor and Radionecrosis; Pathology Aspects

HNEE-56   Cochlear Implantation - A Systematic Approach To Preoperative Radiological Evaluation

Awards
Identified for RadioGraphics
Certificate of Merit

Participants
Shivaprakash Hiremath, DMRD,FRCR, Toronto, Ontario (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to: • Review the basic anatomy of the inner ear, including the cochlear, vestibule, and semicircular canals • Describe the imaging findings that influence the choice of surgery in inner ear malformations • Illustrate the findings in congenital and acquired causes of sensorineural hearing loss that are amenable to cochlear implantation • Depict the anatomical factors that influence surgical approach during cochlear implantation

TABLE OF CONTENTS/OUTLINE

Ø Basic anatomy of the cochlea, vestibule, and semicircular canals Ø Congenital causes of sensorineural hearing loss § Complete labyrinthine aplasia § Cochlear hypoplasia and aplasia § Common cavity malformation § Incomplete partition anomalies § Vestibulocochlear nerve anomalies § Enlarged vestibular aqueductØ Acquired causes of sensorineural hearing loss § Labyrinthitis ossificans § Otosclerosis § Labyrinthine schwannomasØ Anatomical factors influencing surgical approach§ Mastoid pneumatization § Middle ear status § Round window and facial nerve § Dura-meatal distance § Arterial and venous variations

HNEE-57   Don't Feel The World Spinning - Imaging Aspect Of Vertigo And Dizziness

Awards
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Participants
Isabela Alves, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Dizziness affects 30% of the population over the age of 65 years and represents 4% of visits to the emergency department. It is classically dived in peripheral (vestibular) and central (central nervous system) etiologies, although the clinical differential is not always possible. It can be associated with a multiple of pathologies from the ear to the central nervous system. This study aims to discuss and illustrate the radiologist's role in the evaluation of vertigo and dizziness. The purpose of this exhibit is: - To illustrate the anatomy of the membranous and osseus labyrinth, middle and inner ear, internal auditory conduct and vestibular central nervous system pathway - To show the clinical findings to distinguish peripheral from central vestibular syndrome - To describe the imaging technique to investigate vertigo in different settings - To list, classify and describe the causes of vertigo in a case-based approach

TABLE OF CONTENTS/OUTLINE

ANATOMY Membranous and osseus labyrinth Middle and inner ear Internal auditory conduct Vestibular central nervous system pathway CLINICAL FINDINGS AND EXAM Benign paroxysmal positional vertigo (BPPV) - Dix-Hallpicke and supine roll test How differentiate clinically central from peripheral vertigo? IMAGING TECHNIQUES Pöschl and Stenvers reconstruction Acute: fast MRI protocol Meniere disease investigation: specific sequences CASE-BASED APPROACH Causes of vertigo and imaging findings

HNEE-58   Tips And Tricks Of Cervical Lymph Nodes With Ultrasound: Where We Are And Where We Are Going

Participants
Pedro Naime Araujo I, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

- Provide an overview of normal distribution of cervical nodes, and possible causes of unilateral and bilateral cervical adenopathy; - Review the normal and abnormal morphologic features of lymph nodes in the US; - Ascertain the utility of ultrasound B-mode, color and power Doppler for characterizing cervical lymph nodes; - Explain how contrast-enhanced ultrasound (CEUS) and shear-wave elastography (SWE) can be a tool in distinguish the etiology of lymphadenopathy.

TABLE OF CONTENTS/OUTLINE

1- Introductiona. Cervical lymph nodes anatomyb. Differential causes of adenopathy2- Ultrasound techniquesa. Classic: B-mode, color and power Dopplerb. Novel: CEUS and SWEi. Differentiation of benign from malignant lymph ii. nodes Evaluation of effects of treatment. 3- Pearls and Pitfalls4- Take-home messages

HNEE-59   Face To Face With Facial Nerve: Anatomy And Spectrum Of Diseases

Participants
Niedja Santos Goncalves Tsuno, Brasilia, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. Review the anatomy of the facial nerve from its origin in the pons to the extracranial segment.2. Review some facial nerve diseases with typical location in each segment and their radiological findings.3. Learn more about some important differential diagnoses for each nerve segment.

TABLE OF CONTENTS/OUTLINE

1. Simplifying the complex anatomy of the facial nerve and its segments (cisternal, canalicular, labyrinthine, tympanic, mastoid, extratemporal segment).2. Describe the relationship between facial nerve segments and adjacent anatomical structures like temporal bone, auditory canal and middle ear ossicles.3. Summarize the main key points of some different diseases that affect each facial nerve segment, with a focus on computed tomography and magnetic resonance findings, highlighting some pathologies like: Congenital duplication of the mastoid segment;Cochleofacial fistula secondary to cholesteatoma;Venous malformation;Ramsay Hunt syndrome;Facial nerve schwannoma;Herpetic polyneuropathy involving facial nerve;Bell's Palsy;Leptomeningeal carcinomatosis with facial nerve involvement;Traumatic injury of facial nerve;Demyelinating disorders;Sarcoidosis;Malignancy of parotid with facial nerve involvement;Fibrous dysplasia with facial nerve involvement.

HNEE-6   Normal Variants, And Benign And Malignant Lesions Of The Central Skull Base Associated With Notochordal Remnants

Participants
Hiroyuki Fujii, MD, Shimotsuke, Japan (*Presenter*) Nothing to Disclose

TEACHING POINTS

The notochord plays a vital role in development of vertebrates. At the cephalic end, the course of the notochord forms an S shape in the central skull base. Although the notochord is a transient structure, various anatomic variants as well as benign and malignant pathologies can arise from the notochordal remnants. The purpose of this exhibit is:1. To review the normal development of the notochord. 2. To review the normal variants, and benign and malignant lesions associated with notochord remnants. 3. To discuss the differential diagnosis.

TABLE OF CONTENTS/OUTLINE

1. Embryology of the notochord 2. Anatomical locations of the notochord 3. Normal variants: Canalis basilaris medianus, Fossa navicularis.4. Benign lesions: Tornwaldt's cyst, Ecchordosis physaliphora, Benign notochordal cell tumor. 5. Malignant lesions: Chordoma.6. Differential diagnosis: Clival fracture, Retention cyst, Epidermoid cyst Arachnoid cyst, Neurenteric cyst, Meningioma, Hemangioma, Chondrosarcoma, Metastatic bone tumor, Invasive pituitary adenoma, Invasion of nasopharyngeal carcinoma, Plasmacytoma/multiple myeloma, Lymphoma, Skull base osteomyelitis, Fibrous dysplasia.

HNEE-60   Dental Anomalies: What The Radiologist Needs To Know.

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Certificate of Merit

Participants
Gabriela Bandeira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To describe the events that occur during the development of the teeth and associated structures.To recognize the classification of dental anomalies.To integrate the knowledge of the development of the teeth with normal anatomy and developmental disturbances.To illustrate imaging findings related to dental anomalies.

TABLE OF CONTENTS/OUTLINE

1- Introduction2-Tooth Development and Eruption (initiation stage, bud stage, cap stage, bell stage, stages of apposition and maturation).3- Classification of dental anomalies:Developmental Abnormalities: number of Teeth (Supernumerary Teeth and Missing

Teeth), size of teeth (macrodontia and microdontia), eruption of teeth (transposition), altered morphology of teeth (fusion, concrescence,gemination, taurodontism, dilaceration, dens invaginatus, dens in dente, dilated odontome, dens evaginatus, amelogeneses imperfecta, dentinogenesis imperfecta, osteogenises imperfecta, dentin dysplasia, regional odontodysplasia, enamel pearl, talon cusp, turner's hypoplasia,congenital syphilis)Acquired Abnormalities: attrition, abrasion, erosion, resorption, secondary dentin, pulp stones, pulp sclerosis, hypercementosis.4- Illustrative cases of dental anomalies.5- Conclusion.

HNEE-61   Congenital Craniofacial Anomalies: A Rational On Imaging

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Participants
Gabriela Bandeira, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

To describe the events that occur during the development of the craniofacial structures.To integrate the knowledge of the development of craniofacial structures with normal anatomy and developmental disturbances.To illustrate imaging findings related to craniofacial anomalies.

TABLE OF CONTENTS/OUTLINE

1- Introduction2- Craniofacial development and segmentation: neural tube (prosencephalon - forebrain, mesencephalon - midbrain, rhombencephalon -hindbrain) and neural crest (cranial, vagal, trunk, or sacral).3- Craniofacial anomalies: Craniofacial anomalies of the frontonasal process: frontonasal dysplasia, holoprosencephaly spectrum (cyclopia, ethmocephaly, cebocephaly, agenesis of the primary palate, cleft palate and lip, piriform stenosis, single central incisor), Binder syndrome, others.Craniofacial anomalies of the first and second pharyngeal arches: microtia/anotia, facial microssomia (oculoauriculovertebral spectrum), Treacher Collins syndrome, others.Craniosynostoses: Crouzon syndrome, Apert syndrome, Pfeiffer syndrome, Jackson-Weiss syndrome, Saethre-Chotzen syndrome.4- Illustrative cases of craniofacial anomalies.5- Conclusion

HNEE-62   Don't Forget Nasal Cavity And Paranasal Sinus: Anatomy And Imaging Features Of Sinonasal Tumors.

Participants
Laura Fino Velasquez, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the anatomy of the nasal cavity and paranasal sinuses. To determine the main imaging features to differentiate benign and malignant sinonasal tumors.To know and describe tumor-like conditions to avoid diagnostic errors in daily practice.To show the imaging findings of each pathology in different modalities (X-ray, CT, and MR).

TABLE OF CONTENTS/OUTLINE

1. Learning objectives. 2. Anatomy. 3. Imaging features of Benign Sinonasal Tumors. 3.1. Schneiderian papillomas. 3.2. Antrochoanal polyp. 3.3. Juvenile nasopharyngeal angiofibroma. 3.4. Fibrous-osseous lesions. 4. Imaging features of Malignant Sinonasal Tumors. 4.1. Squamous cell carcinoma. 4.2. Adenocarcinoma. 4.3. Olfactory neuroblastoma. ?4.4. Lymphoma. 4.5. Melanoma. 5. Tumor-like Entities. 6. When to suspect a malignancy? 7. Suggested Diagnostic Approach. 8. Structured reporting. 9. Teaching points. 10. References.

HNEE-63   Two For One: Cancer And A Rare Disease, Sarcomas In Head And Neck. Radiology Pathological Correlation Of Soft Tissue Sarcoma.

Participants
Vanessa Velezmoro Diaz, MEd, Lima, Peru (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this updated review is to offer an evaluation of soft tissue sarcoma in the head and neck region.Specifically, this paper aims at radiological evaluation in multidisciplinary management with an emphasis on pathological correlation. Another objective is to highlight the use of CT, classic and advanced MRI sequences and shows impact.

TABLE OF CONTENTS/OUTLINE

Introduction (generalities and New Tumor Entities and Subtypes in the 2020 WHO Classification of Soft Tissue Tumors). Imaging evaluation(CT and classic and advanced sequences MRI). Case review: Liposarcoma Rhabdomyosarcoma . Solitary fibrous tumor. Malignant perispherical nerve sheath tumor. Malignant fibrous histiocytoma. Sinovial sarcoma Pleomorphic sarcoma. Fibroblastic sarcoma. Unclassified sarcoma Treatment - prognosis - follow up Summary Bibliography

HNEE-64   Enhancement Of Facial-vestibulocochlear Nerve Complex On MRI: A Pictorial Review

Participants
Gurkawal Kaur, MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the key points of facial and vestibulocochlear nerve anatomy onMRI. 2. To illustrate imaging findings of various pathological entities resulting in abnormal enhancement of Facial-vestibulocochlear nerve complex on MRI.

TABLE OF CONTENTS/OUTLINE

1. Facial and vestibulocochlear nerve relevant anatomy.2. Causes of abnormal nerve enhancement: inflammation, infections (mucormycosis, tuberculosis), carcinomatous meningitis, schwannomas, meningiomas, metastasis, granulomatous processes. 3. Imaging appearance with case-based examples on Contrast Enhanced MRI.

HNEE-65   Different Methods Of Preoperative Prediction Of Cervical Nodal Metastasis In Papillary Thyroid Carcinoma

Participants
Yaoyuan Wu, Hefei, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

The exhibition aims to introduce different methods of detecting cervical lymph nodes and improve the accurate preoperative diagnosis for cervical nodal metastasis, compared to the diagnostic performance of each method.

TABLE OF CONTENTS/OUTLINE

1.The methods of preoperative detecting cervical lymph nodes of papillary thyroid carcinoma were US, MRI, conventional CT, dual-energy CT and radiomics signature. 2.Illustrate the advantage and disadvantage of the five methods of preoperative detecting cervical lymph nodes in PTC patients, containing US, MRI, conventional CT, dual-energy CT and radiomics signature. 3.Calculate and compare the diagnostic performances of using US, MRI, conventional CT morphological features, dual-energy CT quantitative parameters and radiomics signature for predicting cervical nodal metastasis, with receiver operating characteristic curves. 4.Because some methods had low sensitivity but high specificity and some were opposite, the combination can complement each other. The AUC, sensitivity and specificity can improve to the best.

HNEE-67   Whats Behind The Ground-glass? Imaging Of Fibro-osseous Lesions Of Craniofacial Skeleton

Participants
Andrea De Sousa, BMBS, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:- To discuss and to illustrate through clinical cases the imaging features of the fibro-osseous lesions (FOL) of craniofacial skeleton correlating to current classification and histological aspects.- To identify and to classify the major fibro-osseous lesions of craniofacial skeleton, according to the region of involvement: jaws, paranasal sinuses, nasal cavity, temporal bone, skull base lesions and multifocal lesions.- To propose a practical algorithm for the systematic evaluation of the differential diagnosis.

TABLE OF CONTENTS/OUTLINE

The physiopathology of fibro-osseous lesionsMore important types of FOL of the craniofacial complexFibrous dysplasia;Ossifying fibroma;Cemento-osseous dysplasia and variants;Exostosis;OsteomaTopographic classification of FOL of craniofacial skeletonJaws lesions;Lesions of paranasal sinuses;Lesions of the nasal cavity;Lesions of the temporal bone;Skull base lesions; Multifocal lesionA pictorial review for the main imaging patterns of FOL through clinical cases from our institution's databaseDiagnostic AlgorithmFinal remarks

HNEE-68   Head And Neck Complications In Hospitalized Patients With COVID-19

Awards
Certificate of Merit

Participants
Felipe Lorenzo Marsolla, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Describe the clinical syndrome caused by SARS-CoV-2 and the most common symptoms related to the disease.Summarize the main head and neck complications in hospitalized patients with COVID-19 and present an outline role of imaging methods in the diagnosis, especially computed tomography (CT) and magnetic resonance imaging (MRI).Present a group-based approach following Inflammatory / infectious, Iatrogenic and vascular complications disorders

TABLE OF CONTENTS/OUTLINE

Introduction ApproachInflammatory / infectious Olfactory cleft mucosal thickeningInjury to the olfactory bulbs Parotitis Sinusitis Amygdalitis Fungal infection Mastoiditis Odontogenic complicationsIatrogenic Laryngeal stenosis Tracheal laceration with barotrauma Cricoid chondritis Tracheoesophageal fistulaVascular Arterial thrombosis/occlusions Venous thrombosisHaematomaTake-home messages

HNEE-69   Computed Tomography Of Ossicular Chain Disruption: A Pictorial Essay

Participants
Anagha Joshi, MD, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

To review the normal anatomy of the ossicular chain and to discuss the role of 2-D and 3-D computed tomography in the evaluation of post traumatic ossicular chain disruption.

TABLE OF CONTENTS/OUTLINE

Introduction: Trauma of the middle ear usually manifests as conductive hearing loss that can be due to laceration of the tympanic membrane, hemotympanum or ossicular damage. Ossicular dislocation or fracture is suspected if hearing deficit persists after resolution of hemotympanum or healing of the tympanic membrane.Anatomy: Salient features of ossicular chain anatomy are reviewed in axial, coronal and reformatted CT planes (3D). Typical landmarks in axial plane: Icecream cone, two dot, two dash are described and a checklist is prepared for detection of any abnormality in post traumatic injuries.Imaging findings: CT findings of the five types of dislocation are discussed: 1) Incudomalleolar joint separation 2) Incudostapedial joint separation 3) Dislocation of the incus 4) Dislocation of the malleoincudal complex and 5) Stapediovestibular disclocationTypes of ossicular fractures and other associated imaging findings are also discussed.Finally role of 3-D reconstruction and virtual otoscopy in evaluation of these injuries is highlighted. Summary: Thorough knowledge of the ossicular chain anatomy is essential for detection of the ossicular chain injuries. High resolution CT along with 3-D reconstruction is the modality of choice for early diagnosis and surgical planning of these injuries.

HNEE-7   Imaging Findings Of Melanoma In The Head And Neck With Emphasis On Dce Perfusion

Participants
Shotaro Naganawa, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review imaging findings of melanoma in the head and neck2. To explain and demonstrate the typical and atypical imaging findings of treatment-related changes of brain metastases3. To explore the utility of Perfusion weighted imaging and Quantitative Susceptibility Mapping in melanoma management.

TABLE OF CONTENTS/OUTLINE

Imaging of brain metastases-With hemorrhage-Without hemorrhage-Leptomeningeal MetastasesTreatment related change-Psuedoprogression (SRS and immunotherapy)-Radiation induced cavernomaTreatment related complications-Hypophisiitis-SMART syndromeHead and Neck lesions-Bone metastasis-Muscle-Nasal cavity-ScalpUtility of Perfusion weighted image-Differentiating Melanoma from Pseudoprogression-Differentiating Melanoma from Capillary telangiectasiaUtility of Quantitative Susceptibility Mapping-Differentiating viable part of Melanoma from hemorrhagic change-Quantification of melanin amount in Melanoma

HNEE-70   Check Your Flow: Imaging Findings In Vascular Urgencies And Emergencies Of The Head And Neck

Participants
Maria Cristina Fialho, MD, Teresina, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The objectives of this exhibition are: • Review and illustrate the imaging findings of the main emergency vascular conditions of the head and neck. • Describe the major imaging patterns of the main emergency vascular disorders of non-traumatic and traumatic origin in the head and neck. • Discuss the main differential diagnosis and red flags that aid diagnosis.

TABLE OF CONTENTS/OUTLINE

• Image patterns of the main emergency vascular conditions of the head and neck: occlusion, dissection, pseudoaneurym, partial and total wall disruption, aneurysms, arteriovenous malformation / fistula, TIPIC syndrome (Carotidynia), arteritis, Lemierre syndrome, other thrombosis, • Differential diagnosis based on a pictorial review using representative cases from our institutional database. • Final considerations.

HNEE-71   A Case Based Approach Of The Oculosympathetic Pathway: A Review Of Horner Syndrome

Participants
Tabassum A. Kennedy, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

TEACHING POINTS

1) To identify the components of Horner syndrome and the Oculosympathetic pathway 2) Integrate clinical history with anatomic knowledge of the Oculosympathetic pathway to better localize pathology 3) Develop a focused differential diagnosis based on clinical symptoms and imaging findings

TABLE OF CONTENTS/OUTLINE

1) Introduction: Defining Terms- Horner Syndrome a. Horner syndrome is the clinical syndrome most commonly featuring ptosis, miosis and anhidrosis and is the result of disruption of ipsilateral sympathetic nerve fibers. 2) Anatomy of the Oculosympathetic pathway 3) Case Based Review a. First-order of Horner Syndrome b. Second-order Causes of Horner Syndrome c. Third-order Causes of Horner Syndrome 4) Conclusion a. Understanding the anatomy of the Oculosympathetic pathway, with central, preganglionic and postganglionic components, is critical for accurate interpretation of imaging in the setting of Horner syndrome. b. The identification of clinical features unique to the separate components of the sympathetic pathway should guide imaging selection and search pattern.

HNEE-72   It'S Time To Leave No Stone Unturned: Reviewing The Hyoid-larynx Complex And Styloid Process Anatomy And Associated Lesions

Participants
Camila Acras, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are:- To illustrate the anatomical landmarks of the hyoid-larynx complex and styloid process.- To describe the common normal variants which may be mistaken for pathology.- To show the spectrum of pathologies affecting the hyoid-larynx complex and styloid process, according to a case-based approach.

TABLE OF CONTENTS/OUTLINE

- Anatomy and physiology of the hyoid-larynx complex and styloid process;- Imaging methods;- Differential diagnosis of lesions according to neoplasm, inflammatory/infectious, vascular, degenerative, and traumatic etiologies;- Imaging approach according to the anatomical involvement and clinical information;- Conclusion.

HNEE-73   Can You See It Crystal Clear? A Systematic Review Of Imaging Evaluation Of The Crystalline Lens.

Participants
Tiago Chamel, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. To review the anatomy and physiology of the crystalline lens, making a correlation to its normal appearance in ultrasound, computed tomography and magnetic resonance imaging. 2. To propose a systematic evaluation in order to refine the radiologic propaedeutics of the lens. 3. To present imaging findings of some of the most relevant lens disorders.

HNEE-74   Temporomandibular Joint: Beyond Internal Derangement.

Participants
Niedja Santos Goncalves Tsuno, Brasilia, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

1. The internal derangement of the TMJ is a specific term defined as an abnormal positional and functional relationship between the disk and articulating surfaces. 2. Internal derangement is the most common TMJ disorder, however TMJ can be affected by several other conditions, although clinically the symptoms may be similar. 3. The purpose of this exhibit is to: Describe briefly review normal anatomy of the TMJ and adjacent structures.Illustrate the main pathologies involving these sites beyond internal derangement, with cases demonstrating CT e MRI aspects of each condition.

TABLE OF CONTENTS/OUTLINE

1. Simplifying the complex anatomy of the TMJ and adjacent anatomical structures like temporal bone, external auditory canal, masticator and parotid spaces.2. Summarize the main key points of some different diseases that affect the TMJ with a focus on computed tomography and magnetic resonance findings, highlighting some pathologies like: Infection such as tuberculosis;Congenital anomalies;Synovial osteochondromatosis;Inflammatory conditions like rheumatoid arthritis, juvenile idiopathic arthritis, psoriatic arthritis, TMJ involvement in inflammatory bowel disease and deposit disease of calcium pyrophosphate crystals dihydrate (CPPD);Fibrous Dysplasia; Primary tumors and metastases;Osteonecrosis;Osteoarthritis;Trauma;Post-surgical changes. 3. Conclusion.

HNEE-75   Don't Be Jaw-dropping: All We Need To Know Behind Mandibular Deficiency

Participants
Lucas Ghisleri, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purposes of this exhibit are: - Review retrognathia, hypognathia and micrognathia concepts and diagnose criteria, highlight that although most of the time retro or hypo and micrognathia are concomitant, they are different findings and shouldn't be used as synonyms because of the association of the latter with a wide range of congenital anomalies.- Review MRI and CT imaging evaluation, highlighting the importance of cephalometric evaluation.- Review the most common causes of vertical and transverse mandibular deficiency, passing though acquired causes such as osteoarthritis and congenital anomalies of the 1st and 2nd branchial arches and the most common syndromes that associates with the findings- Highlight Angle's classifications of occlusion: normal, Classes I, II and III malocclusions- Understanding the concept of overbite malocclusion

TABLE OF CONTENTS/OUTLINE

Introduction: Retrognathia and micrognathia definitions, embryology and physiopathology.Systematic Jaw Evaluation: Cephalogram: SNA and ANB angles evaluation.Micrognathia and Retrognathia Associated Image Findings: Acquired causes.Congenital causes and most common syndromes.

HNEE-76   Techniques Applied In Performing A Painless Thyroid Fna.

Participants
Asma Asma Malik, MBBS, Islamabad, Pakistan (*Presenter*) Nothing to Disclose

TEACHING POINTS

Learn to acquire painless FNA of thyroid using capsular infiltration of local anesthetic.

TABLE OF CONTENTS/OUTLINE

Fine needle aspiration (FNA) biopsy of thyroid nodules is one of the minimally invasive, safe and frequently performed procedure on outpatient basis. FNA can be performed under palpation guidance or ultrasound guidance. In addition to knowing the optimum technical skills, one must know the limitations of procedure, its indication and factors affecting the adequacy. FNA is a well tolerated procedure but pain is one of the few drawbacks of FNA, however pain score may vary in different people. Some reports have suggested that FNA can be done without local anesthesia when single puncture is used, however multiple punctures are requires for adequacy of the sample and in this case pain is the limitations.Techniques used to minimize the pain felt during the procedure include the use of the smallest needle size available (we use the needle form a 1 cc diabetic syringe), mixing of the local anesthesia with bicarbonate to neutralize the stinging effect of the acidic local anaesthetic, infiltration of the skin and in addition the thyroid capsule so that all subsequent needle enteries are painless. Since adopting this protocol and technique in our setup at Shifa International Hospital the patients have given excellect feedback especially those who have had a FNA performed prefiously. We will give a pictorial review of the techniques used in performing a painless thyroid procedure.

HNEE-77   NUT Cancers In Head And Neck Regions

Participants
Jay Thakkar, BMBS, Mumbai, India (*Presenter*) Nothing to Disclose

TEACHING POINTS

Molecular definition of the NUclear protein in Testis (NUT) carcinoma includes (15;19)(q14;p13.1) translocation in an undifferentiated squamous cell carcinoma primarily affecting the sinonasal region and thoracic cavity. Molecular derangements apart from the above described are considered as 'NUT variants'NUT cancers are largely underreported or misreported and are highly aggressive in nature with a median survival of around 6-9 months. Basic pathological, molecular information and knowledge of the

imaging features are essential for a reporting radiologist to raise the concern for the diagnosis.These cancers have a tendency to occur in midline and locally destructive. CT, MRI and PET/CT plays an important role in raising suspicion, staging and response assessment of these tumors.Lymph node involvement is uncommon in NUT carcinoma as compared to the conventional SCC and are usually non-necrotic when involved.Distant metastases to bone is frequently present at the time of diagnosis.

TABLE OF CONTENTS/OUTLINE

Introduction to histological and molecular pathology of the NUT cancersEpidemiology, Presentation and Clinical featuresGeneralized imaging features in head and neckSpecific imaging features in head and neckConclusion

HNEE-78   Application of 3D Printing Personalized Fenestration Surgical Guide Plate in Maxillary Bone Osteopenia

Participants
Sihui Chen, Zhengzhou, China (*Presenter*) Nothing to Disclose

TEACHING POINTS

It is difficult to perform surgical tooth implants in maxillary osteopenia patients. Sinus fenestration closely adjacent to vital structures and blood vessels. Accurately assessing and designing sinus fenestration site and fabricating a guide plate using 3D printing technology are of great help in surgery. We will introduce how to start a 3D model design, and print a computer-aided designed fenestration surgical guide plate model. Step 1:Obtain the anatomical structure of the maxilla: segmentation of bone structures with default threshold. Extract facial arteries around the maxillary sinus manually. Step 2:Maxillary fenestration area devise: Principles 1,The margin of fenestration area should be 3mm away from blood vessels, generally 3-5mm. 2. The distance between the edge of the region and the maxillary sinus wall should be greater than 1mm. Step 3:Maxillary fenestration guide plate model design: the distance is 2.2-4mm between the edge of the fenestration guide plate model and the edge of the fenestration area Step 4:Locational structures design: Boolean Subtraction is commanded between guide plate contour surface and fenestration area surface. Step 5:Design of connecting structure.Step 6: 3D printing process: SLS,3D printer: FS403P-M,Nylon material (high temperature resistant, biocompatible),etc.

TABLE OF CONTENTS/OUTLINE

1.Background 2.Overview of Workflow-3D printing of a computer-aided designed (CAD) surgical maxillary fenestration guide plate 3.Quality control 4.Clinical application.

HNEE-8   Brown Syndrome Or Superior Oblique Tendon Sheath Syndrome: Imaging Findings And Clinical Aspects.

Participants
Marcela Marsiglia, MD, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

TEACHING POINTS

To educate the audience on Brown Syndrome, also known as Superior Oblique Tendon Sheath Syndrome, a rare extraocular muscular disorder with well established radiological imaging findings.

TABLE OF CONTENTS/OUTLINE

Background: Superior Oblique Tendon Sheath Syndrome, or Brown syndrome, is defined as the inability to gaze upward beyond the horizontal level while adducting the eye due to an abnormality of the superior oblique tendon sheath complex. Clinical presentation / Symptoms: vertical diplopia, particularly in an upward gaze to the opposite side of the affected eye (on adduction). Imaging characteristics: Asymmetric thickening of the tendon of the affected superior oblique muscle with surrounding enhancing soft tissue is seen on different imaging modalities, including CT and MRI. Cases 1 to 5 Imaging findings Discussion: a) Extraocular muscles anatomy b) Anatomy of the Superior oblique muscle and tendonc) Ocular motion and function of each extraocular muscled) Gazes: diagrams and photose) Impairment on Brown Syndrome: radiological and clinical correlation with examples f) Brown Syndrome types: congenital and acquired g) Treatments: conservative and surgical Summary and Conclusions References

HNEE-9   Imaging Assessment Of Foreign Bodies In Head And Neck: Classification And Pictorial Guide

Awards
Certificate of Merit

Participants
Cristina Biosca, MD, Valencia, Spain (*Presenter*) Nothing to Disclose

TEACHING POINTS

Radiologists are frequently consulted for the evaluation of foreign bodies. Their radiographic identification is essential for the management of these patients. The radiologist must be familiar with their findings and make a detailed report considering some key points. This manuscript presents a compilation of the most frequent foreign bodies, as well as other more infrequent ones.The head and neck regions contain multiple important structures: in addition to the brain, they contain the eye and the ear, the entrance of the gastrointestinal tract and the airway, and multiple anatomical orifices.They are made of different materials and can be identified on X-rays, ultrasound, CT or MR. The appropriate technique depends on sensitivity and availability, taking into account possible contraindications, advantages and limitations.We classify them into two groups depending on their relationship with the medical practice. Those related to the medical practice can be subclassified according to whether they have an iatrogenic origin or not. Those not related to the medical practice can be subdivided according to their entrance mechanism: ingestion, insertion into a cavity or hole, or penetrating foreign bodies through a wound.

TABLE OF CONTENTS/OUTLINE

IntroductionReport and key pointsImaging techniques: advantages, disadvantages. Technical considerationsClassification - Related to the medical practice: iatrogenic and non-iatrogenic - Not related to the medical practice: ingestion, insertion and penetrating foreign bodiesConclusion

Abstract Archives of the RSNA, 2021

W4-CPD09

Fetal Imaging

Participants
Camilo Jaimes Cobos, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Mariana Meyers, MD, Aurora, Colorado (*Presenter*) Nothing to Disclose
Gabrielle C. Colleran, MD, MBBCh, Dublin, Ireland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Describe and illustrate the advantages and limitations of fetal MRI at 3.0 T and at 1.5 T2.Discuss strategies to optimize results at both field strengths: (a) reduce artifacts at 3.0 T and (b) maximize image quality at 1.5 T3.Present examples of clinical scenarios and indications where each field strength is advantageous and indications where they are interchangeable. This course will provide pediatric radiologists and other healthcare professionals updated information on the strengths and challenges of performing clinical fetal MRI at 3.0 T and 1.5 T. The course will also cover practical strategies to optimize image quality at both field strengths. To accomplish this, we will discuss key technical principles of fetal MRI and the most frequently utilized sequences, outline their practical implications, and share strategies to trouble shoot issues encountered in daily practice. The format will be a series of lectures by experienced fetal imagers followed by a moderator-led discussion of dilemmas based on real life cases that will emphasize take home points. The lectures and the discussion will be rich in clinical images and examples that highlight differences in performance between 3.0 T and 1.5 T. The course will also cover parameters of fetal MRI protocols at both field strengths and present a brief update on safety considerations of fetal MRI at 3.0 T.

Printed on: 06/28/22

T5-CRT03

ASRT@RSNA: Current Use of MRI in Radiation Oncology

Participants
Amy Heath, MS, RT, Poynette, Wisconsin (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)Discuss the typical radiation oncology patient process.2)Learn current use of MRI scans during the simulation for external beam radiation therapy.3)Explain why MRI is preferred for brachytherapy treatment planning.4)Discuss currently commercially available MRI Linacs. 5)Review clinical applications for patients who have had treatment on MRI guided machines. Millions of people worldwide have been diagnosed with cancer, with approximately half of which are likely treated with radiation therapy. The field of radiation therapy, like many other specialties in the radiological sciences, has and continues to change at a remarkable pace. One significant change is the addition of Magnetic Resonance Imaging (MRI) into all steps of the radiation therapy process. This lecture will describe how MRI scans are being used throughout the radiation therapy process, as well as compare and contrast the equipment and images used for radiation therapy and diagnostic purposes.

Printed on: 07/01/22

S2-CIN02

Solving Your AI Roadmap Gaps: A Case-Based Approach and Test of Your Knowledge

Participants

Brad Genereaux, Santa Clara, California (*Presenter*) Employee, NVIDIA Corporation
Krishna Juluru, MD, New York, New York (*Presenter*) Nothing to Disclose
Kevin O'Donnell, Pacifica, California (*Presenter*) Employee, Canon Medical Systems Corporation
Stephen M. Moore, MS, Saint Louis, Missouri (*Presenter*) Consultant, 3DHISTECH Ltd;Consultant, Corista LLC;Consultant, Gestalt;Consultant, Hamamatsu Photonics KK;Consultant, Leica Biosystems Nussloch GmbH;Consultant, Pathcore Inc;Consultant, Koninklijke Philips NV;Consultant, F. Hoffmann-La Roche Ltd;Consultant, Sectra AB
Christopher J. Roth, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)Identify the 7 phases of a full AI-enabled ecosystem, and how it intersects with systems and workflows they already have. 2)Understand the boundaries of each participating system in AI-powered workflow, and how these systems can talk to one another. 3)Pinpoint the opportunities and challenges in creating an AI implementation roadmap, and how to overcome such challenges. 4)Recognize the role of Integrating the Healthcare Enterprise in standards-based interoperability for AI.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

Innovations in MR and CT Perfusion

Participants

Shalini Amukotuwa, BMedSc,MBBS, Clayton, Australia (*Presenter*) Spouse, Founder, iSchemaView, Inc
Roland Bammer, PhD, Parkville, Australia (*Presenter*) Founder, iSchemaView, Inc;Director, iSchemaView, Inc;Stockholder, iSchemaView, Inc;Founder, HobbitView, Inc;Director, HobbitView, Inc;Stockholder, HobbitView, Inc
Jerrold L. Boxerman, MD, PhD, Providence, Rhode Island (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Participants

Jayashree Kalpathy-Cramer, MS, PhD, Charlestown, Massachusetts (*Presenter*) Institutional Research Grant, General Electric Company;Institutional Research Grant, F. Hoffmann-La Roche Ltd

Bradley Erickson, MD, PhD, Rochester, Minnesota (*Presenter*) Board of Directors, VoiceIt Technologies, LLC;Stockholder, VoiceIt Technologies, LLC;Board of Directors, FlowSigma, Inc;Officer, FlowSigma, Inc;Stockholder, FlowSigma, Inc;Officer, Yunu, Inc;Stockholder, Yunu Inc

LEARNING OBJECTIVES

1) Collect, format, and standardize medical image data. Use MONAI transforms to pre-process data.2) Architect and train a convolutional neural network (CNN) in Pytorch for classification. 3) Use the trained model to evaluate on test dataset. Medical image classification plays an essential role in aiding clinical diagnosis and treatment. With the rapid development of artificial intelligence (AI) and computer vision (CV), deep learning-based methods become more accurate and applicable to a variety of clinical tasks ---- potentially serving as a valuable ally for radiologists and pathologists. In this course, learners will get a hands-on practical introduction to deep learning for radiology and medical imaging. An end-to-end training and evaluation example based on the MedNIST dataset will be covered. The MONAI deep learning platform will be introduced, which is a Pytorch-based, open-source framework for deep learning in healthcare imaging.

Abstract Archives of the RSNA, 2021

Pain in the Back: A Case-Based Review of Spine Imaging

Participants

Lubdha Shah, MD, Salt Lake Cty, Utah (*Presenter*) Nothing to Disclose
Vinil Shah, MD, San Francisco, California (*Presenter*) Nothing to Disclose
J. Levi Chazen, MD, New York, New York (*Presenter*) Nothing to Disclose
Jeffrey S. Ross, MD, Paradise Valley, Arizona (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review differential findings of spine tumors and inflammatory spondyloarthropathies2) Describe clinically relevant features of spondylolisthesis3) Discuss important pathoanatomical findings on trauma imaging Back pain can be due to a myriad of pathologies. Imaging is critical for developing a differential diagnosis. These case-based spine lectures will discuss the complementary role of imaging in the evaluation of spondylosis, spondyloarthropathies, tumor, and trauma and the key imaging features.

Printed on: 06/28/22

S3-CNR02

Acute Ischemic Stroke Imaging and Treatment: Debates and Controversies

Participants

Achala Vagal, MD, Cincinnati, Ohio (*Presenter*) Departmental Research Grant, Johnson & Johnson

Jeremy Heit, MD,PhD, Los Altos, California (*Presenter*) Consultant, Medtronic plcConsultant, Terumo CorporationConsultant, iSchemaView, IncScientific Advisory Board, iSchemaView, IncMedical Advisory Board, iSchemaView, IncBalt, STEM Trial Clinical Events Committee MemberVesalio, CLEAR Trial Clinical Events Com

Mahesh V. Jayaraman, MD, Providence, Rhode Island (*Presenter*) Nothing to Disclose

Yi Li, MD, Corte Madera, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. To discuss the controversies in acute stroke imaging and treatment 2. Be able to recognize the arguments for and against differing imaging algorithms for triage and treatment. 3. Incorporate information from these discussions into personal clinical practice. Acute stroke care has undergone a paradigm shift in recent years and imaging is a common theme for clinical decision making. Although there are evidence based guidelines, there still remains a number of controversial topics such as best imaging strategies for early and late windows, treatment of large cores and use of AI in acute stroke. This will be a debate/discussion session of such controversial topics in acute ischemic stroke.

Printed on: 06/28/22

W4-CRT08

ASRT@RSNA: Anatomy of an Imaging Malpractice Lawsuit

Participants

Theodore Vanderlaan, Blue Diamond, Nevada (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Anatomy of an Imaging Malpractice Lawsuit ObjectivesFollowing the presentation of Anatomy of an Imaging Malpractice Lawsuit the participant will:1.Be able to distinguish the four elements of Negligencea.Dutyb.Breachc.Harmd.Causation2.Be able to identify at least 3 sources that demonstrate a technologists duty3.Understand how breach and harm are determined in a medical malpractice case4.Be able to understand the two types of Causation, Actual and Proximate cause and describe the difference5.Understand the major differences between Criminal and Civil law6.Know and understand the steps in a medical malpractice lawsuit7.Be aware of the breadth of the discovery processa.Paper discoveryb.E-discoveryi.RISii.HISiii.PACSiv.VR8.Apply their understanding of Negligence to the case that is presented9.Declare a verdict for either the Plaintiff or Defendant10.List at least 5 methods to mitigate the risk of a malpractice lawsuit in their department. Anatomy of an Imaging Department Malpractice Lawsuit takes the participant through the typical elements of a malpractice case, compares and contrasts criminal lawsuits and civil cases, distinguishes the term negligence and how it is determined, and then applies it to a real malpractice case. Through the use of multimedia the participant will see how one malpractice case occurred in an imaging department and experience what it is like to be in a deposition from both the patients side as well as the technologist. The participants have the option of siding with the plaintiff or defendant and will decide the case that is presented. They will have the opportunity to compare their verdict to the actual outcome of the case. Finally, the presenter and participants will explore ways they can mitigate risk of a malpractice case in their own departments.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

Take Control of Your Workday (Sponsored by the Associated Sciences Consortium)

Participants

Donna Blakely, MS,RT, Springfield, Massachusetts (*Presenter*) Nothing to Disclose
Sabala Mandava, MD, Detroit, Michigan (*Presenter*) Nothing to Disclose
Steven Crawford, MBA, Lone Tree, Colorado (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn to manage distractions and interruptions. 2)Take control of your email. 3)Use the calendar to get the right things done. Learn powerful tools that you can implement right away to impact your productivity, sense of control and work/life synergy. Great tips on mitigating interruptions, managing your email and driving your priorities through your calendar. Its all about getting the right things done! Content is pulled from McGhee Productivity Solutions *Take Back Your Life!* personal productivity program.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

Hip Consensus & Controversies: The Labrum, Impingement Syndromes, & MR Arthrography

Participants
Miriam A. Bredella, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Donna Blankenbaker, MD, Fitchburg, Wisconsin (*Presenter*) Nothing to Disclose
Reto Sutter, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose
Sarah D. Bixby, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
William E. Palmer, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
James M. Linklater, MBBS, St Leonards, Australia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe recent insights regarding the development and imaging assessment of femoroacetabular impingement. 2) Identify the best imaging modalities to diagnose labrum damage. 3) Know the pros and cons of different imaging techniques for evaluation of the articular cartilage. Recent scientific works have shed new light on hip diseases and on how they should be evaluated with imaging. Additionally, several consensus papers established recommendations on up-to-date imaging of femoroacetabular impingement. The lectures in this course cover new insights and ongoing controversies about how to best assess the labrum and articular cartilage, as well as the use of different imaging modalities, diagnostic criteria and thresholds for diagnosing femoroacetabular impingement.

Printed on: 06/28/22

R6-CPD12

Challenges in Pediatric Radiology Workflow

Participants
Rama Ayyala, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose
Victor J. Seghers, MD, PhD, Houston, Texas (*Presenter*) Nothing to Disclose
Michael R. Aquino, MD, MS, Cleveland, Ohio (*Presenter*) Co-author with royalties, Reed Elsevier

LEARNING OBJECTIVES

1. To discuss burnout in pediatric radiology, with a specific focus on the impact of COVID-19. 2. To review remote working capabilities in pediatric radiology, including the benefits and challenges, as well as the impact of the COVID-19 pandemic.3. To describe the current common models of overnight pediatric radiology coverage, with a focus on the challenges associated with this and potential strategies for mitigation. Pediatric radiology is a rewarding subspecialty with unique challenges, especially related to workflow. This session will highlight these challenges, with a special focus on the impact of COVID-19. The session will include the following presentations: Discussion of burnout in pediatric radiology, and how it changed with COVID-19; Remote working capabilities in pediatric radiology utilizing survey data from the Society of Pediatric Radiology (SPR) members; and the challenges of 24/7 coverage in pediatric radiology, with a review of different models. The end of the session will include an extended time period for audience discussion. These challenges are critical to address for the future of pediatric radiology. The objective of this session is to not only educate the participant about these topics, but also to foster discussions, with the ultimate goal of identifying effective strategies to address these challenges.

Printed on: 06/28/22

S4-CCA02

Transcatheter Intervention Planning: Case Based Review

Participants

Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Jonathon Leipsic, MD, Vancouver, British Columbia (*Presenter*) Consultant, MVRx, Inc;Consultant, Heartflow, Inc;Consultant, Circle Cardiovascular Imaging Inc;Speakers Bureau, General Electric Company;Research Grant, Edwards Lifesciences Corporation;Speakers Bureau, Edwards Lifesciences Corporation;Support, Edwards Lifesciences Corporation;
Jacobo Kirsch, MD, Weston, Florida (*Presenter*) Medical Advisory Board, Zebra Medical Vision Ltd

LEARNING OBJECTIVES

1. Identify the role of imaging in pre- and post-procedural evaluation of common transcatheter interventional procedures 2. Review the key imaging features required for planning left atrial appendage closure, mitral and tricuspid valve interventions. 3. Explain the complications of transcatheter aortic valve replacement and left atrial appendage closure procedures Imaging plays an important role in the pre- and post-procedural evaluation of structural heart disease interventions. This session provides a case-based review of the role of imaging in common transcatheter interventional procedures. The topics include planning of mitral and tricuspid valve interventions, pre- and post-procedural evaluation of left atrial appendage closure and complications of transcatheter aortic valve replacement(TAVR).

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

R6-CIR12

PE Thrombectomy and Complex Venous Interventions

Participants

Ronald Winokur, MD, Penn Valley, Pennsylvania (*Presenter*) Speaker, Penumbra, Inc;Consultant, Becton, Dickinson and Company;Consultant, Cardinal Health, Inc;Consultant, Gilde Healthcare;Speaker, Gilde Healthcare;Consultant, Medtronic plc;Speaker, Medtronic plc;Consultant, Mentice AB;Consultant, Koninklijke Philips NV;Consultant, Tactile Systems Technology, Inc;;
Akhilesh Sista, MD, New York, New York (*Presenter*) Advisory Board, Thrombolex;Advisory Board, Vascular Medicure
Allison Tan, MD, Philadelphia, Pennsylvania (*Presenter*) Consultant, Becton, Dickinson and Company
Elizabeth Morris, MD, New York, New York (*Presenter*) Nothing to Disclose
Gerard J. O'Sullivan, MBBCh, Galway, Ireland (*Presenter*) Consultant, Marvao Medical Limited;Stockholder, Marvao Medical Limited;Consultant, Boston Scientific Corporation;Consultant, Medtronic plc;Consultant, Cook Group Incorporated;Consultant, WhiteSwell Limited;Consultant, SurModics, Inc;Stockholder, SurModics, Inc;Consultant, Koninklijke Philips NV
Kush Desai, MD, Chicago, Illinois (*Presenter*) Speakers Bureau, Cook Group Incorporated;Consultant, Cook Group Incorporated;Consultant, Koninklijke Philips NV;Speakers Bureau, Becton, Dickinson and Company;Consultant, Becton, Dickinson and Company;Speakers Bureau, Boston Scientific Corporation;Consultant, Boston Scientific Corporation;Consultant, W. L. Gore & Associates, Inc;Speakers Bureau, Medtronic plc;Consultant, Medtronic plc;Speakers Bureau, Penumbra, Inc;Consultant, Penumbra, Inc;Consultant, Shockwave Medical, Inc;Consultant, Cardinal Health, Inc;;;;

LEARNING OBJECTIVES

1.Understand the stratification of patients with Pulmonary Embolism and delineate treatment options2.Understand the indication and modalities for IVC filter retrieval and iliocaval venous reconstruction3.Understand the indication and modalities for central venous reconstruction in the Hemodialysis population4.Understand the indication and technical steps of endovascular arteriovenous fistula creation This educational session is intended to cover the broad entity of venous interventions spanning arteriovenous fistula creation for hemodialysis, management of venous obstructions related to hemodialysis access, chronic iliocaval venous obstruction management including inferior vena cava filter retrieval, and management of pulmonary embolism. These are key components of interventional radiology practices and the goal of this session is to provide didactic educational content to better understand management strategies for each clinical entity.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

S1-CVA01

Cardiovascular Imaging Manifestations of COVID-19: What the Radiologist Needs to Know

Participants

Kate Hanneman, MD, FRCPC, Toronto, Ontario (*Presenter*) Speaker, sanofi-aventis Group;Speaker, Amicus Therapeutics, Inc
Margarita Revzin, MD, Wilton, Connecticut (*Presenter*) Nothing to Disclose
Brian B. Ghoshhajra, MD, Boston, Massachusetts (*Presenter*) Research Grant, Siemens AG;Consultant, Koninklijke Philips NV

LEARNING OBJECTIVES

1.To discuss the role of cardiovascular imaging and optimal imaging protocols in patients with suspected cardiac injury related to COVID-19 or COVID-19 vaccination. 2.To describe cardiovascular imaging manifestations in patients who have recovered from COVID-19 and after COVID-19 vaccination. As of June 2021, coronavirus disease 2019 (COVID-19) caused by severe acute respiratory symptom virus 2 has affected over 180 million individuals globally with more than 3.9 million deaths. Early studies suggested that approximately 25% of patients requiring hospitalization with COVID-19 experience cardiovascular injury, defined by elevation in troponin. In these hospitalized patients, cardiovascular injury has been associated with a 5-10 fold increased risk of death. However, since most individuals survive the acute illness and do not require hospitalization, there is now growing concern for undetected cardiovascular injury in survivors. COVID-19 can result in cardiac complications including myocarditis, arterial and venous thromboembolism, and cardiomyopathy. There are also infrequent emerging reports of myocarditis and myocardial injury in a minority of patients after COVID-19 vaccination, which could potentially be related to the host immune response. This session will focus on cardiovascular imaging findings in patients who have recovered from COVID-19 and after COVID-19 vaccination.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

DLL43

Deep Learning Lab: Multimodal Fusion for Pulmonary Embolism Detection Using CTs and Patient EMR

Participants

Matthew P. Lungren, MD, Palo Alto, California (*Presenter*) Advisor, Segmed, Inc;Shareholder, Segmed, Inc;Advisor, Bunkerhill Health;Shareholder, Bunkerhill Health;Advisor, Microsoft Corporation;Employee, Amazon Web Services
Mars Huang, PhD, Stanford, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Learning Objectives: 1) Understand key terminologies and techniques for multimodal fusion (early, late, joint) and learn the pros and cons of each strategy. 2) Gain practical experiences applying different fusion strategies to a real-world dataset for the task of Pulmonary Embolism detection. DLL43 : DLL: Multimodal Fusion for Pulmonary Embolism Detection Using CTs and Patient EMR. The practice of modern medicine relies heavily on the synthesis of information from multiple sources. Yet most deep learning models for medical imaging applications consider only pixel-value without data informing clinical context. As with human physicians, automated detection and classification systems that can successfully utilize both medical imaging data together with clinical data from the EHR (multimodal fusion), such as patient demographics, previous diagnoses, and laboratory values, may lead to better performing and more clinically relevant models. In this course, you will learn the fundamentals of different data fusion strategies and gain hands-on experiences applying them for the task of pulmonary embolism detection.

Printed on: 06/28/22

S1-CIN01

Cybersecurity for Radiology Practices

Participants
Benoit Desjardins, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Erik Decker, West Valley City, Utah (*Presenter*) Nothing to Disclose
Joshua Corman, Dover, New Hampshire (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe most frequent recent cyberthreats against medical centers and practices. 2) Provide overview of local and national initiatives to defend against those. 3) Describe the current status of security of medical devices. 4) Describe the impact of medical IoT on medical data security. 5) Describe how smaller providers can deal with cybersecurity with limited resources. Four years ago, the Hollywood Presbyterian Medical Center, a 434-bed hospital in California was the victim of a ransomware attack, where access to its medical data was blocked by cybercriminals. The hospital had to pay a ransom to get access to its data back. This was the first indication that US hospitals were vulnerable to cyberattacks. Although hospitals were an easy prey, there was insufficient predator interest in them until that point in time. Since then, it has been a feeding frenzy. In 2020, there were at least 80 publicly reported ransomware attacks against small or large hospitals. Large healthcare networks involving up to 400 medical centers such as United Healthcare Systems were brought down after attacks by ransomware, forcing patients to be transferred, surgeries cancelled, and ambulances redirected. These cyberattacks led to delayed care for some patients causing documented deaths.

The pandemic produced a triple threat for healthcare systems: (1) a rapid expansion of internet-connected technologies and services causing an expanded attack surface, (2) increase in many types of cyberattacks, and (3) fewer available resources to defend against cyberattacks. Phishing attacks pretending to originate from large medical entities such as the World Health Organization spread across the world like wildfire. Websites such as the Johns Hopkins COVID tracking site were duplicated and became major sources of worldwide malware distribution. National alerts about impending massive simultaneous cyberattacks against hospitals were issued by the FBI and Homeland Security, forcing hospitals to rapidly harden their systems. Nation states such as China and Russia attacked medical centers and vaccine developers to steal intellectual property. In December 2020, it was discovered that Russia had infiltrated the computer systems at many large government institutions, including Homeland Security, the Pentagon, the Treasury, the Commerce Department, the Postal Service and the National Institute of Health. Cyberattacks against healthcare were in the news daily. New pieces of legislation were passed by the federal government to help combat this surge of attacks. Whether we like it or not, cybersecurity has become a very important part of healthcare, and it is important to address this topic at RSNA, since every radiology practice in the country can easily become a victim of a cyber-attack.

This refresher course will bring the radiology community up to date on the latest developments in cybersecurity related to healthcare, including recent attacks, techniques of defense and recent legislation. The course will be presented by radiologists and top cybersecurity experts. The information technology issues will be addressed at a technical level appropriate for the radiology community at large, so this community is made aware of this growing era of digital warfare and its implications for their daily practice. This refresher course will bring the radiology community up to date on the latest developments in cybersecurity related to healthcare, including recent attacks, techniques of defense and recent legislation. The course will be presented by radiologists and top cybersecurity experts. The information technology issues will be addressed at a technical level appropriate for the radiology community at large, so this community is made aware of this growing era of digital warfare and its implications for their daily practice. Our refresher course will have **practical, actionable suggestions** that radiologists and

M6-RCP10

A Primer for Health Equity Research: Essential Skills for Health Equity & Disparities Research in Radiology (Sponsored by the RSNA Research Development Committee)

Participants

Lucy Spalluto, MD,MPH, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Ruth C. Carlos, MD, MS, Ann Arbor, Michigan (*Presenter*) In-kind support, Reed Elsevier;Editor, Reed Elsevier;Travel support, General Electric Company
Elyse Park, PhD,MPH, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Andrew Rosenkrantz, MD, New York, New York (*Presenter*) Nothing to Disclose
Christoph Lee, MD, Mercer Island, Washington (*Presenter*) Royalites, The McGraw-Hill CompaniesRoyalties, Oxford University PressRoyalties, Wolters Kluwer nvResearch Consultant, GRAIL, Inc.
Anand Narayan, MD,PhD, Cambridge, Massachusetts (*Presenter*) Nothing to Disclose
Efren J. Flores, MD, Boston, Massachusetts (*Presenter*) 1. Speaker Honorarium, Medscape2. Speaker Honoraria, Grand Rounds presentations (non-profit organizations)

LEARNING OBJECTIVES

1)To understand essential elements of health equity research frameworks around social determinants of health and health disparities.2)To learn about different data sources to conduct research in health disparities and health equity that will lead to successful scientific publications and grant funding. 3)To effectively design interventions to fit the needs of diverse patient populations and improve health outcomes among underserved populations. Transformational change in radiology research is necessary to equip radiologists to address health disparities, advance health equity and achieve better health outcomes among vulnerable patient populations. This session will provide radiologists with several high-priority topics in health disparities/health equity research that include epidemiology, implementation science, community based-participatory research, digital health, among others, followed by a live Q&A session with speakers.

Printed on: 06/28/22

SAT01

NIH Grantsmanship Workshop

Participants
Gayle Woloschak, PhD, Chicago, Illinois (*Presenter*) Nothing to Disclose
Maryellen Giger, PhD, Chicago, Illinois (*Presenter*) Advisor, Emalex Biosciences, Inc;Stockholder, Hologic, Inc;Royalties, Hologic, Inc;Shareholder, Quantitative Insights, Inc;Co-founder, Quantitative Insights, Inc;Shareholder, QView Medical, Inc;Royalties, General Electric Company;Royalties, MEDIAN Technologies;Royalties, Riverain Technologies, LLC;Royalties, Canon Medical Systems Corporation
Ruth C. Carlos, MD, MS, Ann Arbor, Michigan (*Presenter*) In-kind support, Reed Elsevier;Editor, Reed Elsevier;Travel support, General Electric Company
Michael W. Vannier, MD, Crete, Illinois (*Presenter*) Nothing to Disclose
Shumin Wang, PhD, Bethesda, Maryland (*Presenter*) Nothing to Disclose
Elizabeth A. Krupinski, PhD, Atlanta, Georgia (*Presenter*) Institutional research collaboration, Hyperfine Research, Inc;Institutional research collaboration, Microvascular Therapeutics, LLC;Consultant, Circle Cardiovascular Imaging Inc;Consultant, Centerstone, Inc.
David A. Mankoff, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Speaker, Siemens/PETNETAdvisory Board, ImaginAb, IncAdvisory Board, RefleXion Medical IncConsultant, Blue Earth Diagnostics LtdConsultant, General Electric CompanyResearch funded, Siemens AGSpouse, Owner, Trevarx Biomedical

LEARNING OBJECTIVES

1) Identify the parts of an NIH grant application. 2)Explain the current structure of the NIH and its agencies particularly focusing on grant reviews. 3)Examine a study section through an example mock study section Please note: This workshop is being held as an in-person event and will not be live- streamed or recorded. The goal of this course is to help participants understand the basic approach of how to write a grant (particularly for NIH) including all of the components of the grant itself and how to approach funding agencies within NIH for advice on process. The course includes didactic lectures, a question and answer session, and a mock study section that allows participants to learn about the process of review.

Abstract Archives of the RSNA, 2021

Acute and Chronic Lung Injury

Participants

Demetrios Raptis, MD, Frontenac, Missouri (*Presenter*) Nothing to Disclose
Travis Henry, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose
Anu Brixey, MD, Portland, Oregon (*Presenter*) Research support, 4D Medical
Min Jae Cha, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Ryoko Egashira, MD,PhD, Saga, Japan (*Presenter*) Speakers Bureau, Boehringer Ingelheim GmbH;Speakers Bureau, AstraZeneca PLC;Speakers Bureau, Shionogi & Co, Ltd;Speakers Bureau, KYORIN Holdings, Inc;Speakers Bureau, DAIICHI SANKYO Group;Speakers Bureau, Bayer AG;Speakers Bureau, Otsuka Holdings Co, Ltd;

LEARNING OBJECTIVES

1. Recognize the imaging appearances of acute lung injury and provide a relevant differential diagnosis of potential causes.2.Understand different management options for acute and chronic lung injury, and identify potential long term sequelae of lung injury on imaging. This course features five lectures that covers contemporary concepts of the imaging of acute and lung injury. Presentation topics include an overview of diffuse alveolar damage; imaging manifestations of novel causes of lung injury such as COVID-19 and EVALI; an overview of lung injury management with ECMO; and chronic sequelae of lung injury such as pleuroparenchymal fibroelastosis.

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Abstract Archives of the RSNA, 2021

Lung, Mediastinum, Pleura - Case-based Multidisciplinary Review

Participants
Simon Lo, MD, Seattle, Washington (*Presenter*) Committee member, Elekta AB
Michelle S. Ginsberg, MD, New York, New York (*Presenter*) Speaker, Ultimate Opinions In Medicine LLC
David Johnstone, Milwaukee, Wisconsin (*Presenter*) Nothing to Disclose
Stephen Chun, MD, Houston, Texas (*Presenter*) Consultant, AstraZeneca PLC
Cristina Merkhofer, MD, Seattle, Washington (*Presenter*) Research Grant, Merck & Co, Inc

LEARNING OBJECTIVES

1)Review an early stage centrally located non-small cell lung cancer case with radiologist, radiation oncologist, thoracic surgeon and medical oncologist with a radiology focus. 2)Review a stage III non-small cell lung cancer case with radiologist, radiation oncologist, thoracic surgeon and medical oncologist with a radiology focus. 3)Review a non-metastatic mesothelioma case with radiologist, radiation oncologist, thoracic surgeon and medical oncologist with a radiology focus. This Case-Based Multidisciplinary Review will include a panel consisting of a diagnostic radiologist, radiation oncologist, thoracic surgeon, and medical oncologist who will discuss about the management of two lung cancer cases (stage I and III) and one mesothelioma case with a radiology focus.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

Participants

Pouria Rouzrokh, MD,MPH, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Gian Marco Conte, MD, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Bradley Erickson, MD, PhD, Rochester, Minnesota (*Presenter*) Board of Directors, VoiceIt Technologies, LLC;Stockholder, VoiceIt Technologies, LLC;Board of Directors, FlowSigma, Inc;Officer, FlowSigma, Inc;Stockholder, FlowSigma, Inc;Officer, Yunu, Inc;Stockholder, Yunu Inc

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Taking Action to Promote Gender Inclusion and Equity in Radiology: Opportunities for Leadership and Academic Development (Sponsored by RSNA Professionalism Committee)

Participants
Leah Sieck, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Lucy Spalluto, MD,MPH, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Vasantha D. Aaron, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Anastasia L. Hryhorczuk, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Kate Hanneman, MD, FRCPC, Toronto, Ontario (*Presenter*) Speaker, sanofi-aventis Group;Speaker, Amicus Therapeutics, Inc

LEARNING OBJECTIVES

1) Discuss Gender Inclusion and Equity in Radiology 2) Discuss Opportunities for Leadership Development in Radiology to support women 3) Describe Professional Development programs that can be utilized to support, mentor, and sponsor women in radiology and in leadership roles This course will explore practical strategies that can be utilized to promote gender inclusion in radiology. Through lectures, speakers will share their experiences in constructing formal and informal programming to promote women in radiology, as well as the challenges that accompany these efforts. Participants should expect to learn tactics that they can add to their toolkit to create a positive, gender inclusive, environment in their radiology department or group.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

S3-CMS03

Emergency Radiology Coverage: Clinical and Personnel Challenges

Participants

Ferco H. Berger, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose
Aaron Sodickson, MD,PhD, Boston, Massachusetts (*Presenter*) Institutional research agreement, Siemens HealthineeersSpeaker honorarium, Siemens HealthineeersConsultant, Canon Medical Systems Corporation
Jennifer Uyeda, MD, Lexington, Massachusetts (*Presenter*) Consultant, Allena Pharmaceuticals, Inc
Emerson Wickwire, PhD, Baltimore, Maryland (*Presenter*) Institutional research support, Merck & Co, Inc;Institutional research support, ResMed Corp;Consultant, DayZz;Consultant, Eisai Co, Ltd;Consultant, WellTap;

LEARNING OBJECTIVES

1) Discuss important determinants of successful creation of a dedicated emergency radiology practice and how to staff it.2) Illustrate the benefits of integrating trainees into emergency radiology practice keeping in mind their responsibilities and learning goals.3) Identify factors to successfully maintain a thriving Emergency Radiology practice. Imaging volumes in the acute care setting continue to rise and demands of short turnaround times of final reports are increasing, making many centers shift to dedicated Emergency Radiology coverage, including after hours. However, creating and maintaining a thriving emergency radiology practice is challenging. In this session, we will provide the audience with a discussion of important aspects on how to create, staff and maintain an emergency radiology division, emphasizing that it is not a one-size-fits-all model. We will discuss how to best integrate trainees into emergency radiology practice, and explore the impact of after hours coverage on radiologists.

Printed on: 06/28/22

S2-CNPM10

Principles of Cost Effectiveness Research

Participants
Stella Kang, MD,MSc, New York, New York (*Presenter*) Royalties, Wolters Kluwer nv
Pari V. Pandharipande, MD, MPH, Chestnut Hill, Massachusetts (*Presenter*) Nothing to Disclose
Bart Ferket, MD, PhD, New York, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe basic principles of cost-effectiveness analysis.2) Identify imaging research questions that can be addressed using cost-effectiveness analysis.3) Participate in a hands-on introduction to cost-effectiveness analysis using TreeAge Pro software. This course will explain the basic principles and methods of cost-effectiveness analysis. Learners will be able to formulate a research question that can be addressed through cost-effectiveness analysis and conduct a cost-effectiveness analysis using a prepared model in Treeage Pro software. To allow hands-on experience with software, participants are highly encouraged to download the trial version of Treeage software at https://www.treeage.com/trial-download/, which has no cost but requires registration to obtain a unique user key. Please contact stella.kang@nyulangone.org or bart.ferket@mountsinai.org for the course materials.

Abstract Archives of the RSNA, 2021

Deep Learning Lab: Object Detection & Segmentation

Participants

Simukayi Mutasa, MD, Newport Beach, California (*Presenter*) Nothing to Disclose
Peter Chang, MD, Irvine, California (*Presenter*) Co-founder, Avicenna.ai;Stockholder, Avicenna.ai;Research Grant, Canon Medical Systems Corporation;Speakers Bureau, Canon Medical Systems Corporation;Research Grant, General Electric Company

LEARNING OBJECTIVES

Learning Objectives 1. Learn how to run a pre-generated google cloud compiler for implementing a convolutional neural network. 2. Learn how to tweak code for desired results. Course Description In this course, participants without a background in computer programming will use a cloud based compiler to get a hands on introduction in creating a convolutional neural network for object detection and segmentation utilizing a curated dataset. This is important for showing attendees the underlying ease and procedure for generating convolutional neural networks with curated datasets.

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Abstract Archives of the RSNA, 2021

R6-CNPM24

The Problem with Price: Controversies and Solutions

Participants
Gelareh Sadigh, MD, Atlanta, Georgia (*Presenter*) Research Grant, TailorMed Medical Ltd
Richard Heller III, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose
Ed Gaines III, JD, Greensboro, North Carolina (*Presenter*) Officer, Zotec Partners LLC, a revenue cycle management company for radiologists.

LEARNING OBJECTIVES

1) Understand private insurance coverage related to unexpected out-of-network care (surprise medical billing)2) Understand the No Surprise Act and how it effects patients and physicians 3) Apply knowledge gained to improve advocacy and demand for price transparency For both patients and physicians, insurance coverage of unexpected out-of-network care has been a challenging issue. The No Surprises Act (NSA), which was passed in 2020 and addresses the issue of surprise medical billing, is aimed at protecting patients from unanticipated out-of-network costs. However, the new law may also have a substantial impact on the ability of physician practices to contract with commercial insurance companies. This session explores the NSA, its potential impact on patients and radiology practices, and the demand for price transparency. Data from states with constructs similar to the NSA will be discussed as examples of potential impacts to radiology practices.

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W4-CNPM15

Medicolegal Issues and Managing Risk

Participants
Stephen D. Brown, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Jonathan Mezrich, MD, Guilford, Connecticut (*Presenter*) Nothing to Disclose
Scott Grubman, Atlanta, Georgia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain current developments in government healthcare fraud and abuse enforcement.2) Understand medicolegal issues in emergency radiology.3) Identify systems processes that facilitate open communication with patients and families about medical errors. This course will explore several timely medicolegal issues relevant to radiologic practice. 1) Healthcare Fraud and Abuse Enforcement: In 2020, despite the COVID-19 pandemic, the federal government recovered nearly $2 billion from healthcare providers under the False Claims Act. This presentation, by a former federal healthcare fraud prosecutor turned healthcare defense attorney, will discuss current trends in government healthcare fraud and abuse enforcement, and tips on how to stay off of the governments radar. 2) Medicolegal Issues in Emergency Radiology: Emergency Radiology is a subspecialty which is disproportionately impacted by liability risk given the pace, hours and patient acuity. The speaker, an emergency radiologist with a background as a practicing attorney, has published extensively on medicolegal topics.3) Error Disclosure Systems Considerations: Responsibly discussing medical errors with patients and families requires the implementation of principled, coordinated, enterprise-wide processes that support both patients and providers. This presentation, by a pediatric radiologist with extensive experience speaking on ethics, communication, professionalism and error disclosure, will discuss systems processes that facilitate open communication with patients and families about medical errors.

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Abstract Archives of the RSNA, 2021

W6-CNR09

Emerging Neuroimaging Technology: What Does the Future Hold?

Participants

Christopher T. Whitlow, MD, PhD, Winston Salem, North Carolina (*Presenter*) Nothing to Disclose
Timothy Roberts, PhD, Philadelphia, Pennsylvania (*Presenter*) Stockholder, Prism Clinical Imaging, Inc;Stockholder, PROTEUS Technologies;Consultant, CTF MEG International Services LP;Scientific Advisory Board, CTF MEG International Services LP;Consultant, The Ricoh Company, Ltd;Medical Advisory Board, The Ricoh Company, Ltd;Consultant, Spago Imaging AB;Scientific Advisory Board, Spago Imaging AB;Consultant, Novartis AG;Consultant, Allergan plc
Greg Zaharchuk, MD, PhD, Stanford, California (*Presenter*) Research Grant, General Electric Company;Research Grant, Bayer AG;Stockholder, Subtle Medical, Inc;Advisory Board, Biogen Idec Inc
Priti Balchandani, PhD, New York, New York (*Presenter*) I am a named inventor on patents relating to magnetic resonance imaging (MRI) and RF pulse design. The patents have been licensed to GE Healthcare, Siemens AG, and Philips international. I receive royalty payments relating to these patents.I am a seed inv

LEARNING OBJECTIVES

Empty Abstract

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T1-RCP04

The Experiences of Black Radiologists (Sponsored by the RSNA Committee on Diversity, Equity & Inclusion)

Participants

Jinel A. Scott, MD, Brooklyn, New York (*Presenter*) Nothing to Disclose
Paul Rochon, MD, Denver, Colorado (*Presenter*) Speaker, Penumbra, Inc;Advisory Board, Medtronic plc
Andrea Birch, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Curtiland Deville, MD, North Bethesda, Maryland (*Presenter*) Nothing to Disclose
Stephen A. Waite, MD, New York, New York (*Presenter*) Nothing to Disclose
Daniel Chonde, MD, PhD, Boston, Massachusetts (*Presenter*) Stockholder, Alkermes plc;Stockholder, Biogen Idec Inc;Stockholder, Hologic, Inc;Stockholder, Jaguar Health, Inc;Stockholder, Mylan NV;Stockholder, Myomo Inc;Stockholder, Novartis AG;Stockholder, Nuance Communications, Inc;Stockholder, Resmed Inc;Stockholder, Teladoc Health, Inc;Stockholder, Teva Pharmaceutical Industries Ltd;Stockholder, Uniqure NV
Jolie Jean, BA, Valley Stream, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Delineate the history of African Americans in the field of radiology 2. Describe the importance of African Americans in radiology/radiation oncology 3. Describe the experiences of black radiologists and factors associated with career success and satisfaction.4. Describe strategies organizations can use to improve recruitment and retention of black faculty. The gender gap in radiology is slowly narrowing in the United States due to the tremendous efforts to foster career advancement for women by many radiology organizations. However diagnostic radiology is ranked at the bottom among 20 clinical disciplines in terms of racial diversity. To realize similar gains in racial diversity it is important to understand the experiences of black radiologists and radiation oncologists. This course explores the importance of black physician representation in radiology and radiation oncology and provides an insight into the experiences of Black radiologists and radiation oncologists which would aid institutional recruitment and retention efforts.

Abstract Archives of the RSNA, 2021

R5-CMS23

Introducing the "4th Trimester

Participants

Aya Kamaya, MD, Mountain View, California (*Presenter*) Royalties, RELX;Research Grant, Canon Medical Systems Corporation
Nicholas A. Koontz, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Douglas Katz, MD, Mineola, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.To understand the various complications that are unique to the first 13 weeks after delivery or miscarriage, the Fourth Trimester 2.To review causes and imaging appearances of entities that can lead to post partum bleeding 3.To review non-gynecologic disease states in the fourth trimester, including venous pulmonary thromboemboli, urinary tract disorders (obstruction, infection, calculus disease), biliary tract disorders, bowel ileus versus obstruction, and endometritis/ovarian vein thrombosis 4.To understand neurologic complications that may occur on the fourth trimester This course will focus on diseases and complications that are more commonly seen in the post-partum period, also known as the Fourth Trimester. Gynecologic, non-gynecologic abdominal/pelvic, and neurologic complications will be reviewed.

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Abstract Archives of the RSNA, 2021

When Machines Fail

Participants

Bradley Erickson, MD, PhD, Rochester, Minnesota (*Presenter*) Board of Directors, VoiceIt Technologies, LLC;Stockholder, VoiceIt Technologies, LLC;Board of Directors, FlowSigma, Inc;Officer, FlowSigma, Inc;Stockholder, FlowSigma, Inc;Officer, Yunu, Inc;Stockholder, Yunu Inc

Judy Gichoya, MBChB,MS, Atlanta, Georgia (*Presenter*) Consultant, Cook Group Incorporated;Advisor, Boston Scientific Corporation

John Mongan, MD,PhD, San Francisco, California (*Presenter*) Research Grant, General Electric Company;Royalties, General Electric Company;Spouse, Employee, Annexon Biosciences;Spouse, Employee, AbbVie Inc

Katherine Andriole, PhD, Branford, Connecticut (*Presenter*) Nothing to Disclose

Ross Filice, MD, Washington, Dist. of Columbia (*Presenter*) Advisor, BunkerHill Health, IncShareholder, BunkerHill Health, IncSpeaker/Honorarium, GE HealthcareSpeaker/Clinical Trial Participant, Koios Medical

LEARNING OBJECTIVES

1) Learn how and when computer algorithms fail with case examples. 2) Identify clinical and medicolegal implications of machine failure. 3) Learn how to increase awareness of potential machine failure and some ways to overcome them. This course will describe the principles of AI with emphasis on how this can lead to errors of diagnosis or bias. Examples of this will also be given. Finally, approaches to minimize the chance of failure and ways to identify when the algorithm might have failed will be described.

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Abstract Archives of the RSNA, 2021

MRI Safety

Participants

Emanuel Kanal, MD, Pittsburgh, Pennsylvania (*Presenter*) Consultant, Medtronic plc;Consultant, General Electric Company
Robert E. Watson JR, MD, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Attendees will become familiar with:A) The internationally standardized MR safety organizational oversight structure comprised of individuals serving 3 roles: 1) Magnetic Resonance Medical Director (MRMD); 2) Magnetic Resonance Safety Officer (MRSO); and 3) Magnetic Resonance Safety Expert (MRSE); the unique and complementary responsibilities of each role; and the certification of these positions by formal ABMRS testing regarding standardized domains of MR safety knowledge.B) The role that approved product labeling/"instructions for use" plays - and doesn't play - in determining whether or not one can, may, or should proceed with a requested MR imaging examination on a patient in whom there is a medical device or implant. Twenty years have now passed since 6 year old Michael Columbini was tragically killed by an oxygen tank inadvertently brought too close to the MR scanner in which he was about to be examined. During that time the field of MR safety has blossomed. Among the most critical advances in this field have been widespread efforts at increasing standardization in our collective approach to managing safety in MR environments.Perhaps among the most well recognized advances in the field of MR safety has been the generation of an international consensus requiring a standardized organizational structure for MR safety oversight. First published in late 2016, this consensus defines three positions: Magnetic Resonance Medical Directors, Magnetic Resonance Safety Officers, and Magnetic Resonance Safety Experts. Along with this formal oversight structure has been the simultaneous creation of the American Board of MR Safety and its development and implementation of formal certification of these three positions by objective testing of well defined standardized MR safety knowledge domains. Together these have markedly increased overall MR safety awareness and uniformity of knowledge among MR safety practitioners throughout our industry.One of the most vexing problems facing MR practitioners today is that of trying to assess whether one should proceed with a request for MR scanning of a patient in whom there is an implanted medical device. Ironically, there exists a nearly universal misunderstanding of the role that FDA (or other regulatory body) approved product labeling or "instructions for use" plays in determining the answer to this question. The second presentation in this MR Safety session will focus on clarifying the actual responsibilities of the Food and Drug Administration in this regard and the role - and lack thereof - of regulatory product labeling in clinical decision making regarding MRI of device patients.

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Abstract Archives of the RSNA, 2021

S2-CMK01

Knee MRI: How I Do It

Participants
Bruce Forster, MD, Vancouver, British Columbia (*Presenter*) Stockholder, Canada Diagnostic Centres
Andrew J. Grainger, MD, Cambridge, United Kingdom (*Presenter*) Speakers Bureau, Canon Medical Systems Corporation
Kirkland Davis, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose
Lynne Steinbach, MD, Tiburon, California (*Presenter*) Nothing to Disclose
Donald L. Resnick, MD, San Diego, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Understand the approaches to MRI interpretation of common knee injuries.2.Identify dont miss lesions of ACL, posterolateral corner, menisci, bone/cartilage and extensor mechanism. Five compact 10 minute lectures will be offered by experienced MSK Radiologists, highlighting their tricks of the trade in interpretation of MRI of bone/cartilage, ACL, posterolateral corner, meniscal, and extensor mechanism injuries. The approaches illustrated will enhance diagnostic accuracy, and potentially improve patient outcomes in these common MSK injuries, and will be followed by a moderated question and answer session.

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W4-CIR08

Portal Hypertension

Participants

David C. Madoff, MD, New Haven, Connecticut (*Presenter*) Advisory Board, Zimmer BiometConsultant, General Electric CompanyConsultant, Guerbet SAConsultant, Merck & Co, IncConsultant, Sirtex Medical LtdConsultant, Boston Scientific CorporationConsultant, Johnson & JohnsonConsultant, Siemens AG
Sirish Kishore, MD,BA, New York, New York (*Presenter*) Nothing to Disclose
Brett Fortune, MD, New York, New York (*Presenter*) W.L. Gore and Associates, speakerCook Medical, speaker
Valerie Vilgrain, MD, Paris, France (*Presenter*) Expert Witness, Bayer AG;Speaker, Canon Medical Systems Corporation;Speaker, General Electric Company;Advisory board, Guerbet SA;Expert Witness, Guerbet SA;Expert Witness, Zimmer Biomet Holdings, Inc;Speaker, Sirtex Medical Ltd;Expert Witness, Sirtex Medical Ltd;Investigator, AIdream;;
Maria del Pilar Bayona Molano, MD, Irving, Texas (*Presenter*) Nothing to Disclose
Bartley Thornburg, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.) Describe clinical and imaging sequelae of portal hypertension; 2) Explain established and emerging indications for portal interventions such as portosystemic shunt creation and variceal embolization; 3) Define the role of interventional radiology in the management of acute and chronic portomesenteric thrombosis;4) Identify medical and interventional strategies to manage complications of portal interventions including hepatic encephalopathy Liver cirrhosis is associated with high incidence and prevalence worldwide, with increasing incidence of lifestyle-related causes such as obesity, metabolic syndrome, and alcohol abuse. Interventional Radiologists play an increasingly prominent role in the multidisciplinary management of portal hypertension. This lecture-based course will review the epidemiology, medical management, imaging workup, endovascular procedures, and periprocedural care required for the care of patients with non-thrombotic and thrombotic disorders of the portomesenteric system.

Abstract Archives of the RSNA, 2021

W1-CMS15

Spine Emergencies

Participants

Laura L. Avery, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Christopher Potter, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Alexis Boscak, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose
Carlos H. Torres, MD,FRCPC, Ottawa, Ontario (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Review biomechanics, traumatology, and injury classification systems for the cervical and thoracolumbar spine.2. Identify complications of primary and metastatic spinal malignancy in the bones, epidural and intradural spaces.3. Explain the most relevant infectious processes of the spine. Spine Emergencies: high yield session focusing on diverse causes of emergent spine compromise, including traumatic, malignant, and infectious etiologies. The session will include classifying traumatic injuries, problem-solving spinal lesions in malignancy, and imaging common infections. The learner will improve time to recognition and confidence with the interpretation of these high acuity patients.

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Abstract Archives of the RSNA, 2021

Imaging with Impact in GYN Oncology

Participants
Elizabeth A. Sadowski, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose
Priyanka Jha, MBBS, San Francisco, California (*Presenter*) Nothing to Disclose
Ashish Wasnik, MD, Ann Arbor, Michigan (*Presenter*) Royalties, Reed Elsevier;Research Grant, Sequana Medical NV;Royalties, Applied Morphomics Inc;Patent agreement, Applied Morphomics Inc
Yuliya Lakhman, MD, New York, New York (*Presenter*) Stockholder, Y-mAbs Therapeutics, Inc

LEARNING OBJECTIVES

At the completion of the course, learners will: (1) recognize key imaging features enabling risk stratification of adnexal masses; (2) identify principles of primary staging for ovarian, cervical, and endometrial cancer; and (3) adapt their search pattern to optimize recognition of recurrent gynecologic cancers. Gynecologic cancers have an important public health impact worldwide. Existing staging systems are clinically based, and radiologists may be unfamiliar with principles of staging and treatment. This course will review staging and patterns of recurrence for ovarian, endometrial, and cervical cancers. By working in context and proving clinically relevant interpretations, radiologists can be true partners in gynecologic cancer care.

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Abstract Archives of the RSNA, 2021

Spain Presents: Why Do Spaniards Live So Long? Imaging of Longevity

Participants

Milagros Marti de Gracia, MD,PhD, Madrid, Spain (*Presenter*) Nothing to Disclose
Fatima Matute Teresa, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
Nuria Bargallo, PhD, Barcelona, Spain (*Presenter*) Nothing to Disclose
Antonia Arjonilla Lopez, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
Maria Fernandez-Velilla, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To introduce the concept of longevity as a demographic event of Spain, highlighting the influence of both the collective dietary habits and the health system on global life expectancy. 2) To describe the prevalence and incidence of cognitive impairment and neuroimaging findings related to neurodegenerative disease in Spain. 3) To illustrate the relationship of the Mediterranean diet with cardiovascular diseases and the available imaging modalities. 4) To describe the Spanish leading world model of organ donation and transplantation and the radiologist's role in the processes of organ donation, implantation and post-procedure follow-up. Special Remarks by Mary C. Mahoney, MD, President, RSNA. LIFE expectancy in Spain is already the highest in Europe and the fourth on earth, with a forecast average of 85.8 years. Some of the reasons that could be related to this life expectancy: environmental factors (high sunshine levels and a rather pleasant weather in most regions), the Mediterranean diet, physical activity, social relationships, as well as a robust public health system. Radiology plays a fundamental role in understanding the changes that occur related to health habits as well as the development of risk factors for different diseases.

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Abstract Archives of the RSNA, 2021

Mentorship, Sponsorship, and Coaching: Not Just for Early Career

Participants
Lucy Spalluto, MD,MPH, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Jay R. Parikh, MD, West University Place, Texas (*Presenter*) Nothing to Disclose
Cheri Canon, MD, Birmingham, Alabama (*Presenter*) Royalties, The McGraw-Hill Companies

LEARNING OBJECTIVES

1) Define and contrast the activities of mentoring, sponsoring, and coaching. This session will explore the important role of mentorship, sponsorship, and coaching for all professionals, not just early career. It will also highlight the value of each of these as we develop a more diverse profession.

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R5-CBR11

Case-based Review: Post Surgical Breast, Post Radiotherapy, Implants, Breast Augmentation

Participants

Bonnie Joe, MD,PhD, San Francisco, California (*Presenter*) Institutional Research Grant, Kheiron Medical Technologies Institutional Research Agreement, GE Medical SystemsInstitutional Research Agreement, Siemens Healthineers
Thomas H. Helbich, MD, Vienna, Austria (*Presenter*) Grant, Siemens AG;Grant, Bracco Group;Grant, Guerbet SA;Grant, Hologic, Inc;Grant, Novomed GmbH
Jocelyn A. Rapelyea, MD, Washington, Dist. of Columbia (*Presenter*) Speakers Bureau, General Electric Company

LEARNING OBJECTIVES

1 Review expected imaging findings in the post-surgical breast and post-radiotherapy breast. 2) Recognize imaging findings of breast cancer recurrence. 3)Review imaging findings of breast augmentation including implants, breast implant removal, and how to evaluate implant integrity. This course will cover imaging appearance of post-surgical breast, post-radiotherapy breast, breast cancer recurrence, and breast implants and other forms of breast augmentation. Educational material will be presented using a case-based review format by breast imaging experts and will be followed by a live question and answer session.

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Abstract Archives of the RSNA, 2021

AOSR-RSNA Joint Symposium: Optimizing Systems to Improve Value

Participants

Mary Mahoney, MD, Cincinnati, Ohio (*Presenter*) Royalties, Reed Elsevier;Editorial Advisory Board, Wolters Kluwer nv
Evelyn Lai Ming Ho, MBBS, MMed, Kuala Lumpur, Malaysia (*Presenter*) Nothing to Disclose
Marta Heilbrun, MD,MS, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Meng Law, MBBS, Melbourne, Australia (*Presenter*) Nothing to Disclose
Wing Pong Chan, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose
Tessa S. Cook, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Grant, Siemens AG (ended)Grant, Independence Blue CrossGrant, RSNAGrant, ACR (ended)Grant, NIH MIDRCHonorarium, BJR (Ed board)Honorarium, Sectra (webinar speaker)

LEARNING OBJECTIVES

1). Learn a framework to evaluate if activities and projects improve value, quality, safety and cost for an organization. 2).Gain familiarity with machine learning and artificial intelligence tools that increase safety and improve workflows for the radiologist and a radiology department The RSNA/AOSR Joint Symposium: Optimizing Systems to Improve Value course will feature 4 International expert speakers, *Marta Heilbrun, Meng Law, Wing Chan and Tessa Cook*, who will deliver short didactic presentations followed by an interactive panel discussion moderated by the *RSNA president and AOSR leadership*. We will review concepts of quality, safety and cost to serve as guiding principles defining value for a radiology practice. Multiple machine learning and artificial intelligence platforms that address imaging quality and safety will be presented. We will share ideas to help the audience pitch investments in systems and informatics approaches to transform and improve our workspaces. At the end of the session, the audience will understand challenges and opportunities to innovate how we provide imaging care, using a quality improvement and safety framework.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

Personalized Imaging: From Acquisition to Treatment

Participants

Robert Gillies, PhD, Tampa, Florida (*Presenter*) Consultant, HealthMyne, Inc;Investor, HealthMyne, Inc;Research support, HealthMyne, Inc;Consultant, Helix BioPharma Corp;Research support, Helix BioPharma Corp
Vikas Gulani, MD, PhD, Ann Arbor, Michigan (*Presenter*) Research support, Siemens AG;License agreement, Siemens AG;Spouse, License agreement, Siemens AG
Agata A. Exner, PhD, Cleveland, Ohio (*Presenter*) Research Consultant, Akrotome Imaging, Inc

LEARNING OBJECTIVES

As a result of this educational session, attendees should be able to:1)Describe the significant differences between (a) Precise and Personalized Medicine, (b) conventional and deep learning radiomics, (c) prognostic and predictive biomarkers. 2)Describe role of contrast agents, and Ultrasound contrast agents in particular, in advancing theranostic and nanomedicine-based pharmacologic interventions in oncology.3)Describe how imaging biomarkers, in particular multiparametric MRI or PET/CT, can be used to develop Decision Support Tools Modern medicine is evolving into increasing granularity in diagnosis and treatment. At initial presentation, this identifies disease, its subtype, its trajectory and ideally, and optimized initial treatment strategy; a process of "Precision Medicine". Once treatment is initiated, individual patients are longitudinally monitored to adjust and adapt therapy, ideally leading to optimal outcomes; a process known as "Personalized Medicine". Quantitative Imaging (QI) is playing an increasingly important role in delivering granular information for both precise and personalized care. In an increasing number of cases, quantitative imaging is being used to target the delivery of therapy; a process known as Theranostics. In this course, we will present exemplars of how such information can be obtained with routine, standard-of-care radiographic imaging.

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Abstract Archives of the RSNA, 2021

Grappling with the Black Box: Semi-supervised and Unsupervised Learning in Medical Imaging AI

Participants

George L. Shih, MD, New York, New York (*Presenter*) Consultant, MD.ai, Inc;Shareholder, MD.ai, Inc;
Kirti Magudia, MD,PhD, Durham, North Carolina (*Presenter*) Nothing to Disclose
Linda Moy, MD, New York, New York (*Presenter*) Grant, Siemens AG ;Advisory Board, Lunit Inc;Advisory Board, iCad, Inc
Raymond Geis, MD, Fort Collins, Colorado (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn what is Machine Learning. 2)Understand testing and training data-sets. 3)Comparesemi-supervised and unsupervised learning. 4) Use case/scenarios.

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Abstract Archives of the RSNA, 2021

Nuclear Cardiology: Read with the Experts

Participants

E. Gordon Depuey, MD, New York, New York (*Presenter*) Nothing to Disclose
Sharmila Dorbala, MD,MPH, Boston, Massachusetts (*Presenter*) Research Grant, Pfizer IncResearch Grant, General Electric CompanyResearch Grant, Attralus Research grant, Phillips, Consultant Pfizer Inc , General Electric Company Consultant, Janssen Consultant, Ionetix speaking honoraria

LEARNING OBJECTIVES

Systematically examine rotating planar projection images and reconstructed tomograms to assure technical integrity.Systematically examine rotating planar projection images to recognize and anticipate sources of MPI artifacts.Improve MPI interpretive confidence by avoidance of technical pitfalls and artifacts.Systematically review cardiac PET MPI and coronary flow reserve images to improve interpretive confidence.Systematically review cardiac PET FDG metabolic images for sarcoidosis and infective endocarditis to improve interpretive confidence Although myocardial perfusion SPECT (MPI) demonstrates high sensitivity and specificity in the detection of CAD, technical pitfalls and artifacts can significantly decrease test accuracy. In this course a stepwise, systematic approach to the review and interpretation of MPI images will be presented to enable technologists and interpreting physicians to avoid such pitfalls and artifacts and thereby increase their confidence in the performance and interpretation of MPI.Positron emission tomography/computed tomography (PET/CT) imaging is a powerful imaging modality for the assessment of cardiovascular diseases. It offers several advantages over single-photon emission computed tomography (SPECT) MPI including robust attenuation correction and absolute quantification of radiotracer activity. In this session, we will discuss cases to highlight interpretation of PET myocardial perfusion imaging, flow quantification and metabolic imaging with F-18 FDG to evaluate sarcoidosis and infective endocarditis.

Printed on: 06/28/22

R4-CIR07

Global Outreach in Interventional Radiology

Participants

Fabian Laage Gaupp, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose
Janice M. Newsome, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Azza Naif, MD, Dar es Salaam, Tanzania, United Republic Of (*Presenter*) Nothing to Disclose
Hammed Ninalowo, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose
Stephen Hunt, MD,PhD, Philadelphia, Pennsylvania (*Presenter*) Research Consultant, BTG International Ltd;Speakers Bureau, Galil
Medical Ltd;Research Grant, BTG International Ltd;Research Grant, Geurbet SA;Research Grant, Instylla Therapeutics
Charles Sanyika, MD, Johannesburg, South Africa (*Presenter*) Proctor, Cook Group Incorporated

LEARNING OBJECTIVES

1)Describe the extent and implications of the near complete lack of minimally invasive treatment options in LMIC, affecting more than half of the global population. 2)Understand hurdles to widespread implementation of IR training programs, including lack of expertise and lack of equipment, and describe proven and potential solutions. 3)Describe roles and examples of international collaboration in IR education, including sources of information and funding. More than half of the global population currently lacks adequate access to Interventional Radiology (IR). This means that billions worldwide cannot benefit from the many advantages of minimally invasive treatment options for the diagnosis and treatment of infection, cancer, trauma etc. The underlying reasons include lack of expertise, lack of IR training programs, and lack of IR equipment in most low- and middle-income countries (LMIC). Over the last five years, the first in country comprehensive IR training programs have emerged in sub-Saharan Africa, contributing to a better understanding of the extent of the problem and how it can be solved. This course will provide an overview of current global IR with lectures and discussions on the establishment of IR practices and training programs in LMIC, the state of the global IR equipment market, and how we can all benefit from international collaboration in IR.

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Abstract Archives of the RSNA, 2021

Updates in Adnexal Imaging and Reporting

Participants
Maitray D. Patel, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose
Caroline Reinhold, MD, MSc, Westmount, Quebec (*Presenter*) Research Grant, Imagia Cybernetics Inc
Margarita Revzin, MD, Wilton, Connecticut (*Presenter*) Nothing to Disclose
Loretta Strachowski, MD, San Francisco, California (*Presenter*) Royalties, Reed Elsevier
Andrea Rockall, FRCR,MRCP, London, United Kingdom (*Presenter*) Speaker, Guerbet SA

LEARNING OBJECTIVES

1) Understand and utilize size-based management of adnexal simple cysts identified on ultrasound and simple-appearing cysts identified on CT. 2)Recognize features of complex adnexal masses on ultrasound and MR that enable definitive characterization and/or O-RADS categorization into tiers based on risk of malignancy. 3)Recommend appropriate management for adnexal masses based on O-RADS categorization. This course consists of five 12-minute presentations reviewing current approaches to categorizing adnexal masses based on imaging findings, emphasizing ultrasound and magnetic resonance imaging. The presentations review defining and characteristic imaging features of various types of adnexal masses, putting those observations in the context of the recently published Ovarian-Adnexal Reporting and Data System (O-RADS). O-RADS articulates a specific lexicon for describing pertinent ultrasound and MR observations, and it outlines a categorization scheme designed to facilitate accurate diagnosis, estimate risk of malignancy, and promote optimal patient management. Course participants will understand the most important observations in categorizing adnexal masses and how to use O-RADS; this is especially relevant moving forward because the O-RADS lexicon and categorization scheme have been added as a quality measure in Medicares Merit-based Incentive Payment System, thereby tied to reimbursement.

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Abstract Archives of the RSNA, 2021

R4-CMS22

Update your Emergency CT Protocols

Participants

Nicholas Beckmann, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Michael Lev, MD, Boston, Massachusetts (*Presenter*) Research Grant, General Electric Company;Consultant, General Electric Company;Consultant, Takeda Pharmaceutical Company Limited;Consultant, F. Hoffmann-La Roche Ltd;Consultant, Merck & Co, Inc
Christina LeBedis, MD, Newton, Massachusetts (*Presenter*) Nothing to Disclose
Summer Kaplan, MD, MS, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Joachim E. Wildberger, MD, PhD, Maastricht, Netherlands (*Presenter*) Institutional Grant, Agfa-Gevaert Group;Institutional Grant, Becton, Dickinson and Company;Institutional Grant, Cook Group Incorporated;Institutional Grant, Bayer AG;Speakers Bureau, Bayer AG;Institutional Grant, General Electric Company;Institutional Grant, OptiMed Technologies, Inc;Institutional Grant, Koninklijke Philips NV;Institutional Grant, Radiomics;Institutional Grant, Siemens AG;Speakers Bureau, Siemens AG

LEARNING OBJECTIVES

1) Describe recent advances in CT imaging protocols used in the emergency setting. 2) Discuss emerging CT technology being employed in emergency centers. This session is a lecture series on up to date CT protocols used in common clinical scenarios in emergency centers as well as emerging advancements in CT technology that can be utilized for emergency imaging. The session will focus on pediatric, trauma, orthopedic, stroke, and cardiovascular emergency patient populations.

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Abstract Archives of the RSNA, 2021

Participants

Bettina Siewert, MD, Brookline, Massachusetts (*Presenter*) Editor, Wolters Kluwer nv;Reviewer, Wolters Kluwer nv;
Safwan Halabi, MD, Chicago, Illinois (*Presenter*) Advisor, Bunkerhill Health;Advisor, McKesson Corporation;
Shlomit Goldberg-Stein, MD, Manhasset, New York (*Presenter*) Nothing to Disclose
Alex Towbin, MD, Cincinnati, Ohio (*Presenter*) Author, Reed ElsevierConsultant, Anderson Publishing, LtdAdvisory Board, KLAS Enterprises LLC
Jinel A. Scott, MD, Brooklyn, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Design metrics for Peer Learning programs 2) Analyze TAT benchmarks from ACR Grid Registry 3) Discuss Dashboarding for performance metrics 4) Describe new performance metrics 5) Understand how to operationalize strategic goals with performance metrics Currently, the majority of radiologists are assessed through performance metrics such as work performance in wRVU, report turn-around time (TAT) and participation in Peer Review. The former is a business metric and depends more on the practice's business plan than individual performance, TAT is hard to assess without benchmarking, and Peer Review has been heavily criticized for being punitive and inaccurate. This course through lectures and discussions describes new meaningful metrics that result in measurable improvement, such as Peer Learning participation, standardized reporting, and incidental findings management. Key skills to using performance metrics will be discussed. These include the use of dashboards as a means of assuring consistent and reliable data retrieval and sharing, as well as techniques for operationalizing strategic goals.

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Abstract Archives of the RSNA, 2021

T1-CNR06

Practical Epilepsy Imaging: Pearls and Pitfalls / The Misses

Participants
Erik Middlebrooks, MD, Jacksonville, Florida (*Presenter*) Research Consultant, Varian Medical Systems, Inc;Research support, Varian Medical Systems, Inc;Consultant, Boston Scientific Corporation;Research support, Boston Scientific Corporation
Lily L. Wang, MBBS, Cincinnati, Ohio (*Presenter*) Nothing to Disclose
Steven M. Stufflebeam, MD, Charlestown, Massachusetts (*Presenter*) Co-founder, FIND Surgical Sciences Inc;Scientific Advisory Board, FIND Surgical Sciences Inc;Stockholder, FIND Surgical Sciences Inc
Prashant Raghavan, MD, Ellicott City, Maryland (*Presenter*) Speaker, Siemens AG

LEARNING OBJECTIVES

1) Understand considerations in development of a imaging protocols for evaluation of epilepsy. 2) Develop a robust search pattern for evaluation of patients with epilepsy. 3) Understand the role of functional imaging and source localization in assessing potential surgical epilepsy patients. Epilepsy is a common and debilitating disorder with an estimated prevalence of 3.4 million people in the U.S., alone. Neuroimaging plays a critical role in evaluating patients for potential therapy and can heavily influence outcomes. For instance, patients with potentially epileptogenic lesions identified on MRI are nearly three times as likely to have seizure freedom after surgery than those without MRI findings. Evaluation of chronic epilepsy is a complex, multidisciplinary process. In this lecture session, topics will broadly cover evaluation of epilepsy patients ranging from structural imaging, functional imaging, and integration with electrophysiology and other modalities. Upon completion, the audience should have an understanding of basic imaging protocols and interpretation of epilepsy MRI. In addition, participants will have an understanding of the role of functional MRI in predicting cognitive deficits from epilepsy surgery, as well as integration of multimodal source localization.

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Abstract Archives of the RSNA, 2021

Multimodality Lymphatic Imaging: Update, Challenges, and Opportunities

Participants
Anup Shetty, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Alexander C. Kagen, MD, New York, New York (*Presenter*) Chief Medical Officer, Nines, Inc;Board of Directors, Nines, Inc;Consultant, Nines, Inc;Speakers Bureau, Bayer AG
Joseph Dayan, MD, New York, New York (*Presenter*) Consultant, Stryker Corporation
Anna Lillis, MD, PhD, Dublin, Ohio (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the causes and treatment of lymphedema and the imaging that guides management. 2) Explain the etiology and imaging features of central conducting lymphatic disorders. 3) Recognize challenges and opportunities in starting a MR lymphangiography program. Lymphatic imaging is of increasing interest as a growing number of adult and pediatric patients are affected by congenital, acquired and iatrogenic lymphatic disorders. Lectures within this course will review fundamentals of lymphatic imaging including the surgical perspective for lymphedema treatment, will discuss considerations in starting an MR lymphangiography program, and will review the imaging and management of congenital and acquired lymphatic disorders. Learners will be expected to be familiar with central and peripheral lymphatic disorders and principles of lymphatic imaging after attending the session.

Printed on: 06/28/22

Participants

Erik Shapiro, PhD, East Lansing, Michigan (*Presenter*) Founder, Shape Scientific LLC;Researcher, Bruker Corporation
Jocelyn A. Rapelyea, MD, Washington, Dist. of Columbia (*Presenter*) Speakers Bureau, General Electric Company
Gary Luker, MD, Ann Arbor, Michigan (*Presenter*) Institutional Research Grant, Polyphor, Ltd

LEARNING OBJECTIVES

1) Explain the current status of original scientific research and multi modality imaging of malignant tumors and it's implications on clinical care. 2) Attendees will learn optimal practice-based strategies to improve malignant diagnoses and patient management. 3) Identify imaging skill sets to solve the most pressing and complex problems in cancer imaging while underscoring the achievements and ingenuity of junior physician/scientists in cancer imaging. This session will focus on the importance of research and technological advances in the field of oncologic imaging. Attendees will be introduced to timely and relevant topics in imaging malignant tumors in a wide range of subspecialties. The session will highlight those achievements made by Young Investigators as defined by NIH early investigator guidelines.

Sub-Events

T4-RCP43   18F-fluciclovine PET/CT And 68GA-PSMA PET/CT Guidance Of Salvage Radiotherapy In Patients With Biochemical Recurrence Postprostatectomy: Interim Analysis Of A Secondary Endpoint From A Randomized Trial

Participants
Olayinka Abiodun-Ojo, MD,MPH, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

We examined the potential influence of 18F-fluciclovine and 68Ga-PSMA PET/CT on salvage radiotherapy (RT) management decisions (planned secondary endpoint) in patients with biochemical recurrence postprostatectomy.*Methods and Materials 68 patients (accrual goal: 140) with detectable prostate-specific antigen (PSA) postprostatectomy were randomized to treatment planning guided by fluciclovine (mean dose: 9.96 ± 0.80 mCi) [arm A] or Ga-PSMA (mean dose: 5.07 ± 0.21 mCi) with 20 mg Lasix given unless contraindicated [arm B] in an ongoing prospective intention-to-treat clinical trial. Pre-PET RT plans were based on clinical history, histopathology findings at prostatectomy, PSA trajectory and conventional imaging findings. Post-PET RT plans were based on PET findings: no uptake or prostate bed (PB) only uptake - RT to PB only; pelvic nodal uptake - RT to PB+pelvis; extrapelvic nodal uptake - no RT. For each arm, pre- and post-PET management decisions were compared and significance of decision changes were determined using the Clopper-Pearson (exact) binomial method.*Results 3/68 patients dropped out before PET scanning. Of the remaining 65 patients analyzed, 32 (median PSA 0.29 ng/mL) underwent fluciclovine PET and 33 (median PSA 0.31 ng/mL) Ga-PSMA PET. No significant difference in PSA at PET (p = 0.48), Gleason score (p = 0.73) and surgery-PET interval (p = 0.94) between arms. On whole body analysis, positivity rate of fluciclovine was significantly higher than Ga-PSMA (96.9% vs 60.6%; p < 0.01). Overall RT decision change was 9/32 (28.1%) in arm A; in 4/32 (12.5%) patients, RT decision was withdrawn because of systemic disease detected on PET. 5/28 (17.9%) patients with sustained plans to undergo RT had treatment fields changed from RT to PB and pelvis to PB only. RT decision change was 12/33 (36.4%) in arm B; 5/33 (15.2%) patients had RT decision withdrawn because of extrapelvic uptake on PET. 7/28 (25.0%) patients with final decision to undergo RT had fields changed; 6/28 (21.4%) had fields reduced from RT to PB and pelvis to PB only, while 1/28 (3.6%) had fields increased from RT to PB only to PB and pelvis. Changes in overall RT decisions and fields were statistically significant (P < 0.01) for both arms.*Conclusions In this interim analysis, whole body positivity rate for fluciclovine was significantly higher than Ga-PSMA. Both fluciclovine and Ga-PSMA had a significant influence on salvage RT management decisions.*Clinical Relevance/Application For PCa patients with biochemical recurrence fluciclovine PET had higher positivity rate primarily due to superior ability to detect local recurrence compared with Ga-PSMA. Both fluciclovine and Ga-PSMA had a significant influence on salvage radiotherapy management decisions.

RESULTS

3/68 patients dropped out before PET scanning. Of the remaining 65 patients analyzed, 32 (median PSA 0.29 ng/mL) underwent fluciclovine PET and 33 (median PSA 0.31 ng/mL) Ga-PSMA PET. No significant difference in PSA at PET (p = 0.48), Gleason score (p = 0.73) and surgery-PET interval (p = 0.94) between arms. On whole body analysis, positivity rate of fluciclovine was significantly higher than Ga-PSMA (96.9% vs 60.6%; p < 0.01). Overall RT decision change was 9/32 (28.1%) in arm A; in 4/32 (12.5%) patients, RT decision was withdrawn because of systemic disease detected on PET. 5/28 (17.9%) patients with sustained plans to undergo RT had treatment fields changed from RT to PB and pelvis to PB only. RT decision change was 12/33 (36.4%) in arm B; 5/33 (15.2%) patients had RT decision withdrawn because of extrapelvic uptake on PET. 7/28 (25.0%) patients with final decision to undergo RT had fields changed; 6/28 (21.4%) had fields reduced from RT to PB and pelvis to PB only, while 1/28 (3.6%) had fields increased from RT to PB only to PB and pelvis. Changes in overall RT decisions and fields were statistically significant (P < 0.01) for both arms.

CLINICAL RELEVANCE/APPLICATION

For PCa patients with biochemical recurrence fluciclovine PET had higher positivity rate primarily due to superior ability to detect local recurrence compared with Ga-PSMA. Both fluciclovine and Ga-PSMA had a significant influence on salvage radiotherapy

management decisions.

T4-RCP43   Combining CT Radiomic And Pathomic Features From H;E Tissue Images For Prognosticating Outcome In P16+ Oropharyngeal Squamous Cell Carcinoma

Participants
Bolin Song, MS, Cleveland, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

The current paradigm for low-risk patients with p16+ oropharyngeal squamous cell carcinoma (OPSCC) is to reduce the dosage of radio-chemo therapy (treatment de-intensification). The purpose of this study was to combine the pathomic features from digitized H&E images with CT radiomic features to create a prognostic classifier that could enable accurate risk stratification of p16+ OPSCC patients.*Methods and Materials 304 p16+ OPSCC cases from three institutions (N1=100, N2=94, and validation cohort N3=110) were included in this study. The radiomic signature capturing tumor CT textural heterogeneity was trained on pre-treatment CT scans from N1. The tumor infiltrating lymphocytes (TILs)-related features (pathomic) were trained on N2, which quantifies the spatial arrangement of the TILs proximity using network graph metrics. Next, 3 radiomic and 5 pathomic features most associated with disease-free survival (DFS) were identified from N1 and N2, respectively, and used to train Cox regression models. Median of the radiomic and pathomic signatures from N1, N2 were used as cut-off for defining high vs low-risk groups. We then applied the consensus clustering on isomap embedding of the rad-pathomic features on N3, from which two patient clusters were generated. Kaplan-Meier survival analysis was used to quantify the DFS difference between risk groups or clusters (Figure 1).*Results Hazard ratios (HR) for comparing DFS of high vs low-risk groups for the radiomic and the pathomic signatures in validation cohort N3 are 1.99 (95% CI, 0.896-4.42, p=0.0912) and 2.37 (95% CI, 1.09-5.16, p=0.0302). The two clusters from isomap of rad-pathomic resulted in an improved HR of 3.36 (95% CI, 1.52-7.39, p=0.00264). The rad-pathomic consensus matrix approach yielded higher sensitivity (0.88) in detecting recurrence than either individual radiomic (0.76) or pathomic signatures (0.76).*Conclusions Combing CT radiomic features with pathomic features from H&E slides enabled improved prognosis prediction for p16+ OPSCC.*Clinical Relevance/Application With additional validation, the fused rad-pathomic signature could allow for identifying p16+ OPSCC patients who will benefit from treatment de-intensification.

RESULTS

Hazard ratios (HR) for comparing DFS of high vs low-risk groups for the radiomic and the pathomic signatures in validation cohort N3 are 1.99 (95% CI, 0.896-4.42, p=0.0912) and 2.37 (95% CI, 1.09-5.16, p=0.0302). The two clusters from isomap of rad-pathomic resulted in an improved HR of 3.36 (95% CI, 1.52-7.39, p=0.00264). The rad-pathomic consensus matrix approach yielded higher sensitivity (0.88) in detecting recurrence than either individual radiomic (0.76) or pathomic signatures (0.76).

CLINICAL RELEVANCE/APPLICATION

With additional validation, the fused rad-pathomic signature could allow for identifying p16+ OPSCC patients who will benefit from treatment de-intensification.

T4-RCP43   Ga-68 FAPI Imaging Versus FDG-PET Imaging In Hepatocellular Carcinoma

Participants
Vineel Inampudi I, MD, Vijayawada, India (*Presenter*) Nothing to Disclose

PURPOSE

This study aims to assess the diagnostic accuracy of FDG PET-CT assessment of Hepatocellular Carcinoma and the benefit of using Ga-68 Fibroblast Activation Protein Inhibitor (FAPI) instead of FDG in the PET assessment of the same.*Methods and Materials This study is a prospective study that has been carried out at our institution on 850 patients between January 2015 to January 2021 who were diagnosed to have HCCs on PET-CT assessment with confirmation on either biopsy or AFP assessment. The SUVmax of these tumors using both FDG and Ga-68 FAPI were studied and compared.*Results 850 patients, had both FDG and Ga-68 FAPI assessment 1 day apart. 581 patients had lesions where the largest dimension was more than 5 cm while 269 patients had a largest lesion dimension of less than 5 cm. 443 patients had background cirrhosis and 407 patients did not have chronic liver disease. Out of the total 850 patients who underwent FDG PET-CT, 781 lesions were FDG avid and 69 lesions did not show FDG uptake while all 850 patients who underwent Ga-68 FAPI imaging showed lesion avidity. The mean SUVmax of HCCs among the 850 patients who underwent both imaging modalities 1 day apart was 4.39 + 2.1 for FDG and 12.29 + 6.86 for Ga-68 FAPI with a p value < 0.05 (significant). The sensitivity of FDG in detection of HCC was 92% and that of Ga-68 FAPI was 100%.*Conclusions Ga-68 FAPI PET assessment for Hepatocellular carcinomas is a useful imaging tool in terms of definitive assessment of malignancy and scores higher than FDG-PET in accuracy for diagnosing HCC and can possibly replace FDG in the future.*Clinical Relevance/Application Hepatocellular carcinoma is one of the most common malignancies in our country and is encountered across various age groups. Apart from a few clinical parameters, imaging forms a major part of the assessment of these malignancies which present as hepatic masses and the core question to be answered in every case is whether the mass is benign or malignant and if malignant, then whether it is hepatocellular carcinoma or another malignancy such as Cholangiocarcinoma. The use of multiple imaging characteristics on contrast enhanced CT scans has formed the basis of diagnosis however PET-CT assessment with FDG has been less accurate owing to the variable uptake by HCCs.

RESULTS

850 patients, had both FDG and Ga-68 FAPI assessment 1 day apart. 581 patients had lesions where the largest dimension was more than 5 cm while 269 patients had a largest lesion dimension of less than 5 cm. 443 patients had background cirrhosis and 407 patients did not have chronic liver disease. Out of the total 850 patients who underwent FDG PET-CT, 781 lesions were FDG avid and 69 lesions did not show FDG uptake while all 850 patients who underwent Ga-68 FAPI imaging showed lesion avidity. The mean SUVmax of HCCs among the 850 patients who underwent both imaging modalities 1 day apart was 4.39 + 2.1 for FDG and 12.29 + 6.86 for Ga-68 FAPI with a p value < 0.05 (significant). The sensitivity of FDG in detection of HCC was 92% and that of Ga-68 FAPI was 100%.

CLINICAL RELEVANCE/APPLICATION

Hepatocellular carcinoma is one of the most common malignancies in our country and is encountered across various age groups. Apart from a few clinical parameters, imaging forms a major part of the assessment of these malignancies which present as hepatic masses and the core question to be answered in every case is whether the mass is benign or malignant and if malignant, then whether it is hepatocellular carcinoma or another malignancy such as Cholangiocarcinoma. The use of multiple imaging characteristics on contrast enhanced CT scans has formed the basis of diagnosis however PET-CT assessment with FDG has been

less accurate owing to the variable uptake by HCCs.

T4-RCP43   Diagnosis Of Bone Marrow Metastases In Children And Young Adults With Solid Tumors:18F-FDG-PET Or DW-MRI?

Participants
Ali Rashidi, MD, Stanford, California (*Presenter*) Nothing to Disclose

PURPOSE

To compare the diagnostic performance of 18F-labeled fluorodeoxyglucose (18F-FDG) enhanced positron emission tomography (PET) and diffusion-weighted magnetic resonance imaging (DW-MRI) in the diagnosis of bone marrow metastases in children and young adults with solid malignancies.*Methods and Materials In a prospective clinical trial, we performed 64 simultaneous 18F-FDG-PET and DW-MRI scans (with a gadolinium chelate (gadobutrol, Gd) or an iron oxide nanoparticle compound (ferumoxytol)), including 21 baseline and 43 post-chemotherapy scans on twenty-three children and young adults (mean age 16.8 +/- 5.1 years, 16 males, 7 females) with bone marrow metastases. Four reviewers determined the presence or absence of 925 bone marrow metastases on 18F-FDG-PET and DW-MRI and measured the tumor-to-bone marrow contrast on 18F-FDG-PET and DW-MRI by calculating the difference between tumor and bone marrow standardized uptake values (SUV) and signal-to-noise ratios (SNR), respectively. The one-sample Wilcoxon test and Generalized Estimation Equation were used for statistical analysis.*Results At baseline, a high tumor-to-bone marrow contrast was detected in DW-MRI (SNR: 1069.57 +/- 815.45%) and 18F-FDG-PET (SUV: 1258.39 +/- 1325.95%, p=0.539). The sensitivities and specificities were 87.7% and 100%, respectively, for DW-MRI, as well as 95.4%, and 100% for 18F-FDG-PET, (p = 0.206). On post-treatment scans, the lesion-to-bone marrow contrast was higher on DW-MRI (SNR: 794.44 +/- 721.89%) compared to 18F-FDG-PET (SUV: 501.98 +/- 727.36 %; p=0.064). The sensitivities and specificities were 89.7% and 100% respectively, for DW-MRI and 89.1% and 100% for 18F-FDG-PET (p>0.999). Ferumoxytol-enhanced DW-MRI scans had higher diagnostic accuracy compared to Gd-enhanced DW-MRI scans (p=0.002). At both baseline and post-treatment scans, each modality missed lesions while the combination of DW-MRI and 18F-FDG-PET led to significantly higher sensitivities and specificities of 100% Compared to either technique alone (p<0.001).*Conclusions While either 18F-FDG-PET or DW-MRI can miss bone marrow metastases, the combined 18F-FDG-PET and DW-MRI is the most precise modality in the detection of bone marrow metastases in children and young adults.*Clinical Relevance/Application Both DW-MRI and 18F-FDG-PET can miss bone marrow metastases. The combined 18F-FDG-PET and DW-MRI can detect accurately the lesions missed on either modality alone.

RESULTS

At baseline, a high tumor-to-bone marrow contrast was detected in DW-MRI (SNR: 1069.57 +/- 815.45%) and 18F-FDG-PET (SUV: 1258.39 +/- 1325.95%, p=0.539). The sensitivities and specificities were 87.7% and 100%, respectively, for DW-MRI, as well as 95.4%, and 100% for 18F-FDG-PET, (p = 0.206). On post-treatment scans, the lesion-to-bone marrow contrast was higher on DW-MRI (SNR: 794.44 +/- 721.89%) compared to 18F-FDG-PET (SUV: 501.98 +/- 727.36 %; p=0.064). The sensitivities and specificities were 89.7% and 100% respectively, for DW-MRI and 89.1% and 100% for 18F-FDG-PET (p>0.999). Ferumoxytol-enhanced DW-MRI scans had higher diagnostic accuracy compared to Gd-enhanced DW-MRI scans (p=0.002). At both baseline and post-treatment scans, each modality missed lesions while the combination of DW-MRI and 18F-FDG-PET led to significantly higher sensitivities and specificities of 100% Compared to either technique alone (p<0.001).

CLINICAL RELEVANCE/APPLICATION

Both DW-MRI and 18F-FDG-PET can miss bone marrow metastases. The combined 18F-FDG-PET and DW-MRI can detect accurately the lesions missed on either modality alone.

T4-RCP43   Improved Response Prediction Based On Dual Energy CT Radiomics In Patients With Stage IV Melanoma Before Immunotherapy

Participants
Andreas Brendlin, Tuebingen, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To assess the additive value of dual energy CT (DECT) over single energy CT (SECT) to radiomics based response prediction in patients with metastatic melanoma undergoing immunotherapy.*Methods and Materials A total of 140 consecutive patients with melanoma (58 female, 63±16 years) for whom baseline DECT tumor load assessment revealed stage IV and who were subsequently treated with immunotherapy were included. Best response was determined using the clinical reports (81 responders: 27 complete response, 45 partial response, 9 stable disease). Individual lesion response was classified manually in the style of RECIST 1.1 through 1291 follow-up examinations on a total of 776 lesions (6.7±7.2 per patient). The patients were sorted chronologically into a study and a validation cohort (each n = 70). The baseline DECT was examined using specialized tumor segmentation software, and radiomic features were analyzed for response predictors. Significant features were selected using univariate statistics with Bonferroni correction and multiple logistic regression. The area under the curve of the best subset was computed (AUROC). A random forest classifier with 10-fold internal cross-validation was trained on the study cohort and tested on the validation cohort to confirm the predictive performance.*Results A total of 4074 timepoint evaluations were performed. Multivariate statistics selected significant features for patient response in SECT (min. brightness, AUROC = 0.67, MI = 0.077 R^2 = 0.112, padj. = 0.001) and DECT (textural coarseness, AUROC = 0.71, MI = 0.064, R^2 = 0.121, padj. = 0.001), as well as lesion response in SECT (mean absolute voxel intensity deviation, AUROC = 0.67, MI = 0.088 R^2 = 0.115, padj. = 0.001) and DECT (iodine uptake metrics, (AUROC = 0.88, MI = 0.1 R^2 = 0.12, padj. = 0.001) Machine-learning application validated the additive predictive power of DECT (patient response AUROC SECT = 0.5, DECT = 0.75; lesion response AUROC SECT = 0.61, DECT = 0.85; p < 0.001).*Conclusions The new method of DECT-specific radiomic analysis provides a significant additive value over SECT radiomics approaches for response prediction in patients with metastatic melanoma preceding immunotherapy, especially on a lesion-based level. As mixed tumor response is not uncommon in metastatic melanoma, this lends a powerful tool for clinical decision-making and may potentially be an essential step towards individualized medicine.*Clinical Relevance/Application Considering mixed responses under immunotherapy, this approach can be a powerful additional tool for oncological decision-making.

RESULTS

A total of 4074 timepoint evaluations were performed. Multivariate statistics selected significant features for patient response in SECT (min. brightness, AUROC = 0.67, MI = 0.077 R^2 = 0.112, padj. = 0.001) and DECT (textural coarseness, AUROC = 0.71, MI = 0.064, R^2 = 0.121, padj. = 0.001), as well as lesion response in SECT (mean absolute voxel intensity deviation, AUROC = 0.67, MI = 0.088 R^2 = 0.115, padj. = 0.001) and DECT (iodine uptake metrics, (AUROC = 0.88, MI = 0.1 R^2 = 0.12, padj. = 0.001) Machine-learning application validated the additive predictive power of DECT (patient response AUROC SECT = 0.5, DECT = 0.75; lesion

response AUROC SECT = 0.61, DECT = 0.85; p < 0.001).

CLINICAL RELEVANCE/APPLICATION

Considering mixed responses under immunotherapy, this approach can be a powerful additional tool for oncological decision-making.

T4-RCP43   **Automatic MRI Analysis In Multiple Myeloma: A Framework Combining Deep Learning For Automatic Pelvic Bone Marrow Segmentation And Radiomics For Prediction Of Plasma Cell Infiltration In Multiple Myeloma Patients**

Participants
Markus Wennmann, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To establish an automated framework including (I) automatic pelvic bone marrow (BM) segmentation from MRI and (II) a radiomics model to predict the plasma cell infiltration (PCI) in Multiple Myeloma (MM) patients.*Methods and Materials Five cohorts including a total of 541 MRIs from 270 patients were included; 158 patients had received MRI on one 1.5T MRI Scanner and had information on PCI from concomitant biopsy at the iliac crest available. MRIs without biopsy data were used for training of the nnU-Net only, which is state of the art for medical image segmentation. MRIs with biopsy data were split by date into a training-set (n=116) for both, nnU-Net and radiomics model, and an independent test-set for the framework (n=42). BM segmentations of the right and left pelvic bone on coronal T1tse images on the training cohort were used for training of the nnU-Net. A random forest classifier was trained on the pelvic radiomics features to predict PCI. The framework was then tested on the independent test-set. Dice scores report accuracy of segmentations and mean absolute error (MAE) in [%PCI] reports the accuracy of the PCI prediction. For comparison, two radiologists rated the diffuse infiltration according to 3 levels of severity (none-to-mild vs. moderate vs. severe). The mean PCI within each severity level from the training set was determined and assigned as a prediction to patients with the same level diffuse infiltration in the test-set (the radiologists` PCI prediction). This study was approved by the institutional review board.*Results The mean Dice score of the nnU-Net segmentation for right / left pelvic bone marrow on 8 cases of the test-set (last 8 by acquisition date) were 0.94 and 0.94, respectively, the mean Dice score between manual pelvic BM segmentation of two radiologists on these 8 cases were 0.87 and 0.88. The MAE of the prediction of PCI by the automated framework was 14.3 [%PCI]. The MAE of the radiologists PCI predictions were 16.1 [%PCI] (rater 1) and 16.7 [%PCI] (rater2).*Conclusions We established automatic BM segmentation with radiologist level precision, which is a critical step towards automated analysis of MM MRI. Radiomics analysis of these segmentations can predict PCI with considerable accuracy. Further improvement of the PCI prediction model is necessary and is currently in progress, by (I) adding T2 and DWI sequences, (II) adding 600 additional cases from a second institution, (III) a prospective, multi-scanner radiomics feature stability study (recruitment and measurements completed, data analysis in progress).*Clinical Relevance/Application Automatic bone marrow (BM) segmentation is a crucial step to automate reading of multiple myeloma (MM) MRI. Plasma cell infiltration (PCI) is a critical marker for staging and risk assessment in MM.

RESULTS

The mean Dice score of the nnU-Net segmentation for right / left pelvic bone marrow on 8 cases of the test-set (last 8 by acquisition date) were 0.94 and 0.94, respectively, the mean Dice score between manual pelvic BM segmentation of two radiologists on these 8 cases were 0.87 and 0.88. The MAE of the prediction of PCI by the automated framework was 14.3 [%PCI]. The MAE of the radiologists PCI predictions were 16.1 [%PCI] (rater 1) and 16.7 [%PCI] (rater2).

CLINICAL RELEVANCE/APPLICATION

Automatic bone marrow (BM) segmentation is a crucial step to automate reading of multiple myeloma (MM) MRI. Plasma cell infiltration (PCI) is a critical marker for staging and risk assessment in MM.

Printed on: 06/28/22

T1-CCA05

Role of Imaging in Cardio-Oncology

Participants
Lauren Baldassarre, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose
Susan Dent, Ottawa, Ontario (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand the utility of a multimodality cardiac imaging approach to cardio-oncology. 2. Explain which cardiac imaging is appropriate for the monitoring, diagnosis, and management of a variety of cardiotoxicities. Cardio-oncology is a rapidly growing field that addresses the cardiotoxic effects from cancer therapeutics. Cardiac imaging is central to the practice of cardio-oncology, as it plays a large role in the monitoring, diagnosis, and management of cancer patients. This lecture series will demonstrate the utility of the different cardiac imaging modalities in the assessment of a variety of cardiovascular disease states in cancer patients. The importance of a multidisciplinary approach amongst radiologists, cardiologists and oncologists in this field will be emphasized.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

MESH Incubator Presents: The CORE Healthcare Innovation Bootcamp: Putting It Together - Crucial Aspects to Successful Implementation

Participants

Marc Succi, MD, Boston, Massachusetts (*Presenter*) Inventor, Frequency Therapeutics
Carl Berke, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Michael S. Gee, MD, PhD, Boston, Massachusetts (*Presenter*) Research Grant, Takeda Pharmaceutical Company Limited;Researcher, General Electric Company ;Researcher, Siemens AG
Efren J. Flores, MD, Boston, Massachusetts (*Presenter*) 1. Speaker Honorarium, Medscape2. Speaker Honoraria, Grand Rounds presentations (non-profit organizations)
James Brink, MD, Boston, Massachusetts (*Presenter*) Board of Directors, Accumen Inc

LEARNING OBJECTIVES

1. Learn the process involved in forming a new healthcare company/startup, including cautionary tales about equity, founders, and conflict.2. Understand different types of investing, including benefits and drawbacks, from friends and family to venture and IPO.3. Understand structure of academic departments in order to implement equitable innovations in healthcare. Good ideas are necessary but not sufficient to successfully implement healthcare innovations. In this afternoon session from the MESH incubator, the program will focus on key steps to implementing your vision, product, idea, or company. This begins with teaching the fundamentals of startup formation as well as venture funding by a successful healthcare investor. Furthermore, understanding organization challenges in academic institutions, and tackling these challenges with an understanding of key issues in diversity, equity, and inclusion are required for systematic and equitable innovation two leaders in this arena will teach fundamental understanding in these areas.

Printed on: 07/01/22

M2-CAS02

Artificial Intelligence in the Hands of Medical Imaging and Radiation Therapy Professionals Part II: Getting Ready for a Future with AI (Sponsored by the Associated Sciences Consortium)

Participants
Susie Moseley, BS, RT, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose
Sharon Wartenbee, RT, Sioux Falls, South Dakota (*Presenter*) Nothing to Disclose
Caitlin Gillan, BSC, MEd, Toronto, Ontario (*Presenter*) Nothing to Disclose
Hakon Hjemly, MSc,RT, Sorumsand, Norway (*Presenter*) Nothing to Disclose
Craig St George, ARRT,RT, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify how artificial intelligence is being used in everyday activities and technologies in radiation therapy. 2) Explain the current and future effect of AI on workflows, ethics, and perceptions of practitioners and patients. 3) Discuss future applications of AI and ML technologies and how they might shape the profession. This is a two-part presentation titled Artificial Intelligence in the Hands of Medical Imaging and Radiation Therapy Professionals. Part I aims to identify the development and terminology of artificial intelligence (AI), machine learning (ML), and automation associated with the radiologic sciences. Additionally, current and proposed patient care practices for AI and ML will be discussed. Part II will cover practitioner trust, the role of education, future applications and effects of AI and ML in shaping the profession, and ethical responsibilities of health care facilities and employees when implementing AI and ML into everyday practice.

Printed on: 06/28/22

W6-RCP05

Trailblazers in Health Equity: Lessons Learned & Leadership Opportunities to Advance Health Equity in Radiology and Beyond (Sponsored by the RSNA Committee on Diversity, Equity & Inclusion)

Participants

Efren J. Flores, MD, Boston, Massachusetts (*Presenter*) 1. Speaker Honorarium, Medscape2. Speaker Honoraria, Grand Rounds presentations (non-profit organizations)
Carolyn Meltzer, MD, Los Angeles, California (*Presenter*) Nothing to Disclose
Yoshimi Anzai, MD,MPH, Salt Lake City, Utah (*Presenter*) Nothing to Disclose
Jacqueline A. Bello, MD, New York, New York (*Presenter*) Nothing to Disclose
Geraldine McGinty, MD, MBA, New York, New York (*Presenter*) Board member and Stockholder, NextGen Healthcare (NXGN)
Lucy Spalluto, MD,MPH, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Valerie L. Ward, MD, MPH, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Ruth C. Carlos, MD, MS, Ann Arbor, Michigan (*Presenter*) In-kind support, Reed Elsevier;Editor, Reed Elsevier;Travel support, General Electric Company

LEARNING OBJECTIVES

At the end of the presentation, attendees will be able to:1)Learn from for the experiences of current leaders as they candidly discuss experiences establishing efforts in health equity at their institutions. 2)Effectively identify strategies and opportunities for leadership development and growth in health equity in radiology and beyond. 3)Understand the value of developing key transdisciplinary collaborations to effectively lead organizational transformation into an equitable imaging care delivery environment. Radiology leaders, institutional leaders, and national organizations are committed to advancing health equity. To effectively catalyze organizational commitment to advancing health equity and broaden the impact of radiology in these institutional and national efforts, we will learn from the experience of influential radiology leaders who are at the forefront of these efforts.

Printed on: 06/28/22

M4-CAS04

AI Productivity ? The Dash for Cash (Sponsored by the Associated Sciences Consortium)

Participants

Jennifer Kroken, MBA, Lewisville, Texas (*Presenter*) Nothing to Disclose
Steven DeColle, Edmonton, Alberta (*Presenter*) Nothing to Disclose
Benjamin Strong, MD, Eden Prairie, Minnesota (*Presenter*) Officer, Virtual Radiologic Corporation
Rob Gontarek, Plano, Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain how AI can be practically used and applied in billing and physician dictation 2) Identify the potential financial implications AI can have for a practice. AI has been well-recognized in the clinical environment of radiology but has also made tremendous inroads on the business side. The session will discuss the real-world use of AI to support billing and dictation including a discussion of reducing overhead, leveraging productivity and improving financial performance.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

R6-CPH13

Protocol Optimization for Low Dose CT

Participants

Timothy Szczykutowicz, PhD, Madison, Wisconsin (*Presenter*) Consultant, AiDoc Medical Ltd;Consultant, Flowhow.ai;Consultant, medInt Holdings, LLC;Consultant, Alara, Inc;Consultant, AstoCT, Inc;Research Grant, General Electric Company;Research Grant, Canon Medical USA

Rebecca Smith-Bindman, MD, San Francisco, California (*Presenter*) Founder, Alara Imaging, Inc

Lawrence N. Tanenbaum, MD, Riverside, Connecticut (*Presenter*) Speaker, General Electric Company;Speaker, Siemens AG;Speaker, Guerbet SA;Speaker, Koninklijke Philips NV;Consultant, Enlitic, Inc;Consultant, icoMetrix NV;Consultant, Subtle Medical, Inc;Consultant, Columbo;Consultant, Canon Medical Systems Corporation;Consultant, FUJIFILM Holdings Corporation

LEARNING OBJECTIVES

1) Identify the magnitude of dose variations within centers and between centers. 2) Learn where how CT technology can enable lower doses, but also how CT practice culture often enables the largest dose reductions. 3) Identify hurdles to dose reduction efforts in the "real world" This is a lecture based session. We will open with a talk on the variability in dose our community sees for low dose CT applications like screening, renal calculi f/u, LCS, etc. We will make observations about the sources for this variation. Then we will transition to discussing what technology and practice culture behaviors enable Low dose. Finally, we will discuss protocol optimization in the real world; specifically how implementation of low dose protocols or low dose technology in the real world actually works.

Printed on: 07/01/22

SAT02

AAPM/RSNA Physics Tutorial Session 1: Theranostics and the Novel Application of Radionuclides in Interventional Procedures

Participants

Thaddeus Wilson, PhD, Memphis, Tennessee (*Presenter*) Nothing to Disclose
King Li, MD, EMERALD HILLS, California (*Presenter*) Nothing to Disclose
Furqan Syed, MD, Germantown, Tennessee (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Describe the radiation physics and various dosimetry calculation methods employed in Y-90 radioembolization.Discuss the transarterial radionuclide therapy for treatment of primary and secondary hepatic malignancies transarterial therapies, including the advanced techniques, radiation safety and dose management.Provide a primer on theranostics.

Printed on: 06/28/22

W2-CNR07

Systematic Approach to Hard Cases: Pediatric 'Neuro-Radiology' Case Based-Review

Participants
Manohar Shroff, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose
Kartik Reddy, MD, Decatur, Georgia (*Presenter*) Nothing to Disclose
Susan Palasis, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose
John A. Maloney, MD, Denver, Colorado (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Course Objectives: 1) to identify strategies to work up challenging cases in the areas of neonatal encephalopathy, unwitnessed head trauma in a young child, pediatric stroke and pediatric orbit, 2) to demonstrate the use of appropriate imaging techniques, including advanced imaging in such scenarios. This case-based format will demonstrate how to approach the diagnostic work-up of challenging pediatric neuroradiology cases. The speakers will focus on neonatal encephalopathy, unwitnessed child trauma, pediatric stroke and pediatric orbital disease. At the end of the course, the audience will gain insights into 1) signs and symptoms that prompt urgent/emergent imaging, 2) how to use the most appropriate sequence of imaging modality considering the childs age/developmental state and clinical context, and 3) the value of detailed imaging, including advanced imaging sequences.

Printed on: 07/01/22

W1-CIN15

AI Governance

Participants
Dania Daye, MD, PhD, Medford, Massachusetts (*Presenter*) Research Consultant, Sigilon Therapeutics;Research Consultant, Medtronic plc
Walter Wiggins, MD, PhD, Durham, North Carolina (*Presenter*) Nothing to Disclose
Curtis Langlotz, MD,PhD, Menlo Park, California (*Presenter*) Stockholder, whiterabbit.ai;Advisor, whiterabbit.ai;Stockholder, Galileo CDS, Inc;Advisor, Galileo CDS, Inc;Stockholder, Bunker Hill, Inc;Board of Directors, Bunker Hill, Inc;Stockholder, Sirona Medical, Inc;Advisor, Sirona Medical, Inc
Nina E. Kottler, MD, MS, San Diego, California (*Presenter*) Partner, Radiology Partners;Stockholder, Radiology Partners;Stockholder, Aidoc Medical;Stockholder, Rad AI
Bernardo Bizzo, MD,PhD, Newton, Massachusetts (*Presenter*) Consultant, Diagnosticos da America (Dasa)

LEARNING OBJECTIVES

#NAME? To provide an overview governance structures and key considerations for the implementation of Artificial Intelligence into practice

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Nonischemic Cardiomyopathies: Case Based Review

Participants
Jadranka Stojanovska, MD, New York, New York (*Presenter*) Nothing to Disclose
Bradley Allen, MD, Chicago, Illinois (*Presenter*) Consultant, Circle Cardiovascular Imaging Inc;Speaker, Medscape, LLC
Jens Bremerich, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1Differentiate CMR imaging for assessment of hypertrophic heart disease2.Discuss causes and imaging appearances of restrictive cardiomyopathy 3.Review diagnostic and management strategies, in particular the importance of CMR in guiding clinical management in right ventricular cardiomyopathy Cardiac MR imaging,' an important imaging modality to diagnose, differentiate, and guide clinical management of non-ischemic cardiomyopathy, has generated considerable excitement in cardiac imaging. Cardiac MR techniques, such as tissue characterization including, strain imaging and parametric mapping generate additional imaging findings that aid not only in the diagnosis but also the management of non-ischemic cardiomyopathy. This case based review session of non-ischemic cardiomyopathies will provide a deeper overview of the impact of MR in cardiac imaging. It will address how cardiac imaging physicians can diagnose, differentiate, and manage patients with non-ischemic cardiomyopathies. Topics of this multi-speaker session will cover: 1) differentiating hypertrophic heart disease 2) restrictive cardiomyopathy: causes and imaging appearance 3) the forgotten ventricle: right ventricular cardiomyopathy. The presentations will be case cased review at a level relevant to the RSNA audience.

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Abstract Archives of the RSNA, 2021

M5-CIN09

Ethics of AI in Radiology

Participants

David Larson, MD, MBA, Portola Valley, California (*Presenter*) Research Grant, Siemens AG ;Advisor, Bunkerhill Health;Shareholder, Bunkerhill Health

Yvonne Lui, MD, New York, New York (*Presenter*) Research collaboration lead, Siemens AGResearch collaboration lead, Facebook AI Research

Julius Chapiro, MD, New Haven, Connecticut (*Presenter*) Research Grant, Guerbet SA;Consultant, Guerbet SA;Research Grant, Boston Scientific Corporation;Consultant, AstraZeneca PLC;Consultant, Bayer AG

LEARNING OBJECTIVES

1) Understand the value of radiology data for algorithm development and how to control access to it. 2) Recognize different types of bias in radiology data. 3) Appreciate ethical issues for machine learning and AI in radiology.4) Understand unique aspects of transparency, fairness, and privacy when using AI in radiology.

Printed on: 07/01/22

W6-CIN20

Data Element Standardization in Radiology

Participants
Marc Kohli, MD, San Francisco, California (*Presenter*) Founder, Alara ImagingStockholder, Alara Imaging
Alex Towbin, MD, Cincinnati, Ohio (*Presenter*) Author, Reed ElsevierConsultant, Anderson Publishing, LtdAdvisory Board, KLAS Enterprises LLC
Tessa S. Cook, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Grant, Siemens AG (ended)Grant, Independence Blue CrossGrant, RSNAGrant, ACR (ended)Grant, NIH MIDRCHonorarium, BJR (Ed board)Honorarium, Sectra (webinar speaker)

LEARNING OBJECTIVES

1) Describe how semantic interoperability is important for the practice of radiology.2) Explain current gaps in assigning body parts to imaging studies.3) Identify the IHE profiles that are important for integration of AI into imaging workflow. This course will describe the importance of using discrete data elements, with shared semantic understanding for integration of AI into imaging workflows. Additionally, the course will describe the current state-of-the-art for identification of imaged body parts as well as IHE integration profiles specific to AI.

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Abstract Archives of the RSNA, 2021

S4-CPH02

Innovations in Dual and Multi-Energy CT

Participants

Wei Zhou, PhD, Aurora, Colorado (*Presenter*) Nothing to Disclose
Rick R. Layman, PhD, Houston, Texas (*Presenter*) Research Grant, Siemens AG;Consultant, General Electric Company;Research collaboration, MARS Bioimaging Ltd;
Daniele Marin, MD, Cary, North Carolina (*Presenter*) Research support, General Electric Company;Research support, Siemens AG;Research support, Bracco Group;Research Consultant, Bracco Group;Research Consultant, Bayer AG

LEARNING OBJECTIVES

1) Understand the basic principles of Dual and Multi-energy CT. 2) Discuss how Dual- and Multi-energy CT is implemented clinically, from acquisitions to post-processing. 3) Learn recent advances in Dual- and Multi-energy CT to benefit a variety of clinical applications. This session will have three speakers to cover the latest innovations in Dual- and Multi-energy CT. The first talk will introduce the technical approaches of clinical systems and emerging technology including photon counting detector. The second talk will discuss the experience when implementing Dual- and Multi-energy CT in clinical practice, including protocol management and image post-processing. Finally, the third talk will focus on a range of current and emerging applications of Dual- and Multi-energy CT for patients examination.

Printed on: 07/01/22

M1-RCP03

Moving Beyond the Gender Binary: Exploring the Gender Spectrum and Diversity in Patient Care, Education, and Research (Sponsored by the RSNA Committee on Diversity, Equity & Inclusion)

Participants
Nolan J. Kagetsu, MD, New York, New York (*Presenter*) Spouse, Employee, Pfizer Inc
David Pryluck, MD, MBA, Danville, Pennsylvania (*Presenter*) Nothing to Disclose
Micah Weir, MD, North Andover, Massachusetts (*Presenter*) Nothing to Disclose
Florence Doo, MD, New York, New York (*Presenter*) Nothing to Disclose
Vaz Zavaletta, MD,PhD, Aurora, Colorado (*Presenter*) Nothing to Disclose
Evelyn Carroll, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Timothy J. Blackburn, PhD, Dallas, Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To improve understanding of transgender and non-binary (gender diverse) terminology. 2)To address the medical needs for transgender and non-binary (gender diverse) patients. 3)To develop an inclusive organizational culture to welcome transgender and non-binary (gender diverse) students, providers, and patients. 4) To address transgender and non-binary research issues. We will review the topic of the gender spectrum and how increased knowledge can benefit our patients, colleagues, and research. There will be 5 lectures with time for a moderated discussion.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

T1-RCP16

Bring On Your Game: Audience Interactive Competitive Hot Seat Review of Best of the Case Collection (NUCS, NEURO, GI, IR, OB)

Participants

Mariam Moshiri, MD, Brentwood, Tennessee (*Presenter*) Nothing to Disclose
Sarah Bastawrous, DO, Seattle, Washington (*Presenter*) Nothing to Disclose
Saeed Elojeimy, MD, PhD, Charleston, South Carolina (*Presenter*) Nothing to Disclose
Xin Wu, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Douglas Katz, MD, Mineola, New York (*Presenter*) Nothing to Disclose
Kush Desai, MD, Chicago, Illinois (*Presenter*) Speakers Bureau, Cook Group Incorporated;Consultant, Cook Group Incorporated;Consultant, Koninklijke Philips NV;Speakers Bureau, Becton, Dickinson and Company;Consultant, Becton, Dickinson and Company;Speakers Bureau, Boston Scientific Corporation;Consultant, Boston Scientific Corporation;Consultant, W. L. Gore & Associates, Inc;Speakers Bureau, Medtronic plc;Consultant, Medtronic plc;Speakers Bureau, Penumbra, Inc;Consultant, Penumbra, Inc;Consultant, Shockwave Medical, Inc;Consultant, Cardinal Health, Inc;;;;
Catherine Phillips, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Develop differential diagnoses for the five radiology subspecialties presented in this courseRecognize imaging features that aid in differential diagnoses, allowing for a more specific diagnosisLearn evaluation of cases in a methodical and clinically applicable fashion This is an interactive and practice-based course for all radiologists at all levels. The format is case-based and rapid-fire evaluation of one's diagnostic skills. The participants are guided through a selection of the best cases from the RSNA Case Collection across 5 subspecialties.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

R3-CNPM09

Implementing Evidence-based Imaging Practices

Participants

Jeffrey D. Robinson, MD, MBA, Seattle, Washington (*Presenter*) Consultant, HealthHelp, LLC
Jeremy D. Collins, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the Medicare Appropriate Use Criteria (AUC) Program requirements, various components of Clinical Decision Support (CDS) and the rationale for its use. 2) Appreciate the challenges to implementing CDS at the enterprise level. 3) Gain strategies for successful implementation of CDS. Speakers from CMS and large academic practices will share their experiences implementing Clinical Decision Support mechanisms.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

ASRT@RSNA: The Changing World of Contraband Smuggling

Participants

Barry Daly, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. To describe newer formulations and packaging of concealed illegal drugs and recent advances in imaging techniques for their detection.2. To discuss the recent sharp increase in abuse of synthetic opioids and problems in the detection of this contraband.3. To describe efforts to detect and curtail contraband smuggling into and within prisons. The recent rapid growth of narcotic abuse worldwide may be described as the unseen Pandemic behind the Pandemic. The last 2 years have seen increasing addiction, with rapidly worsening overdose and related death rates in many countries. The purpose of this lecture is to describe the recent evolution of newer, more dangerous illegal drug formulations and recent advances in imaging techniques for drug detection and interdiction. The detection of concealed contraband drugs in hospital emergency rooms and in prisons is also addressed. The high prevalence of street drug use in the U.S. and many other countries should encourage radiographic technologists to be aware of this serious global health problem.

Abstract Archives of the RSNA, 2021

RSNA/ESR Symposium: Current Status of Stroke Workup and Treatment

Participants

Raman Uberoi, MBChB, FRCR, Oxford, United Kingdom (*Presenter*) Nothing to Disclose
Achala Vagal, MD, Cincinnati, Ohio (*Presenter*) Departmental Research Grant, Johnson & Johnson
Max Wintermark, MD, San Carlos, California (*Presenter*) Consultant, Magnetic Insight, Inc;Consultant, icoMetrix NV;Consultant, Subtle Medical, Inc;Consultant, NOUS Imaging, Inc;Consultant, EMTensor Imaging

LEARNING OBJECTIVES

1)To learn about current evidence of endovascular treatment in acute ischaemic stroke. 2)To discuss advantages and challenges of CT and MRI based stroke imaging work-up. Imaging plays a central role in stroke work up and treatment. This session will focus on evidence based guidelines and the imaging work up of acute ischemic stroke.

Printed on: 07/01/22

W4-CBR08

Controversy Session: To Look or Not to Look?Does Every Woman with Newly Diagnosed Breast Cancer Need Axillary Imaging?

Participants
Penelope Moyle, MBChB, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose
Jessica Leung, MD, Houston, Texas (*Presenter*) Scientific Advisory Board, Subtle Medical, IncSpeaker, General Electric CompanySpeaker, Hologic, IncScientific Advisory Board, Seno Medical
Kelly K. Hunt, MD, Houston, Texas (*Presenter*) Institutional Research Grant, CairnSurgical, Inc;Institutional Research Grant, Eli Lilly and Company;Institutional Research Grant, Lumicell, Inc;Medical Advisory Board, ArmadaHealth

LEARNING OBJECTIVES

1)Understand the prognostic implications and treatment strategies of metastatic lymph nodes in the neo-adjuvant and non-neoadjuvant setting in early breast cancer .2)Understand the optimal imaging and biopsy techniques in the staging of early breast. The presence of axillary node metastases remains one of most important prognostic factors in breast cancer .The diagnosis of axillary metastases determines the need for systemic chemotherapy and radiation therapy. Controversy remains on when and how we should stage axillary lymph nodes in early breast cancer. Imaging is helpful in identifying metastases yet has poor sensitivity and specificity in many modalities which has led to criticism of over treatment of the axilla. With increasing neoadjuvant treatments, advanced imaging modalities and localisation of metastatic lymph nodes, many believe accurate staging optimises patient outcomes and reduces morbidity. This controversy session will explore this topic through three lectures: the prognostic information of metastatic axillary lymph nodes and ideal treatment in early breast cancer, the optimal imaging of the axilla and finally the optimal biopsy methods with cost effectiveness. The session with end with a discussion summarizing the evidence for us to make a balanced decision on how and when to image the axilla in early breast cancer .

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Health Policy Agenda: Are Radiologists at the Table?

Participants
Richard Heller III, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose
Denise R. Aberle, MD, Los Angeles, California (*Presenter*) Investigator, Johnson & Johnson;Research Grant, Johnson & Johnson
Etta D. Pisano, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Sarah S. Avery, MD, Austin, Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)Using specific examples, explain the reasons that physician engagement on health policy is important for patients and the specialty of radiology.2)Describe the influence of clinical research on policy decisions.3)Identify multiple ways to become involved in advocacy efforts. Radiology does not exist in a vacuum. Lawmakers and regulators, as well as commercial insurance companies, influence how medical imaging services are accessed and reimbursed. This case-based lecture session explores the importance of radiologist-led advocacy, including examples of when research did and did not influence policy. Attendees should walk away from this session with an understanding of the importance of physician engagement on policy, as well as ways to become involved themselves.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

M4-RCP01

Flexible Work Arrangements and Their Impact on Advancement of Women in Radiology (Sponsored by the American Association for Women in Radiology)

Participants

Kristin Porter, MD,PhD, Birmingham, Alabama (*Presenter*) Stockholder, Pfizer Inc;Medical Advisory Board, Bracco Group
Parisa Mazaheri, MD, St Louis, Mississippi (*Presenter*) Nothing to Disclose
K. Elizabeth Hawk, MD,PhD, Studio City, California (*Presenter*) Nothing to Disclose
Eric Ledermann, MBA,DO, Tampa, Florida (*Presenter*) Nothing to Disclose
Kay D. Lozano, MD, Centennial, Colorado (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Inform women in radiology and practice leaders regarding the A) potential benefits and B) negativeconsequences of flexible work arrangements, C) with special attention to during and after the COVID-19pandemic. Flexible scheduling arrangements have been suggested as an opportunity to improvephysician well-being, improve work-life integration, and increase retention, particularly ofwomen in radiology and during the pandemic. Incorporating more flexible work opportunitiesmay improve employee engagement and satisfaction in the workplace; however, there arefinancial and advancement implications for part-time work as well. The flexible schedulingsolution, while keeping more women in radiology, may be hindering their advancement.Drawing from the experience of women in radiology and radiology leaders across practicetypes, this educational panel will address the pros and cons of flexible scheduling,with particular emphasis on the advancement implications for women in radiology in thecontext of the COVID-19 pandemic.

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Abstract Archives of the RSNA, 2021

S2-CCH04

Thoracic Malignancy I: Imaging Treatment in Non-small Cell Lung Cancer

Participants

Jane P. Ko, MD, New York, New York (*Presenter*) Research collaboration, Siemens AG
Mylene T. Truong, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Brett W. Carter, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Girish S. Shroff, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Mizuki Nishino, MD, Boston, Massachusetts (*Presenter*) Institutional Research Grant, DAIICHI SANKYO GroupInstitutional Research Grant, AstraZeneca PLCInstitutional Research Grant, Canon Medical Systems CorporationConsultant, AstraZeneca PLC
Florian Fintelmann, MD, Boston, Massachusetts (*Presenter*) Research support, Boston Scientific Corporation
Anastasia Oikonomou, MD,PhD, Toronto, Ontario (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Understand challenges in diagnosing and treating lung cancer.2.Review expected imaging features related to therapy for lung cancer. This session focuses on lung cancer, a leading cause of death from cancer. The diagnosis and management of lung cancer is challenging. Therapy for lung cancer requires a multidisciplinary approach in which surgery, radiation therapy, chemotherapy, and immunotherapy have roles. An understanding of the typical findings and complications after therapy is important. Therefore, this lecture format session will cover lung cancer in the background of interstitial lung disease and current and future understanding of the potential role of radiomics in lung cancer. Lectures will review new targeted and immunotherapy approaches for treating lung cancer, covering aspects in regards to tumor response assessment on imaging and lung toxicity. Additionally, review will include discussion of imaging findings after radiotherapy; an awareness of these aids in both minimizing misdiagnosis and identifying tumor recurrence.

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Abstract Archives of the RSNA, 2021

Essentials of Quality Research and Practice Standards

Participants

Marta Heilbrun, MD,MS, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Matthew Davenport, MD, Ann Arbor, Michigan (*Presenter*) Royalties, Wolters Kluwer nv
Rajesh P. Shah, MD, Palo Alto, California (*Presenter*) Research support, Merit Medical Systems, Inc;Consultant, Intuitive Surgical, Inc;Consultant, F. Hoffmann-La Roche Ltd;Research support, Lucence Health;Consultant, Histosonics, Inc;Consultant, Artio Medical, Inc
Jenny K. Hoang, MBBS, Baltimore, Maryland (*Presenter*) Spouse, Employee, Merck & Co, Inc

LEARNING OBJECTIVES

1) Understand requirements for quantitative methodologies in Quality Improvement work. 2) Become familiar with national databases and development work that supports systems approaches to quality improvement. 3) Learn to incorporate registries and data capture into daily work in order to improve quality. The Essentials of Quality Research and Practice Standards course will feature 4 Quality Improvement expert speakers, Marta Heilbrun, Matt Davenport, Rajesh Shah and Jenny Hoang, who will deliver short didactic presentations followed by an interactive moderated panel discussion. We will go over the basic data requirements and considerations that are necessary for high impact quality improvement work. We will share ideas to help you develop your own quality improvement dashboards, using reporting tools and data registries. By the end of the session, participants will have concrete ideas and access to tools that facilitate participation in quality improvement activities at both a local level and on a national stage.

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Abstract Archives of the RSNA, 2021

W2-CIN17

Natural Language Processing in 2021

Participants

Wendy Chapman, PhD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose
Imon Banerjee, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Barbara Jones, MD,MSc, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Describe potential roles for NLP for research and quality improvement 2. List some of the challenges of using NLP on clinical notes 3. Map the appropriate processing technique to a radiology information extraction problem Natural language processing (NLP) is a potentially powerful tool for extracting meaning from radiology reports. What you may not realize is the complexity involved in going on an NLP journey. This panel will provide a practical look at NLP for radiology by stepping through a real quality improvement project using NLP and comparing and contrasting the main methodologies being used in radiology today.

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Abstract Archives of the RSNA, 2021

Deep Learning in MRI

Participants
Fang Liu, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Matthew Rosen, PhD, Charlestown, Massachusetts (*Presenter*) Founder, HyperfineStockholder, HyperfineConsultant, HyperfineFounder, Vizma Life SciencesStockholder, Vizma Life SciencesConsultant, Vizma Life SciencesFounder, Intact Data ServicesStockholder, Intact Data ServicesConsultant, Intact Data ServicesFounder,
Greg Zaharchuk, MD, PhD, Stanford, California (*Presenter*) Research Grant, General Electric Company;Research Grant, Bayer AG;Stockholder, Subtle Medical, Inc;Advisory Board, Biogen Idec Inc
Li Feng, PhD, New York, New York (*Presenter*) Research support, Hyperfine Research, IncResearch collaboration, Hyperfine Research, Inc

LEARNING OBJECTIVES

1)Explain the basic principles of Deep Learning (DL) in MR image acquisition, reconstruction, and analysis. 2)Describe the principles and practical significance of several advanced DL clinical applications in MRI. 3) Recognize the limitations, challenges, and promises associated with DL in MRI. In this session, we will cover principles and basics that serve as the theoretical foundation of deep learning, and provide examples of how deep learning improves MRI for image acquisition, reconstruction, and analysis from both a technical and clinical point of view. Our speakers will give lectures for an overview of the emerging deep learning techniques applied in challenging MRI applications, including quantitative MRI, low field MRI, image transformation, and disease prediction using MRI. Learners are expected to recognize the important aspects of deep learning in MRI research and clinical practice, learn how to apply basic and advanced deep learning techniques to accelerate MRI acquisition, enhance image analysis, automate clinical workflows, and predict outcomes and prognosis.

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Abstract Archives of the RSNA, 2021

Essentials in Head and Neck Radiology: Anatomy, Search Patterns, and Structured Reports

Participants

Matthew S. Parsons, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Tanya Rath, MD, Scottsdale, Arizona (*Presenter*) Nothing to Disclose
Harprit Bedi, MD, Wellesley, Massachusetts (*Presenter*) Nothing to Disclose
Paul Bunch, MD, Winston Salem, North Carolina (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Review relevant imaging anatomy of the brachial plexus, paranasal sinuses, neck, and temporal bone2.Reveal key search patterns which aid in the interpretation of brachial plexus, paranasal sinuses, neck, and temporal bone examinations3.Promote the use of structured reports for these examinations as a manner to provide added value to ordering providers In the field of head and neck radiology, the evaluation of structures such as the brachial plexus, paranasal sinuses, and temporal bone can be challenging for the practicing radiologist. Through a series of didactic lectures, this essentials course will review relevant anatomy and reveal search patterns fundamental to the interpretation of these studies. Lecturers will also specify examples of structured reports that can provide added value to ordering providers.

Printed on: 06/28/22

W2-RCP14

Hands-on Course: 3D Printed Anatomic Models (Sponsored by the RSNA 3D Printing Special Interest Group)

Participants
Nicole Wake, PhD, Bronx, New York (*Presenter*) Employee, General Electric Company
Peter Liacouras, PhD, North Potomac, Maryland (*Presenter*) Nothing to Disclose
Amy Alexander, MS, Rochester, Minnesota (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Explain the workflow to create patient-specific 3D printed anatomical models from volumetric medical imaging data.2. Identify and apply image segmentation techniques used to create 3D printed anatomical models, including thresholding, region growing, and manual editing. 3. Describe and apply image post-processing techniques and 3D design principles required to save models in appropriate file formats (e.g. STL). Three-dimensional (3D) printed anatomic models derived from volumetric medical imaging data can enhance pre-surgical planning, provide real-time intra-operative guidance, and facilitate both patient and trainee education. In order to generate patient-specific anatomic models for 3D printing, imaging data must first be segmented and converted to virtual 3D models which represent the intended anatomy of interest; and these models are saved in a format such as the standard tessellation language (STL) which are compatible with 3D printers. This course, sponsored by the RSNA 3D Printing Special Interest Group, covers the use of industry-standard FDA-cleared software for the design and fabrication of patient-specific 3D anatomic models. Specifically, this course will explore image segmentation and image post-processing techniques to create patient-specific anatomic models for use in clinical practice.

Printed on: 06/28/22

M6-CMS10

Update on Whole Body MRI for Pediatric Malignancies

Participants
Birgit Ertl-Wagner, MD, Toronto, Ontario (*Presenter*) Spouse, Employee, Siemens AG
Andrea S. Doria, MD, Toronto, Ontario (*Presenter*) Research Grant, Shire plc;Research Grant, Novo Nordisk AS;
Lisa J. States, MD, Plymouth Mtng, Pennsylvania (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.To review basic MRI and WBMRI techniques unique in pediatric patients and the current role of WBMRI for the assessment of pediatric tumors2.To describe features of pediatric tumors on MRI from head to toe3.To discuss pitfalls and challenges to interpretation of pediatric oncological cases This session will present an anatomic based review of common and uncommon pediatric malignancies focused on MRI and Whole-Body MRI techniques. The purpose of this session is to educate, review and foster future discussions on promoting the value and role of MRI in pediatric oncology imaging.

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Abstract Archives of the RSNA, 2021

W4-CIN19

Medical Imaging and Data Resource Center: A Multi-Society Approach to Advance Research on COVID-19 and Other Diseases

Participants

Maryellen Giger, PhD, Chicago, Illinois (*Presenter*) Advisor, Emalex Biosciences, Inc;Stockholder, Hologic, Inc;Royalties, Hologic, Inc;Shareholder, Quantitative Insights, Inc;Co-founder, Quantitative Insights, Inc;Shareholder, QView Medical, Inc;Royalties, General Electric Company;Royalties, MEDIAN Technologies;Royalties, Riverain Technologies, LLC;Royalties, Canon Medical Systems Corporation

Adam Flanders, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

John Mongan, MD,PhD, San Francisco, California (*Presenter*) Research Grant, General Electric Company;Royalties, General Electric Company;Spouse, Employee, Annexon Biosciences;Spouse, Employee, AbbVie Inc

Judy Gichoya, MBChB,MS, Atlanta, Georgia (*Presenter*) Consultant, Cook Group Incorporated;Advisor, Boston Scientific Corporation

Tessa S. Cook, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Grant, Siemens AG (ended)Grant, Independence Blue CrossGrant, RSNAGrant, ACR (ended)Grant, NIH MIDRCHonorarium, BJR (Ed board)Honorarium, Sectra (webinar speaker)

LEARNING OBJECTIVES

1.Appreciate the motivation and collaborations in the establishment of MIDRC.2.Understand the methods for creating, de-identifying, curating, and transferring imaging data from clinical sites to the public commons.3.Attain a realistic appreciation of the process for clinical sites to contribute to MIDRC.4.Obtain exposure to the various research developments and applications involving machine intelligence and natural language processing by MIDRC investigators. This course will include presentations from five MIDRC investigators who will clarify the motivation behind the establishment of MIDRC in addressing the COVID-19 pandemic. They will give overviews of the work of over 80 investigators involved in developing the infrastructure of MIDRC and in conducting research in machine intelligence and natural language processing. Speakers will also describe the methods for creating, de-identifying, curating, harmonizing, and transferring imaging data from clinical sites to the public commons, and demystify the process for clinical sites to contribute to MIDRC.

Printed on: 06/28/22

W1-CNMMI04

Pediatric Nuclear Medicine: Read with the Experts

Participants
Susan E. Sharp, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose
Neha Kwatra, MBBS, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Frederick Grant, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Frederic H. Fahey, DSc, Boston, Massachusetts (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss advances in pediatric general nuclear medicine and PET. 2) To review patient preparation and clinical indications for nuclear medicine and PET studies in pediatrics. 3) To illustrate pearls and pitfalls of imaging in the pediatric population. This course will provide an update on pediatric general nuclear medicine and PET. We will include an introduction including patient preparation, clinical indications for various studies, pearls and pitfalls and artifacts as well as a discussion of both oncologic and non-oncologic topics with illustrative cases. The course will include primarily core topics in pediatric nuclear medicine and PET with focus on the general radiologist, residents and fellows.

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Abstract Archives of the RSNA, 2021

S3-CRI02

Pelvic Pain: Non Pregnancy-related

Participants
Phyllis Glanc, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose
Mary C. Frates, MD, Sharon, Massachusetts (*Presenter*) Nothing to Disclose
Gayatri Joshi, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Familiarize the learner with the sonographic appearance of common sources of gynecological and non-gynecological pelvic pain.
2. Improve the learners diagnostic acumen and ability to provide an appropriate differential for common and relatively uncommon sources of gynecological .3. Enhance the knowledge required to recommend appropriate imaging pathways for pelvic pain. This course will be divided into 3 segments with ample time for Q&A. The initial section will focus on ovarian causes of pelvic pain. At the end of this section, the learner will be able to describe the sonographic appearances of ovarian torsion, tubo-ovarian abscess, hemorrhagic cysts and other pathology of the ovary, and will be able to use US to help differentiate ovarian causes of pelvic pain.The second session will focus on non-ovarian gynecological sources of pelvic pain. At the end of this session the learner will be able to evaluate and diagnosis ectopic pregnancies, sequalae of deep infiltrating endometriosis and adenomyosis, IUD placement, in addition to other less common sources of gynecological pain.The last session will focus on non-gynecological causes of pelvic pain. At the end of this section the learner will be able to identify and diagnosis entities including but not limited to acute appendicitis, appendiceal mucocele, inflammatory bowel pathology and distal ureter or UJV calculi.

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Abstract Archives of the RSNA, 2021

Deep Learning Lab: Pneumonia Detection Model Building

Participants

Felipe C. Kitamura, MD, PhD, Sao Paulo, Brazil (*Presenter*) Consultant, MD.ai, IncSpeaker, GE Healthcare

Ian Pan, MD, Brookline, Massachusetts (*Presenter*) Consultant, MD.ai, Inc;Consultant, Centaur Labs;Consultant, Diagnósticos da América SA (Dasa);Consultant, CoRead AI

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

M6-CRI04

Hiding in Plain Site: Endometriosis

Participants
Nancy Kim, MD, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose
Scott Young, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose
Hye-Chun Hur, MD, MPH, Scarsdale, New York (*Presenter*) Author with royalties, Wolters Kluwer nv

LEARNING OBJECTIVES

1) Improve awareness about endometriosis to radiologists. 2) Recognize the US and MR appearance of endometriosis. 3) Optimize systematic reporting of endometriosis findings (structured reporting) to help our gynecology colleagues manage endometriosis. Endometriosis is a common cause of chronic pelvic pain and infertility in women of reproductive age. Imaging findings of endometriosis can be hiding in plain site on routine pelvic imaging. This course will be a lecture series with a short Q&A session going over US and MR appearances of endometriosis as well as discussing ways to help our gynecology colleagues with management of endometriosis. After this course, the attendee should be able to identify US and MR imaging features of endometriosis and consider structured reporting to help our gynecology colleagues.

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Abstract Archives of the RSNA, 2021

M2-RCP30

Mentored Cardiac CT Angiography Case Review: Part II

Participants

Jacobo Kirsch, MD, Weston, Florida (*Presenter*) Medical Advisory Board, Zebra Medical Vision Ltd
Brian B. Ghoshhajra, MD, Boston, Massachusetts (*Presenter*) Research Grant, Siemens AG;Consultant, Koninklijke Philips NV
Prachi P. Agarwal, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, South Carolina (*Presenter*) Research Grant, Bayer AGResearch Grant, Bracco GroupResearch Grant, Elucid BioImaging IncConsultant, Elucid BioImaging IncResearch Grant: General Electric CompanyResearch Grant, Guerbet SAResearch Grant, Heartflow, IncSpeakers Bureau, Heartflow IncResearc
Harold I. Litt, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Siemens AG Research grant, Philips

LEARNING OBJECTIVES

Empty Abstract

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T4-CIR10

MSK Interventions

Participants

Steven Yevich, MD, MPH, Houston, Texas (*Presenter*) Advisory Board, Medtronic plcEditor, HMP Global, LLC
Matthew Callstrom, MD,PhD, Rochester, Minnesota (*Presenter*) Research Grant, EDDA Technology, Inc;Research Grant, Galil Medical Ltd;Consultant, Johnson & Johnson;Consultant, Boston Scientific Corporation
Majid Khan, MD, Philadelphia, Pennsylvania (*Presenter*) Consultant, Stryker Corporation;Consultant, MedWaves, Inc
Dimitrios Filippiadis, MD, PhD, Athens, Greece (*Presenter*) Nothing to Disclose
Frederic Deschamps, Villejuif, France (*Presenter*) Consultant, Medtronic plc;Consultant, General Electric Company;Consultant, Ablatech
Brandon Key, MD, Milwaukee, Wisconsin (*Presenter*) Consultant, Siemens

LEARNING OBJECTIVES

1) Identify new technologies for the treatment of musculoskeletal pathology that can be applied in daily practice. 2) Consider new safety measures to implement during treatment of musculoskeletal pathology. 3) Identify triage options for the different IR treatments used for musculoskeletal pathology. This didactic educational session focuses on the emerging Interventional Oncology treatment options for musculoskeletal tumors. Clinical approach will be discussed to help guide pre-procedure triage of patient care. Technical and safety factors will be reviewed using case examples. New and exciting applications will include microwave ablation in the spine, screw fixation, and the application of digital technologies. The session is designed to stimulate MSK IO experts and also encourage those who are interested to explore this bludgeoning niche.

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Abstract Archives of the RSNA, 2021

Arthritis: When is it NOT Osteoarthritis

Participants

Carl S. Winalski, MD, Rocky River, Ohio (*Presenter*) Institutional service agreement, PAREXEL International Corporation;Institutional service agreement, CartiHeal Ltd;Research Consultant, Siemens AG;Stockholder, Pfizer Inc;;;;;;;;
Monique Reijnierse, MD, Leiden, Netherlands (*Presenter*) Research Consultant, ASAS Group, LLC
Donald Flemming, MD, Hershey, Pennsylvania (*Presenter*) Nothing to Disclose
Anne Cotten, MD, Lille, France (*Presenter*) Nothing to Disclose
Nele Herregods, MD, PhD, Lierde, Belgium (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Recognize pediatric-specific imaging characteristics of the most commonly involved joints in JIA 2.Describe the radiologic features of rapid idiopathic arthritis (RIA)3.Differentiate osteoarthritis from psoriatic arthritis and pseudolesions4.Characterize vertebral bony outgrowths based on origin and growth direction5.Differentiate hemochromatosis related arthropathy The specific diagnosis of an arthropathy is often challenging because the imaging presentation of these entities may overlap with each other. It is important for radiologists to recognize features and clues that support one diagnosis over another. The purpose of this course's lectures is to improve participant understanding of the imaging features of arthritis and increase confidence in their diagnosis.

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Abstract Archives of the RSNA, 2021

Innovating Education During the COVID-19 Pandemic

Participants

Priscilla Slanetz, MD,MPH, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Lilja Solnes, MD, Baltimore, Maryland (*Presenter*) Consultant, Lantheus Holdings;Research funded, Novartis AG;Research funded, Precision Molecular Imaging;Royalties, Reed Elsevier
Omer Awan, MD, Lutherville Timonium, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

By the end of this session, participants will:1. Become familiar with several educational innovations implemented during the COVID-19 pandemic;2. Be able to identify educational obstacles with and solutions while transitioning back to a new normal of trainee education; and3. Understand the lasting impact of the pandemic on workplace culture and trainee education The COVID-19 pandemic led to substantial immediate change with regard to trainee education. In spring 2019, training programs rapidly adapted to a virtual learning environment. In addition to converting to remote case readouts and online education, several national organizations and resident-driven educational initiatives helped to meet the ongoing educational needs of trainees, especially for those at smaller programs. Now as we emerge from the pandemic, training programs are establishing a new normal which presents some unique challenges and opportunities. Finally, as we reflect back on the pandemic, there are some positive lasting changes including a renewed focus on wellness, greater inter-institutional collaborations, incorporation of new curricular topics related to health equity and crisis management, and new virtual faculty development programs designed to both enhance trainee education and advance the careers of early and mid-career faculty. The format of this session will be lecture based. By the end of the session, participants will leave with an awareness of new approaches to teaching the next generation of radiologists.

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Abstract Archives of the RSNA, 2021

The Impact of Radiology Extenders

Participants

Saurabh Jha, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Ruth C. Carlos, MD, MS, Ann Arbor, Michigan (*Presenter*) In-kind support, Reed Elsevier;Editor, Reed Elsevier;Travel support, General Electric Company
Taj Kattapuram, MD, Arvada, Colorado (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand the economic and logistic arguments in favor of skill mix.2. Appreciate the arguments against non-physicians rendering radiology reports.3. Speculate on how the future of the field should influence the the type and quantity of labor. Physician extenders in radiology are controversial. Proponents contend that by absorbing cognitively simple work they allow radiologists to practice at the top of their license. Opponents fear that extenders are a slippery slope to devaluing of the field. The two points of view will be debated. The audience will appreciate the nuances of both sides of the argument

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Abstract Archives of the RSNA, 2021

Inclusion as a Key to Success of Diversity Efforts (Sponsored by the RSNA Committee on Diversity, Equity & Inclusion)

Participants
Jorge Soto, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Maureen Kohi, MD, Chapel Hill, North Carolina (*Presenter*) Nothing to Disclose
Yoshimi Anzai, MD,MPH, Salt Lake City, Utah (*Presenter*) Nothing to Disclose
Marques Bradshaw, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Judy Yee, MD, New York, New York (*Presenter*) Advisor, Bracco GroupResearch Grant, Koninklijke Philips NVResearch Grant, General Electric Company

LEARNING OBJECTIVES

1. To understand the difference between Diversity and Inclusion 2. To become aware that inclusive culture is essential for recruiting and retaining diverse faculty and staff 3. To discuss what can be done to change the culture of department and organization to welcome diverse faculty This course will provide learners the tools to discern the differences between diversity and inclusion and how the two must occur together in order to impact change. In addition, the audience will walk-away with a toolkit and strategies to lead such change and be a part of this movement locally, regionally, and nationally.

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Abstract Archives of the RSNA, 2021

M6-CIN10

Data Sharing and Patient Privacy in the World of AI

Participants

Fred W. Prior, PhD, Little Rock, Arkansas (*Presenter*) Nothing to Disclose
John B. Freymann, BS, Rockville, Maryland (*Presenter*) Nothing to Disclose
Alistair Johnson, DPhil, Cambridge, Massachusetts (*Presenter*) Nothing to Disclose
Matthew P. Lungren, MD, Palo Alto, California (*Presenter*) Advisor, Segmed, Inc;Shareholder, Segmed, Inc;Advisor, Bunkerhill Health;Shareholder, Bunkerhill Health;Advisor, Microsoft Corporation;Employee, Amazon Web Services
Avishek Chatterjee, Maastricht, Netherlands (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand current HIPAA/GDPR policies and some of the challenges related to anonymization of medical images. 2) Identify the concepts of differential privacy and new privacy preserving initiatives.3) Discuss how radiomics and artificial intelligence (AI) analyses of medical images use anonymized open access data. The rapid growth of AI in medical imaging is heavily dependent on the availability of high-quality image data for testing and validation. Open access data sharing is critical to enable adequate sampling of the human population and the wide variety of disease states. It is equally critical to protect patient privacy and to comply with national and international regulations governing protected or sensitive health information and personally identifiable information. In the U.S. the HIPAA Privacy Rule establishes national standards to protect individuals' healthcare information. The General Data Protection Regulation (GDPR) acts similarly in the European Union. These two sets of regulations require images and other patient information to be de-identified, anonymized or pseudonymized depending on how the data will be used, but do so in significantly different ways. This course will explore these regulations as they relate to data sharing and discuss the challenges they pose. We will introduce the concepts of differential privacy and new privacy preserving initiatives particularly in relation to the use of images in AI applications. Finally, we will discuss how radiomics and machine learning, including deep learning, applications depend on anonymized, open access data and what alternatives there might be if such data sharing is not possible. The course will provide a blended learning experience by including a didactic component prior to a panel discussion.

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Abstract Archives of the RSNA, 2021

T1-CCH01

HRCT Interpretation Session

Participants

David A. Lynch, MBBCh, Denver, Colorado (*Presenter*) Research Consultant, CALYX Inc;Research Consultant, Boehringer Ingelheim GmbH;Research Consultant, Veracyte, Inc;Research Consultant, DAIICHI SANKYO Group;Research Consultant, AstraZeneca PLC;Consultant, Polarean, Inc;Consultant, Bristol Myers Squibb Company
Jeffrey Galvin, MD, Silver Spring, Maryland (*Presenter*) Nothing to Disclose
Marie-Pierre Revel, Paris, France (*Presenter*) Nothing to Disclose
Cornelia Schaefer-Prokop, MD, Amersfoort, Netherlands (*Presenter*) Nothing to Disclose
Santiago Rossi, MD, Buenos Aires City, Argentina (*Presenter*) Advisor, AstraZeneca PLC;Advisor, Boehringer Ingelheim GmbH;Speaker, Boehringer Ingelheim GmbH
Teri Franks, MD, Silver Spring, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Identify key imaging features of interstitial lung disease that lead to a useful categorization. 2. Describe the most recent Fleischner criteria for the diagnosis of Idiopathic pulmonary fibrosis. 3. Analyze the key imaging features of diffuse lung disease that lead to pulmonary fibrosis including: organizing pneumonia, idiopathic pulmonary fibrosis, acute interstitial pneumonia/ARDS, cigarette smoke related fibrosis and sarcoidosis. 4. Manage and contribute to a multi-disciplinary conference (MDD) that focuses on diffuse lung disease. The assessment of fibrotic diffuse lung injury is difficult and multidisciplinary diagnosis (MDD) is recommended for a more accurate diagnosis of the underlying disease. Radiologists are a key member of the MDD team. This session is designed to help the radiologist understand the strengths and weaknesses of the MDD. Ten cases of diffuse lung disease will be presented to 4 experienced chest radiologists. The complete DICOM set of images will be displayed to both the panelists and the participants. The panelists will describe the key features that support a diagnosis. The session will also allow the participants to gauge the degree of agreement between experienced chest radiologists. The Chief of Pulmonary Pathology at the Joint Pathology Center in Silver Spring will discuss the pathology in each case. The case review session will begin with short presentations providing a general approach to the imaging features of fibrotic lung disease, and explaining the current Fleischner criteria for idiopathic pulmonary fibrosis. The unknown cases can be viewed on your internet enabled phone, tablet or computer.

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Abstract Archives of the RSNA, 2021

Advances in SPECT & PET: Technology & Clinical Applications

Participants

Kevin P. Banks, MD, Joint Base San Antonio, Texas (*Presenter*) Nothing to Disclose
Olga G. James, MD, Chapel Hill, North Carolina (*Presenter*) Nothing to Disclose
Gary Ulaner, MD,PhD, Irvine, California (*Presenter*) Speaker, Siemens AG;Speaker,Lantheus Holdings;Research support, General Electric Company;Research support, F. Hoffmann-La Roche Ltd;Research support, Lantheus Holdings;Research support, Novartis AG
Michael V. Knopp, MD, PhD, Columbus, Ohio (*Presenter*) Nothing to Disclose
Janis P. O'Malley, MD, Birmingham, Alabama (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss advances in SPECT and PET technology. 2) To review advances in breast imaging with radiopharmaceuticals. 3) To illustrate advances with images from the field. This course will provide an update on advances in SPECT and PET with a focus on technological advances, improvements in infection imaging and breast imaging. There will be a series of lectures including a mix of core material and new innovations. We will also include clinical pearls and pitfalls and illustrative cases.

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T4-CIN12

The Business of Artificial Intelligence in Radiology: A Cost, a Long-term Investment or an Immediate Business Opportunity?

Participants

Mona Flores, MD,MBA, Santa Clara, California (*Presenter*) Employee, NVIDIA Corporation
Hari Trivedi, MD, Atlanta, Georgia (*Presenter*) Consultant, Sirona Dental GmbH;Founder, Lightbox AICMO, BioData Consortium;Research Support, Kheiron Medical Technologies Ltd;Research Support, Nightingale Project;Consultant, Arterys Inc
Nina E. Kottler, MD, MS, San Diego, California (*Presenter*) Partner, Radiology Partners;Stockholder, Radiology Partners;Stockholder, Aidoc Medical;Stockholder, Rad AI
Luciano M. Prevedello, MD, MPH, Columbus, Ohio (*Presenter*) Nothing to Disclose
Paul J. Chang, MD, Chicago, Illinois (*Presenter*) Research Grant, Koninklijke Philips NV;Advisory Board, Bayer AG;Advisory Board, Aidoc Inc;Advisory Board, Inference Analytics, Inc;Advisory Board, Subtle Medical, Inc;Advisory Board, Gesund.ai

LEARNING OBJECTIVES

1) Learn what it takes to implement AI at your practice. 2) Understand the business models.

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Abstract Archives of the RSNA, 2021

M4-CIN07

The Imaging Informatics Clinical Interspace Between Radiology and Pathology

Participants

R. Nick Bryan, MD, PhD, Austin, Texas (*Presenter*) Stockholder, Galileo CDS, Inc;Officer, Galileo CDS, Inc

John A. Carrino, MD, MPH, New York, New York (*Presenter*) Research Consultant, Pfizer Inc;Consultant, Covera Health;Research Consultant, Globus Medical, Inc;Research Consultant, NuVasive, Inc;Advisory Board, Carestream Health, Inc;Scientific Advisory Board, IAG, Image Analysis Group;Advisory Board, ImageBiopsy Lab;;;;;

Marilyn Bui, MD,PhD, Tampa, Florida (*Presenter*) Scientific Advisory Board, Aiforia Technologies Oy;Scientific Advisory Board, ContextVision AB;Scientific Advisory Board, Visiopharm

Jacob J. Visser, MD, PhD, Rotterdam, Netherlands (*Presenter*) Medical Advisor, contextflow GmbH

Anil Parwani, MD,PhD, Columbus, Ohio (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Understand Integrated Diagnostics and its role in filling clinical interspaces between specialties, particularly radiology and pathology.2.Appreciate contemporary Imaging Informatics and its central role in advancing and linking radiology and pathology practices.3.Be prepared to drive institutional programs in integrated diagnostics, building on imaging informatics cores in radiology and pathology. The term Integrated Diagnostics (ID) refers to a vision for the future where data from the entire diagnostic arsenal including imaging, pathology and molecular diagnostics, as well as clinical data from the Electronic Health Record (EHR), are aggregated and contextualized to enhance insights. Medical informatics, including Clinical Decision Support (CDS) tools, play a central role in the ID concept. By simply performing a myriad of diagnostic tests, radiology and pathology already play major, though often disconnected and relatively passive roles in medical diagnosis. The transition to discrete medical data, though challenging, has enabled the contemporary EHR. In the case of radiology and pathology, the digitization of medical image data now allows radiology and pathology to take common advantage of inexpensive digital archival and distribution systems to more efficiently link our data into the EHR, allowing us to more efficiently communicate our test results to referring physicians and patients. Digital image data also enables powerful Artificial Intelligence (AI) and Machine Learning (ML) techniques to improve the quality of our images and analyze them more efficiently and, possibly, more accurately. Incorporating these digital resources into an integrated Imaging Informatics environment now offers radiology and pathology the opportunity to not only better each others individual diagnostic processes by timely sharing of data and results, but, in combination, improve the overall diagnostic process. However, the current administrative and departmental separation of radiology and pathology restricts our ability to take common advantage of digital resources, limits intellectual interchange between the specialties, discourages coeducational opportunities, and contributes to the fragmented nature of health care. A robust Imaging Informatics organization and infrastructure, along with departmental reorganization and priority realignment could fill that gap, interspace, between the diagnostic giants of radiology and pathology. This course will present the basis of and need for more integrated diagnostics in general, but specifically between radiology and pathology. Real world experiences and practical steps towards this challenge will be discussed. Course content will include the Bayesian principles of diagnostics; contemporary medical informatics including CDS; medical applications of Artificial Intelligence (AI) and Machine Learning (ML) particularly as applied to medical image data; radiology and pathology workflow integration; and practice experience in ID. Session Format: Short didactic presentations; panel discussions; Q/A sessions with audience response; and Case based presentations.

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Abstract Archives of the RSNA, 2021

Fundamental of Diffuse Lung Disease

Participants
Brett M. Elicker, MD, San Francisco, California (*Presenter*) Nothing to Disclose
David M. Naeger, MD, Denver, Colorado (*Presenter*) Nothing to Disclose
Joanna Escalon, MD, New York, New York (*Presenter*) Research Consultant, VinBrain (not relevant to the presentation)
Laura Heyneman, MD, Durham, North Carolina (*Presenter*) Author, RELX

LEARNING OBJECTIVES

1. List typical findings of diffuse lung disease on HRCT and their most common mimics2. Develop an approach to nodules, cysts, airspace opacity, and mosaic attenuation on HRCT3. Describe the role of high-resolution CT (HRCT) in the multi-disciplinary diagnosis of diffuse lung disease Fundamentals of diffuse lung disease will discuss typical findings of diffuse lung diseases on CT and their significance. The course will focus on pitfalls, differential diagnosis, and the role of HRCT in the multi-disciplinary approach.

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T6-CCH07

Pearls and Pitfalls in Chest Radiography

Participants
Andetta R. Hunsaker, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
H. Page McAdams, MD, Durham, North Carolina (*Presenter*) Consultant, MedQIA Imaging Core Laboratory Author, Reed ElsevierResearch Consultant, Novartis AGStockholder, Novartis AGStockholder, Abbott LaboratoriesStockholder, AbbVie IncStockholder, Bristol-Myers Squibb CompanyStockholder, CVS Health CorporationStoc
Gerald F. Abbott, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Mark S. Parker, MD, Richmond, Virginia (*Presenter*) Co-author, Thieme Medical Publishers, Inc

LEARNING OBJECTIVES

1) Show the value of a thorough search of both the frontal and lateral films in diagnosing lung malignancies which may otherwise be missed2) Identify key structures on the lateral chest film that will aid in diagnosis3) Review the many plain film findings in the wide differential diagnosis of pleural disease In this course we will show the value of plain film as the first line diagnostic tool in identifying lung and pleural malignancies. Thorough knowledge of the anatomy on Frontal and lateral chest radiographs is the basis of this course and will teach the attendees the large value in applying this knowledge to the timely diagnosis and management of incidental findings on these studies. This course is intended for anyone who is private practice, or in a specialty practice.

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R2-RCP12

An Introduction for Radiologists to the Learning Healthcare System: Pragmatic Trials: Yes, We Can Randomize (Sponsored by the RSNA Research Development Committee)

Participants

Jeffrey (Jerry) Jarvik, MD,MPH, Seattle, Washington (*Presenter*) Royalties, Springer Publishing, LLC;Co-editor, Springer Publishing, LLC;Travel support, General Electric Company;Royalties, Wolters Kluwer nv;
Rebecca Smith-Bindman, MD, San Francisco, California (*Presenter*) Founder, Alara Imaging, Inc
Adrian Hernandez, MD, Durham, North Carolina (*Presenter*) Research Consultant, Amgen Inc;Research Consultant, AstraZeneca PLC;Research Consultant, Bayer AG;Research Consultant, Merck & Co, Inc;Research Consultant, Boston Scientific Corporation;Research Consultant, Bristol-Myers Squibb Company;Research Consultant, Cytogen Corporation;Research Consultant, Relypsa;Research Grant, Amgen Inc;Research Grant, AstraZeneca PLC;Research Grant, Bayer AG;Research Grant, American Regent;Research Grant, Merck & Co, Inc;Research Grant, Novartis AG;Research Grant, Verily Lifesciences LLC

LEARNING OBJECTIVES

1) To review approaches and challenges for embedding trials into routine clinical care. 2) To describe key aspects of a learning healthcare System that relate to Clinical Trials 3) To describe specific examples of embedded randomized clinical trials and review lessons learned As a group, radiologists have little exposure to learning healthcare systems (LHS). The goal of this course and a companion course is to educate radiologists about two important aspects of LHS: unique data/informatics issues and unique trial design issues. This course will focus on methods for conducting clinical trials as part of routine care as well as challenges and solutions of embedding of these trials within health care delivery systems. A companion course will focus on data issues confronted by radiologists who want to participate in LHS

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Abstract Archives of the RSNA, 2021

S4-CIN04

Radiology Informatics: Implications of Legislation

Participants

Jeffrey Sunshine, MD,PhD, Pepper Pike, Ohio (*Presenter*) Research Grant, Siemens AG
Howard Chen, MD, MBA, Cleveland, Ohio (*Presenter*) Nothing to Disclose
William Auffermann, MD, PhD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose
Shinjini Kundu, MD,PhD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Know when, in what context and under what names the most impactful recent legislation on informatics has presented. 2) Understand implications of current legislative product or debate on Informatics. 3) Perceive the political context in which Informatics relevant legislation has occurred.

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Abstract Archives of the RSNA, 2021

Participants

Walter Wiggins, MD, PhD, Durham, North Carolina (*Presenter*) Nothing to Disclose
Kirti Magudia, MD,PhD, Durham, North Carolina (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

(1) Extract relevant data from radiology and pathology reports. (2) Understand how to manage and process image-based annotations. (3) Perform image registration and normalization. (4) Recognize features of data formats ideal for deep learning. This course will provide attendees with the essential tools to perform data processing and curation necessary for deep learning projects. Attendees will start with free text radiology and pathology reports as well as anonymized DICOM data and process data into a unified data file ready for deep learning applications.

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R4-CPH12

Advanced Ultrasound Technology and Applications

Participants

Carl Herickhoff, PhD, Memphis, Tennessee (*Presenter*) Nothing to Disclose
Stephen McAleavey, PhD, Rochester, New York (*Presenter*) Research collaboration, Siemens AG;
Thaddeus Wilson, PhD, Memphis, Tennessee (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain the approach, capabilities, and limitations of conventional Doppler imaging techniques. 2) Present how new technologies are improving sensitivity and visualization of flow in smaller vessels (with high resolution and contrast) and how this could impact clinical practice. 3) Compare classic beam forming with software methods while looking at new transducer technology enabling these methods and look at what it all means for the sonographer/clinician To explore an in depth, look at advanced ultrasound technology and applications with the speakers hopefully offering a basis by which people new to the field will be able to understand the technologies being discussed, an update on current methods for current users and further offering a look at the direction these applications are taking in the future.

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Abstract Archives of the RSNA, 2021

Non-traumatic Emergency Abdominopelvic CT Angiography

Participants
Ajay K. Singh, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Urvi P. Fulwadhva, MD, Rye, New Hampshire (*Presenter*) Nothing to Disclose
Vincent M. Mellnick, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Tarek N. Hanna, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Review the imaging protocols for GI bleeding.2.To review the CT and Tc-99m -RBC imaging features of acute GI bleeding In this course we will review the role of abdominopelvic CT angiogram for the assessment of GI bleeding, splanchnic aneurysm, arterial dissection, aortitis, bowel ischemia and postoperative complications.

Abstract Archives of the RSNA, 2021

DLL23

Deep Learning Lab: Generative Adversarial Networks

Participants

Gian Marco Conte, MD, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Bradley Erickson, MD, PhD, Rochester, Minnesota (*Presenter*) Board of Directors, VoiceIt Technologies, LLC;Stockholder, VoiceIt Technologies, LLC;Board of Directors, FlowSigma, Inc;Officer, FlowSigma, Inc;Stockholder, FlowSigma, Inc;Officer, Yunu, Inc;Stockholder, Yunu Inc

LEARNING OBJECTIVES

Empty Abstract

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Abstract Archives of the RSNA, 2021

W2-CHN05

Case-based Review: Head and Neck Imaging

Participants
Greg Avey, MD, Madison, Wisconsin (*Presenter*) Research Consultant, General Electric Company
Caroline Robson, MBChB, Boston, Massachusetts (*Presenter*) Author with royalties, Reed Elsevier
Courtney Tomblinson, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Salman Qureshi, MBChB, Doha, Qatar (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify key imaging findings of both common and dont miss lesions in the head and neck. 2) Understand the evolving classification of tumors of the neck, temporal bone, and sinuses. 3) Review important imaging advances which enable improved diagnosis and care of patients with lesions in the head and neck. This case based review will examine the imaging appearance of common, important, and dont miss lesions of the paranasal sinuses and temporal bone as well as the adult and pediatric neck. Key differential diagnoses will be highlighted for each of these challenging areas, along with an emphasis on new and emerging tumor types and advanced / multimodality imaging findings. At the end of this course participants will have an increased understanding of how to diagnose and manage lesions of the paranasal sinuses, neck and temporal bone.

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Abstract Archives of the RSNA, 2021

Lymphoma - Case-based Multidisciplinary Review

Participants
Sarah A. Johnson, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose
Anca Prica, Toronto, Ontario (*Presenter*) Speaker, AstraZeneca PLC;Speaker, Kite Gilead
Chelsea Pinnix, MD,PhD, Houston, Texas (*Presenter*) Research Grant, Merck & Co, Inc;Speaker, Modernizing Medicine, Inc
Jillian Gunther, MD, PhD, Houston, Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Learning Objectives:At the conclusion of this course, the attendee should:- Have a high level of confidence in their assessment of key features in lymphoma staging.- Be more familiar with response assessment systems for lymphoma patients.- Become aware of clinically important aspects of Diagnostic Radiology reports for lymphoma patients. Course Description:Medical imaging plays a key role in lymphoma staging and response assessment. This course will focus on review of several lymphoma cases and their attendant key learning points. Supplemental information will be provided in lecture format by a multidisciplinary panel. Attendees are expected to gain an increased familiarity with important concepts in lymphoma staging and more detailed knowledge of formal response assessment.

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Abstract Archives of the RSNA, 2021

R1-CRO09

Breast Oncodiagnostic Session

Participants

Anna Shapiro, MD, Syracuse, New York (*Presenter*) Nothing to Disclose
Bethany L. Niell, MD,PhD, Tampa, Florida (*Presenter*) Nothing to Disclose
Lisa Lai, MD, Syracuse, New York (*Presenter*) Nothing to Disclose
Abirami Sivapiragasam, MD, Jamesville, New York (*Presenter*) Advisor, Pfizer Inc;Advisor, Puma Biotechnology, Inc;Advisor, Immunomedics, Inc

LEARNING OBJECTIVES

1) Learn how to sequence multimodality imaging and interventions to provide specific diagnoses and map disease extent as well as assess responses to breast cancer therapies. 2) Describe the surgical options in the treatment of breast cancer. 3) Understand the principles of radiation therapy, including external and brachytherapy and various treatment fractionation and dose schedules. 4) Review new techniques to reduce dose to normal tissue and novel radiation therapy modalities. 5) Describe the role of systemic therapy and tools used to individualize treatment in breast cancer. Participants will obtain a better understanding of the pros and cons of neoadjuvant and adjuvant systemic therapies based on breast cancer subtypes. This course provides essential knowledge of most current therapeutic approaches in breast cancer care in case-based format. A comprehensive review of current diagnostic, surgical, radiation and medical oncologic management for breast cancer is included.

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Abstract Archives of the RSNA, 2021

R6-CRO10

Gastrointestinal Oncodiagnostic Session

Participants

Jennifer Wo, MD, Boston, Massachusetts (*Presenter*) Research funded, F. Hoffmann-La Roche Ltd;

Spencer C. Behr, MD, San Francisco, California (*Presenter*) Grant, Cancer Targeted TechnologyScientific Advisory Board, Novartis AGResearch Consultant, GenVivo

Eugene Koay, MD, PhD, Houston, Texas (*Presenter*) Research Grant, Elekta AB;Research Grant, General Electric Company;Research Grant, Koninklijke Philips NV;Research Grant, RenovoRx, Inc

Nicholas Fidelman, MD, San Francisco, California (*Presenter*) Research Grant, Sirtex Medical Ltd;Research Grant, Merck & Co, Inc;Research Grant, Boston Scientific Corporation;

Motaz Qadan, MD,PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

Lipika Goyal, MD, Boston, Massachusetts (*Presenter*) Institutional research support, Agios Pharmaceuticals, Inc;Scientific Advisory Board, Agios Pharmaceuticals, Inc;Consultant, Agios Pharmaceuticals, Inc;Institutional research support, Adaptimmune Therapeutics plc;Institutional research support, Bayer AG;Institutional research support, Eisai Co, Ltd;Scientific Advisory Board, Eisai Co, Ltd;Institutional research support, Merck & Co, Inc;Institutional research support, Jazz Pharmaceuticals plc;Institutional research support, F. Hoffmann-La Roche Ltd;Consultant, F. Hoffmann-La Roche Ltd;Institutional research support, Novartis AG;Institutional research support, Incyte Corporation;Scientific Advisory Board, Incyte Corporation;Consultant, Incyte Corporation;Institutional research support, Eli Lilly and Company;Institutional research support, Relay Therapeutics;Institutional research support, BridgeBio Pharma;Scientific Advisory Board, BridgeBio Pharma;Consultant, BridgeBio Pharma;Institutional research support, Otsuka Holdings Co, Ltd;Scientific Advisory Board, Otsuka Holdings Co, Ltd;Consultant, Otsuka Holdings Co, Ltd;Institutional research support, Leap Therapeutics, Inc;Institutional research support, Bristol-Myers Squibb Company;Institutional research support, NuCana PLC;Scientific Advisory Board, Alentis Therapeutics AG;Consultant, Alentis Therapeutics AG;Scientific Advisory Board, Sirtex Medical Ltd;Consultant, Sirtex Medical Ltd;Consultant, Exelixis, Inc;Data Safety Monitoring Board, AstraZeneca PLC

LEARNING OBJECTIVES

1) Gain understanding for complex multidisciplinary care for primary liver tumors. 2) Learn about novel local therapy and systemic therapy options for primary liver tumors. This course will highlight complex multidisciplinary discussions that are critical to selection of optimal treatments for patients with primary liver tumors. These cases will highlight novel treatment strategies, potential treatment toxicities, and the existing literature that supports these modalities.

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Abstract Archives of the RSNA, 2021

S4-CCH02

Thoracic HRCT Advanced Topics

Participants

Edward Lee, MD, MPH, Boston, Massachusetts (*Presenter*) Nothing to Disclose
David A. Lynch, MBBCh, Denver, Colorado (*Presenter*) Research Consultant, CALYX Inc;Research Consultant, Boehringer Ingelheim GmbH;Research Consultant, Veracyte, Inc;Research Consultant, DAIICHI SANKYO Group;Research Consultant, AstraZeneca PLC;Consultant, Polarean, Inc;Consultant, Bristol Myers Squibb Company
Nicola Sverzellati, MD, Parma, Italy (*Presenter*) Nothing to Disclose
Sujal R. Desai, MBBS, London, United Kingdom (*Presenter*) Educator, Boehringer Ingelheim GmbH;Committee member, GlaxoSmithKline plc;Committee member, AstraZeneca PLC;Consultant, Sensyne Health PLC
Chi Wan Koo, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Kimberly Kallianos, MD, San Rafael, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand the role of HRCT imaging in early detection, quantification, and management of pediatric and adult patients with interstitial lung disease2. Review characteristic HRCT imaging findings of specific common interstitial lung diseases3. Recognize pearls and pitfalls of HRCT imaging in children and adults Clinically relevant interpretation of HRCT requires knowledge of the clinical and imaging aspects of interstitial lung disease. This course aims to provide the practicing radiologist with greater understanding of the clinical role of high resolution CT. Discussion topics will include the imaging implications of new drug treatments in ILD, imaging aspects of immune related diseases, clinical importance of early interstitial lung abnormality, features of interstitial lung disease in children, use of machine learning in ILD and evolving aspects of drug induced ILD.

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Abstract Archives of the RSNA, 2021

R2-CGI10

Essentials of GI Imaging

Participants

Courtney Moreno, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Mustafa Bashir, MD, Cary, North Carolina (*Presenter*) Research Grant, Siemens AGResearch Grant, NGM Biopharmaceuticals, IncResearch Grant, Madrigal Pharmaceuticals, IncResearch Grant, Metacrine, IncResearch Grant, ProSciento, IncResearch Grant, Medscape, LLCResearch Grant, Carmot Therapeutics Inc
Alessandro Furlan, MD, Pittsburgh, Pennsylvania (*Presenter*) Royalties, Reed ElsevierResearch support, Endra, Inc
Jeff L. Fidler, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Kristin Porter, MD,PhD, Birmingham, Alabama (*Presenter*) Stockholder, Pfizer Inc;Medical Advisory Board, Bracco Group

LEARNING OBJECTIVES

1) Identify imaging characteristics of liver lesions in noncirrhotic patients. 2) Explain techniques for luminal imaging including of the upper and lower GI tract. 3) Describe imaging findings in patients with cholangiocarcinoma and pancreatitis. Case-based course providing a timely overview of liver lesions in noncirrhotic patients, cholangiocarcinoma, newer techniques for luminal imaging (including CT esophagography and small bowel follow through challenge), colonic imaging, and imaging of pancreatitis.

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R2-CMS20

Oncologic Emergencies

Participants
Carolyn L. Wang, MD, Mercer Island, Washington (*Presenter*) Research Grant, General Electric Company
Sadia Qamar, MBBS, Toronto, Ontario (*Presenter*) Nothing to Disclose
Alexander Kessler, MD, Pittsford, New York (*Presenter*) Nothing to Disclose
Joseph Davis, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Recognize common and uncommon oncologic emergencies involving the head, neck, cardiothoracic, abdomen and pelvis in adults and pediatric patient populations associated with the natural progression and/or recurrence of malignancy. 2.Recognize common and uncommon oncologic emergencies associated with various treatment options including chemotherapy, immunotherapy, surgery, and radiation.3.Review relevant radiological findings/patterns and imaging follow up for these oncologic emergencies that help guide treatment decisions for referring physicians. Oncology patients can develop acute emergencies that can be a de novo presentation, a complication related to the disease progression, recurrence or treatment. This session will focus on emergent conditions related to malignancy and their treatment, that the radiologist should know using a case-based format.

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Abstract Archives of the RSNA, 2021

S1-CBR01

Essentials of Breast Imaging: Symptomatic Practice

Participants
Sophia Zackrisson, Malmo, Sweden (*Presenter*) Speaker, Siemens AG;Consultant, Collective Minds Radiology AB
Wendy B. Demartini, MD, Stanford, California (*Presenter*) Advisory Board, Kheiron Medical Technologies Ltd
Andrew Evans, MRCP, FRCR, Chesterfeild, United Kingdom (*Presenter*) Speaker, Samsung Electronics Co, Ltd

LEARNING OBJECTIVES

to have a basic knowledge of the advantages and limitations of x-ray-based breast imaging methodsto understand when to do ultrasound in symptomatic breast practice and in what situations add-on US techniques are useful to acknowledge in what situation image-guided procedures are needed and how to perform them This course will introduce you to the basics of breast imaging and interventions and give you practical advice how to handle patients seeking help for symptoms from the breast. We will describe the advantages and limitations of the most used x-ray and ultrasound-based imaging methods and give a comprehensive overview of typical normal, benign, and malignant findings as well as the pitfalls. Image-guided procedures will be illustrated from a technical and practical perspective.

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Abstract Archives of the RSNA, 2021

T5-RCP36

Case-based Review of Nuclear Medicine: PET/CT Workshop ? Prostate (In Conjunction with SNMMI)

Participants

Jonathan E. McConathy, MD, PhD, Birmingham, Alabama (*Presenter*) Research Consultant, Eli Lilly and Company;Research Grant, Eli Lilly and Company;Research Consultant, Blue Earth Diagnostics Ltd;Research Grant, Blue Earth Diagnostics Ltd;Research Consultant, General Electric Company;Research support, CytoSite Biopharma;Research Consultant, Canon Medical Systems Corporation;Research Consultant, ImaginAb, Inc;Spouse, Research Consultant, Baird Capital;Spouse, Research Grant, Navidea Biopharmaceuticals, Inc;Spouse, Research Grant, AbbVie Inc

Jeremie Calais, MD, Los Angeles, California (*Presenter*) Consultant, RadioMedix, IncConsultant, Blue Earth Diagnostics LtdConsultant, Lantheus HoldingsConsultant, Johnson & JohnsonConsultant, Curium SASConsultant, General Electric Company

LEARNING OBJECTIVES

1. Understand best clinical practices for use and interpretation of 18F-fluciclovine (Axumin) PET/CT for patients with prostate cancer. 2. Understand best clinical practices for use and interpretation of PSMA-targeted PET/CT for patients with prostate cancer. Novel PET/CT agents are revolutionizing the imaging and therapy of patients with prostate cancer. In this session, experts on 18F-fluciclovine (Axumin) and PSMA-targeted PET/CT will use clinical cases to demonstrate fundamentals of interpretation, as well as pearls and pitfalls to help improve interpretation of these studies.

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Abstract Archives of the RSNA, 2021

T3-CMS25

Nuclear Medicine in the Acute Setting

Participants
Gad Abikhzer, MD, Montreal, Quebec (*Presenter*) Nothing to Disclose
Cigdem Akincioglu, MD,FRCPC, London, Ontario (*Presenter*) Consultant, Pfizer Inc;Speakers, Pfizer Inc
John Millstine, MD, Scottsdale, Arizona (*Presenter*) Nothing to Disclose
Darlene F. Metter, MD, San Antonio, Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of Nuclear Medicine and PET/CT imaging in the acute care setting. 2) Review the indications and essentials of V/Q scans, GI bleed studies and cardiac imaging for emergency indications. 3) Review the indications and essentials of FDG PET/CT for acute infectious and inflammatory diseases. CT has become a primary imaging modality in the acute setting. However, nuclear medicine still remains fundamental to the diagnosis of many emergent conditions. This session will review the essentials of nuclear medicine and PET/CT in the emergency and acute care settings.

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W6-CCA08

Cardiac Imaging in Private Practice: Lessons Learned

Participants
Michael F. Morris, MD, Paradise Valley, Arizona (*Presenter*) Educator, Medtronic plc;
Richard L. Hallett II, MD, Carmel, Indiana (*Presenter*) Nothing to Disclose
Alastair Moore, MD, Dallas, Texas (*Presenter*) Speaker, Boehringer Ingelheim GmbH;Consultant, Boehringer Ingelheim GmbH

LEARNING OBJECTIVES

1) Identify unique benefits and challenges to creating, growing, and maintaining a cardiac imaging practice in private practice. 2) Identify emerging techniques in cardiac imaging that can be leveraged to improve patient care and/or service to referring clinicians. Cardiac imaging in private practice has evolved to encompass both bread-and-butter and newer, novel techniques in cardiac care. Course lectures will review the challenges, benefits, and opportunities involved in starting and growing a cardiac imaging practice. Specific attention to turf battles, reimbursement strategies, and training will be discussed. Time will be reserved for audience questions/participation. At course conclusion, participants should acquire deeper knowledge and practical information to improve their cardiac imaging practice.

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Abstract Archives of the RSNA, 2021

M1-CGU03

GU Specific Diagnostic Classification Systems

Participants

Nicola Schieda, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose
Atul Shinagare, MD, Boston, Massachusetts (*Presenter*) Consultant, VirtualScopics, Inc;Consultant, Imaging Endpoints
Valeria Panebianco, MD, Rome, Italy (*Presenter*) Nothing to Disclose
Andrea Rockall, FRCR,MRCP, London, United Kingdom (*Presenter*) Speaker, Guerbet SA
Caroline Reinhold, MD, MSc, Westmount, Quebec (*Presenter*) Research Grant, Imagia Cybernetics Inc

LEARNING OBJECTIVES

1) Identify opportunities to improve clinical practice when implementing standardized reporting systems in the genitourinary system. 2) Recognize strengths and weaknesses of new GU based standardized reporting systems for kidney, bladder and ovary. 3) Explain current clinical applications of GU based standardized reporting and how artificial intelligence may change application in the future. In this 5 lecture course, learners will be introduced to new genitourinary standardized reporting systems for Bladder (VI-RADS), Kidney (Bosniak version 2019) and Ovary (O-RADS) applied to CT and MRI. Lectures will emphasize supporting evidence and strengths of diagnostic classification systems compared to unstructured reporting or other classification systems. Lectures will also focus on challenges and opportunities created by standardized reporting systems, how to integrate into a busy and modern clinical practice while maintaining or improving efficiency and how artificial intelligence may change reporting classification systems in the future.

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T6-CGI07

Dual- and Multi-energy CT of the Abdomen: Today and Tomorrow

Participants

Benjamin M. Yeh, MD, Hillsborough, California (*Presenter*) Grant, Koninklijke Philips NVGrant, General Electric CompanyConsultant, Canon Medical Systems CorporationSpeaker, Canon Medical Systems CorporationRoyalties, Oxford University PressShareholder, Board Member Nextrast, Inc

Joel Fletcher, MD, Rochester, Minnesota (*Presenter*) Research Grant, Siemens AG;Research Grant, Pfizer Inc;Research Grant, Takeda Pharmaceutical Company Limited;Consultant, Takeda Pharmaceutical Company Limited;Research Grant, NEXTRAST, INC;Consultant, Medtronic plc;Consultant, Johnson & Johnson;Consultant, GlaxoSmithKline plc;Consultant, Boehringer Ingelheim GmbH

Lakshmi Ananthakrishnan, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

Achille Mileto, MD, Rochester, Minnesota (*Presenter*) Research Grant, General Electric Company;Research support, Koninklijke Philips NV;

Jennifer Uyeda, MD, Lexington, Massachusetts (*Presenter*) Consultant, Allena Pharmaceuticals, Inc

LEARNING OBJECTIVES

Review basic concepts and diagnostic use of dual- and multi-energy CT techniques for the evaluation of the liver, pancreas, bowel, and other organs of the gastrointestinal tract.Describe specific ways to use dual- and multi-energy CT image reconstruction techniques to interrogate ambiguous densities, improve the conspicuity of lesions and contrast-enhancement, minimize artifacts, and improve diagnostic confidence.Summarize how to integrate dual- and multi-energy CT techniques into a busy clinical practice.Discuss the use of novel contrast agents with dual- and multi-energy CT. Dual- multi-energy CT techniques are increasingly being used to improve the CT evaluation of the gastrointestinal tract. This course will include five talks, followed by a question-and-answer session, to review the use of dual- and multi-energy CT techniques for abdominopelvic diagnoses. The latest concepts relevant to dual- and multi-energy CT applications will be reviewed, with focus on practical implementation for routine imaging, use in the emergency setting and oncologic imaging.

Abstract Archives of the RSNA, 2021

Mentored Cardiac CT Angiography Case Review: Part III

Participants
Carlo N. De Cecco, MD, Atlanta, Georgia (*Presenter*) Research Grant, Siemens AGConsultant, Covanos
Carole Dennie, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose
Suhny Abbara, MD, Dallas, Texas (*Presenter*) Royalties, Reed Elsevier;;;
Phillip M. Young, MD, Rochester, Minnesota (*Presenter*) Advisory Board, Arterys Inc

LEARNING OBJECTIVES

1) To explain the elements of coronary atherosclerosis2) To describe pulmonary venous anatomy and pericardial diseases3) To discuss CT of Cardiac Valves and CT Cardiac Function, notably normal cardiac chamber sizes Left Atrial Pre- and Post-Ablation Imaging This course provides a case-based mentored approach to several important topics in cardiac CT including coronary disease, valvular and pericardial disease and the pulmonary venous system.

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Abstract Archives of the RSNA, 2021

W6-CCH10

Thoracic Malignancy II: Beyond Non-small Cell Lung Cancer

Participants

Kristopher W. Cummings, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose
Michelle S. Ginsberg, MD, New York, New York (*Presenter*) Speaker, Ultimate Opinions In Medicine LLC
Chad D. Strange, MD, Seabrook, Texas (*Presenter*) Nothing to Disclose
Edith Marom, MD, Tel Aviv, Israel (*Presenter*) Speaker, Boehringer Ingelheim GmbHSpeaker, Merck & Co, IncSpeaker, Astrazeneca
John Lichtenberger III, MD, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose
Myrna C. Godoy, MD, PhD, Houston, Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Describe and differentiate the typical imaging manifestations of the various neuroendocrine malignancies.2.List key imaging findings that affect management and staging of mesothelioma and thymoma.3.Explain the role of imaging in guiding airway interventions and recognizing potential complications during the management of thoracic malignancies. This didactic session will focus on the important diagnostic imaging findings of and management implications for neuroendocrine malignancies, mesothelioma, thymoma, airway malignancies and other thoracic neoplasms less commonly encountered in clinical practice. After attending this session, the learner will be able to more accurately diagnosis these non-small cell thoracic malignancies and provide crucial imaging information which will impact patient care.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

W2-CVA07

Multimodal Aortic Imaging: What the Radiologist Needs to Know and What the Surgeon Wants to Know

Participants
Dominik Fleischmann, MD, Palo Alto, California (*Presenter*) Research Grant, Siemens AG;Stockholder, iSchemaView, Inc;Stockholder, Segmed, Inc
Santiago Restrepo, MD, San Antonio, Texas (*Presenter*) Nothing to Disclose
Diana Litmanovich, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Prachi P. Agarwal, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

(1) accurately classify traumatic aortic injuries, (2) appropriately select and apply imaging and measurement techniques for aortic aneurysms, (3) understand the spectrum of acute aortic syndromes, and (4) evaluate new endovascular aortic devices and their complications. This session features 4 highly-focused lectures covering the essentials and recent updates in aortic imaging, targeted to radiologists and trainees in body-, cardiovascular- and cardiothoracic imaging: (1) classification of traumatic aortic injuries; (2) current imaging and surveillance of aortic aneurysms, (3) update on acute aortic syndromes, and (4) new thoracic endovascular devices and therapies.

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Abstract Archives of the RSNA, 2021

Practical Chest MRI

Participants

Lea Azour, MD, Mamaroneck, New York (*Presenter*) Nothing to Disclose
Christopher Francois, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Deepa Gopalan, MRCP, FRCR, Stockholm, Sweden (*Presenter*) Speakers Bureau, Bayer AG and Actelion
Yoshiharu Ohno, MD,PhD, Toyoake, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation;Research Grant, DAIICHI SANKYO Group

LEARNING OBJECTIVES

1) Identify opportunities to integrate chest MRI into clinical practice. 2) Describe current applications of chest MRI for evaluation of acute and chronic PE. 3) Highlight advancements in chest MRI for assessment of mediastinal masses and lung disorders. Practical Chest MRI will present a diverse cohort of experts synthesizing the value and clinical applicability of thoracic MRI! The session will explore MRI diagnosis and evaluation in three main compartments of thoracic pathology: thromboembolic disease, mediastinal lesions, and lung disorders. Presentations will be case-enriched, and include information on both exam acquisition and interpretation, facilitating attendee translation of updates into clinical practice.

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Abstract Archives of the RSNA, 2021

Liver Cancer Interventions

Participants

Nicholas Fidelman, MD, San Francisco, California (*Presenter*) Research Grant, Sirtex Medical Ltd;Research Grant, Merck & Co, Inc;Research Grant, Boston Scientific Corporation;
Karen T. Brown, MD, Salt Lake City, Utah (*Presenter*) Consultant, AstraZeneca PLC
Muneeb Ahmed, MD, Boston, Massachusetts (*Presenter*) Stockholder, Agile Devices, Inc;Scientific Advisory Board, Agile Devices, Inc;Consultant, Canon Medical Systems Corporation;Consultant, RevOps Health, Inc;
Aparna Kalyan, MD, Chicago, Illinois (*Presenter*) Advisory Board, Eisai Co, Ltd ;Advisory Board, Exelis;Advisory Board, Boston Scientific Corporation;Speakers Bureau, Boston Scientific Corporation;Advisory Board, Bristol-Myers Squibb Company;Speakers Bureau, Bristol-Myers Squibb Company;Research funded, Bristol-Myers Squibb Company;Advisory Board, QED Therapeutics
Carlos Corvera, MD, San Francisco, California (*Presenter*) Consultant; Johnson and Johnson;
Alda Tam, MD, Houston, Texas (*Presenter*) Consultant, Johnson & Johnson;Research Grant, Boston Scientific Corporation;Research Grant, Johnson & Johnson;Consultant, AstraZeneca PLC;Consultant, Endocare, Inc;

LEARNING OBJECTIVES

1) Provide update for current used treatment strategies for patients with hepatocellular carcinoma (HCC).2) Review developing treatment trends. Liver Cancer Interventions course will focus on current loco-regional therapy treatment options for patients with hepatocellular carcinoma and will review treatments in development.

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Abstract Archives of the RSNA, 2021

Normal or Not? The Borderlands of Imaging Findings

Participants
Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (*Presenter*) Nothing to Disclose
Russell C. Fritz, MD, Mill Valley, California (*Presenter*) Nothing to Disclose
Yulia Melenevsky, MD, Vestavia, Alabama (*Presenter*) Nothing to Disclose
Kathleen Emery, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose
Marco Zanetti, MD, Baden, Switzerland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To identify osseous variants on radiographs in correlation with cross-sectional imaging. 2) To learn to differentiate between normal developmental variants and true pathology in children and adolescents. 3) To know how to differentiate normal variants of the labrum and true lesions in the shoulder and hip joint. 4) To differentiate normal aging and asymptomatic findings from clinically relevant internal derangement of joints Normal variants and asymptomatic findings are very frequent and a major diagnostic challenge in imaging of the muskuloskelettal system. This course addresses the borderlands of imaging findings in a rapid-fire format. Relevance of findings are discussed and tips and tricks to differentiate for asymptomatic findings are presented.

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Abstract Archives of the RSNA, 2021

Pulmonary Vascular Imaging: Current Issues

Participants

Stephanie Tan, MD, Brossard, Quebec (*Presenter*) Nothing to Disclose
Linda B. Haramati, MD, MS, New Rochelle, New York (*Presenter*) Nothing to Disclose
Seth J. Kligerman, MD, La Jolla, California (*Presenter*) Speakers Bureau, Boehringer Ingelheim GmbH;Author, RELX;Consultant, Riverain Technologies, LLC;Consultant, Bayer AG
Pamela Woodard, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Mannudeep Kalra, MD, Lexington, Massachusetts (*Presenter*) Research Grant, Siemens AGResearch Grant, Riverain Technologies, LLCResearch Grant, Coreline Soft, Co Ltd

LEARNING OBJECTIVES

1. Explain the radiologists implications in overutilization, overdiagnosis and misdiagnosis related to pulmonary embolism.2. Describe the findings and expected complications of patients with pulmonary embolism in the setting of COVID-19.3. Assess the value of energy/spectral CT in the diagnosis and management of pulmonary embolism. Although radiologists play a crucial role in the diagnosis of pulmonary embolism, they may be unaware of the short- and long-term impacts of their interpretations, impacts which are non-negligible. Therefore, the subtle but important difference between overutilization, overdiagnosis and misdiagnosis in the context of pulmonary embolism are issues that will be discussed in this discussion session, laying out the latest data and sparking discussion about the concerns relevant to patients, clinicians and radiologists. Other hot topics in development which may affect current practice including pulmonary embolism in the setting of COVID and the value of dual energy/spectral CT will also be explored.

Abstract Archives of the RSNA, 2021

Review and Update on Blunt and Penetrating Abdominopelvic Trauma

Participants
James Lee, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose
Hei Shun Yu, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Felipe Munera, MD, Key Biscayne, Florida (*Presenter*) Nothing to Disclose
Christina LeBedis, MD, Newton, Massachusetts (*Presenter*) Nothing to Disclose
David Dreizin, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Following this session on imaging blunt and penetrating abdominopelvic trauma, course participants will be able to: - Describe key findings that determine immediate operative, angiography or observation care pathways. - List the common imaging pitfalls encountered in the evaluation of abdominopelvic trauma. - Discuss current controversies and emerging frontiers in abdominopelvic trauma imaging. This course will be a lecture format review of imaging findings in blunt and penetrating abdominopelvic trauma. Discussion of finding that directly impact patient care pathways will be emphasized. Examples of pitfalls encountered in the evaluation of abdominopelvic trauma, controversies and emerging techniques in imaging will be discussed.

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Abstract Archives of the RSNA, 2021

W2-CMS02

Hot Topics in Emergency Radiology

Participants
Krystal Archer-Arroyo, MD, Decatur, Georgia (*Presenter*) Nothing to Disclose
Constantine Raptis, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Vincent M. Mellnick, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Tarek N. Hanna, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

At the end of this session, participants will be able to:1. Summarize the fundamentals of dual energy and spectral computed tomography.2. Discuss the applications of multi-energy computed tomography in the trauma setting.3. Recognize potential drawbacks and artifacts of multi-energy computed tomography. This session will highlight some of the most current Hot Topics in Emergency Radiology, focusing on multi-energy CT, trauma CT protocols, and CT for esophageal emergencies.

Printed on: 06/28/22

M5-CMS09

Artificial Intelligence and Machine Learning in Emergency Radiology

Participants
Melissa Davis, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Robert Moreland, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose
Tim O'Connell, MD, Vancouver, British Columbia (*Presenter*) CEO, Emtelligent Software Ltd

LEARNING OBJECTIVES

1. Understand how new technologies in the field of machine learning and artificial intelligence align with Emergency Radiology Practice.2. Learn from implementations of artificial intelligence and machine learning in the Emergency Radiology setting.3. Explore the potential of new technologies within radiology. In this course we will learn about how artificial intelligence and machine learning tools can be implemented into the emergency radiology practice. This course will look at current and future applications as well as implementation needs for this particular setting. There will be three course lectures on this topic. Attendees should leave these lectures with an increased understanding of the potential tools in the market and how to leverage them in an emergent setting.

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Abstract Archives of the RSNA, 2021

T5-CVA06

Imaging of Vascular Trauma: Optimize Imaging Techniques to Limit Imaging Time - How I Do It

Participants

Sameer Raniga, FRCR, MD, Muscat, Oman (*Presenter*) Nothing to Disclose
Avneesh Gupta, MD, Boston, Massachusetts (*Presenter*) Speaker, Philips Medical Systems
Jennifer Uyeda, MD, Lexington, Massachusetts (*Presenter*) Consultant, Allena Pharmaceuticals, Inc
Patrick Sutphin, MD,PhD, Boston, Massachusetts (*Presenter*) Stockholder, Gilead Sciences, Inc;Stockholder, Editas Medicine;Stockholder, CRISPR Therapeutics AG;Stockholder, Intellia Therapeutics;Stockholder, Pediatrix Medical Group;Stockholder, Amwell;Stockholder, Teladoc Health Inc.;Stockholder, Jazz Pharmaceuticals plc;Stockholder, ViewRay, Inc

LEARNING OBJECTIVES

After completing this course, the participants will be able to:1.Understand the MDCT technique optimization in assessing vascular trauma with special emphasis on optimizing protocols that limit the imaging time.2.How MDCT protocols impact the identification and characterization of different types of vascular injuries? Type: lecture-based. This session will provide an overview of evidence-based practice in imaging vascular trauma, emphasizing MDCT protocol optimization. We will discuss different MDCT technical parameters and protocols which limit the imaging time without compromising the image quality. We will focus on providing real-world clinical examples and cases illustrating the impact of MDCT protocols on the detection and characterization of vascular injuries. This session will be helpful for trainees, fellows, CT technologists, general and emergency radiologists dealing with vascular injury assessment in daily clinical practice.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

T6-CMK07

Musculoskeletal Tumors: To Touch or Not to Touch?

Participants
Laura M. Fayad, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose
Mark D. Murphey, MD, Silver Spring, Maryland (*Presenter*) Nothing to Disclose
Behrang Amini, MD, PhD, Houston, Texas (*Presenter*) Nothing to Disclose
Connie Y. Chang, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Mark J. Kransdorf, MD, Scottsdale, Arizona (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Learning objectives1) To review the imaging appearance of common benign musculoskeletal lesions in children and adults2) To identify imaging strategies for confidently diagnosing lesions that are benign or probably benign 3) To emphasize lesional features that suggest a potentially malignant nature DescriptionIn this educational course, we will review salient benign musculoskeletal lesions that are commonly encountered in clinical practice, in both pediatric and adult populations. Given that patients with benign musculoskeletal lesions present to clinics 100 times more frequently than those with malignant lesions, it is important for radiologists to recognize clearly benign entities and avoid a referral for biopsy. Through five lectures from experienced musculoskeletal radiologists, examples and strategies will be presented that help the radiologist arrive at the decision "to touch" or "not to touch" a lesion.

Printed on: 06/28/22

R1-CNPM18

COVID Conundra: Imaging Practice During the COVID-19 Pandemic

Participants

Mahmud Mossa-Basha, MD, Seattle, Washington (*Presenter*) Nothing to Disclose
Max Rosen, MD,MPH, Weston, Massachusetts (*Presenter*) Consultant, Calyx.ai;Stockholder, LungLife AI;Scientific Advisory Board, LungLife AI;Scientific Advisory Board, Canon Medical Systems Corporation
Bien Soo Tan, FRCR,MBBS, Singapore, Singapore (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Understand strategies to better manage and prepare for the financial impact of pandemicsUnderstand operational changes to best equip radiology departments to manage a pandemicUnderstand radiology department culture and its effect on the pandemic response This course will consist of 3 lectures by radiology leaders who have actively led their departments through the COVID-19 pandemic. The course will cover the impact of COVID-19 on radiology practices from financial, operational and leadership perspectives, steps taken to manage the issues faced and potential approaches to manage future pandemics. This course will help radiologists and radiology leaders mitigate the adversity faced from future pandemics and better lead their departments through the associated hardship.

Printed on: 07/01/22

T6-CIR03

International IR Keynotes

Participants

Bernhard Gebauer, MD, Berlin, Germany (*Presenter*) Speaker, PAREXEL International Corporation;Speaker, Becton, Dickinson and Company;Speaker, Sirtex Medical Ltd;Speaker, Abbott Laboratories;Speaker, Cook Group Incorporated;Speaker, AngioDynamics, Inc;Speaker, PharmCept;Speaker, ewimed GmbH;Speaker, Novartis AG;Speaker, F. Hoffmann-La Roche Ltd;Speaker, Merck & Co, Inc;Speaker, ICON plc;Speaker, Ipsen SA;Speaker, Bayer AG;Speaker, Pfizer Inc;Speaker, Guerbet SA;Speaker, Terumo Corporation
Yasuaki Arai, Tokyo, Japan (*Presenter*) Royalties, Sumitomo Bakelite Co, Ltd;Speakers Bureau, Sumitomo Bakelite Co, Ltd;Speakers Bureau, Merit Medical Systems, Inc;Speakers Bureau, Fuji Pharma Co, Ltd;Speakers Bureau, Canon Medical Systems Corporation;Speakers Bureau, Terumo Corporation;Speakers Bureau, Bristol-Myers Squibb Company;Speakers Bureau, Nippon Kayaku Co, Ltd;Speakers Bureau, Boston Scientific Corporation;Speakers Bureau, Bayer AG;Speakers Bureau, Synexmed (Shenzhen) Co., Ltd;Speakers Bureau, Otsuka Holdings Co, Ltd;Speakers Bureau, Guerbet SA;Speakers Bureau, KYORIN Holdings, Inc;Speakers Bureau, AstraZeneca PLC;;;;;
Gao-Jun Teng, MD, Nanjing, China (*Presenter*) Nothing to Disclose
Elika Kashef, FRCR, London, United Kingdom (*Presenter*) Advisory Board, Guerbet SA;Consultant, Guerbet SA;Consultant, Rocket Medical plc;Consultant, Boston Scientific Corporation;Consultant, Medtronic plc
Melisa Lim, MBBS, Malacca, Malaysia (*Presenter*) Nothing to Disclose
Ricardo Garcia-Monaco, MD,PhD, Buenos Aires City, Argentina (*Presenter*) Consultant, Sirtex Medical Ltd;Consultant, Boston Scientific Corporation;Speakers Bureau, Guerbet SA

LEARNING OBJECTIVES

To learn about variable IR practice models across the globe, including in systems with public healthcare optionsTo better understand cultural and societal influence on global IR developmentTo appreciate the challenges IR has faced globally during the COVID19 pandemic

Abstract Archives of the RSNA, 2021

S3-CGU02

Multi-organ Assessment Local Treatment Response

Participants
Priyanka Jha, MBBS, San Francisco, California (*Presenter*) Nothing to Disclose
Mishal Mendiratta-Lala, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Aradhana Venkatesan, MD, Houston, Texas (*Presenter*) Research Grant, Siemens AG
Gaurav Khatri, MD, Dallas, Texas (*Presenter*) Nothing to Disclose
Stuart Silverman, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Review the standard imaging modalities for local therapy and post-treatment follow-up for hepatocellular carcinoma, renal, cervix and rectal cancers. 2. Develop a systematic approach to identify the expected imaging appearance and complications resultant from local therapy.3. Identify features of recurrence and differentiation from post treatment fibrosis. This lecture series will present local therapy options and standard imaging techniques for hepatocellular carcinoma, renal, cervix and rectal cancers. Imaging utilization during pre-therapy planning, immediate and late post-therapy evaluation will be reviewed. Following the session, the attendee should be knowledgeable in identifying key imaging-based planning assessment, identify complications and recurrence of cancer post therapy. Updated society guidelines for imaging of each of the above entities will be reviewed.

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W6-RCP28

The Science and Practice of Image-Based Screening: Radiologist Educational and Leadership Opportunities

Participants

Hannah Milch, MD, Santa Monica, California (*Presenter*) Nothing to Disclose
Linda B. Haramati, MD, MS, New Rochelle, New York (*Presenter*) Nothing to Disclose
Edward F. Patz JR, MD, Durham, North Carolina (*Presenter*) Institutional research agreement, Laboratory Corporation of America Holdings;Founder, Grid Therapeutics, LLC;Advisory Board, AstraZeneca PLC;
Jonathan G. Goldin, MBChB, PhD, Santa Monica, California (*Presenter*) Founder, MedQIA Imaging Core Laboratory
Nogah Haramati, MD, Bronx, New York (*Presenter*) Nothing to Disclose
John Pellerito, MD, Syosset, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand key screening concepts (goals, risks, biases) and the importance and limitations of the randomized controlled trials that drive screening recommendations. 2. Appreciate the growth of image-based screening practices over the past 50 years and the key evidence behind screening recommendations, with a particular focus on the following cancers and other diseases: osteoporosis, thyroid cancer, abdominal aortic aneurysms, breast cancer, and lung cancer.3. Describe challenges and recent advances affecting image-based screening - ie screening special populations, application of artificial intelligence and opportunities for radiologists to have a lead role in this field and improve patient care. Screening is a critical component of preventive care medicine. Radiologists are at the center of image-based screening, and yet have minimal training on the basic epidemiology and the evidence that drives current recommendations. Perhaps as a consequence, radiologists do not have a prominent role in the decision-making with respect to screening guidelines, on either a public health or an individual scale. For example, no radiologists serve as members of the United States Preventive Services Task Force (USPSTF), the leading organization that establishes national screening guidelines in the United States. Instead, the task force is made up of other clinicians with expertise in screening who lack expertise in imaging. This course is designed to review key epidemiological concepts and evidence with an eye towards enhanced educational and leadership opportunities for radiologists. This refresher course includes a series of short lectures from experts across the country in image-based screening.

Abstract Archives of the RSNA, 2021

RSNA/ESR Symposium: Practical Stroke Imaging and Mimics

Participants
Jean-Pierre Pruvo, MD, PhD, Lille, France (*Presenter*) Nothing to Disclose
Achala Vagal, MD, Cincinnati, Ohio (*Presenter*) Departmental Research Grant, Johnson & Johnson
Didier Leys, Lille, France (*Presenter*) Nothing to Disclose
Lotfi Hacein-Bey, MD, Sacramento, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn about definitions and clinical challenges of stroke mimics and chameleons. 2)To become familiar with the imaging signs and differential diagnosis of stroke mimics. 3)To learn about optimal patient triage in acute ischemic stroke in early and delayed time windows and for wake up strokes. This will be a case based discussion on stroke mimics and chameleons and also a practical review on using imaging in triage in early and late windows.

Printed on: 07/01/22

M2-CIN06

Partnering with Clinical Colleagues on a Point of Care Ultrasound Program

Participants
Summer Kaplan, MD, MS, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Brenda Boardwine, RT, Durham, North Carolina (*Presenter*) Nothing to Disclose
Nilam Soni, MD,MS, San Antonio, Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Define point of care ultrasound and how it differs from traditional radiology ultrasound. 2. Describe training, professional standards, informatics, and billing infrastructure needs in point of care ultrasound practice 3. Discuss how collaboration and integration of point of care ultrasound into imaging IT improves patient care. This informatics course offers an interactive panel highlighting pearls and pitfalls in radiology collaboration with clinical colleagues practicing point of care ultrasound (POCUS). Our speakers include Dr. Nilam Soni, an adult hospitalist and expert in POCUS, Ms. Brenda Boardwine, an imaging IT strategist overseeing POCUS integration, and Dr. Summer Kaplan, a pediatric radiologist with experience in radiology-POCUS collaboration and data mining. Short talks by these experts will highlight how informatics helps strengthen collaboration between radiologists and POCUS clinicians. Attendees will learn common informatics needs from the perspective of three different health systems and will understand how and why radiology practices can support POCUS programs at their home institutions.

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Abstract Archives of the RSNA, 2021

T1-CAS07

Patient Voice: The Power of Patient Engagement on Education and Service Development (Sponsored by the Associated Sciences Consortium)

Participants
Charlotte Beardmore, MBA, London, United Kingdom (*Presenter*) Nothing to Disclose
Brandy Willis, MBA,RT, Houston, Texas (*Presenter*) Nothing to Disclose
Janice St. John-Matthews, BSC,MSc, Leeds, United Kingdom (*Presenter*) Nothing to Disclose
Laura Vasquez, PhD, ARRT, Chicago, Illinois (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify why service user engagement is important in radiology technologists/radiographers education 2)Show how service users can support training and work with imaging service professionals to deliver positive change for patients offering US and UK perspectives. 3)Describe approaches to supporting patient engagement across education and within service improvement.4)Assess barriers to optimal contributions. 5)Identify learning strategies to engage interprofessional stakeholders for role optimization. 6)Apply academic and practice partnerships to maximize opportunities. This session considers the role of service users (clients/patients) and careers in the design of and delivery of health professions education programmes specifically outlining how service users (clients/patients) and careers are embedded in radiology technologist/ radiographers programmes of study. The speakers will offer a range of takeaway toolkits to help support this important work. Patients are at the heart of practice and therefore attendance at this session is encouraged.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

T4-CRT02

ASRT@RSNA: Essential Traits of Effective Leadership

Participants

Melissa Pergola, RT, Albuquerque, New Mexico (*Presenter*) Siemens Healthineers, Past Employee (left June 2021)

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

W4-CNMMI05

Nuclear Cardiology, Correlative Imaging and Incidental Pulmonary Nodules

Participants
Rachna Madan, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Ryan J. Avery, MD, Chicago, Illinois (*Presenter*) Research Consultant, Konica Minolta, Inc
Robert K. Zeman, MD, Potomac, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review cases with correlative imaging in nuclear cardiology. 2) To discuss the available imaging techniques and where/ when to use them. 3) To illustrate incidental findings on chest CT and review what to do with them.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

R4-RCP09

Low Quality Radiology Requests and the Effect on Radiology Output and Patient Care (Sponsored by the RSNA Quality Improvement Committee)

Participants

Frank J. Rybicki III, MD, PhD, Cincinnati, Ohio (*Presenter*) Medical Director, Imagia Cybernetics Inc
Leonid Chepelev, MD,PhD, Ottawa, Ontario (*Presenter*) Nothing to Disclose
Mary Mahoney, MD, Cincinnati, Ohio (*Presenter*) Royalties, Reed Elsevier;Editorial Advisory Board, Wolters Kluwer nv
William Thorwarth JR, MD, Reston, Virginia (*Presenter*) Nothing to Disclose
Cree Gaskin, MD, Keswick, Virginia (*Presenter*) Author with royalties, Oxford University Press;Author with royalties, Thieme Medical Publishers, Inc;Research Grant, Carestream Health, Inc;Research Grant, Koninklijke Philips NV;Consultant, IBM Corporation
Jennifer Uyeda, MD, Lexington, Massachusetts (*Presenter*) Consultant, Allena Pharmaceuticals, Inc
Jonathan Flug, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose
Benjamin Gold, Queensbury, New York (*Presenter*) Employee, Change Healthcare

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Innovations in MRI

Participants

Matthew Bernstein, PhD, Rochester, Minnesota (*Presenter*) Receive pension payments, GE
Yunhong Shu, PhD, Rochester, Minnesota (*Presenter*) Patent agreement, General Electric Company
Florian Knoll, New York, New York (*Presenter*) Advisor, Subtle Medical, Inc;Stockholder, Subtle Medical, Inc
Kawin Setsompop, Stanford, California (*Presenter*) Research Grant, Siemens AG;Royalties, General Electric Company;Royalties, Koninklijke Philips NV;Scientific Advisory Board, KinetiCor, Inc;Scientific Advisory Board, Subtle Medical, Inc

LEARNING OBJECTIVES

1) Identify recent strategies to accelerate MRI acquisitions. 2) Explain uses of AI and machine learning in MRI beyond diagnosis, such as for image reconstruction. 3) Identify novel MR systems including those that are portable or easier to site, or have high-performance gradients. The course "Innovations in MR" will provide three lectures on emerging topics that are having increasing impact on clinical practice. The presentation on Fast MRI explains recent advances in accelerated acquisition methods. The presentation on AI and Machine Learning focuses on applications beyond diagnostic interpretation, such as image reconstruction. Finally, New Directions MR Scanners focuses on recent innovations including portable or easy-to-site systems, as well as high-performance systems to further accelerate MRI acquisitions.

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Abstract Archives of the RSNA, 2021

Multimodal Imaging of Venous Congestion Syndromes: Pearls and Pitfalls

Participants

Chandana Lall, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose
Candice Bookwalter, MD, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Elizabeth Hecht, MD, New York, New York (*Presenter*) Nothing to Disclose
Gloria Salazar, MD, Boston, Massachusetts (*Presenter*) Consultant, Medtronic plc
Rebecca Rakow-Penner, MD, PhD, San Diego, California (*Presenter*) Research Grant, General Electric Company;Consultant, Human Longevity Inc;Stockholder, CureMetrix, Inc;Stock options, CorTechs Labs, Inc;

LEARNING OBJECTIVES

Identify and discuss key imaging features of abdominal & pelvic venous congestive and compressive syndromes. Discuss the importance of multimodality imaging for diagnosis and treatment planning.Discuss non-invasive interventional radiology options for treatment and alleviation of symptoms. This course will discuss and illustrate abdominal and pelvic venous compression/congestive syndromes with multimodality imaging. An important aspect of this course will focus on interventional procedures used in alleviation of abdominal and pelvic congestion/compression syndromes.

Printed on: 06/28/22

S3-CPD02

Pediatric Oncology

Participants
Gary Schooler, MD, Dallas, Texas (*Presenter*) Nothing to Disclose
M. Beth McCarville, MD, Memphis, Tennessee (*Presenter*) Support, Bracco Group;Support, Koninklijke Philips NV;;
Shailee V. Lala, MD, New York, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)Refresh imaging-based knowledge of pediatric musculoskeletal, ovarian, and liver tumors2)Learn up-to-date tumor imaging techniques 3)Review applicable tumor staging systems This refresher course will provide an update on imaging in pediatric oncology, focusing on pediatric bone, ovarian, and liver neoplasms. Pediatric cancer care continues to expand rapidly, with radiologic imaging playing an important role in tumor surveillance, diagnosis, staging, and follow-up. A review of fundamental imaging appearances, up-to-date imaging techniques, and staging systems will be presented in a traditional lecture format. Attendees will learn strategies for successful imaging performance and interpretation from experts in the field.

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Abstract Archives of the RSNA, 2021

How Does AI in Medical Imaging Work? ? Learn by Creating Your Own Model

Participants

Luciano M. Prevedello, MD, MPH, Columbus, Ohio (*Presenter*) Nothing to Disclose
Tara Retson, MD,PhD, San Diego, California (*Presenter*) Research writing, CureMetrix Inc
Felipe C. Kitamura, MD, PhD, Sao Paulo, Brazil (*Presenter*) Consultant, MD.ai, IncSpeaker, GE Healthcare
Errol Colak, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn how deep learning and convolutional neural networks work by building a basic image classifier (intracranial hemorrhage detection algorithm). 2) Understand some of the important steps in the development of Deep Learning algorithms in Radiology including: (i) Data Curation: Learn why and how datasets are organized into training/validation/test sets and the importance of the labeling process; (ii) Training: Understand how algorithm training is performed and important consideration for generalizability; (iii) Inference: Understand how to evaluate algorithm performance.

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Abstract Archives of the RSNA, 2021

T1-RCP33

Case-based Review of Nuclear Medicine: PET/CT Workshop? Brain/Head & Neck (In Conjunction with SNMMI)

Participants
Phillip Kuo, MD,PhD, Tucson, Arizona (*Presenter*) Senior Medical Director, Invicro/Konica MinoltaConsultant, Invicro/Konica MinoltaConsultant, Amgen IncConsultant, Blue Earth DiagnosticsConsultant, Novartis AGConsultant, Chimerix IncConsultant, Fusion PharmaceuticalsConsultant, Bayer AGConsultant, Eisai
Lawrence E. Ginsberg, MD, Houston, Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand best clinical practices for use and interpretation of dementia PET imaging. 2. Understand best clinical practices for use and interpretation of PET/CT in patients with head/neck cancer. The head/neck is as area of high anatomic and metabolic complexity. In this session, experts on dementia imaging and PET/CT for head/neck malignancy will use clinical cases to demonstrate fundamentals of interpretation, as well as pearls and pitfalls to help improve interpretation of these studies.

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Abstract Archives of the RSNA, 2021

Deep Learning Lab: YOLO: Bounding Box Segmentation & Classification

Participants

Pouria Rouzrokh, MD,MPH, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Bradley Erickson, MD, PhD, Rochester, Minnesota (*Presenter*) Board of Directors, VoiceIt Technologies, LLC;Stockholder, VoiceIt Technologies, LLC;Board of Directors, FlowSigma, Inc;Officer, FlowSigma, Inc;Stockholder, FlowSigma, Inc;Officer, Yunu, Inc;Stockholder, Yunu Inc

LEARNING OBJECTIVES

1. Define object detection deep learning models, their scope, and applications in medical imaging.
2. Introduce the object detection model You Look Only Once (YOLO) and explain about its general underlying principles, different versions, and recent advancements.
3. Using a public dataset of brain CT scans including different hemorrhage types, Demonstrate how to train a PyTorch implementation of YOLO v5 on custom medical imaging datasets, apply it on unseen images, and interpret the inference results. Deep learning is attracting more and more attention in all medical fields, especially medical imaging. Nowadays we have access to many valid and reliable deep learning models that can help radiologists in detecting pathologies, differentiating benign and malignant masses, segmenting organs, or even enhancing the quality of different imaging modalities. This course aims to further improve the toolbox diversity of those interested in applying deep learning to medical imaging by introducing an easy way to train and apply object detection deep learning models. These models are used to detect objects of interest in given images and put bounding boxes around them . We will start our course by a brief review of the field of object detection and then proceed to introduce You Look Only Once (YOLO), version 5, that is probably the most recognized and easy to use object detection model. This training is hands-on, and you will spend most of the course coding on Google Colab notebooks, so at least basic familiarity with Python and deep learning models (preferentially with PyTorch) are recommended. Also, please have your Gmail account set up and ready to use!

Abstract Archives of the RSNA, 2021

ASRT@RSNA: Technologist Story Telling Panel: An Experimental Learning Tool for Mental Health Education and Practice for Medical Radiation Technologists

Participants

Jennifer Carey, RT, Moncton, New Brunswick (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Provide general overview of the awareness of mental health among Canadian MRTs and the impact of mental health struggles on practice and wellbeing2. Provide a background on experiential learning philosophy for adult learners3. Demonstrate the use and impact of a MRT storytelling panel as a learning tool4. Provide an outline and considerations for hosting a MRT storytelling panel Recognition for Medical Radiation Technologist (MRT) education opportunities that focus on caring aspects of the profession is growing. While technology continues to dominate continuing education, opportunities for exploring technologists mental health are often overlooked. A recent national Canadian survey examining the mental health of MRTs in Canada found 57% feel moderate to high levels of emotional exhaustion at work.Experiential learning philosophy incorporates relational learning and storytelling. These elements enhance the learning experience of sensitive subject matter, like mental wellness. To address the gap in mental health promotion among MRT, a storytelling panel was developed where participants shared the impact of mental health struggles on their lives and practice. This crafted mechanism for sharing provided a unique opportunity for storytellers and learners. This session will discuss the background, development process and impact of a Technologist Storytelling Panel on Mental Health.

Abstract Archives of the RSNA, 2021

Participants

Judy Yee, MD, New York, New York (*Presenter*) Advisor, Bracco GroupResearch Grant, Koninklijke Philips NVResearch Grant, General Electric Company
Mukesh Harisinghani, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
David Kim, MD, Madison, Wisconsin (*Presenter*) Shareholder, Cellectar Biosciences, Inc;Shareholder, Elucent Medical;
Zahra Kassam, MD, London, Ontario (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn tips to obtain optimal CT Colonography exams with excellent distention and cleansing. 2) Understand CT colonography reading methods and the impact of dual energy CT and artificial intelligence. 3) Explain the current use of MRI for rectal cancer staging and evaluation of anorectal fistula This lecture based course will provide learners with practical tips for assuring high quality CT Colonography exams and how to interpret CTC for colorectal cancer screening and diagnosis. Novel techniques for CTC such as dual energy CT and artificial intelligence will be discussed. The usefulness of MRI for rectal cancer staging and for the evaluation of anorectal fistula will be included.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

T2-CGI05

Case-based Review of GI Imaging

Participants
Jorge Soto, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Shannon P. Sheedy, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Kevin Chang, MD, Sharon, Massachusetts (*Presenter*) Speaker, Anderson Publishing, Ltd;Speaker, Koninklijke Philips NV;
Ellie Korngold, MD, Portland, Oregon (*Presenter*) Nothing to Disclose
Anil Dasyam, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Develop a reasonable list of differential diagnoses for unusual abdominal conditions based on specific imaging findings.2) Understand the complementary role of different imaging tests when approaching difficult cases. This is a case-based course that will help the learner develop a reasonable list of differential diagnostic possibilities for unusual cases that can be encountered in clinical practice. Although some of the specific diagnoses may be difficult to make with certainty, the presenters will help the learner understand why therapeutic or management decisions are made. All discussions will be derived from the illustrative cases shown, and there will be active particiaption by the audience.

Printed on: 06/28/22

M1-CRO02

Head & Neck - Case-based Multidisciplinary Review

Participants

Suresh K. Mukherji, MD, Carmel, Indiana (*Presenter*) Nothing to Disclose
Sung Kim, MD, New Brunswick, New Jersey (*Presenter*) Consultant, Nanobiotix
Chad Zender, MD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose
Francis Worden, MD, Ann Arbor, Michigan (*Presenter*) Speaker, Merck & Co, Inc;Advisory Board, Merck & Co, Inc;Institutional research support, Merck & Co, Inc;Travel support, Merck & Co, Inc;Speaker, Eisai Co, Ltd;Advisory Board, Eisai Co, Ltd;Institutional research support, Eisai Co, Ltd;Speaker, Bristol-Myers Squibb Company;Advisory Board, Bristol-Myers Squibb Company;Research funded, Bristol-Myers Squibb Company;Speaker, Eli Lilly and Company;Advisory Board, Eli Lilly and Company;Research funded, Eli Lilly and Company;Speaker, Bayer AG;Advisory Board, Bayer AG;Travel support, Bayer AG;Speaker, Cue Biopharma, Inc;Advisory Board, Cue Biopharma, Inc;Advisory Board, Rakuten Group, Inc;Research funded, Oragenics, Inc;Institutional research support, Pfizer Inc

LEARNING OBJECTIVES

1) Review multiple head & neck cancer cases with radiologist, radiation oncologist and other specialties, highlighting radiology value added. This will be an interesting case session. The participants will be comprised of a head and neck radiologist, radiation oncologist, medical oncologist and surgeon. The intented goal of this session is to introduce the audience to a multidisciplinary tumor board and highlight the importance of imaging in staging, treatment and management.

Abstract Archives of the RSNA, 2021

M5-CVA03

Imaging of Acute Coronary Syndromes

Participants

Brian B. Ghoshhajra, MD, Boston, Massachusetts (*Presenter*) Research Grant, Siemens AG;Consultant, Koninklijke Philips NV
Julian Luetkens, MD, Bonn, Germany (*Presenter*) Speakers Bureau, Koninklijke Philips NVResearch Consultant, Bayer AG
Farhood Saremi, MD, Irvine, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

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Abstract Archives of the RSNA, 2021

T3-CRT01

ASRT@RSNA: How CT Protocols Affect Technologist Repeat Rates, Throughput, and Image Quality

Participants

Timothy Szczykutowicz, PhD, Madison, Wisconsin (*Presenter*) Consultant, AiDoc Medical Ltd;Consultant, Flowhow.ai;Consultant, medInt Holdings, LLC;Consultant, Alara, Inc;Consultant, AstoCT, Inc;Research Grant, General Electric Company;Research Grant, Canon Medical USA

LEARNING OBJECTIVES

1) Learn the factors motivating CT scans to be repeated 2) Understand the negative departmental and workflow issues arising from poor CT protocols 3) Obtain guidance on how to develop robust CT protocols as a physician/technologist/physicist team which will free technologists to focus on the patient at scan time, not CT scan parameters Repeated imaging is a source of: wasted time, wasted contrast agent, extra patient radiation exposure, and unpredictable exam scheduling. This course reviews what causes repeated imaging in CT, describes current methods to monitor and track repeated imaging, and offers solutions for sites wishing to decrease repeated imaging at their institutions. It is a lecture format. Attendees should walk away from this course understanding what repeats in CT are caused by, how often they happen, and how to reduce them at their own site.

Printed on: 07/01/22

S3-CNPM03

Addressing Organizational Bias, Opportunity for Allyship, and Inclusive Leadership

Participants
Miriam A. Bredella, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Carolyn Meltzer, MD, Los Angeles, California (*Presenter*) Nothing to Disclose
Alexander M. Norbash, MD, San Diego, California (*Presenter*) Scientific Advisor, Penumbra, IncScientific Advisor, Stryker CorporationStockholder, Boston Imaging Core Lab, LLCResearch Grant, Canon Inc.
Cheri Canon, MD, Birmingham, Alabama (*Presenter*) Royalties, The McGraw-Hill Companies

LEARNING OBJECTIVES

1) Understand bias and how to counter it in yourself and others2) Develop a culture of inclusivity and belonging3) Identify strategies to increase diversity in radiology. A diverse biomedical workforce is essential for excellence in patient care. The physician workforce in radiology is predominately male and white. This interactive Hot Topic session will address conscious and unconscious biases, identify strategies to create a culture of inclusion with the goal to increase diversity and belonging in radiology.

Printed on: 07/01/22

S1-RCP06

Humanism in Radiology: Combatting Burnout and Robots (Sponsored by the RSNA Public Information Committee)

Participants
Susan John, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Keith Herr, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Nicole Restauri, MD, Denver, Colorado (*Presenter*) Nothing to Disclose
Bettina Siewert, MD, Brookline, Massachusetts (*Presenter*) Editor, Wolters Kluwer nv;Reviewer, Wolters Kluwer nv;

LEARNING OBJECTIVES

1)Employ strategies in the workplace that foster caring and collaborative professionalism.2)Explore the healing power of narrative to combat burnout.3)Understand connection as an integral element of meaningful work Medical literature and lay news media have portrayed the growing challenges of burnout among physicians, including radiologists. Reports of impending displacement of radiologists by advanced computers and machine learning have added to stress in our specialty and may be discouraging medical students from pursuing diagnostic radiology as a career. Loss of autonomy, isolation, and dehumanization are important contributors to the burnout epidemic, and loss of professional identity and diminished engagement in patient care give credence to the rumors of radiologys demise. Creation of a more humanistic culture in radiology is one way to avert the crisis.Strategies to increase humanism in radiology involve finding ways to increase empathy, foster connectedness, and restore meaning in the workplace. This course will present methods that have been shown to improve radiologist engagement and joy in the work. The use of narrative to share experiences, developing gratitude practices, and developing a focus on personal and organizational values and fulfilling work tasks will be presented as methods to mitigate burnout and demonstrate value in radiology.

W5-CMS17

Practical Multi-Energy CT In Routine Clinical Practice

Participants

Savvas Nicolaou, MD, Vancouver, British Columbia (*Presenter*) Institutional research agreement, Siemens AG;Stockholder, Canada Diagnostic Centres

Jeremy Wortman, MD, Burlington, Massachusetts (*Presenter*) Consultant, United Imaging Healthcare Technology Group

Krystal Archer-Arroyo, MD, Decatur, Georgia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Gain a practical approach to the interpretation of dual-energy CT2) Identify the advantages of multi-energy CT vs. conventional CT3) Explain how to optimize and maximize workflow and efficiency in interpreting dual-energy CT exams4) Discuss the different dual-energy application classes (eg. material decomposition, monoenergetic imaging)5) Work through practical cases illustrating the clinical value of dual-energy CT This session will cover the basics of spectral/dual-energy CT, the clinical value and common pitfalls of multi-energy CT in comparison to conventional CT, workflow considerations and optimization for a clinical practice, and applications of multi-energy CT with practical cases illustrating non-traumatic and traumatic applications.

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M4-CMS08

Artificial Intelligence and Machine Learning in Oncologic Imaging

Participants

Walter Wiggins, MD, PhD, Durham, North Carolina (*Presenter*) Nothing to Disclose
Judy Gichoya, MBChB,MS, Atlanta, Georgia (*Presenter*) Consultant, Cook Group Incorporated;Advisor, Boston Scientific Corporation
Guido Davidzon, MD, Stanford, California (*Presenter*) Nothing to Disclose
Nina E. Kottler, MD, MS, San Diego, California (*Presenter*) Partner, Radiology Partners;Stockholder, Radiology Partners;Stockholder, Aidoc Medical;Stockholder, Rad AI

LEARNING OBJECTIVES

1) Explain the basic principles of data curation and AI model development for medical imaging.2) Identify important health disparities and access issues (especially for cancer screening), as well as potential methods to mitigate these issues with AI.3) Enumerate key considerations for integrating AI technologies into the clinical workflow.4) Recognize current and emerging applications for AI in tumor detection and staging. In this course, speakers will present a series of didactic lectures covering basic concepts in artificial intelligence (AI) and machine learning (ML) for radiology with a particular emphasis on new and emerging uses in oncologic imaging. Lectures will cover the basics of data curation and model development, disparity and access issues (with special attention to cancer screening) and how AI may worsen or be used to improve these problems, considerations for integrating AI into the clinical workflow, and current/emerging applications of AI for tumor detection and staging. The course will conclude with a question-and-answer session with the panel of speakers.

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T4-RCP22

RSNA Resident and Fellow Symposium 2021

Participants
Erik Velez, MD, Los Angeles, California (*Presenter*) Nothing to Disclose
Eric M. Rubin, MD, Media, Pennsylvania (*Presenter*) Nothing to Disclose
Tarang V. Patel, DO, Scottsdale, Arizona (*Presenter*) Nothing to Disclose
Elizabeth Dibble, MD, Warwick, Rhode Island (*Presenter*) Nothing to Disclose
Paul G. Thacker JR, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Melissa Chen, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Benjamin Strong, MD, Eden Prairie, Minnesota (*Presenter*) Officer, Virtual Radiologic Corporation
Frank Chen, MD, Ponte Vedra, Florida (*Presenter*) Nothing to Disclose
Gautam A. Agrawal, MD, Reno, Nevada (*Presenter*) Co-founder, Vision Radiology

LEARNING OBJECTIVES

1) Gain a better understanding of the radiology job market, how to interview for a job, and evaluate a job offer. This symposium will help prepare residents and fellows for jobs as attending in both private practice and academics. 2)Learnabout personal finance and how artificial intelligence is being incorporated into the work place. The Resident and Fellow Symposium is a course targeted towards residents and trainees to gain a better understand of the radiology work place and prepare for life as an attending. The Symposium will begin with courses dedicated to the radiology job market, including current hiring practices, how to interview for jobs, and contract negotiation. The second half of the symposium will be dedicated to personal finance, how artificial intelligence can be reimbursed in practice, and a career panel with panelists from academic, private, hybrid, and tele-radiology practices.

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S3-CIR02

Interventional Oncology ? What?s New?

Participants

Isabel G. Newton, MD, PhD, San Diego, California (*Presenter*) Advisory Board, Boston Scientific Corporation;Advisory Board, Varian, Inc;Advisory Board, BridgeBio Pharma

Nadine Abi-Jaoudeh, MD, Orange, California (*Presenter*) Research collaboration, Koninklijke Philips NV (PI money to institution)Research collaboration, Teclison Limited (PI money to institution)Intellectual property, Bruin Biosciences IncOwner, Bruin Biosciences IncResearch collaboration, Sirtex Medical Ltd (P

Miyuki Sone, MD, Chuo-ku, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation;Speakers Bureau, Canon Medical Systems Corporation;Research Grant, Dream Medical Partners Co., Ltd;Speakers Bureau, Bayer AG;Consultant, Astellas Group;Consultant, Guerbet SA

Bradford Wood, MD, Bethesda, Maryland (*Presenter*) Royalties, Koninklijke Philips NV;Researcher, Koninklijke Philips NV;Intellectual property, Koninklijke Philips NV;Equipment Support, Koninklijke Philips NV;Researcher, Celsion Corporation;Research Grant, Celsion Corporation;Researcher, BTG International Ltd;Intellectual property, BTG International Ltd;Researcher, Boston Scientific Corporation;Research Grant, Boston Scientific Corporation;Intellectual property, Boston Scientific Corporation;Researcher, Siemens AG;Equipment Support, Siemens AG;Researcher, Sarasota Interventional Radiology;Researcher, NVIDIA Corporation;Research Grant, NVIDIA Corporation;Equipment support, AngioDynamics, Inc;Equipment support, Profound Medical Inc;Researcher, Canon Medical Systems Corporation;License agreement, Canon Medical Systems Corporation;Researcher, AstraZeneca PLC;Researcher, Exact Imaging Inc

Ziv J. Haskal, MD, Charlottesville, Virginia (*Presenter*) Speaker's Bureau, W. L. Gore & Associates, IncConsultant, Becton, Dickinson and CompanyStockholder, BlackSwan Vascular, IncConsultant, Boston Scientific CorporationConsultant, Sirtex Medical Ltd

Michael Soulen, MD, Lafayette Hill, Pennsylvania (*Presenter*) Consultant, F. Hoffmann-La Roche Ltd;Consultant, Guerbet SA;Research support, Guerbet SA;Consultant, Instylla, Inc;Research support, BTG International Ltd;Research Support, Sirtex Medical Ltd;Research Support, Pfizer Inc;

LEARNING OBJECTIVES

1) Describe funding opportunities and challenges for advances in IO. 2) Describe recent, key IO clinical trials and IO publications. 3) Summarize what has been new for IO in the past year and what is on the horizon. S3-CIR02: Interventional Oncology Whats New? This educational session, comprised of 5 short lectures, aims to catch participants up on latest advances, innovations, and challenges in IO, a rapidly-expanding area of interventional radiology.

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Abstract Archives of the RSNA, 2021

T6-CPD07

Mimics in Pediatric Imaging: Do Not Miss!

Participants
Asha Sarma, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Sarah D. Bixby, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Monica Epelman, MD, Orlando, Florida (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Identify normal variants, developmental findings, and disease processes that may resemble one another on imaging of pediatric patients, focusing on the chest, abdomen, and pelvis, musculoskeletal system, and head and neck. 2. Recognize key clinical and imaging characteristics that help to differentiate among mimics in pediatric imaging. Many pathologies and developmental variants may bear resemblance to one another on imaging in pediatric patients. Radiologist awareness of key clinical and imaging features that help to differentiate among pathologies is essential to optimal diagnosis. In this lecture-based session, attendees will gain exposure to potential imaging mimics of disease in the chest, abdomen, and pelvis, musculoskeletal system, and head and neck. Clinically helpful pearls and pitfalls that will help to differentiate among disease entities and normal variants will be highlighted. Included cases will focus on pathologies that are often missed. Following the session, attendees will feel more comfortable in interpreting imaging studies including these organ systems in pediatric patients.

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Abstract Archives of the RSNA, 2021

DLL52

Deep Learning Lab: Basics of NLP in Radiology

Participants
Timothy Chen, San Jose, California (*Presenter*) Nothing to Disclose
Jae Ho Sohn, MD, San Francisco, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)Understand common terminology and preprocessing techniques in NLP 2)Identify several classic and modern approaches used to capture semantic meaning in text 3)Learn how to implement a basic NLP pipeline from preprocessing to performance evaluation This session will feature a brief lecture introducing the basics of natural language processing (NLP) and highlight potential uses for it in radiology. The goal is to survey standard text preprocessing techniques and traditional NLP approaches as well as modern neural network based approaches. We will follow up the didactic portion with a hands-on Google Colab demo implementing discussed concepts for a text classification task. For best experience, we highly recommend attendees bring a laptop with a keyboard as well as have a Gmail account to access Google Colab.

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Abstract Archives of the RSNA, 2021

Molecular Imaging and Targeted Therapy: NETS and Thyroid Cancer

Participants
Rathan M. Subramaniam, MD,PhD, Dunedin, New Zealand (*Presenter*) Nothing to Disclose
Delphine Chen, MD, Seattle, Washington (*Presenter*) Grant support and speaker honorarium, Telix Pharmaceuticals
Terence Z. Wong, MD, PhD, Durham, North Carolina (*Presenter*) Consultant, General Electric Company
Don Yoo, MD, Lexington, Massachusetts (*Presenter*) Consultant, Konica Minolta, Inc
Carina Mari Aparici, MD, San Francisco, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss advances in neuroendocrine tumor imaging and therapy using radiopharmaceuticals. 2) To discuss advances in thyroid cancer imaging and therapy using radiopharmaceuticals. 3) To illustrate advances using a series of images from the field. This course will provide an update on molecular imaging and targeted therapy for endocrine tumors. There will be a series of lectures including a mix of core materials and new innovations. We will also include clinical pearls and pitfalls and illustrative case examples.

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Abstract Archives of the RSNA, 2021

Infections and Inflammatory Cardiac Disorders: Case Based Review

Participants
Marco Francone, MD,PhD, Rome, Italy (*Presenter*) Nothing to Disclose
Jordi Broncano, MD, Cordoba, Spain (*Presenter*) Nothing to Disclose
Matthew Cham, MD, Kenmore, Washington (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review the role of imaging in COVID-19 related myocardial injury.2) To evaluate the imaging clues in patients with native and prosthetic infectious endocarditis and potential pitfalls. 3) To describe the imaging pearls in the diagnosis of pericardial infection and inflammation. Infections and inflammatory cardiac diseases include a broad range of entities that can involve cardiac valves, endocardium, myocardium, pericardium, but also prosthetic valves or be associated to implantable devices. These conditions can have a subclinical presentation, and are associated to significant morbidity and mortality. This impact in healthcare systems has been recently exposed during the Coronavirus Disease (COVID-19) pandemic, where cardiac injury has been associated with excess of mortality. Imaging have an important role in prompt diagnosis, and may reduce the risk of complications and recurrence. In this course we will review, with case-based lectures, the role of imaging in the diagnosis and management of SARS-CoV-2 related myocardial injury, in cardiac valve infections and pericardial infections and inflammation.

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M4-CGI04

Management of Cystic Pancreatic Lesions

Participants
Desiree Morgan, MD, Birmingham, Alabama (*Presenter*) Institutional Research Grant, General Electric Company
David M. Hough, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
William W. Mayo-Smith, MD, Weston, Massachusetts (*Presenter*) Nothing to Disclose
Elizabeth Hecht, MD, New York, New York (*Presenter*) Nothing to Disclose
Hanna M. Zafar, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Eric Tamm, MD, Houston, Texas (*Presenter*) Institutional Research Grant, General Electric Company

LEARNING OBJECTIVES

1. Identify commonalities and differences in pancreatic cyst surveillance guidelines.2. Explain the role of imaging, cyst aspiration and genetic evaluation in patients with IPMN.3. Explore the evidence for pancreatic cyst risk stratification and apply in conjunction with imaging features. This course on management of patients with pancreatic cysts will educate the learner on key imaging features of cystic pancreatic lesions and explain the major surveillance management guidelines in the context of evidence based risk stratification. Six expert pancreatic speakers will present rapid summaries, followed by a panel discussion that will encourage real-time audience opinion and feedback.

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M1-CGI03

Pancreatic Tumor Imaging

Participants

Avinash Kambadakone, MD, Boston, Massachusetts (*Presenter*) Advisory Board, Bayer AG;Research Grant, General Electric Company;Research Grant, Koninklijke Philips NV;Research Grant, PanCAN
Zhen J. Wang, MD, San Francisco, California (*Presenter*) Stockholder, Nextrast, Inc
Priya R. Bhosale, MD, Bellaire, Texas (*Presenter*) Nothing to Disclose
Suresh Chari, Houston, Texas (*Presenter*) Nothing to Disclose
Linda C. Chu, MD, Lutherville, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Describe key imaging features for the diagnosis, staging, and response assessment in pancreatic cancer.2. Summarize the role of screening in patients at risks for developing pancreatic cancer.3. Discuss potential applications of artificial intelligence in pancreatic tumors.4. Explain recent advances in pancreatic neuroendocrine tumor imaging This course contains a series of short lectures and reviews the current state-of-the-art and recent advances in imaging of pancreatic adenocarcinoma and pancreatic neuroendocrine tumor. Attendees will also learn updates on pancreatic cancer screening and artificial intelligence applications in pancreatic cancer.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

W4-CPH09

Digital PET in Current Radiology Practices

Participants
Osama R. Mawlawi, PhD, Houston, Texas (*Presenter*) Nothing to Disclose
Dustin Osborne, PHD, Knoxville, Tennessee (*Presenter*) Nothing to Disclose
Jun Zhang, PhD, Columbus, Ohio (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

At the end of this session, the audience should have gained knowledge of:1) The design characteristics of digital PET detectors and systems from various manufacturers. 2) The performance characterizations of PET systems from various manufacturers.3) PET systems options and clinical examples from the various manufacturers. PET scanners with digital detectors is one of the latest innovations in PET scanner system designs. This course will cover the detector design and system performance of digital PET scanners from various manufacturers. The course will also cover the resultant image quality for these systems as well as the various capabilities of these commercial systems.

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Abstract Archives of the RSNA, 2021

Advances in Cerebrovascular Imaging

Participants

Luca Saba, MD, Cagliari, Italy (*Presenter*) Nothing to Disclose
Mahmud Mossa-Basha, MD, Seattle, Washington (*Presenter*) Nothing to Disclose
Tobias Saam, MD, Munich, Germany (*Presenter*) Nothing to Disclose
Hediyeh Baradaran, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss stroke imaging features that can predict the outcome and allow to better stratify the patients.2) Identify the imaging strategy to incorporate intracranial wall imaging and its potential benefits in the daily clinical activity3) Identify the controversial topics in carotid plaque imaging according to the newer evidences In this session Advances in Cerebrovascular Imaging, some challenging topics at the edge between research and clinical will be focused, in order to offer the participants new opportunities to face the cerebro-vascular imaging. The lectures we will start from the prevention of the stroke by exploring the more controversial areas related to the carotid plaque and intracranial wall imaging and then we will assess the diagnosis and outcome stratification for the ischemic stroke

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

M4-CMK04

Musculoskeletal Infection and Its Mimics: Pearls and Pitfalls

Participants
Jim S. Wu, MD, Lexington, Massachusetts (*Presenter*) Nothing to Disclose
Patrick Omoumi, MD, Lausanne, Switzerland (*Presenter*) Nothing to Disclose
Corrie M. Yablon, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Erin F. Alaia, MD, New York, New York (*Presenter*) Nothing to Disclose
Matthew Bucknor, MD, San Francisco, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Identify and describe imaging features of musculoskeletal infection. 2.Differentiation of osseous and soft tissue infection from important mimickers. 3.Avoid common pitfalls in the diagnosis of musculoskeletal infection. This session will cover imaging of musculoskeletal infection through case-based lectures. Lectures will cover infection of the soft tissues, the articulations, and imaging of acute and chronic osteomyelitis. Pearls and pitfalls of musculoskeletal infection will be emphasized as teaching points. At the completion of the course, the learner will be able to identify and describe imaging features of musculoskeletal infection, and will be able to differentiate infection from common and important mimics.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Pediatric - Case-based Multidisciplinary Review

Participants

Shannon MacDonald, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Michael S. Gee, MD, PhD, Boston, Massachusetts (*Presenter*) Research Grant, Takeda Pharmaceutical Company Limited;Researcher, General Electric Company ;Researcher, Siemens AG
Camilo Jaimes Cobos, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
David Ebb, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)Identify important imaging anatomy relevant to pediatric tumors.2) Explain the pros and cons of different imagingmodalities in pediatric oncology staging.3) Understand imaging and clinical considerations related to the treatment decisions in pediatric cancer. The course will be amultidisciplinary review of pediatric oncology cases that will include radiation oncology,medical oncology, and radiology perspectives and considerations for clinicalmanagement of pediatric oncology patients. Issues related to relevant imaging anatomy, imagingmodalities, radiation planning, and therapeutic options will be discussed. The format of the course will be amultidisciplinary case review and discussionmirroring that of a tumor board conference. This synopsis can be used as amarketing/promotional tool to gauge interest in the session. The expected outcome is that the audience will have familiarity with diagnostic imaging and treatment planning of pediatric cancer patients.

Printed on: 07/01/22

W6-CIR05

Career Planning and Leadership Development

Participants

Anne M. Covey, MD, New York, New York (*Presenter*) Stockholder, Amgen Inc

Alan Matsumoto, MD, Charlottesvle, Virginia (*Presenter*) Speakers Bureau, Cook Group Incorporated;Advisory Board, Vascular Medcure, Inc;Advisory Board, Boston Scientific Corporation;Reviewer, Boston Scientific Corporation;Data Safety Monitoring Board, W. L. Gore & Associates, Inc;Data Safety Monitoring Board, Endologix, Inc;Data Safety Monitoring Board, Penumbra, Inc;Stockholder, Brightwater Medical, Inc;Advisory Board, Brightwater Medical, Inc;Stockholder, Respiratory Motion, Inc;;

Laura K. Findeiss, MD, Atlanta, Georgia (*Presenter*) Consultant, Becton, Dickinson and Company;Spouse, Consultant, Medtronic plc

Juan Camacho, MD, Sarasota, Florida (*Presenter*) Research grant Elesta Echolaser

M. Victoria Marx, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

Ripal T. Gandhi, MD, Miami, Florida (*Presenter*) Consultant, Sirtex Medical Ltd;Speaker, Sirtex Medical Ltd;Proctor, Sirtex Medical Ltd;Consultant, Medtronic plc;Speaker, Medtronic plc;Consultant, Becton, Dickinson and Company;Speaker, Becton, Dickinson and Company;Consultant, Cardinal Health, Inc;Consultant, TriSalus Life Sciences;

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Participants
Jennifer McCarty, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Ashok Srinivasan, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Gul Moonis, MD, South Orange, New Jersey (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Highlight different modalities and imaging techniques that improve postoperative head and neck assessment.2.Discuss expected postoperative appearances of the neck, sinuses, orbits, and temporal bones.3.Cover potential associated complications for each of these anatomic regions. Image interpretation of the postoperative head and neck is notoriously challenging. In order to provide accurate and useful reports, radiologists must understand the expected postoperative appearance and recognize associated complications. The lectures of this session cover postoperative imaging and interpretation of the neck, sinuses, orbits, and temporal bones.

Abstract Archives of the RSNA, 2021

Innovations in Hybrid Imaging

Participants

Ramsey Badawi, PhD, Sacramento, California (*Presenter*) Research Grant, Shanghai United Imaging Healthcare Co, Ltd;Institutional research agreement, Shanghai United Imaging Healthcare Co, Ltd
Ciprian Catana, MD, PhD, Charlestown, Massachusetts (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the state-of-the-art hardware for hybrid imaging. 2) Explain software innovations in combining the multimodality information. 3) Identify current applications of artificial intelligence in hybrid imaging. This session will provide an overview of the recent developments in hybrid PET/CT and PET/MRI instrumentation. It will also present the latest progress in the integration of the multimodality information for research and clinical applications. Finally, the use of artificial intelligence for addressing remaining challenges in hybrid imaging and for performing advanced analyses of the multimodal datasets will be discussed.

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Abstract Archives of the RSNA, 2021

Non Physician Radiology Providers (NPRP)

Participants
Jacqueline A. Bello, MD, New York, New York (*Presenter*) Nothing to Disclose
Eugenia Brandt, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose
Eric M. Rubin, MD, Media, Pennsylvania (*Presenter*) Nothing to Disclose
Timothy L. Swan, MD, Marshfield, Wisconsin (*Presenter*) Nothing to Disclose
William Thorwarth JR, MD, Reston, Virginia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the benefits, concerns and controversies regarding non-physician radiology providers (NPRP) use.2)Become familiar with state regulations for scope of practice and independent practice for nurse practitioners and physician assistants. 3)Gain peer-to-peer knowledge of the near- and long-term implications of NPRP use in radiology by participating in the open discussion session. Non-physician radiology providers are increasingly utilized in various capacities in practices across the country. State and national agencies have encouraged use of these physician extenders -- especially during the COVID-19 public health emergency (PHE). Nurse practitioner and physician assistant efforts to increase their scope of practice and gain independent practice through state legislative initiatives have created controversy.Radiologists are concerned that increased physician extender scope of practice and autonomy may impact care and limit patient access to radiologist expertise.An expert panel will discuss: The history of registered radiologist assistants, nurse practitioners and physician assistants in radiology State-based rules and regulations of scope of practice and PA and NP independent practice Controversies and concerns regarding use of these physician extenders The panel will then open the discussion for audience participation.

Printed on: 07/01/22

S4-RCP11

An Introduction to the Learning Healthcare System and Tackling the Critical Data Hurdles (Sponsored by the RSNA Research Development Committee)

Participants

Safwan Halabi, MD, Chicago, Illinois (*Presenter*) Advisor, Bunkerhill Health;Advisor, McKesson Corporation;
Caroline Chung, MD, FRCPC, Houston, Texas (*Presenter*) Research support, RaySearch Laboratories AB;Research support, Siemens AG
Charles Kahn JR, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. To review approaches and challenges for aggregating structured data within a practice to support a Learning Health System. 2. To describe the value and key aspects of generating quantitative imaging to support a Learning Health System. 3. To describe specific examples of data management approaches and review lessons learned. This lecture sponsored by the RSNA Research Development Committee aims to provide the framework whereby healthcare professionals and researchers can help establish and contribute to a Learning Health System (LHS). An LHS is defined as a collaboration of science, informatics, incentives, and culture [which] are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the delivery process, [with] patients and families active participants in all elements, and new knowledge captured as an integral by-product of the delivery experience.

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W6-CGI09

Crohn Disease Imaging

Participants
Tracy A. Jaffe, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose
Jonathan Dillman, MD, MSc, Cincinnati, Ohio (*Presenter*) Research Grant, Perspectum LtdResearch Grant, Siemens AGResearch Grant, Canon Medical Systems CorporationResearch support, Koninklijke Philips NVResearch support, GE HealthcareResearch support, Motilent
Bari Dane, MD, New York, New York (*Presenter*) Nothing to Disclose
Sudha A. Anupindi, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Mahmoud M. Al-Hawary, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Implement state-of-the-art MRI, CT, and ultrasound MRI techniques for evaluating children and adults with Crohns disease. 2) Understand the roles of MRI, CT, and ultrasound in diagnosing Crohns disease as well as characterizing intra-abdominal and perianal disease-related complications. 3) Accurately assess Crohns disease inflammatory activity and treatment response by imaging. Imaging, including MRI, CT, and ultrasound, is critical to the diagnosis and care (medical and surgical) of patients with Crohns disease. Using a series of short didactic lectures, participants will learn: effective patient preparation and state-of-the-art imaging techniques, how to accurately assess disease activity and treatment response, and the role of imaging in detecting and characterizing intra-abdominal and perianal disease-related complications. Attendees also will be exposed to the potential roles of ultrasound in evaluating patients with known and suspected Crohns disease, including how to get started in clinical practice.

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Abstract Archives of the RSNA, 2021

S3-CIN03

Hoping for the Best, Planning for the Worst: Ensuring Platform Speed, Reliability, and Disaster Recovery for Your Practice

Participants

Jonathan Shoemaker, BS, ARRT, Rocklin, California (*Presenter*) Nothing to Disclose
Ross Filice, MD, Washington, Dist. of Columbia (*Presenter*) Advisor, BunkerHill Health, IncShareholder, BunkerHill Health, IncSpeaker/Honorarium, GE HealthcareSpeaker/Clinical Trial Participant, Koios Medical
Jason B. Wiesner, MD, Granite Bay, California (*Presenter*) Nothing to Disclose
Sylvia Devlin, MS,RT, Fulton, Maryland (*Presenter*) Nothing to Disclose
Matthew Geeslin, MD, MS, Burlington, Vermont (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand how to optimize your image archive, viewing, and sharing platforms for speed and reliability.?2. Debate decision points for cloud versus local research and clinical deployment?3. Learn best practices in returning to normal operations after planned or unexpected downtimes?4. Understand the likely evolution of your viewing and archive platform5. How to build resiliency within your staff6. How to prepare for a Cyber Attack Designing Your Imaging Platform For Speed, High Availability, and Disaster Recovery while considering the growing cyber attack risks. This course will show different architectures at various medical centers that designed their platforms to address speed, high availability, security, research, cloud and staff resilience. Lessons learned from sites that experienced cyber attacks and how they overcame these events.

Printed on: 06/28/22

W2-CRT06

ASRT@RSNA: Standards of Ethics in Practice

Participants
Cheryl DuBose, ARRT, Jonesboro, Arkansas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Increase participants understanding of the ARRT Mission, Standards of Ethics, and ARRT Equation for Excellence.2. Explain the purpose of the aspirational Code of Ethics and enforceable Rules of Ethics.3. Describe the processes followed in handling challenges raised under the Standards of Ethics Administrative Procedures. Participants will gain an understanding of the ARRTs mission and how the Standards of Ethics support the mission. The purpose of the aspirational Code of Ethics and enforceable Rules of Ethics will be discussed.

Printed on: 07/01/22

W1-CBR07

Supplemental Imaging in Breast Screening

Participants
Sarah J. Vinnicombe, FRCR,MRCP, Cheltenham, United Kingdom (*Presenter*) Consultant for Advisory Board, Bayer
Wendie A. Berg, MD, PhD, Gibsonia, Pennsylvania (*Presenter*) Institutional Research Grant, Koios Medical, Inc
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Presenter*) Researcher, Siemens AGConsultant, Siemens AGResearcher, Bayer
AGConsultant, Bayer AGResearcher, Medtronic plcConsultant, Medtronic plcResearcher, Becton, Dickinson and CompanyConsultant,
Becton, Dickinson and CompanyResearcher, ScreenPoint Medical BVConsu

LEARNING OBJECTIVES

1.Assess the individual risk of women for the development of breast cancer, taking familial, hormonal and imaging factors into
account2.Identify women for whom supplemental ultrasound may be beneficial, and discuss the pros and cons3.Identify women for
whom MRI may be beneficial; and discuss the pros and cons Breast screening has long been a one-size fits all technique, using
annual or biennial mammography to detect breast cancers early. Although for the average population this approach has shown to
reduce breast cancer specific mortality, the effect for the individual woman is highly variable. Mammography screening is still
associated with significant underdiagnosis of relevant breast cancers, and some populations, e.g. women with dense breasts, are
more affected by this than others. In this course, risk stratification techniques and supplemental (or alternative) screening
techniques are presented. After this course you will have a thorough understanding of risk stratification and screening possibilities.
You will be capable of discussing tailored breast cancer screening strategies for individual women.

Printed on: 06/28/22

M2-CPH03

Practical Aspects of MRI

Participants

Nicole Seiberlich, PhD, Ann Arbor, Michigan (*Presenter*) Royalties, Siemens AGResearch support, Siemens AG
Liliana Ma, PhD, Chicago, Illinois (*Presenter*) Nothing to Disclose
Kathryn Fowler, MD, San Diego, California (*Presenter*) Consultant, Bayer AG;Research support, General Electric Company;Research Grant, Pfizer Inc;Institutional Grant, MEDIAN Technologies;Consultant, General Electric Company
Kathryn Keenan, PhD, Boulder, Colorado (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe how differences in contrast can be induced by the selection of particular pulse sequence settings to differentiate tissues using MRI. 2) List several options for mitigating motion artifacts in MRI, and explain how images showing motion can be captured (i.e. cine imaging). 3) Explain the practical considerations involved in selecting the sequences to be included in an MRI protocol In this course, comprised of three 20-minute lectures, practical aspects of deploying Magnetic Resonance Imaging will be discussed. The aim of this course is to help radiologists to better understand the basics of MRI, and why clinical MRI exams are structured the way that they are. A detailed understanding of MRI physics is not required. MRI is complex due to the large number of parameters that can be adjusted and the unexpected artifacts that can arise, especially in the presence of motion. Determining an appropriate protocol for a clinical question balances the need for contrast between healthy and diseased tissue, the speed of the individual sequences, exam length, and the incremental diagnosic utility provided by adding to the protocol. This course will tackle these questions by focusing on three topics: 1) image contrast, and how it is generated and used to discriminate different tissues; 2) motion, including how it can be measured or reduced to avoid artifacts, and 3) protocol selection, specifically how appropriate protocols are chosen for clinical exams.

R3-CNMMI08

Neurologic Molecular Imaging Applications

Participants

Alexander Drzezga, MD, Cologne, Germany (*Presenter*) Research support, Siemens AG Research support, Life Molecular ImagingResearch support, General Electric CompanyResearch support, Eli Lilly and CompanyResearch support, Eisai CompanyConsultant, Siemens AG Consultant, General Electric CompanyConsultant, Bio

Satoshi Minoshima, MD, PhD, Salt Lake City, Utah (*Presenter*) Advisor, HAMAMATSU Group;Grant, Nihon Medi-Physics Co, Ltd

Katherine Zukotynski, MD, PhD, Hamilton, Ontario (*Presenter*) Research Consultant, Konica Minolta, Inc;Research Consultant, General Electric Company;Speakers Bureau, Jubilant DraxImage Inc

Peter Herscovitch, MD, Chevy Chase, Maryland (*Presenter*) Nothing to Disclose

Kirk A. Frey, MD, PhD, Ann Arbor, Michigan (*Presenter*) Consultant, MIM Software Inc;Stockholder, General Electric Company;Stockholder, Johnson & Johnson;Stockholder, Novo Nordisk AS;Stockholder, Bristol-Myers Squibb Company;Stockholder, Merck & Co, Inc;Stockholder, Medtronic plc;Stockholder, Amgen Inc

LEARNING OBJECTIVES

1) To discuss advances in imaging of dementia and Parkinsonism using radiopharmaceuticals. 2) To review imaging interpretation. 3) To illustrate advances and imaging interpretation with images from the field. This course will provide an update on molecular imaging and for neurologic applications. There will be a series of lectures including a mix of core materials and new innovations. We will also include clinical pearls and pitfalls and illustrative case examples.

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W3-CRT10

ASRT@RSNA: Let's Get Lifted! Elevating Yourself as an Imaging Professional through Advocacy, Engagement and Ethics

Participants

Jennifer Clayton, MBA, RT, Albany, Oregon (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Consider the ethical and legal aspects of serving patients, colleagues and our profession.Discuss the application of ARRT standards of ethics.Review disciplinary cases brought to licensure boards related to ethical or legal violations. Discuss legislative issues facing imaging professionals and the potential impact on patient interactions.Explain effective methods to personally engage in professionalism, advocacy and create awareness about the imaging field. During this presentation we will discuss various ethical and legal issues related to imaging. We'll also share information related to engagement, being actively involved as imaging professionals and the importance of advocacy.

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M1-CIR11

GU/Lymphatic Interventions

Participants

Rajasekhara R. Ayyagari, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose
Maxim Itkin, MD, Bala Cynwyd, Pennsylvania (*Presenter*) Stockholder, ControlRad Systems, Inc;Consultant, ControlRad Systems, Inc
Shivank S. Bhatia, MD, MBBS, Miami, Florida (*Presenter*) Consultant, Merit Medical Systems, Inc;Grant, Merit Medical Systems, Inc;Grant, Siemens AG;Consultant, Mentice AB;Consultant, Terumo Corporation;Consultant, Medtronic plc;Stockholder, Embolx, Inc
Maureen Kohi, MD, Chapel Hill, North Carolina (*Presenter*) Nothing to Disclose
Theresa Caridi, MD, Birmingham, Alabama (*Presenter*) Consultant and Speaker - Boston Scientific, Cook, Terumo, VarianSpeaker - PenumbraResearch grant - Varian
Saebeom Hur, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. To understand current landscapes and future directions for prostate embolization, MRI-guided prostate lesion biopsy, and MRI-guided prostate cancer ablation.2. To understand contemporary image-guided procedural treatment options for pelvic congestion, syndrome, female infertility, uterine fibroid disease, and uterine artery hemorrhage.3. To become familiar with state-of-the-art advances in lymphatic imaging and image-guided interventions for lymphatic disorders. Genitourinary intervention topics will include men's health sessions on 1) prostate interventions for benign and malignant disease and 2) the existing data and future directions for prostate embolization, as well women's health sessions on 1) pelvic venous and infertility interventions and 2) applications for uterine artery embolization. Lymphatic intervention topics will include sessions on 1) recent advances in lymphatic imaging and 2) state-of-the-art lymphatic interventions.

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T2-CMS11

Update on Whole Body MRI for Adult Malignancies

Participants

Evis Sala, MD, PhD, Cambridge, United Kingdom (*Presenter*) Co-founder, Lucida Medical Ltd
Vasantha D. Aaron, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Hebert Alberto Vargas, MD, New York, New York (*Presenter*) Nothing to Disclose
Anwar Padhani, MD,FRCR, Northwood, United Kingdom (*Presenter*) Advisory Board, Siemens AGSpeakers Bureau, Siemens AGAdvisory Board, Lucida Medical LtdStockholder, Lucida medical Ltd
Christina Messiou, MD, BMBS, London, United Kingdom (*Presenter*) I am a co-founder of Diafora (alongside the Institute of Cancer Research and The Royal Marsden) that has formed a joint venture, Celescan, with Sopra Steria

LEARNING OBJECTIVES

1.To illustrate the limitations of conventional imaging especially for malignant bone disease detection and response assessments2.To learn the strengths and limitations of different modalities and next-generation imaging probes used in advanced prostate cancer3.To exemplify how WB-MRI could help deliver the promise of precision oncology for patients with bone disease 4.To discuss indications for (whole body) PET/MRI imaging with focus on specific pathologies and identify challenges to implementing clinical PET/MRI programs This session will discuss the limitations of conventional imaging especially for malignant bone disease detection and response assessments. It will highlight that heterogeneity of clinical outcomes is related to imperfect classification systems, underlying genomic and molecular alternations and variable therapy effectiveness and the need for better diagnostic, prognostic, predictive, theragnostic and response biomarkers, including next-generation imaging. It will also discuss the role of WBMRI in prostate cancer and myeloma as well the role of PET in prostate cancer and whole body PET/MRI in specific pathologies. Finally, it will discuss physician barriers for adopting next-generation imaging and the need for better evidence on management impacts.

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Abstract Archives of the RSNA, 2021

Participants

Ramin Khorasani, MD, Roxbury Crossing, Massachusetts (*Presenter*) Nothing to Disclose
Lindsey Shea, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Neena Kapoor, MD, Wellesley, Massachusetts (*Presenter*) Nothing to Disclose
Gloria Hwang, MD, Hillsborough, California (*Presenter*) Spouse, Stockholder, Thrombx Medical, IncSpouse, Consultant, Terumo CorporationSpouse, Consultant, Johnson & JohnsonSpouse, Research Grant, Stryker CorporationSpouse, Research Grant, Siemens AGSpouse, Research Grant, Route 92 Medical, IncSpouse, Consultan
Kristine Burk, MD, Winchester, Massachusetts (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Using case examples, illustrate how informatics tools can be used to enable quality, patient safety and performance improvement. 2. Describe how informatics tools can be used to create specific metric, communicate performance, and monitor and sustain gains.3. Describe relevance and use of informatics tools to enable various components of a performance improvement initiative. Session title: Quality, patient safety and performance improvement using informatics tools to measure, display and monitor performance (dashboards/analytics) Goal: Illustrate how to use informatics tools to measure, display, monitor unambiguous metrics, and targets to make needed improvements. Speakers will describe why/how they chose the specific issue to address, the urgency for change, improvement goal, metrics, target performance and how they used informatics tools to bring about the needed change. Format: Three 15-minute talks, followed by 15 min panel discussionMode: Mixed (in person/virtual) Talks:Kristine Burk, MD, Brigham and Womens Hospital, Harvard Medical School: Radiology Patient Outcome Measures: Improving radiologist performance by incentivizing quality and patient safety metricsGloria Hwang, MD, Stanford School of Medicine: Reducing ordering errors by simplifying the radiology ordering process in the EHR.Neena Kapoor, MD, Brigham and Womens Hospital, Harvard Medical School - Ensuring timely performance of clinically necessary radiologist follow up recommendations to improve reduce diagnostic errorsModerator:Lindsay Shea, MD

Abstract Archives of the RSNA, 2021

R1-CIR06

Practice Building in IR

Participants

Meridith J. Englander, MD, Albany, New York (*Presenter*) Medical Director, Capital District Physicians' Health Plan
Agnieszka O. Solberg, MD, Bismarck, North Dakota (*Presenter*) Owner, RadCX;Speakers Bureau, Argon Medical Devices, Inc;Owner, SunMountain Medical Consulting LLC;Spouse, Owner, SunMountain Medical Consulting LLC
Nicholas Petruzzi, MD, Galloway, New Jersey (*Presenter*) Medical Advisory Board, Boston Scientific Corporation;Speakers Bureau, Boston Scientific Corporation;Speakers Bureau, Abbott Laboratories;Speakers Bureau, ShockWave Medical;Speakers Bureau, Becton, Dickinson and Company
Aneesa S. Majid, MD, Chicago, Illinois (*Presenter*) CEO, ZipData, Inc;Proctor, Sirtex Medical Ltd;Owner, StrategiesMD, LLC
C. Matthew Hawkins, MD, Decatur, Georgia (*Presenter*) Nothing to Disclose
Stephanie Dybul, MBA,RT, Milwaukee, Wisconsin (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Describe the many practice models that currently exist for Interventional Radiologists Understand recent updates to interventional radiology reimbursement and how to optimize your procedural and E/M coding and billing List some basic marketing techniques that can help grow your practice and understand the role of Social Media in patient and referring physician outreach Discuss why a diverse workforce can benefit an IR practice and identify steps to make your practice more inclusive Though medicine is a calling, healthcare is very much a business. You have the knowledge and skills to take care of your patients, but have you thought about practice building? How do you know what kind of practice you want? How do you grow referrals and grow your practice? How do you get paid for your procedural and non-procedural work? Why should you care about diversity and inclusion as an integral part of your practice building? Training fails to address the majority of these topics in training. This session covers a variety of topics, all relevant to practice development in IR.

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R2-CIN23

The New Normal: Home Workstations, Teleradiology and Remote Reading

Participants

Mindy Yang, MD, Philadelphia, Pennsylvania (*Presenter*) Clinical Advisory Board, SolutionReach
Rishi Seth, MD, Ashburn, Virginia (*Presenter*) Shareholder, Hyperfine Research, Inc;Shareholder, Alphabet Inc
Omer Awan, MD, Lutherville Timonium, Maryland (*Presenter*) Nothing to Disclose
K. Elizabeth Hawk, MD,PhD, Studio City, California (*Presenter*) Nothing to Disclose
Samir S. Shah, MD, Gibsonia, Pennsylvania (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify technical requirements for deployment of remote reading solutions. 2) Discuss advantages and disadvantages of remote reading and remote education. 3) Discuss optimal strategies for successful deployment of remote reading models. Radiology has seen an unprecedented, exponential trend towards remote reading during the COVID-19 pandemic. As remote reading becomes a potential permanent fixture for many practices moving forward, this course will serve as a springboard for discussion of innovative solutions and cover both advantages as well as disadvantages of various models. We will explore multiple facets of teleradiology, from technical implementation, challenges faced, impact on radiologists as well as radiology resident trainees, and differences amongst practice needs.

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Abstract Archives of the RSNA, 2021

S2-CCA01

Rapid Fire: 60 Cardiac Cases in 60 Minutes

Participants

Satinder P. Singh, MD, Birmingham, Alabama (*Presenter*) Nothing to Disclose
Juan Batlle, MD, Boulder, Colorado (*Presenter*) Speakers Bureau, Boehringer Ingelheim GmbH
Jean Jeudy JR, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose
Diana M. Palacio, , Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. To review key clinical and imaging features of variety of cardiac cases including cardiac masses, pericardial disease, valvular and congenital heart disease.2. Discuss imaging based differential diagnosis. Case based session to review 60 cardiac cases in 60 minutes discussing imaging characteristics, differential diagnosis, clinical presentation and complications utilizing multimodality approach.

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Abstract Archives of the RSNA, 2021

R4-CMK03

Elbow, Wrist and Hand Imaging: Pearls and Pitfalls

Participants

Tetyana A. Gorbachova, MD, Huntingdon Valley, Pennsylvania (*Presenter*) Nothing to Disclose
Robert Boutin, MD, Stanford, California (*Presenter*) Nothing to Disclose
James Griffith, MD, Shatin, Hong Kong (*Presenter*) Nothing to Disclose
Rob Campbell, MBBCh, Liverpool, United Kingdom (*Presenter*) Nothing to Disclose
Catherine Petchprapa, New York, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review imaging features and technical and interpretational pitfalls in the diagnosis of the abnormalities of the elbow, wrist and hand. 2) To analyze the biomechanics and clinical significance of injuries to the elbow, wrist and hand. 3) To become familiar with the expected findings and complications in imaging of the post-operative wrist. This course is composed of a series of lectures focused on imaging of the elbow, wrist and hand, in a format of short didactic lectures and Q&A. Individual lectures will highlight the tips and pitfalls of imaging diagnosis of common conditions that occur in clinical practice including diagnostic interpretation of postoperative imaging.

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Abstract Archives of the RSNA, 2021

M2-RCP21

Professionalism as an Educator in Radiology: Strategies to Engage Learners in Person and Virtually (Sponsored by RSNA Professionalism Committee)

Participants
Brandon Brown, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Kate Hanneman, MD, FRCPC, Toronto, Ontario (*Presenter*) Speaker, sanofi-aventis Group;Speaker, Amicus Therapeutics, Inc
Aaron Kamer, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Jesse L. Courtier, MD, San Francisco, California (*Presenter*) Founder, Sira Medical, Inc;Consultant, Sira Medical, Inc
David Sarkany, MD, Staten Island, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Assess and define the role of in-person and didactic lectures for radiology trainees in the current environment. 2) Discuss practical tips for implementing innovative tools that can be used in radiology education, including platforms for audience participation, virtual and augmented reality, and web-based teaching. 3) Explore strategies to provide consistent and effective feedback to radiology trainees. Radiology educators have had to adapt quickly over the past 18 months as medical education has shifted to a virtual format. Innovative tools for education are increasingly relevant to radiologists who teach trainees and provide other educational content including continuing medical education. These educational tools can increase audience participation and engagement and are highly relevant in the current era where many teaching rounds and seminars have been moved to a virtual on-line environment. This session will provide practical tips for implementing innovative tools that can be used in radiology education, including platforms for audience participation, virtual and augmented reality, and web-based teaching. The session will also explore strategies to provide consistent and effective feedback to trainees, given the shifting dynamics of teaching and learning.

Abstract Archives of the RSNA, 2021

DLL13

Deep Learning Lab: CT Body Part Classification

Participants
Ish Talati, MSc, Lake Forest, California (*Presenter*) Nothing to Disclose
Ross Filice, MD, Washington, Dist. of Columbia (*Presenter*) Advisor, BunkerHill Health, IncShareholder, BunkerHill Health, IncSpeaker/Honorarium, GE HealthcareSpeaker/Clinical Trial Participant, Koios Medical

LEARNING OBJECTIVES

Empty Abstract

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Abstract Archives of the RSNA, 2021

T1-CGU07

A GU Audience Participation Session

Participants
Erica Stein, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Peter S. Liu, MD, Cleveland, Ohio (*Presenter*) Nothing to Disclose
Tristan Barrett, MBBS, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose
Aradhana Venkatesan, MD, Houston, Texas (*Presenter*) Research Grant, Siemens AG

LEARNING OBJECTIVES

1. Discuss classic radiology findings of genitourinary disease processes. Two-part lecture that will review genitourinary disease processes in a case-based and interactive format. Topics that will be covered include: kidney/ureter, prostate/bladder, benign gynecology, and malignant gynecology.

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Abstract Archives of the RSNA, 2021

Deep Learning Lab: Working with Public Datasets: TCIA & IDC

Participants
Justin Kirby, Rockville, Maryland (*Presenter*) Nothing to Disclose
Andriy Fedorov, PhD, Arlington, Massachusetts (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the capabilities and complementary nature of the TCIA and IDC repositories, including those related to identifying and visualizing relevant data, defining cohorts and retrieving the data for subsequent analysis; 2) Gain familiarity with the process of retrieving the data and applying a representative processing pipeline using free compute resources available via Google Colab; 3) Establish awareness about the related components of the broader NCI data science ecosystem, and the learning resources available to the community to facilitate the use of IDC and TCIA for cancer imaging research. The National Cancer Institute (NCI), of the National Institutes of Health (NIH), has made significant investments in the creation and development of public data repositories to enable and promote data sharing and secondary analysis of cancer imaging data through an open science approach. The two flagship repositories supported by NCI are The Cancer Imaging Archive (TCIA) (https://www.cancerimagingarchive.net/) and Imaging Data Commons (IDC) (https://imaging.datacommons.cancer.gov/). TCIA works directly with data submitters to implement de-identification, curation and hosting of imaging collections for download. IDC is an emerging repository within the NCI Cancer Research Data Commons (CRDC) (https://datacommons.cancer.gov/), which replicates de-identified public collections on the cloud, co-locating the imaging data alongside the analysis resources and tools, and other types of linked data. The purpose of this course is to introduce the attendees to the complementary capabilities of TCIA and IDC, and demonstrate how the data available in both TCIA and IDC can be accessed and utilized via hands-on examples with Google Colab notebooks. At the completion of this course the attendees are expected to be equipped with the knowledge needed to proceed with identifying and analyzing relevant datasets from TCIA and IDC.

Abstract Archives of the RSNA, 2021

R1-CMS19

Challenging Fractures in the Emergent Setting

Participants
Claire Sandstrom, MD, Seattle, Washington (*Presenter*) Spouse, Consultant, Boston Scientific Corporation
Susanna C. Spence, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Lee A. Myers, MD, Los Angeles, California (*Presenter*) Nothing to Disclose
Manickam Kumaravel, MD, FRCR, Houston, Texas (*Presenter*) Nothing to Disclose
Bharti Khurana, MD, Brookline, Massachusetts (*Presenter*) Consultant, General Electric Company ;Editor, Wolters Kluwer nv;Author, Cambridge University Press;Consultant, ROKIT Healthcare, INC

LEARNING OBJECTIVES

1) Recognize the subtle signs of easily missed extremity injuries--including fractures, dislocations, and instability--encountered in the Emergency Department. 2) Correlate the clinical significance and avoid pitfalls of easily missed extremity injuries. 3) Recognize injury patterns commonly associated with intimate partner violence. Case-based review of subtle and challenging fractures and MSK injuries of clinical significance in the Emergency Department.

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T2-RCP34

Case-based Review of Nuclear Medicine: PET/CT Workshop ? Chest (In Conjunction with SNMMI)

Participants
Gary Ulaner, MD,PhD, Irvine, California (*Presenter*) Speaker, Siemens AG;Speaker,Lantheus Holdings;Research support, General Electric Company;Research support, F. Hoffmann-La Roche Ltd;Research support, Lantheus Holdings;Research support, Novartis AG
Rathan M. Subramaniam, MD,PhD, Dunedin, New Zealand (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand best clinical practices for use and interpretation of PET imaging in patient with lung cancer. 2. Understand best clinical practices for use and interpretation of FDG and FES PET/CT in patients with breast cancer. PET/CT has greatly impacted the imaging and therapy of chest malignancies, including longstanding value for staging of lung cancer, as well as novel Estrogen Receptor targeted imaging for breast cancer. In this session, experts on lung and breast cancers will use clinical cases to demonstrate fundamentals of interpretation, as well as pearls and pitfalls to help improve interpretation of FDG PET and FES (Cerianna) PET.

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Abstract Archives of the RSNA, 2021

Basic and Translational Research in IR ? How I Get Started

Participants

Terence Gade, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Support, TriSalus Life Sciences;Support, Incept LLC
Erik N. Cressman, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Suresh Vedantham, MD, Clayton, Missouri (*Presenter*) Institutional research support, Cook Group Incorporated;Institutional research support, Medi USA
Sanjay Misra, MD, Rochester, Minnesota (*Presenter*) Support, Cardinal Health, Inc
Laura Crocetti, MD, Pisa, Italy (*Presenter*) Speaker, Terumo Corporation;Advisory Board, Boston Scientific Corporation;Research Consultant, Biomedical;Speaker, Eisai Co, Ltd
Nishita Kothary, MD, Stanford, California (*Presenter*) Research Grant, EchoPixel, Inc;Scientific Advisory Board, Quantum Surgical

LEARNING OBJECTIVES

1) Identify critical elements for building an IR research lab.2) Describe considerations unique to clinical trial design, grantsmanship and manuscript preparation in IR.3) Explain the role of Academic-Industrial Partnerships in building IR science. This educational session will focus on elements critical for the development of successful basic and/or translational research programs in IR. Leading clinician-scientists will deliver lectures that provide unique insights into building a lab, developing clinical trials, providing and receiving effective mentorship, writing grants that resonate with reviewers, preparing impactful manuscripts as well as cultivating academic-industrial partnerships. These lectures will empower attendees to develop and enhance their own research initiatives in IR.

Printed on: 06/28/22

M1-RCP25

MESH Incubator Presents: The CORE Healthcare Innovation Bootcamp: AI, Digital and More

Participants
Katherine Andriole, PhD, Branford, Connecticut (*Presenter*) Nothing to Disclose
Mark Zhang, DO, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Marc Succi, MD, Boston, Massachusetts (*Presenter*) Inventor, Frequency Therapeutics
Florian Fintelmann, MD, Boston, Massachusetts (*Presenter*) Research support, Boston Scientific Corporation

LEARNING OBJECTIVES

1. Learning the basics of AI and ML as applied to healthcare, specifically radiology. Work through a real-world problem using AI (personal laptop required).2. Learn the basics of intellectual property in healthcare (patents, copyright, trademarks etc).3. Gain an understanding of the challenges towards implementing digital health solutions, and further challenges in commercializing digital solutions in the healthcare arena. Artificial Intelligence (AI), Machine Learning (ML), and digital health are rapidly influencing the healthcare landscape. This morning session from the MESH Incubator teaches the fundamentals of AI, ML, and digital health for emerging MD and non-MD innovators in healthcare, and allows the learner to visualize the landscape of these domains as they pertain to patient care. No prior knowledge of these topics is necessary to attend. This session will also teach the fundamentals of intellectual property, including patents, trademarks, and copyright, as applied to healthcare innovation.

Printed on: 06/28/22

R1-CCA10

Is Parametric Mapping an Essential Part of Cardiac MRI?

Participants

Karen Ordovas, MD, Seattle, Washington (*Presenter*) Nothing to Disclose
Kate Hanneman, MD, FRCPC, Toronto, Ontario (*Presenter*) Speaker, sanofi-aventis Group;Speaker, Amicus Therapeutics, Inc
Elsie Nguyen, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Essentials of Diagnostic Accuracy Assessment

Participants

Chaya Moskowitz, PhD, New York, New York (*Presenter*) Nothing to Disclose
Nancy Obuchowski, PhD, Cleveland, Ohio (*Presenter*) Research Consultant, Siemens AG;Research Consultant, IBM Corporation;Research Consultant, Elucid Bioimaging Inc;Research Consultant, Takeda Pharmaceutical Company Limited

LEARNING OBJECTIVES

1. Understand key concepts of study design and biases in imaging studies 2. Understand how to evaluate accuracy for a variety of different study designs This lecture will provide a survey of statistical methods used in imaging studies. The course will focus on concepts of study design and data analysis that are frequently used when evaluating imaging tests. Topics to be covered include ROC curves, multi-reader studies, localization accuracy, and common sources of bias. By the end of the lecture, attendees will have acquired an essential foundation of key statistical analysis methods used in evaluating imaging tests.

Printed on: 06/28/22

M6-RCP23

Shark Tank (Sponsored by the Academy for Radiology & Biomedical Imaging Research)

Participants

Scott Penner, JD, San Diego, California (*Presenter*) Spouse, Research Grant, General Electric Company;Spouse, Consultant, Human Longevity Inc;Spouse, Stockholder, CureMetrix, Inc
Susan Harris, Wauwatosa, Wisconsin (*Presenter*) Employee, General Electric Company
Mitchell Schnall, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Siemens AG
Emir Sandhu, MD, Stanford, California (*Presenter*) Nothing to Disclose
Kelsey Tsai, Chicago, Illinois (*Presenter*) Nothing to Disclose
Kevin Bennett, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Selva Jeganathan, PhD, Cleveland, Ohio (*Presenter*) Nothing to Disclose
Valeria Makeeva, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identifying strategies for bringing research to the competitive marketplace.2)Presenting a proposal in a way that elicits interest from potential investors.3)Taking steps to secure investor funding while developing and protecting their intellectual property. 4)Identifying ways to generate business value through licensing and collaborations. This session is meant to be educational, fun, and interactive. The goal is to be of value to investigators who would like to learn more about pitching an idea to an academic chair, an industry rep, or Venture Capitalist. Similar to the format of the hit show, each pitcher/pitch team will be given 5 minutes to present their product/idea to a panel of leading experts from academia, patent law, industry, and venture capital. They will be put to the test in a rapid fire 5-minute Q&A session immediately following their pitch and will even take questions from the audience at the end of the session. Using a uniquely designed rubric, our panel will score and choose a winner live during this session.

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Abstract Archives of the RSNA, 2021

M5-RCP32

Mentored Cardiac CT Angiography Case Review: Part IV

Participants

Gregory Kicska, MD, PhD, Seattle, Washington (*Presenter*) Nothing to Disclose
Amar B. Shah, MD, New York, New York (*Presenter*) Nothing to Disclose
Cristina Fuss, MD, Portland, Oregon (*Presenter*) Nothing to Disclose
Eric E. Williamson, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Daniel Vargas, MD, Denver, Colorado (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

T4-RCP35

Case-based Review of Nuclear Medicine: PET/CT Workshop ? Abdomen (In Conjunction with SNMMI)

Participants

Katherine Zukotynski, MD, PhD, Hamilton, Ontario (*Presenter*) Research Consultant, Konica Minolta, Inc;Research Consultant, General Electric Company;Speakers Bureau, Jubilant DraxImage Inc

Lisa Bodei, MD, PhD, New York, New York (*Presenter*) Consultant, Novartis AG ;Speaker, Novartis AG;Research Grant, Novartis AG;Consultant, Ipsen SA;Consultant, ITM Isotopen Technologien Muenchen AG;Speaker, ITM Isotopen Technologien Muenchen AG;Consultant, Clovis Oncology, Inc;Consultant, Ion Beam Applications, SA

LEARNING OBJECTIVES

1. Appreciate difficulties urinary excretion of PET tracers can cause for interpretation of images around the kidneys, ureters, and bladder. 2. Understand best clinical practices for use and interpretation of PET/CT in patients with neuroendocrine tumors. The kidneys, ureters, and bladder have caused difficulty in interpretation of multiple PET tracers, due to urinary tracer excretion. PET/CT has greatly impacted the imaging and therapy of neuroendocrine malignancies, including continuing improvements in somatostatin receptor-targeted PET. In this session, experts on kidneys/ureter/bladder and neuroendocrine tumors will use clinical cases to demonstrate fundamentals of interpretation, as well as pearls and pitfalls to help improve interpretation of PET studies.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

M4-RCP47

Physics Symposium: Image Guidance in Radiation Therapy: Best of Summer School

Participants

Vrinda Narayana, PHD, Southfield, Michigan (*Presenter*) Nothing to Disclose
Parham Alaei, PhD, Minneapolis, Minnesota (*Presenter*) Nothing to Disclose
George Ding, PhD, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Ryan Flynn, PhD, Iowa City, Iowa (*Presenter*) Patent holder, Ion Beam Applications SA;Founder and President, Pxalpha, LLC
Hania Abdulraouf Al-Hallaq, PHD, Chicago, Illinois (*Presenter*) Research Grant, Varian Medical Systems, Inc
Carri Glide-Hurst, PHD, Madison, Wisconsin (*Presenter*) Research collaboration, General Electric Company;Research collaboration, Modus Medical Devices Inc

LEARNING OBJECTIVES

1) Specify the role of image guidance and its limitations in radiotherapy. 2) Explain the current state-of-the-art image guidance modalities used in radiotherapy including IGRT, surface image guidance and MR guidance. 3) Outline various imaging doses to patients and offer guidance to optimize imaging dose. This educational session is targeted towards medical physicists who are interested in the current image guidance techniques and modalities used in Radiation Therapy. A brief review of the past, present and future of image guidance in radiotherapy will be followed by detailed discussions on Surface image guidance, MR image guidance and X-ray based image guidance. Perspectives on managing imaging doses in radiotherapy will be described along with calculations and measurement of imaging dose.

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Abstract Archives of the RSNA, 2021

R4-CGU05

PI-RADS Hands-On Workshop

Participants
Baris Turkbey, MD, Rockville, Maryland (*Presenter*) Nothing to Disclose
Clare M. Allen, MBBCh, London, United Kingdom (*Presenter*) Nothing to Disclose
Sandeep Arora, MBBS, New Haven, Connecticut (*Presenter*) Research support, Profound Medical Inc
Andrei S. Purysko, MD, Westlake, Ohio (*Presenter*) Contract, Profound Medical IncResearch support, Blue Earth Diagnostics LtdConsultant, KOELISResearch grant, American College of Radiology
Lori Mankowski Gettle, MD, Madison, Wisconsin (*Presenter*) Stockholder, Elucent Medical

LEARNING OBJECTIVES

1- To understand basic principles of prostate MRI and PI-RADS v2.12- To provide guidance on location of clinically significant prostate cancers at prostate mpMRI3- To recognize benign intra-prostatic findings and pitfalls which can overlap with prostate cancer This course will include short lectures from experts in the field of prostate MRI and participants will be able to further utilize the presented lecture content in histopathologically confirmed prostate MRI sample cases with varying difficulty levels using RadPix platform. After each case evaluation, participants' questions will be answered by expert course faculty.

Printed on: 06/28/22

T2-CBR05

Case Based Breast Review: CESM & MRI

Participants
Jonathan James, BMBS, Nottingham, United Kingdom (*Presenter*) Nothing to Disclose
Masako Y. Kataoka, MD, PhD, Kyoto, Japan (*Presenter*) Speaker, Siemens AG;Speaker, Bayer AG;Author with royalties, Bayer AG;Author with royalties, Guerbet SA
Katja Pinker-Domenig, MD, New York, New York (*Presenter*) Speakers bureaus:European Society of Breast Imaging (active)Siemens Healthineers (ended)IDKD 2019 (ended)Olea Medical (ended) Consulting, AdvisoryConsultantGenentech, Inc.05/19-presentConsultantMerantix Healthcare05/20- presentConsultantAURA Health
Almir Bitencourt, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain breast cancer detection with CESM and MRI due to imaging of neoangiogenesis as tumor specific feature2) Identify the indications of CESM and MRI in breast imaging2) Understand the challenges and limitations of CESM and MRI in clinical breast imaging CESM has emerged as an alternative test to dynamic contrast-enhanced MRI for breast cancer detection through imaging of neovascularity as a tumor specific feature. This educational course will explain the technique and indications of CESM and summarize the indications of CESM and MRI in clinical breast imaging. Upon completion of this course participants will understand the current clinical applications and limitations of each individual technique.

Abstract Archives of the RSNA, 2021

W4-CRO07

Genitourinary - Case-based Multidisciplinary Review

Participants

Tristan Barrett, MBBS, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose
Daniel A. Hamstra, MD, PhD, Dearborn, Michigan (*Presenter*) Consultant, Augmenix, Inc;Consultant, Boston Scientific Corporation
Nicole Curci, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Robert Dess, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Arvin George, MD, Ann Arbor, Michigan (*Presenter*) Research Consultant, TROD Medical;Researcher, Nanospectra Biosciences, Inc;Researcher, Koninklijke Philips NV;

LEARNING OBJECTIVES

1) To understand the typical imaging findings of prostate cancer on mpMRI. 2) To assess the impact of MRI on staging prostate cancer in a multidisciplinary setting.3) To assess the role of imaging in the diagnosis of prostate cancer through case examples. This course uses a case-based approach to diagnostic and management decision making in the work-up of patients presenting with prostate cancer. The panel includes radiologists, urologists and radiation oncologists.

Printed on: 06/28/22

R1-CNPM20

Making the Most of Radiologist Peer-Learning Tools

Participants
Dorothy Sippo, MD, Westport, Connecticut (*Presenter*) Nothing to Disclose
Andrew Moriarity, MD, Grand Rapids, Michigan (*Presenter*) Nothing to Disclose
Mara Kunst, MD, Winchester, Massachusetts (*Presenter*) Nothing to Disclose
Nelly Tan, MD, Scottsdale, Arizona (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Identify strategies for a successful transition from peer-review to peer-learning.2. Describe the role of the conference in a Peer-Learning Program and practical considerations for a successful conference.3. Explain how peer-learning can impact clinical practice. This course will explore practical aspects of a successful Peer-Learning Program. Topics will include: (1) transitioning from peer-review to peer-learning, (2) approaches to peer-learning and self-review, (3) development and maintenance of peer-learning conferences, and (4) the impact of peer-learning on clinical practice. With a lecture format, followed by question and answer discussion, presenters will share best practices for peer-learning tools. This course will provide useful pearls and strategies for making the most out of your Peer-Learning Program.

Printed on: 06/28/22

M4-CPD05

Pediatric Chest and Beyond: New Pathology

Participants

Maddy Artunduaga, MD, Dallas, Texas (*Presenter*) Nothing to Disclose
R. Paul Guillerman, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Marcelo Takahashi, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize imaging patterns of recently described pediatric lung conditions, including EVALI and COVID-19, among others. 2) Review up-to-date imaging recommendations in the evaluation of patients with these new pediatric lung entities. This educational course reviews a spectrum of new lung conditions that can be encountered in the pediatric population. Lectures will focus on the imaging features of EVALI, COVID-19, filamin A mutation-related lung disease, pleuroparenchymal fibroelastosis and COPA syndrome, among others. After completing this course, learners are expected to identify the key imaging findings of each entity and to be cognizant of the latest imaging recommendations in the assessment of these patients.

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W6-CNMMI06

Molecular Imaging and Targeted Therapy: Prostate Cancer

Participants

Bital Savir-Baruch, MD, Maywood, Illinois (*Presenter*) Research Grant, Blue Earth Diagnostics Ltd;Speaker, Blue Earth Diagnostics Ltd

Martin Pomper, MD, PhD, Baltimore, Maryland (*Presenter*) Co-founder, D&D Pharmatech Inc;Research support, D&D Pharmatech Inc;Stockholder, D&D Pharmatech Inc;Royalties, D&D Pharmatech Inc;Royalties, Intuitive Surgical, Inc;Research support, Lantheus Holdings;Research support, Novartis AG;Royalties, Novartis AG

Medhat M. Osman, MD, SAINT LOUIS, Missouri (*Presenter*) Consultant, Biomedical Systems

Hossein Jadvar, MD, PhD, Pasadena, California (*Presenter*) Consultant, Blue Earth Diagnostics Ltd;Speakers Bureau, Lantheus Holdings;Advisory Board, RadioMedix, Inc;Researcher, ImaginAb, Inc;

Ayse Karagulle Kendi, MD, Rochester, Minnesota (*Presenter*) Investigator, Novartis AG

LEARNING OBJECTIVES

1) To discuss advances in prostate cancer imaging and therapy using radiopharmaceuticals. 2) To review clinical interpretation of PET/CT with Fluciclovine and PSMA-targeting agents. 3) To illustrate advances using a series of images from the field. This course will provide an update on molecular imaging and targeted therapy for prostate cancer. There will be a series of lectures targeting focussed on a hot topic. For example, the first PSMA targeted radiopharmaceutical was FDA approved in late 2020. We will also include clinical pearls and pitfalls and illustrative case examples.

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Abstract Archives of the RSNA, 2021

M4-RCP48

Best of Clinical Trials at RSNA 2021

Participants

David A. Mankoff, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Speaker, Siemens/PETNETAdvisory Board, ImaginAb, IncAdvisory Board, RefleXion Medical IncConsultant, Blue Earth Diagnostics LtdConsultant, General Electric CompanyResearch funded, Siemens AGSpouse, Owner, Trevarx Biomedical

Janie Lee, MD, Seattle, Washington (*Presenter*) Research Grant, General Electric Company

LEARNING OBJECTIVES

1)Review objectives, study design, and results from high impact clinical trials of 2021.2)Discuss clinical implications of trial results. 3)Describe the need for any additional confirmatory or follow on trials. This special session will present abstract results from top-scoring clinical trials, paired expert discussants to support the translation of evidence to clinical practice.

Sub-Events

M4-RCP48   **Discussant for Pivotal Trial Of Magnetic Resonance Imaging-guided Transurethral Ultrasound Ablation In Men With Localized Prostate Cancer: Three-year Follow-up And Multiparametric Magnetic Resonance Imaging Prediction Of Salvage Treatment**

Participants

Pejman Ghanouni, MD, PhD, Stanford, California (*Presenter*) Medical Advisory Board, InSightec Ltd;Scientific Advisory Board, SonALASense

LEARNING OBJECTIVES

1)Review objectives, study design, and results from high impact clinical trials of 2021.2)Discuss clinical implications of trial results. 3)Describe the need for any additional confirmatory or follow on trials. This special session will present abstract results from top-scoring clinical trials, paired expert discussants to support the translation of evidence to clinical practice.

M4-RCP48   **The Impact Of 18F-DCFPyL PET/CT On The Management Of Patients With Recurrent Prostate Cancer: Results Of A Prospective, Multicenter Trial.**

Participants

Ur Metser, MD, FRCPC, Toronto, Ontario (*Presenter*) Consultant, POINT Biopharma Inc

PURPOSE

To assess the disease detection rate of 18F-DCFPyL PET/CT (=PSMA PET) and the PET-directed change in the clinical management of men with suspected limited recurrent prostate cancer after primary therapy.*Methods and Materials This prospective, multicenter registry trial enrolled 1289 patients (Dec 2018-Sept 2020). Eligibility included biochemical failure after primary therapy, 0-4 sites of disease on conventional imaging (CT and bone scintigraphy) and one of the following predefined clinical cohorts: 1. Node positive or detectable serum PSA after radical prostatectomy (RP) 2. Post RP; 3. Post RP and pelvic radiotherapy; 4. Post RP or primary radiotherapy (RT) and androgen deprivation therapy; 5. Post lesion directed treatment for oligometastases (=4 sites); 6. Post primary RT.*Results 841/1289 men (65.2%) had disease detected with PSMA PET. PET detection rates among men with negative conventional imaging was 615/999 (61.6%). Detection rate of any lesion by serum PSA level (ng/ml) at enrollment were 160/424 (37.7%) for PSA <0.5; 107/171 (62.6%) 0.5-1.0 and 573/692 (82.8%) for PSA >1.0. On PSMA PET 399/1289 men (31.0%) had locoregional failure (limited to pelvis), 314/1289 men (24.4%) had oligometastatic disease and 128/1289 men (9.9%) had extensive metastatic disease (Table 1; results by cohort). Post PSMA PET, a change in planned management was recorded in 748/1289 men (58.0%) and in 371/1250 men (29.7%), there was a change in management intent, most commonly from palliative to potentially curative intent (255/1289; 19.8%); Figure 1. The most common change was conversion from observation or systemic therapy to salvage radiation or surgery for locoregional (236/1289;18.3%) or oligometastatic disease (132/1289; 10.2%). In 89 additional patients (6.9%) nodal-directed therapy was added to management plan after PET.*Conclusions PSMA-PET detects additional sites of disease compared with standard of care imaging in most men with biochemical failure and suspected low volume metastatic disease, resulting in frequent change in management including a change from palliative to curative/radical intent therapy in 20% of men. Long term follow-up is needed to determine whether this impacts disease control.*Clinical Relevance/Application The detection of additional disease sites on PSMA PET in men with biochemical failure after primary therapy and suspected low volume metastatic disease results in a frequent change in management.

RESULTS

841/1289 men (65.2%) had disease detected with PSMA PET. PET detection rates among men with negative conventional imaging was 615/999 (61.6%). Detection rate of any lesion by serum PSA level (ng/ml) at enrollment were 160/424 (37.7%) for PSA <0.5; 107/171 (62.6%) 0.5-1.0 and 573/692 (82.8%) for PSA >1.0. On PSMA PET 399/1289 men (31.0%) had locoregional failure (limited to pelvis), 314/1289 men (24.4%) had oligometastatic disease and 128/1289 men (9.9%) had extensive metastatic disease (Table 1; results by cohort). Post PSMA PET, a change in planned management was recorded in 748/1289 men (58.0%) and in 371/1250 men (29.7%), there was a change in management intent, most commonly from palliative to potentially curative intent (255/1289; 19.8%); Figure 1. The most common change was conversion from observation or systemic therapy to salvage radiation or surgery for locoregional (236/1289;18.3%) or oligometastatic disease (132/1289; 10.2%). In 89 additional patients (6.9%) nodal-directed

therapy was added to management plan after PET.

CLINICAL RELEVANCE/APPLICATION

The detection of additional disease sites on PSMA PET in men with biochemical failure after primary therapy and suspected low volume metastatic disease results in a frequent change in management.

M4-RCP48   Pivotal Trial Of Magnetic Resonance Imaging-guided Transurethral Ultrasound Ablation In Men With Localized Prostate Cancer: Three-year Follow-up And Multiparametric Magnetic Resonance Imaging Prediction Of Salvage Treatment

Participants
Steven Raman, MD, Santa Monica, California (*Presenter*) Consultant, Johnson & Johnson;Consultant, Bayer AG;Consultant, Merck & Co, Inc;Consultant, Amgen Inc;Consultant, Profound Medical Inc

PURPOSE

MRI-guided transurethral ultrasound ablation (TULSA) is a minimally invasive procedure for prostate ablation using directional ultrasound. The treatment is controlled in real-time using MRI thermometry feedback. We report 3 year outcomes from the pivotal TULSA-PRO Ablation Clinical Trial (TACT).*Methods and Materials TACT enrolled 115 men with organ-confined prostate cancer (=T2b, PSA =15 ng/ml, Grade Group 1-2) across 13 centers. Treatment was whole-gland sparing the urethra and urinary sphincter. Primary endpoints were safety and PSA reduction at 1 year. Secondary endpoints included 1 year prostate volume reduction, mpMRI, and 10 core biopsy. Three year follow-up included adverse events, quality of life and PSA for men who are salvage-free, and mpMRI prediction of salvage therapy.*Results Median (IQR) baseline age was 65 (59-69) years, median PSA 6.3 (4.6-7.9) ng/mL, with Grade Group (GG) =2 disease in 72/115 men (63%). Targeted prostate volumes of 40 (32-50) cc were ablated in 51 (39-66) min. Grade 3 adverse events in 9 (8%) men included GU infection, stricture, retention, urethral calculus and pain, and urinoma, all resolved before 1 year. There were no rectal injuries or Grade =4 events. By 3 years, 15 men (13%) received salvage treatment. At 1 year MRI and biopsy, median prostate volume decreased from 37 to 3 cc, GG2 disease was eliminated in 54/68 (79%) men, and 72/111 (65%) had no evidence of any cancer. Median PSA decreased 95% to a nadir of 0.26 ng/mL, stable from 0.53 ng/mL at 1 year to 0.70 ng/ml (n=56) at 3 years. Median IPSS decreased from 7 at baseline to 4 (n=61) by 3 years. Moderate urinary incontinence (Grade 2, pads) in 3 men (2.6%) at 1 year persisted to 3 years in 1 patient, with no new incontinence past 1 year. The rate of moderate erectile dysfunction (Grade 2, responding to medication) was 23% at 1 year and 24% at 3 years. Median change in IIEF-5 was -2 from baseline to 1 year, and nil from 1 to 3 years (n=61). Erections sufficient for penetration (IIEF Q2 =2) were maintained by 36/50 (72%) and 40/50 (80%) men at 1 and 3 years. On follow-up mpMRI, a visible lesion was predictive of persistent or recurrent disease and salvage therapy at 3 years (p=0.001; aOR 31.0, CI [6.4,150.0]).*Conclusions With 3 year follow-up, MRI-guided transurethral ultrasound ablation (TULSA) showed durable control of localized prostate cancer with low toxicity and stable quality of life. The presence of a visible lesion on follow-up mpMRI predicted for persistent or recurrent disease and salvage therapy.*Clinical Relevance/Application Whole-gland ablation using MRI-guided TULSA achieves effective disease control at 3 years with favourable functional and safety outcomes. The 1 year follow-up mpMRI is predictive of salvage therapy by 3 years.

RESULTS

Median (IQR) baseline age was 65 (59-69) years, median PSA 6.3 (4.6-7.9) ng/mL, with Grade Group (GG) =2 disease in 72/115 men (63%). Targeted prostate volumes of 40 (32-50) cc were ablated in 51 (39-66) min. Grade 3 adverse events in 9 (8%) men included GU infection, stricture, retention, urethral calculus and pain, and urinoma, all resolved before 1 year. There were no rectal injuries or Grade =4 events. By 3 years, 15 men (13%) received salvage treatment. At 1 year MRI and biopsy, median prostate volume decreased from 37 to 3 cc, GG2 disease was eliminated in 54/68 (79%) men, and 72/111 (65%) had no evidence of any cancer. Median PSA decreased 95% to a nadir of 0.26 ng/mL, stable from 0.53 ng/mL at 1 year to 0.70 ng/ml (n=56) at 3 years. Median IPSS decreased from 7 at baseline to 4 (n=61) by 3 years. Moderate urinary incontinence (Grade 2, pads) in 3 men (2.6%) at 1 year persisted to 3 years in 1 patient, with no new incontinence past 1 year. The rate of moderate erectile dysfunction (Grade 2, responding to medication) was 23% at 1 year and 24% at 3 years. Median change in IIEF-5 was -2 from baseline to 1 year, and nil from 1 to 3 years (n=61). Erections sufficient for penetration (IIEF Q2 =2) were maintained by 36/50 (72%) and 40/50 (80%) men at 1 and 3 years. On follow-up mpMRI, a visible lesion was predictive of persistent or recurrent disease and salvage therapy at 3 years (p=0.001; aOR 31.0, CI [6.4,150.0]).

CLINICAL RELEVANCE/APPLICATION

Whole-gland ablation using MRI-guided TULSA achieves effective disease control at 3 years with favourable functional and safety outcomes. The 1 year follow-up mpMRI is predictive of salvage therapy by 3 years.

M4-RCP48   Discussant for The Impact Of 18F-DCFPyL PET/CT On The Management Of Patients With Recurrent Prostate Cancer: Results Of A Prospective, Multicenter Trial

Participants
Steve Cho, MD, Madison, Wisconsin (*Presenter*) Research Grant, General Electric Company;Consultant, Novartis AG;Consultant, Lantheus Holdings;Consultant, Bristol-Myers Squibb Company;Consultant, Blue Earth Diagnostics Ltd;Consultant, Radmetrix

LEARNING OBJECTIVES

1)Review objectives, study design, and results from high impact clinical trials of 2021.2)Discuss clinical implications of trial results. 3)Describe the need for any additional confirmatory or follow on trials. This special session will present abstract results from top-scoring clinical trials, paired expert discussants to support the translation of evidence to clinical practice.

M4-RCP48   Discussant for Magnetic Resonance Guided Focused Ultrasound Versus External Beam Radiation Therapy For The Treatment Of Pain In Bone Metastases: A Phase II Trial

Participants
Bruce Haffty, MD, New Brunswick, New Jersey (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)Review objectives, study design, and results from high impact clinical trials of 2021.2)Discuss clinical implications of trial results. 3)Describe the need for any additional confirmatory or follow on trials. This special session will present abstract results from top-scoring clinical trials, paired expert discussants to support the translation of evidence to clinical practice.

M4-RCP48   **Magnetic Resonance Guided Focused Ultrasound Versus External Beam Radiation Therapy For The Treatment Of Pain In Bone Metastases: A Phase II Trial**

Participants
Alessandro Napoli, MD, Rome, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To assess the efficacy of MR guided Focused Ultrasound (MRgFUS) for the palliative treatment of painful bone metastases in comparison to external beam radiation therapy (EBRT).*Methods and Materials This prospective double-arm phase II study was conducted between January 2019 and March 2019. Participants with painful bone metastases were included in the trial and underwent either MRgFUS or EBRT. The primary end point was improvement in self-reported pain score assessed by using Visual Analogue Scale (VAS) 1 month after treatment. Secondary end point was the improvement in VAS at 12-month and quality of life (QoL) assessed by QoL Questionnaire Cancer 15 Palliative Care (C15-PAL) and QoL Questionnaire Bone Metastases 22 (BM22). Statistical analysis was conducted using a per-protocol principle.*Results 198 study participants were included; 100 participants (mean age, 63.2 years ± 13.4) underwent MRgFUS and 98 (mean age, 65.3 years ± 14.5) underwent EBRT. Response rate for the primary endpoint was 55% in the MRgFUS arm and 30% in the EBRT (p= 0.001). No significant difference between groups was found for BM22 and C15-PAL. Subtests analysis of C15-PAL for areas of physical function (p=0.002), appetite (p<0.001), nausea and vomiting (p<0.001), dyspnea (p<0.001) and quality of life (p<0.001) showed significant differences in favor of MRgFUS.*Conclusions MRgFUS in comparison to EBRT showed promising response when used as a palliative treatment in patients with painful bone metastases.*Clinical Relevance/Application MRgFUS may represent a valid option for the palliative treatment of patients with metastatic bone disease, with promising results in terms of pain relief and quality of life when compared to EBRT

RESULTS

198 study participants were included; 100 participants (mean age, 63.2 years ± 13.4) underwent MRgFUS and 98 (mean age, 65.3 years ± 14.5) underwent EBRT. Response rate for the primary endpoint was 55% in the MRgFUS arm and 30% in the EBRT (p= 0.001). No significant difference between groups was found for BM22 and C15-PAL. Subtests analysis of C15-PAL for areas of physical function (p=0.002), appetite (p<0.001), nausea and vomiting (p<0.001), dyspnea (p<0.001) and quality of life (p<0.001) showed significant differences in favor of MRgFUS.

CLINICAL RELEVANCE/APPLICATION

MRgFUS may represent a valid option for the palliative treatment of patients with metastatic bone disease, with promising results in terms of pain relief and quality of life when compared to EBRT

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Abstract Archives of the RSNA, 2021

Controversies in Pediatric GU Imaging

Participants
Jeanne S. Chow, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Patricia Acharya, MD, Monrovia, California (*Presenter*) Nothing to Disclose
Jeffrey Tutman, MD, Colorado Springs, Colorado (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

The purpose of the lectures of this section is to discuss the most recent innovations in pediatric genitourinary imaging in discussing the UTD classification system and its use, cystic renal disease, and use of contrast enhanced ultrasound.

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Abstract Archives of the RSNA, 2021

M3-CMS07

Review and Update on Imaging of Acute Abdominal Pain

Participants

Robin B. Levenson, MD, Newton, Massachusetts (*Presenter*) Nothing to Disclose
Kimberly Shampain, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Michael Patlas, MD,FRCPC, Hamilton, Ontario (*Presenter*) Royalties, Springer Nature
Aashish A. Patel, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Review causes of acute abdominal pain, with a focus on acute urinary and GI related conditions 2.Identify key imaging findings and pitfalls of acute urinary and GI related conditions, as well as imaging features of potential complications. 3.Discuss current imaging protocol considerations Acute abdominal pain is one of the most common presenting symptoms of patients in the emergency setting. The differential diagnosis can be broad, clinical symptoms nonspecific, and thus, imaging often plays a critical role in diagnosis. It is important for radiologists to be familiar with key imaging features of various causes of abdominal pain to aid in making timely, appropriate diagnoses. The format of this educational session is lecture, didactic based. Topics to be discussed include urinary and gastrointestinal-related emergencies; imaging findings and pitfalls, review of the literature, update on imaging protocol considerations.

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Abstract Archives of the RSNA, 2021

RSNA/ESR Symposium: Endovascular Treatment

Participants

Jean-Pierre Pruvo, MD, PhD, Lille, France (*Presenter*) Nothing to Disclose
Raman Uberoi, MBChB, FRCR, Oxford, United Kingdom (*Presenter*) Nothing to Disclose
Ansgar Berlis, MD, Augsburg, Germany (*Presenter*) Proctor, Stryker Corporation;Proctor, Terumo Corporation;Speaker, Penumbra, Inc;Speaker, phenox GmbH
Jeremy Heit, MD,PhD, Los Altos, California (*Presenter*) Consultant, Medtronic plcConsultant, Terumo CorporationConsultant, iSchemaView, IncScientific Advisory Board, iSchemaView, IncMedical Advisory Board, iSchemaView, IncBalt, STEM Trial Clinical Events Committee MemberVesalio, CLEAR Trial Clinical Events Com
Gregoire Boulouis, MD, MSc, Tours, France (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the different approaches of endovascular treatment. 2)To appreciate the importance of efficient work-up and time metrics in angiosuite. 3)To understand the optimal organisation in angiosuite and workflow. This session will provide practical pearls for endovascular treatment (EVT) and discuss organization of an optimal EVT.

Printed on: 07/01/22

T5-CIN13

Looking Beyond the Hype: A Scientific Perspective on AI in Imaging

Participants

Paula M. Jacobs, PhD, Bethesda, Maryland (*Presenter*) Nothing to Disclose
Yan Chen, PhD, NOTTINGHAM, United Kingdom (*Presenter*) Nothing to Disclose
Charles Kahn JR, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Katherine Andriole, PhD, Branford, Connecticut (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review practical examples of what current AI algorithms can and cannot do in medical imaging. 2) Learn the current state of AI in Imaging by critically reviewing some of the clinical trials in this area. 3) Understand current gaps in the scientific literature and discuss some potential pathways forward. Application of artificial intelligence/machine learning to various aspects of imaging has become ubiquitous in recent years, greeted by the popular press by uncritical enthusiasm or apocalyptic predictions of computers taking over the world. This hot topic session will feature short presentations by each of three experts exploring and evaluating aspects of artificial intelligence/machine learning as currently applied to various aspects of imaging, such as logistics and scheduling, image processing, and image interpretation. The panel will then discuss some provocative questions posed by the chair and by the audience.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Multimodal Imaging of Basic Vascular Anatomy and Vascular Variants

Participants
Filipe Caseiro Alves, MD, PhD, Coimbra, Portugal (*Presenter*) Nothing to Disclose
Sandeep S. Hedgire, MD, Lexington, Massachusetts (*Presenter*) Nothing to Disclose
Sara Zhao, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Richard D. White, MBChB, FRCR, Cardiff, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. To review arterial and venous anatomy in the chest, abdomen, and pelvis and common pitfalls encountered on imaging. 2. To understand the relevance of conventional anatomy and variants in the treatment of vascular disorders. The course features four lectures on arterial and venous anatomy in the chest, abdomen, and pelvis. Besides commonly encountered conventional arterial and venous anatomy, anatomical variants will be illustrated by multimodality imaging. Upon completion of the course, participants should be able to identify anatomical variants and understand their clinical relevance that affects image interpretation as well as aid procedure planning.

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Abstract Archives of the RSNA, 2021

M6-CAS06

Implementing the Critical Relationships of Quality and Performance for Effective Imaging Services (Sponsored by the Associated Sciences Consortium)

Participants

Morris Stein, BArch, Phoenix, Arizona (*Presenter*) Nothing to Disclose
Donna Blakely, MS,RT, Springfield, Massachusetts (*Presenter*) Nothing to Disclose
Melody Mulaik, Powder Springs, Georgia (*Presenter*) Nothing to Disclose
Carlos Amato, Los Angeles, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand and discuss the regulatory and compliance issues associated with the ordering, supervision and delivery of imaging services in the current and future state of healthcare facilities.2. Understand and assess how architectural planning and design directly influences or enhances the delivery of imaging quality and performance.3. Recommendations and look ahead noting how clinical support systems and design work together to provide performance insights. A deep dive on how clinical support systems and physical design/planning both impact quality and delivery of care.

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Abstract Archives of the RSNA, 2021

T4-CNPM02

The Resonant Leader: Stories of Impactful Leaders

Participants

Reed Omary, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose
Alexander M. Norbash, MD, San Diego, California (*Presenter*) Scientific Advisor, Penumbra, IncScientific Advisor, Stryker CorporationStockholder, Boston Imaging Core Lab, LLCResearch Grant, Canon Inc.
Pari V. Pandharipande, MD, MPH, Chestnut Hill, Massachusetts (*Presenter*) Nothing to Disclose
Marta Heilbrun, MD,MS, Atlanta, Georgia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the power of narrative to instill lessons in leadership; 2) Explain the difference between traditional command-and-control and newer influence styles of leadership. This course will use narratives and panel-based discussion to teach leadership skills critical for success for emerging radiology leaders. Presenters will illustrate how narratives can be used to inspire change, and how these narratives are especially useful when we are overwhelmed with data. Additionally, audience members will leave with an understanding how influence is the major currency for leadership in the future.

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Abstract Archives of the RSNA, 2021

Participants
Summer Kaplan, MD, MS, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Laura L. Hayes, MD, Pensacola, Florida (*Presenter*) Nothing to Disclose
Delma Y. Jarrett, MD, New York, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Define pearls and pitfalls in pediatric spine emergencies 2. Describe features of elbow injuries unique to pediatrics 3. Identify etiologies and key imaging for pediatric GI emergencies This pediatric imaging refresher course will review highlights in imaging use and interpretation in an emergency setting. The course will feature high-yield content for pediatric spine emergencies, elbow injuries, and gastro-intestinal emergencies. Pediatric emergencies and trauma often have different etiologies and mechanisms than adult emergencies, and learners at this course will appreciate unique features of pediatric imaging in spine, elbow, and GI emergencies.

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Abstract Archives of the RSNA, 2021

S3-RCP24

Desaf?os de la Educaci?n en Radiolog?a en Tiempos de Pandemia - Sesion del Colegio Interamericano de Radiologia (CIR) en Espanol/ Challenges of Radiological Education during Pandemic Times- Session of the Interamerican College Radiology (CIR) in Spanish

Participants
Pablo Soffia, MD, Santiago, Chile (*Presenter*) Nothing to Disclose
Jose L. Criales, MD, Huixquilucan, Mexico (*Presenter*) Nothing to Disclose
Luis E. Fajre SR, MD, Tucuman, Argentina (*Presenter*) Nothing to Disclose
Guillermo Elizondo-Riojas, MD,PhD, Monterrey, Mexico (*Presenter*) Nothing to Disclose
Beatriz Gonzalez, MD, Zapopan, Mexico (*Presenter*) Nothing to Disclose
Alvaro Huete Garin, MD, Santiago, Chile (*Presenter*) Nothing to Disclose
Javier Romero, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)*Situacin actual de la formacin de postgrado en radiologa en su pas\Current status of postgraduate training in Radiology in your country. 2)Efectos de pandemia en los programas de formacin\Pandemic effects on training programs 3)Desafos en la formacin de radilogos para los prximos aos en su pas\Challenges in the training radiologists for the coming years in your country* The pandemic produced by the SARS-Cov2 virus has had a great impact on Latin American countries, which have been forced to modify undergraduate and graduate teaching in medicine.In the case of Radiology, the capacity of the reading rooms has been reduced and many radiologists are working remotely, from their homes. Lectures, clinical and academic meetings are also held virtually. In this context, the interaction between residents and staff has become a challenge.In this course, four leaders of radiology education from Mexico, Colombia, Argentina and Chile will show us how they have had to adapt, innovate and modify the way of teaching radiology residents in their respective countries. Likewise, the experts will share their vision of how resident education in radiology will be in the coming years.La pandemia producida por el virus SARS-Cov2 ha golpeado fuertemente a los pases latinoamericanos, los que se han visto obligados a modificar la docencia de pre y postgrado en medicina.En el caso de Radiologa, se han reducido los aforos de las salas de informe y muchos radilogos estn trabajando en forma remota, desde sus hogares. Las conferencias, reuniones clnicas y acadmicas tambin se realizan de manera virtual. En este contexto, la relacin entre residentes y staff se ha vuelto un desafo.En este curso, cuatro lderes de la educacin en radiologa e Mxico, Colombia, Argentina y Chile nos mostrarn cmo han debido adaptarse, innovar y modificar la forma de ensear a los residentes de radiologa en sus respectivos pases . Asmismo, los expertos nos mostrarn su vision sobre cmo ser la educacin en radiologa durante los prximos aos.

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Abstract Archives of the RSNA, 2021

T1-CRO01

CNS - Case-based Multidisciplinary Review

Participants

Christina Tsien, MD, Washington, Dist. of Columbia (*Presenter*) Advisory Board, Blue Earth Diagnostics Ltd;Speakers Bureau, Varian, Inc;Speakers Bureau, Merck & Co, Inc
Soonmee Cha, MD, San Francisco, California (*Presenter*) Nothing to Disclose
Roger Stupp, MD, Chicago, Illinois (*Presenter*) Research Consultant, CarThera;Research Grant, CarThera;Committee member, Celularity, Inc;Scientific Advisory Board, CranioVation Inc;Scientific Advisory Board, Hemispherian AS;Research Consultant, InSightec Ltd;Consultant, GT Medical Technologies, Inc;Consultant, Triact Therapeutics Inc
Clark Chen, MD,PhD, Minneapolis, Minnesota (*Presenter*) Consultant, Medtronic plc;Consultant, MRI Interventions, Inc;Consultant, GT Medical

LEARNING OBJECTIVES

1. Review the recent updates to the 5th edition of the WHO Classification of Tumors of the CNS (2021). Emphasis will be on recognizing the implications of the substantial heterogeneity that exists amongst CNS tumor types and understanding the prognostic and predictive variables that help to guide selection of appropriate therapy. 2. Discuss key imaging modalities and imaging features to differentiate recurrent tumor and treatment effect and to identify brain tumor mimics. 3. Discuss the various treatment modalities, including surgery, radiotherapy, and chemotherapy, in managing gliomas, with emphasis on integrative or multi-modality strategies. Recent updates to the 5th edition WHO Classification of CNS tumors (2021) including the new tumor classifications will be discussed. The session will address the significant impact of molecular prognostic and predictive biomarkers that help to direct treatment selection for CNS tumors. The role of neuro-imaging in aiding clinicians improve the diagnosis, treatment and response assessment for CNS tumors will be emphasized. The session will follow "a rapid-fire" tumor board style to highlight the interactive multi-disciplinary treatment approach.References: 1. Louis DN, Wesseling P, Aldape K et al. cIMPACT-NOW update 6: new entity and diagnostic principle recommendations of the cIMPACT-Utrecht meeting on future CNS tumor classification and grading. Brain Pathol. 2020 Jul;30(4):844-8562. Wick W, Gorlia T, Bendszus M, Taphoorn M, Sahm F, Harting I, Brandes AA, Taal W, Domont J, Idbaih A, Campone M, Clement PM, Stupp R, Fabbro M, Le Rhun E, Dubois F, Weller M, von Deimling A, Golfinopoulos V, Bromberg JC, Platten M, Klein M, van den Bent MJ. Lomustine and Bevacizumab in Progressive Glioblastoma. N Engl J Med. 2017 Nov 16;377(20):1954-1963 3. Keskin DB, Anandappa AJ, Sun J et al. Neoantigen vaccine generates intratumoral T cell responses in phase Ib glioblastoma trial. Nature. 2019 Jan;565(7738):234-239

Abstract Archives of the RSNA, 2021

Response Assessment: Read with the Experts

Participants

Esma Akin, MD, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose
David A. Mankoff, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Speaker, Siemens/PETNETAdvisory Board, ImaginAb, IncAdvisory Board, RefleXion Medical IncConsultant, Blue Earth Diagnostics LtdConsultant, General Electric CompanyResearch funded, Siemens AGSpouse, Owner, Trevarx Biomedical
Eric M. Rohren, MD, PhD, Houston, Texas (*Presenter*) Consultant, Radiology Partners Inc
Phillip Kuo, MD,PhD, Tucson, Arizona (*Presenter*) Senior Medical Director, Invicro/Konica MinoltaConsultant, Invicro/Konica MinoltaConsultant, Amgen IncConsultant, Blue Earth DiagnosticsConsultant, Novartis AGConsultant, Chimerix IncConsultant, Fusion PharmaceuticalsConsultant, Bayer AGConsultant, Eisai

LEARNING OBJECTIVES

1) To review current response assessment criteria applicable to PET/CT. 2) To illustrate the application of these response assessment criteria in clinical practice. 3) To discuss advances in the field of FDG PET/CT and response assessment. This course will provide a review of response assessment and their application to clinical reporting of PET/CT. We will include an overview of response assessment criteria, pearls and pitfalls in applying the criteria in clinical practice and illustrative examples of how to apply response criteria with focus on the general radiologist, residents and fellows.

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Abstract Archives of the RSNA, 2021

Musculoskeletal Ultrasound: Pathologic Conditions and Hands-on Demo

Participants

Viviane Khoury, MD, Laval, Quebec (*Presenter*) Nothing to Disclose
Linda Probyn, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose
Marnix Van Holsbeeck, MD, Northville, Michigan (*Presenter*) Stockholder, Koninklijke Philips NV;Stockholder, General Electric Company;Stockholder, MedEd3D;Advisory Board, Canon Medical Systems Corporation
Mark Cresswell, MBBCh, Vancouver, British Columbia (*Presenter*) Consultant, Koninklijke Philips NV
Jon Jacobson, MD, Ann Arbor, Michigan (*Presenter*) Research Consultant, BioClinica, IncAdvisory Board, Koninklijke Philips NVRoyalties, Reed ElsevierContactor, POCUS PRO
Luca Maria Sconfienza, MD, PhD, Milano, Italy (*Presenter*) Travel support, Bracco GroupTravel support, Esaote SpASpeakers Bureau, Esaote SpATravel support, ABIOGEN PHARMA SpASpeakers Bureau, P&R HoldingSpeakers Bureau, Pfizer Inc Fees for lectures, Novartis AGFees for lectures, Merck SeronoFees for lectures, MSDF

LEARNING OBJECTIVES

1. Review anatomy and ultrasound imaging techniques for common musculoskeletal ultrasound indications.2. Describe useful dynamic imaging techniques to enhance assessment of musculoskeletal conditions.3. Discuss ultrasound imaging of common pathologic musculoskeletal conditions. This session will review ultrasound appearances of normal anatomy including soft tissue structures and joints that are commonly requested for musculoskeletal assessment. Tips on how to optimize imaging to best evaluate the area of concern will be discussed. The hands-on demonstration will illustrate dynamic assessment and maneuvers to further enhance assessment and problem solving to improve diagnostic interpretation. Common pathologic musculoskeletal conditions will be discussed. At the end of the session, participants will improve their approach to ultrasound assessment of musculoskeletal structures and diagnosis of common pathologic musculoskeletal conditions.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Artificial Intelligence and Machine Learning in CV Imaging

Participants

Albert Hsiao, MD,PhD, La Jolla, California (*Presenter*) Co-founder, Arterys Inc;Shareholder, Arterys Inc;Research Grant, Bayer AG;Research Grant, General Electric Company
Alexander Bratt, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Tessa S. Cook, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Grant, Siemens AG (ended)Grant, Independence Blue CrossGrant, RSNAGrant, ACR (ended)Grant, NIH MIDRCHonorarium, BJR (Ed board)Honorarium, Sectra (webinar speaker)

LEARNING OBJECTIVES

1) discuss the state of the art in AI as it pertains to cardiovascular imaging2) present use cases of AI for image acquisition, image postprocessing, and reporting and interpretation of cardiovascular examinations In this session, we will present applications of AI to all aspects of the cardiovascular imaging examination, from image acquisition, to automated post-processing, and finally, to natural language processing for reporting and downstream patient management. The course will present some state-of-the-art technologies as well as prognosticate on future applications and use cases of AI for cardiovascular imaging practice.

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Abstract Archives of the RSNA, 2021

R2-CMK11

Practical Tips and Tricks: How I Do and Interpret Advanced CT & MRI

Participants
Eric A. Bogner, MD, Boca Raton, Florida (*Presenter*) Research Consultant, Globus Medical, Inc
Jan Fritz, MD, New York, New York (*Presenter*) Institutional research support, Siemens AGScientific Advisor, Siemens AGPatent agreement, Siemens AGInstitutional research support, Johnson & JohnsonInstitutional research support, Zimmer Biomet Holdings, IncInstitutional research support, BTG Internation
Naveen Subhas, MD, Cleveland, Ohio (*Presenter*) Research support, Siemens AG;
Shivani Ahlawat, MD, Ellicott City, Maryland (*Presenter*) Nothing to Disclose
Roman Guggenberger, MD, Zurich, Switzerland (*Presenter*) Advisory Board, Aison Technologies AG

LEARNING OBJECTIVES

1. Describe the current state-of-the-art of CT and MRI applications in evaluating musculoskeletal disorders. 2. Apply modern CT and MRI techniques for evaluating and diagnosing sports-related, inflammatory, and neoplastic disorders. 3. Utilize state-of-the-art MR Neurography techniques diagnosing and monitoring neuropathies. 4. Implement CT and MRI techniques for diagnosing healing and complications following arthroplasty and spinal surgeries. A series of concise lectures providing comprehensive overviews of the role of advanced CT and MRI techniques, including metal artifact reduction MRI, dual-energy CT, MR Neurography, ultra-short echo time MRI and synthetic CT, as well as high-resolution 3D CT in the evaluation of sports injuries, neuromuscular disorders, inflammatory and neoplastic diseases, and following arthroplasty and spinal surgeries.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Practice Updates in Chest Imaging: Guidelines and Research

Participants
Carol C. Wu, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Jeffrey Kanne, MD, Madison, Wisconsin (*Presenter*) Research Consultant, PAREXEL International Corporation;
Stephen Hobbs, MD, Lexington, Kentucky (*Presenter*) Author with royalties, Wolters Kluwer nvAuthor with royalties, Reed Elsevier
Constantine Raptis, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Micheal McInnis, MD, Toronto, Ontario (*Presenter*) Speakers Bureau, Boehringer Ingelheim GmbHSpeakers Bureau, Bayer AG

LEARNING OBJECTIVES

1) Explain current imaging guidelines for COVID-19, hemoptysis, and incidental chest CT findings2) Understand recent developments in role of imaging in management of pulmonary fibrosis and lung transplantation Lectures in this educational session will provide timely updates on current guidelines and research in imaging of pulmonary fibrosis, COVID-19, hemoptysis, lung transplantation, and incidental chest CT findings.

Printed on: 06/28/22

W6-CNPM17

Practice Standards: High-Value Structured Reporting

Participants
Shlomit Goldberg-Stein, MD, Manhasset, New York (*Presenter*) Nothing to Disclose
Olga R. Brook, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Victoria Chernyak, MD,MS, Bronx, New York (*Presenter*) Consultant, Bayer AG

LEARNING OBJECTIVES

1) Share a strategic roadmap on how to accomplish the rollout of structured radiology reporting in your organization. 2) Provide data for use in stakeholder negotiations on the value proposition of structured reporting. 3) Present data on the impact of ACR RADS on clinical patient outcomes. This course will share the latest data on the impact of standardized structured reporting systems on both the quality of radiology reporting and on patient clinical outcomes. Data will be presented in a format that can be used to highlight the value of structured reporting in stakeholder meetings. Finally, a strategic roadmap and resources will be shared to support the rollout of structured reporting within your organization. This educational course is in didactic lecture format.

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Abstract Archives of the RSNA, 2021

Peer-Review Methods: Useful or Useless?

Participants
Jason Itri, MD,PhD, Charlottesville, Virginia (*Presenter*) Nothing to Disclose
Nadja Kadom, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Saurabh Jha, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1.Explain the limitations of RADPEER and random peer review.2.List approaches to identify diagnostic errors in a radiology practice.3.Describe the pros and cons of methods used for peer review. Peer review is the primary method used by radiology practices to assess radiologist performance in clinical practice. In this 60-minute session, radiologists will debate the usefulness (or futility) of current peer review practices and discuss future directions. Peer review: safety in collective camaraderie by Dr. Harry JhaPeer review: no practice left behind by Dr. Jason ItriFuture directions by Dr. Nadja Kadom

Printed on: 07/01/22

S1-CMS01

Radiology Department Pandemic Response - Lessons Learned and Preparing for the Next Contagion

Participants

Eric Roberge, MD, Fox Island, Washington (*Presenter*) Nothing to Disclose
Siobhan O' Neill, MBBCh,PhD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose
Jamlik-Omari Johnson, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Jeffrey W. Dunkle, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Apply the disaster management framework to your local practice in order to better plan for the next contagion. 2) Describe a variety of responses to COVID-19 undertaken by different radiology departments from around the world. 3) Discuss the humanitarian considerations of pandemic preparation, support, and recovery. 4) Understand the financial impacts of the pandemic to radiology practices as well as mitigation strategies. This session will provide an overview of disaster response, with deeper dives into the impact of the COVID-19 pandemic with specific respect to how various radiology departments internationally adapted to provide optimal care while maintaining staff safety, and the impact on the bottom line.

Printed on: 06/28/22

R5-CNPM23

AI and Imaging Quality/Safety

Participants

Nathan M. Cross, MD, MS, Seattle, Washington (*Presenter*) Consultant, Koninklijke Philips NV;Consultant, General Electric Company
Charles Kahn JR, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Curtis Langlotz, MD,PhD, Menlo Park, California (*Presenter*) Stockholder, whiterabbit.ai;Advisor, whiterabbit.ai;Stockholder, Galileo
CDS, Inc;Advisor, Galileo CDS, Inc;Stockholder, Bunker Hill, Inc;Board of Directors, Bunker Hill, Inc;Stockholder, Sirona Medical,
Inc;Advisor, Sirona Medical, Inc

LEARNING OBJECTIVES

(1)Enumerate common metrics used to assess clinical AI tool performance and some of their limitations. (2)Identify steps in the process of finding, evaluating and adopting a clinical AI tool for your practice. As clinical AI tools enter the radiology marketplace it is crucial to have a systematic approach to assess how these tools (1)fit clinical workflows, (2)how the AI tool is assessed and the relevance of these metrics to real world usage in your practice, and (3)how to choose, test, implement and monitor their usage at your site. Three experts will discuss the spectrum of solutions, the FDA's role in evaluating these tools, and provide a critical data based approach to assess them for practical use. Participants should understand categories of tools on the market, basic metrics used to report performance, pitfalls or misleading aspects to some AI metrics, and have an outline for how to approach the search for an AI solution for clinical use.

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Abstract Archives of the RSNA, 2021

R1-CNR10

Artificial Intelligence in Neuroimaging: Where Are We Now?

Participants

Elizabeth Tong, MD, Stanford, California (*Presenter*) Nothing to Disclose
Emanuele Neri, MD, Pisa, Italy (*Presenter*) Speakers Bureau, General Electric Company
Christopher Filippi, MD, Boston, Massachusetts (*Presenter*) Research Consultant, Syntactx, LLCStockholder, Avicenna.aiResearch grant, National Multiple Sclerosis Society
Yvonne Lui, MD, New York, New York (*Presenter*) Research collaboration lead, Siemens AGResearch collaboration lead, Facebook AI Research

LEARNING OBJECTIVES

1) Understand the potential role of artificial intelligence (AI) in clinical applications of neuroradiology. 2) Describe ways that AI may assist in brain tumor and stroke imaging. This course is designed to provide an update on the developing role of AI in clinical applicatoins of neuroimaging, including brain tumor and stroke imaging. The educational format includes lectures and Q&A. The expected outcome of the session is that attendees will have an understanding of the potential and current clinical applications of AI in neuroimaging.

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Abstract Archives of the RSNA, 2021

M5-RCP49
Fast 5

Participants

Sherry Wang, MBBS, Salt Lake City, Utah (*Presenter*) Royalties, RELX;Research Grant, Samsung Electronics Co, Ltd

LEARNING OBJECTIVES

Empty Abstract

Sub-Events

M5-RCP49   Radiology's Sustainable Future: Tackling Climate Change from the Reading Room

Participants

Julia Schoen, MD,MS, Winston Salem, North Carolina (*Presenter*) Stockholder, Merck & Co, Inc;Stockholder, Moderna;Stockholder, Aurinia Pharmaceuticals

LEARNING OBJECTIVES

Empty Abstract

M5-RCP49   Addressing Imaging Inequality at the Frontline: A Free Imaging Clinic Model for the Underserved

Participants

Charlotte Chung, MD, PhD, New York, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

M5-RCP49   The Millennial Transformation of Radiology

Participants

Angel Gomez-Cintron, MD,MPH, San Antonio, Texas (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

M5-RCP49   Embracing Artificial Intelligence for Mitigating Health Disparities and Achieving Health Equity: Challenges and Opportunities

Participants

Noushin Yahyavi-Firouz-Abadi, MD, Potomac, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

M5-RCP49   Supporting Family/Medical Leave: Where Are We and Where Do We Go from Here?

Participants

Elizabeth Dibble, MD, Warwick, Rhode Island (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

R1-CIN22

Chasing the Holy Grail: Reducing Radiation Dose and Improving Image Quality

Participants
Matthew E. Zygmont, MD, Decatur, Georgia (*Presenter*) Nothing to Disclose
Timothy Szczykutowicz, PhD, Madison, Wisconsin (*Presenter*) Consultant, AiDoc Medical Ltd;Consultant, Flowhow.ai;Consultant, medInt Holdings, LLC;Consultant, Alara, Inc;Consultant, AstoCT, Inc;Research Grant, General Electric Company;Research Grant, Canon Medical USA
Sebastian T. Schindera, MD, Riehen, Switzerland (*Presenter*) Nothing to Disclose
Madan Rehani, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Rebecca Smith-Bindman, MD, San Francisco, California (*Presenter*) Founder, Alara Imaging, Inc

LEARNING OBJECTIVES

To understand the importance of dose optimization for CT, and to understand different perspectives on how to tackle this important area of patient safety in health care. Medical Imaging with Computed Tomography has been one of the most impactful and transformative aspects of medicine. But along with the potential benefits of medical imaging with CT come potential risks, including the risk of cancer from the radiation associated with CT. There is broad interest from diverse stakeholders radiologists, medical physicists, hospitals, policy makers and those involved in quality improvement in reducing the doses for CT, but how to reduce those doses is not so simple. The session will include short lectures from individuals who have worked on a range of approaches for reducing the radiation doses for CT from diverse perspectives and for diverse populations with various levels of success and failures. The experiences will range from efforts at the level of a single hospital system, to broad international efforts.

Printed on: 07/01/22

W6-CMS18

MRI Protocols in the Emergency Room

Participants

Hersh Chandarana, MD, Scarsdale, New York (*Presenter*) As part of institutional Master Research Agreement:Equipment support, Siemens AGSoftware support, Siemens AG
Jessica Rotman, MD, New York, New York (*Presenter*) Nothing to Disclose
Nucharin Supakul, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Michael Repplinger, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize the usefulness of MRI in imaging non-stroke acute neurologic conditions2) Identify situations in which musculoskeletal MRI is additive or superior to CT in the ER3) Understand the emergency physician's perspective of abbreviated MRI protocols4) Examine MRI protocols used to evaluate abdominal pain This session will provide an update on MRI protocols for common indications in the emergent setting, and how these protocols can be optimized for efficient scanning.

T6-CBR06

Management of B3 Risk for Upgrade Lesions: Breast Lesions

Participants

Nisha Sharma, MBChB, Leeds, United Kingdom (*Presenter*) Nothing to Disclose
Sarah Pinder, London, United Kingdom (*Presenter*) Advisory Board, AstraZeneca PLC;Advisory Board, F. Hoffmann-La Roche Ltd;Speakers Bureau, F. Hoffmann-La Roche Ltd;Advisory Board, Exact Sciences Corporation;Speakers Bureau, Exact Sciences Corporation

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

What's New in Fetal and Obstetric Imaging

Participants
Carol Benson, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Deborah Levine, MD, Weston, Massachusetts (*Presenter*) Editor, Reed Elsevier;Editor, Wolters Kluwer nv;
Edward R. Oliver, MD, PhD, Media, Pennsylvania (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Differentiate the roles of ultrasound, including the nuchal translucency, and other tests, such as NIPT, in screening for fetal abnormalities in the first trimester.2. Explain the new guidelines for the first trimester early anatomy sonogram.3. Differentiate the complete obstetrical sonogram from the detailed obstetrical scan in second and third trimester and understand the required components of the detailed obstetrical scan.4. Review the sonographic markers associated with placenta accreta spectrum and the prenatal ultrasound evaluation in at-risk pregnancies so that participants can incorporate the appropriate scanning techniques for evaluation in these high risk pregnancies. This lecture course will address topics in Obstetrical Ultrasound. First will be a discussion of screening in the first trimester and the strengths and weaknesses of the NIPT test, and why the nuchal translucency measurement may still be indicated after the test. Also discussed will be the new guidelines for the first trimester early anatomy scan, as well as the relationship of cesarean scar pregnancies to placenta accreta spectrum complications. To follow this will be a presentation covering the second and third trimester detailed sonogram and how the role the interpreting physician, whether a radiologist or maternal-fetal-medicine physician, is evolving. An explanation about the difference the complete obstetrical scan and the detailed scan will be provided. Lastly will be a presentation on placenta accreta spectrum, including the guidelines for sonographic evaluation, as well as the important role of MRI in some cases.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

M1-CIN05

Best Practices in Radiology: Clinical Decision Support Rollout

Participants

Pamela T. Johnson, MD, Baltimore, Maryland (*Presenter*) Intellectual property, AgileMD;Future royalties, AgileMD
Hanna M. Zafar, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
John Mongan, MD,PhD, San Francisco, California (*Presenter*) Research Grant, General Electric Company;Royalties, General Electric Company;Spouse, Employee, Annexon Biosciences;Spouse, Employee, AbbVie Inc
Keith D. Hentel, MD, MS, Briarcliff, New York (*Presenter*) Nothing to Disclose
Christopher J. Roth, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Define the requirements of the CMS Advanced Imaging Appropriate Use Criteria mandate, slated to be fully operational January 1, 2022. 2) Describe solutions that different health systems have implemented to meet the regulation. 3) Understand the implementation process and how to overcome barriers. 4) Design research investigations using robust methodologies and clinical effectiveness outcome metrics to evaluate the utility of these tools. The Protecting Access to Medicare Act includes a regulation that medical providers are guided by appropriate use criteria (AUCs) when ordering advanced imaging (CT, MRI and nuclear medicine). This regulation is slated to become fully operational January 1, 2022. While many medical centers have licensed a CMS-approved clinical decision support mechanism (CDSM) to be in compliance, some remain unaware. The purpose of this session is to inform clinicians and administrators about the requirements of CMS' advanced imaging AUC mandate. The implementation process is time and labor intensive and requires engagement of radiology and nonradiology providers. Key steps include allocating resources to cover licensing costs, selecting a clinical decision support tool, integrating the tool into the electronic medical record, and educating ordering providers about changes to order workflow for CT, MRI and nuclear medicine scans as well as why they are required to consult AUCs through a CDSM at order entry. Experienced medical centers will share different CDSM solutions, provide guidance on how to overcome implementation hurdles, and highlight new opportunities they have identified with respect to clinical effectiveness, efficiency and research.

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Abstract Archives of the RSNA, 2021

S4-CMK02

Shoulder Imaging: How I Do It

Participants

Michael J. Tuite, MD, Verona, Wisconsin (*Presenter*) Nothing to Disclose
Soterios Gyftopoulos, MD, Scarsdale, New York (*Presenter*) Nothing to Disclose
Nathalie J. Bureau, MD, MSc, Montreal, Quebec (*Presenter*) Research Grant, Siemens AG
Donald L. Resnick, MD, San Diego, California (*Presenter*) Nothing to Disclose
Mark W. Anderson, MD, Charlottesville, Virginia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe techniques that improve efficiency and accuracy when interpreting MR imaging of challenging areas of the shoulder, including the rotator interval and the superior labrum. 2) Explain a concise and useful system for characterizing rotator cuff tears on ultrasound. Get Tips and Tricks from five experts in shoulder MR and US imaging. These how-I-do-it lectures will discuss five challenging aspects of shoulder imaging for which the speakers have developed techniques to improve their efficiency and accuracy. The speakers will share helpful tips on MR of the rotator interval, what to report for instability, how to differentiate SLAP lesions from normal variants, optimizing your MR imaging planes, and US of the rotator cuff. You will be able to integrate these useful pearls into your practice and read shoulder images like the experts.

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Abstract Archives of the RSNA, 2021

T4-CPD04

Pediatric Small Parts Ultrasound: When to Worry or Not

Participants

Cassandra Sams, MD, Providence, Rhode Island (*Presenter*) Nothing to Disclose
Tess Chapman, MD,MA, Seattle, Washington (*Presenter*) Nothing to Disclose
Claudia M. Martinez Rios Arellano, MD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Recognize the spectrum of sonographic findings in pediatric thyroid carcinoma and features that differentiate benign from malignant thyroid nodules in children.2.Recognize normal sonographic appearances of breast development and describe imaging features of commonly seen benign breast masses3. Recognize key sonographic findings to suggest the presence of gonadal torsion, as well as worrisome features in the setting of trauma. Small parts in small people can be a large source of consternation. This session will address the normal and abnormal appearance of the pediatric thyroid, breast, and gonads to help radiologists know when to worry.

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Abstract Archives of the RSNA, 2021

T5-CMS14

Forensic Imaging

Participants

Marc Camacho, MD, Tampa, Florida (*Presenter*) Nothing to Disclose
Summer J. Decker, PhD, Tampa, Florida (*Presenter*) Nothing to Disclose
Thomas Ptak, MD, PhD, Severn, Maryland (*Presenter*) Nothing to Disclose
Robin D. Hines, MD, Spokane, Washington (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Define Forensic Imaging and explain the various applications in antemortem and postmortem patient populations.2) Identify barriers to implementation of a forensic imaging program.3) Gain an understanding of the state-of-the-art multimodality approach of the "Virtopsy", or virtual autopsy, and its use in Europe. This session will offer a primer into Forensic Imaging, a pictorial gallery of fascinating representative cases, an overview on how to start a forensic imaging program from the ground up, and an introduction to the "Virtopsy" and the European experience.

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Abstract Archives of the RSNA, 2021

R6-CMK13

Post-op Imaging: The Lower Extremity

Participants

Alice S. Ha, MD, Seattle, Washington (*Presenter*) Nothing to Disclose
Emma Rowbotham, MBBCHIR,FRCR, Leeds, United Kingdom (*Presenter*) Nothing to Disclose
Tobias Dietrich, MD, St Gallen, Switzerland (*Presenter*) Nothing to Disclose
Luis S. Beltran, MD, Chestnut Hill, Massachusetts (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) learn about latest developments in lower extremity surgeries 2) identify imaging findings, both normal and abnormal, after these surgeries Course will highlight latest trends in surgeries for 1) femoroacetabular impingement (Dr. Beltran), 2) meniscus (Dr. Rowbotham), and 3) ACL (Dr. Dietrich).

Printed on: 06/28/22

R1-RCP07

Improving Patient Experience through Human Design Thinking (Sponsored by the RSNA Public Information Committee)

Participants
Susan John, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Achala Vagal, MD, Cincinnati, Ohio (*Presenter*) Departmental Research Grant, Johnson & Johnson
Ruth C. Carlos, MD, MS, Ann Arbor, Michigan (*Presenter*) In-kind support, Reed Elsevier;Editor, Reed Elsevier;Travel support, General Electric Company
Lucy Spalluto, MD,MPH, Nashville, Tennessee (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Apply human design thinking processes to create practical solutions to improve patient experience. 2) Use novel teaching methods to improve empathy and communication between physicians and patients 3) Develop a health equity curriculum through human design thinking As patients become increasingly engaged in their medical care, attention to the quality of the patient experience must become a priority in radiology departments and imaging facilities. Human centered design is an approach to problem-solving that uses the patient perspective through all phases of the process. This technique emphasizes human dignity, access, and abilities when developing solutions. Empathetic communication with patients is a key factor in designing patient-centered solutions. This course will introduce the concept of human design thinking and how it can be applied to improve patient experience and communication in radiology and to develop a curriculum to teach health equity in imaging.

Abstract Archives of the RSNA, 2021

S4-CVA02

Inflammatory Vascular Diseases: Imaging Findings and Complications

Participants
Constantine Raptis, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Kohsuke Kudo, MD, Sapporo, Japan (*Presenter*) Research Grant, FUJIFILM Holdings Corporation
Linda C. Chu, MD, Lutherville, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Review the imaging findings and important complications of inflammatory vascular conditions in the central nervous system 2. Explore the imaging findings of inflammatory vascular conditions in the thorax within the context of the Chapel Hill nomenclature system3. Discuss the imaging findings and complications of syndromic and non-syndromic heritable vascular diseases such as Marfan disease, Loeys-Dietz syndrome, and bicuspid aortic valve Inflammatory and heritable vascular diseases, or vasculopathies, represent a spectrum of noninfectious conditions that affect the vascular wall. These conditions can produce a wide array of clinical presentations and may result in important complications including aneurysm, stenosis, and dissection. Radiologists have an important role in the multidisciplinary approach to these diseases, as imaging findings are important pieces of their diagnostic and management puzzle. In this course, a discussion and case based review of inflammatory and heritable vascular diseases will be presented, with an emphasis on the central nervous system and thorax. After this course, attendees will be better equipped to tackle the challenges presented by these conditions.

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Abstract Archives of the RSNA, 2021

Does Contrast Induced Nephropathy Really Exist?

Participants

Jill Jacobs, MD, New York, New York (*Presenter*) Nothing to Disclose
Brian B. Ghoshhajra, MD, Boston, Massachusetts (*Presenter*) Research Grant, Siemens AG;Consultant, Koninklijke Philips NV
Phillip M. Young, MD, Rochester, Minnesota (*Presenter*) Advisory Board, Arterys Inc

LEARNING OBJECTIVES

This course will underscore the current advantages and limitations of low dose contrast CT and MR angiography techniques for imaging the typically "brittle" TAVR patient population while trying to prevent exacerbation of renal insufficiency. This course will debate whether or not Contrast Induced Nephropathy exists and which modality, low dose contrast CT or MR angiography, is preferable to utilize in the typically "brittle" TAVR population with renal insufficiency.

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Abstract Archives of the RSNA, 2021

Impact of COVID-19 on Breast Imaging and Modification of Practice

Participants
Rudolf Pijnappel, MD, PhD, Utrecht, Netherlands (*Presenter*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Hologic, Inc;Advisory Panel, Hologic, Inc;Research Grant, OM1, Inc;Research Grant, iCad, Inc;Advisory Panel, iCad, Inc;Speaker, Medscape, LLC
Stephen W. Duffy, London, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)Identify the long-term effect of prolonging the screening interval due to COVID-192)Explain the side effect of COVID-19 vaccination on axillary lymph nodes3)Impact on breast care in a clinical setting from COVID-19 The impact of COVID-19 was huge not only as infectious disease but also had its impact on Cancer care. Breast Cancer Screening programs were heavily hampered and some even were forced to stop for a couple of months. The long-term impact of this disturbance on outcome will be highlighted during this session. Not only the screening programs but also the clinical breast care suffered from COVID-19. The impact regarding breast practice will be evaluated in combination with the side effects of vaccination since axillary lymph node enlargement due to vaccination plays an important role in the clinical setting. Three lectures from Europe and the US will highlight the effect of COVID-19 on screening, outcome and clinical management of breast care.

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Abstract Archives of the RSNA, 2021

The Report of the Future: Interactive Multimedia Reporting

Participants

Les Folio, MPH,DO, Tampa, Florida (*Presenter*) Institutional research agreement, Koninklijke Philips NV
Patricia Balthazar, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
David Kwan, BSC, Thornhill, Ontario (*Presenter*) Nothing to Disclose
Seth Berkowitz, MD, Boston, Massachusetts (*Presenter*) Advisory Board, Change HealthcareResearch Grant, Change HealthcareResearch Grant, Koninklijke Philips NV

LEARNING OBJECTIVES

Understand how multimedia reports can add value to patients and referring physicians.List barriers to creating and distributing multimedia reports.Recite various approaches to interoperable multimedia report creation. We describe how interactive multimedia reports can add value to patients and referring physicians by clicking on clinical report text that directs one to the image annotation. Our first white paper was recently published in JDI that is clinically focused and describes how this reporting could benefit all image centric specialties such as dermatology and pathology. A common adoption barrier for advanced reporting shared by most participating centers is the current lack of interoperability between disparate electronic health records (EHR), picture archiving and communications systems (PACS), a variety of imaging modalities, acquisitions and capture devices. The largest challenge remains: the limited interoperability between radiologys most commonly used diagnostic image viewers and speech recognition-based reporting systems. Some radiology practices utilize innovative combined viewer and report creation applications which lower the IMR creation barrier significantly, though this is a minority of sites. Even if radiologists could easily create and distribute such reports, proprietary and site-specific output interfaces and integrations involving the downstream electronic health record (EHR) often erode IMR quality and value by displaying the IMR using portable document format (PDF) viewers with limited capabilities, rather than software able to manage the full interactive and multimedia features included by the application on which the report was created directly as it was created. We share examples of how to overcome these challenges with technical development requirements, including established and evolving standards. Dr. Berkowitz will explain how Beth Israel Deaconess became interactive and multimedia across various vendors and platforms.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

The Enlarged Uterus: Fibroids and Adenomyosis

Participants

Susan M. Ascher, MD, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose
Mindy Horrow, MD, Philadelphia, Pennsylvania (*Presenter*) Spouse, Employee, Bristol-Myers Squibb Company
Malcolm Munro, MD, Tarzana, California (*Presenter*) Consultant, AbbVie Inc;Consultant, Sumitovant Biopharma Ltd;Consultant, Hologic, Inc;Consultant, Luitpold Pharmaceuticals, Inc;Consultant, DAIICHI SANKYO Group;Consultant, Pharmacosmos Therapeutics Inc;Stockholder, Gynesonics, Inc;Stockholder, UVision 360

LEARNING OBJECTIVES

1) Identify the US and MR features of fibroids and adenomyosis to include overlapping features2)Explain the role of imaging in the management of women with symptomatic fibroids and/or adenomyosis This course will focus on the pathophysiology, classification, and US and MR diagnosis of fibroids and adenomyosis. The course will emphasize imaging information critical to gynecologists caring for symptomatic women. The format is three lectures followed by a question and answer session.

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Abstract Archives of the RSNA, 2021

Bring On Your Game: Audience Interactive Competitive Hot Seat Review of Best of the Case Collection (MSK, GU, CHEST, BREAST, PEDS)

Participants

Mariam Moshiri, MD, Brentwood, Tennessee (*Presenter*) Nothing to Disclose
Priya Sharma, MD, Gainesville, Florida (*Presenter*) Nothing to Disclose
Manickam Kumaravel, MD, FRCR, Houston, Texas (*Presenter*) Nothing to Disclose
Keyanoosh Hosseinzadeh, MD, Winston Salem, North Carolina (*Presenter*) Nothing to Disclose
Christopher Walker, MD, Fairway, Kansas (*Presenter*) Author, RELXSpeakers Bureau, Boehringer Ingelheim GmbH
Debbie Bennett, MD, Saint Louis, Missouri (*Presenter*) Speaker, Hologic, Inc;Scientific Advisory Board, Devicor Medical Products, Inc;
Ramesh S. Iyer, MD, Sammamish, Washington (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Develop differential diagnoses for the five radiology subspecialties presented in this course Recognize imaging features that aid in differential diagnoses, allowing for a more specific diagnosis Learn evaluation of cases in a methodical and clinically applicable fashion This is an interactive and practice-based course for all radiologists at all levels. The format is case-based and rapid-fire evaluation of one's diagnostic skills. The participants are guided through a selection of the best cases from the RSNA Case Collection across 5 subspecialties.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Deep Learning Lab: DICOM Data Wrangling with Python

Participants

Katherine Andriole, PhD, Branford, Connecticut (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

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Abstract Archives of the RSNA, 2021

SAT03

AAPM/RSNA Physics Tutorial Session 2: A Radiation Oncologist Perspective on Advanced Imaging Methods for Treating and Managing Prostate Cancer

Participants

Thaddeus Wilson, PhD, Memphis, Tennessee (*Presenter*) Nothing to Disclose
Nicholas Nickols, MD, Los Angeles, California (*Presenter*) Research Grant, Johnson & Johnson;Research Grant, Varian Medical Systems, Inc;Research Grant, Bayer AG;Research Grant, Lantheus Holdings;Consultant, Oncolinea Pharmaceuticals, Inc
Patrick McLaughlin, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe how modern PET imaging is changing the landscape of prostate cancer staging in the primary and recurrent settings. 2) Describe how incorporation of advanced PET imaging can impact prostate cancer radiotherapy planning. 3) The role of MRI in tumor definition and focal dose escalation as well as predicting quality of life outcomes and fullpreservation of GI, GU, and Sexual function.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

DLL42

Deep Learning Lab: Working with Public Datasets: TCIA & IDC

Participants
Andriy Fedorov, PhD, Arlington, Massachusetts (*Presenter*) Nothing to Disclose
Justin Kirby, Rockville, Maryland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand the capabilities and complementary nature of the TCIA and IDC repositories, including those related to identifying and visualizing relevant data, defining cohorts and retrieving the data for subsequent analysis; 2. Gain familiarity with the process of retrieving the data and applying a representative processing pipeline using free compute resources available via Google Colab; 3. Establish awareness about the related components of the broader NCI data science ecosystem, and the learning resources available to the community to facilitate the use of IDC and TCIA for cancer imaging research. The National Cancer Institute (NCI), of the National Institutes of Health (NIH), has made significant investments in the creation and development of public data repositories to enable and promote data sharing and secondary analysis of cancer imaging data through an open science approach. The two flagship repositories supported by NCI are The Cancer Imaging Archive (TCIA) (https://www.cancerimagingarchive.net/) and Imaging Data Commons (IDC) (https://imaging.datacommons.cancer.gov/). TCIA works directly with data submitters to implement de-identification, curation and hosting of imaging collections for download. IDC is an emerging repository within the NCI Cancer Research Data Commons (CRDC) (https://datacommons.cancer.gov/), which replicates de-identified public collections on the cloud, co-locating the imaging data alongside the analysis resources and tools, and other types of linked data. The purpose of this course is to introduce the attendees to the complementary capabilities of TCIA and IDC, and demonstrate how the data available in both TCIA and IDC can be accessed and utilized via hands-on examples with Google Colab notebooks. At the completion of this course the attendees are expected to be equipped with the knowledge needed to proceed with identifying and analyzing relevant datasets from TCIA and IDC.

Printed on: 06/28/22

R6-CNR12

Controversies in Spine Intervention: To stick or not to stick?

Participants

Joshua Hirsch, MD, Boston, Massachusetts (*Presenter*) Consultant, Medtronic plc;Consultant, Relievant Medsystems, Inc;Committee member, Relievant Medsystems, Inc;Consultant, Persica Pharmaceuticals Limited;Committee member, Persica Pharmaceuticals Limited
Miriam Peckham, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose
Peter G. Kranz, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose
Afshin Gangi, MD,PhD, Strasbourg, France (*Presenter*) Consultant, AprioMed AB

LEARNING OBJECTIVES

1) Discuss indications and techniques for epidural patching, with a focus on patient selection and technical considerations specific to particular subtypes of spinal CSF leak2) Discuss the current evidence regarding a) efficacy of and b) indications for facet and sacroiliac joint interventional techniques including steroid/anesthetic injection, radiofrequency ablation, and platelet-rich plasma.3) Discuss the role radiologists might play in diagnosing and managing benign tumors of the spine. The focus will be the most frequent benign tumors of the spine which can be treated percutaneously with an emphasis on complication avoidance. 4) Understand the impact of augmentation on mortality in patients with vertebral compression fractures. This session will address several topical themes in the field of image-guided spine intervention, covering procedures for spinal pain, CSF leak, tumors, and vertebral compression fractures. Speakers will variably emphasize key questions about when each type of spine intervention is necessary, factors that promote success, practical considerations for the radiologist performing the procedure and/or general reasons to consider treatment vs. other therapy. Following the lecture, all speakers will participate in a panel discussion and engage the audience in a discussion about the questions and controversies surrounding these procedures.

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Abstract Archives of the RSNA, 2021

Hot Topic: AI in MSK - What You Need to Know

Participants

Michael Recht, MD, New York, New York (*Presenter*) Nothing to Disclose
Leon Lenchik, MD, Winston-salem, North Carolina (*Presenter*) Nothing to Disclose
Benjamin Fritz, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose
Michael L. Richardson, MD, Seattle, Washington (*Presenter*) Nothing to Disclose
Richard Kijowski, MD, New York, New York (*Presenter*) Research Consultant, Boston Imaging Core Lab, LLC
Hillary Garner, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn to translate practical theories in artificial intelligence (AI) into musculoskeletal radiology practice. 2) Explain the current applications of AI in musculoskeletal imaging. This update course will include 6 brief lectures on AI applications to musculoskeletal imaging and allow learners to gain insight into how AI may help improve their practice.

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Abstract Archives of the RSNA, 2021

R5-CPD11

Whole Body Imaging in Pediatrics

Participants

Andrea S. Doria, MD, Toronto, Ontario (*Presenter*) Research Grant, Shire plc;Research Grant, Novo Nordisk AS;
Lisa J. States, MD, Plymouth Mtng, Pennsylvania (*Presenter*) Nothing to Disclose
Arthur B. Meyers, MD, Cincinnati, Ohio (*Presenter*) Author with royalties, Reed Elsevier;Editor with royalties, Reed Elsevier

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

M1-CBR03

Contrast Enhanced Mammography

Participants

Vasiliki Papalouka, MD, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose
Marc Lobbes, MD, Maastricht, Netherlands (*Presenter*) Speaker, General Electric Company;Medical Advisory Board, General Electric Company;Speaker, Bayer AG;Medical Advisory Board, Bayer AG;Speaker, Guerbet SA;Medical Advisory Board, Guerbet SA
Christopher E. Comstock, MD, New York, New York (*Presenter*) Advisory Board, Bracco AG

LEARNING OBJECTIVES

1. Review the background, principals and technique of Contrast Enhanced Mammography (CEM) and discuss its current clinical applications, limitations and future directions;2. Discuss whether CEM is ready to replace breast magnetic resonance imaging, specifically for the indication of preoperative staging of women with breast cancer;3. Identify the limitations of current breast cancer screening techniques and review data on the use of CEM as a screening technique. In this course, three expert speakers will address the current status of Contrast Enhanced Mammography (CEM). A short introduction will be given on the techniques, the principles and potential clinical applications. More specifically, we will go into details whether CEM is ready to replace breast MRI for certain indications, zooming in on the preoperative staging of breast cancer as specific indication. Finally, the limitations of current breast cancer screening will be identified and we will discuss what future role CEM can play in screening, despite the slightly increased radiation dose and the use of iodinated contrast agents.

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Abstract Archives of the RSNA, 2021

M4-CCH05

Thoracic Imaging Practice - Polling Session

Participants
Ioannis Vlahos, MRCP,FRCR, Houston, Texas (*Presenter*) Director, Grayscale Ltd;Co-owner, Grayscale Ltd;
Sanjeev Bhalla, MD, Saint Louis, Missouri (*Presenter*) Advisory Board, Precisa Gravimetrics AG
Brett M. Elicker, MD, San Francisco, California (*Presenter*) Nothing to Disclose
Ella Kazerooni, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Jo-Anne O. Shepard, MD, Boston, Massachusetts (*Presenter*) Editor with royalties, Reed Elsevier
Ann N. Leung, MD, Stanford, California (*Presenter*) Nothing to Disclose
Cristopher Meyer, MD, Middleton, Wisconsin (*Presenter*) Investor, Elucent Medical

LEARNING OBJECTIVES

1. The audience will become aware of latest imaging/reporting guidance for certain defined clinical/radiological scenarios.2. For situations where there is no formalized guidance on interpretation/reporting or practice, the audience will be able to assess their practice against the practice variation of the RSNA audience. The expert panel will show their choices and discuss their best recommendations. 3. The polling of areas of uncertainty in our practice and the expert panel discussion may define future areas for research and formalized radiological guidance. This is a new interactive course format. The attending audience will be polled on a series of cardiopulmonary imaging topics where practice may vary. This may include the audience opinion on how they might interpret, measure or report individual image findings, what imaging strategy they might select for different scenarios, what imaging/management guidance we might offer, or survey practice/technical variations.The same polling questions will be asked to a panel of experts to determine their practice choices and variability. The expert panel will present whether there is formal guidance on the different topic issues, or discuss between them their best recommendations for areas of uncertainty in current practice. The format of the course will be adjusted according to whether the meeting session is in person, or virtual, in view of uncertainty with regards to Covid.

Abstract Archives of the RSNA, 2021

Breast MRI: Increase the Value

Participants
Pascal A. Baltzer, MD, Vienna, Austria (*Presenter*) Nothing to Disclose
Christopher E. Comstock, MD, New York, New York (*Presenter*) Advisory Board, Bracco AG
Dana Smetherman, MD, MPH, New Orleans, Louisiana (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

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Abstract Archives of the RSNA, 2021

M3-CAS03

Radiation Safety Culture for Technologists (Sponsored by the Associated Sciences Consortium)

Participants
Nancy McDonald, MS, Dallas, Texas (*Presenter*) Nothing to Disclose
Rennie Mohabir, MBA,RT, Valley Stream, New York (*Presenter*) Nothing to Disclose
Anzi Zhao, MS, Chicago, Illinois (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

By the end of this presentation, the attendees will be able to:Understand the background of eliminating patient shielding initiativeUnderstand rationales for eliminating patient shieldingUnderstand fetal risks from ionizing radiationKnow fetal dose from typical imaging examsIdentify shielding that will be discontinuedKnow Northwestern Medicines experience on eliminating patient shielding WHY ARE WE NOT SHIELDING PATIENTS ANY LONGER??????This course will help you understand the WHY, the WHAT and the RATIONALE of why you have been asked to eliminate patient shielding in most radiology procedures.

Abstract Archives of the RSNA, 2021

Controversies in Imaging Utilization

Participants
Rebecca Smith-Bindman, MD, San Francisco, California (*Presenter*) Founder, Alara Imaging, Inc
H. Gilbert Welch, MD,MPH, Thetford, Vermont (*Presenter*) Nothing to Disclose
Etta D. Pisano, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) At the end of the session the attendees will understand the value of well-done radiology research with a focus on appropriate study design to inform clinical practice. Radiology plays a critically important role in the diagnosis, management and treatment of nearly every medical disease. Radiologists have been involved in some of the most exciting, transformative and innovative areas of medical discovery. However, the research that supports how imaging should be integrated into patient care to improve patient outcomes often falls short of the rigorous research that is used to support other areas of health care. Often a simplistic and false narrative is created that focuses on whether imaging is good or bad, without a more nuanced discussion and quantification of both the potential risks and the potential benefits that are associated with the use of a particular test that could then inform how new technologies should be used.

W5-RCP40

RSNA/ESR Symposium: The Future Strategy for Stroke Thrombectomy

Participants

Jean-Pierre Pruvo, MD, PhD, Lille, France (*Presenter*) Nothing to Disclose
Raman Uberoi, MBChB, FRCR, Oxford, United Kingdom (*Presenter*) Nothing to Disclose
Achala Vagal, MD, Cincinnati, Ohio (*Presenter*) Departmental Research Grant, Johnson & Johnson
Hans Van Overhagen, MD, Den Haag, Netherlands (*Presenter*) Nothing to Disclose
Mahesh V. Jayaraman, MD, Providence, Rhode Island (*Presenter*) Nothing to Disclose
Klaus A. Hausegger, MD, Klagenfurt, Austria (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn about the subgroups that were not studied in the recent stroke trials. 2)To understand the global organisation of stroke interventionists and neurologists. 3)To appreciate the evolution in stroke thrombectomy technology. This session will discuss the future of thrombectomy addressing workforce, innovations and future areas of research.

Printed on: 07/01/22

S3-CRO04

Musculoskeletal - Case-based Multidisciplinary Review

Participants
Edward Y. Kim, MD, Seattle, Washington (*Presenter*) Nothing to Disclose
F. Joseph Simeone, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Kevin Raskin, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Seth Pollack, MD, Chicago, Illinois (*Presenter*) Consultant, Bayer AG;Consultant, Deciphera Pharmaceuticals, LLC;Consultant, Apexigen, Inc;Consultant, T-Knife, GmbH;Consultant, Aadi Bioscience, Inc;Consultant, Epizyme, Inc;Consultant, Obsidian

LEARNING OBJECTIVES

1. Identify ways to incorporate imaging data into the management of soft tissue and bone sarcomas. 2. Explain optimal management strategies for rare soft tissue tumors. This multidisciplinary panel will discuss a series of challenging soft tissue and bone sarcoma cases. The session will highlight the importance of imaging in the diagnosis and treatment of these rare tumors. Panelists will include radiology, orthopedic oncology, medical oncology, and radiation oncology.

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Abstract Archives of the RSNA, 2021

Mentored Cardiac CT Angiography Case Review: Part I

Participants

Jill Jacobs, MD, New York, New York (*Presenter*) Nothing to Disclose
Karen Ordovas, MD, Seattle, Washington (*Presenter*) Nothing to Disclose
Carole A. Ridge, MD, London, United Kingdom (*Presenter*) Nothing to Disclose
Diana Litmanovich, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Linda B. Haramati, MD, MS, New Rochelle, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

R6-CGI12

Advanced Techniques for Abdominal Imaging

Participants

Meghan G. Lubner, MD, Madison, Wisconsin (*Presenter*) Grant, Koninklijke Philips NV;Grant, Johnson & Johnson

Andrew Smith, MD, PhD, Birmingham, Alabama (*Presenter*) CEO, AI Metrics LLC ;Owner, AI Metrics LLC ;CEO, Radiostics LLC;Owner, Radiostics LLC;Research Grant, General Electric Company;Speaker, General Electric Company;Speaker, Canon Medical Systems Corporation;Speaker, AlgoMedica, Inc

Perry J. Pickhardt, MD, Madison, Wisconsin (*Presenter*) Advisor, Bracco Group;Advisor, Zebra Medical Vision Ltd;Advisor, Nano X Imaging;

Ajit H. Goenka, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

Vikas Gulani, MD, PhD, Ann Arbor, Michigan (*Presenter*) Research support, Siemens AG;License agreement, Siemens AG;Spouse, License agreement, Siemens AG

LEARNING OBJECTIVES

1) Identify current quantitative CT and MRI applications in abdominal radiology.2) Discuss current uses of PET MRI in abdominal radiology.3) Explain how AI applications for body composition analysis can be used for opportunistic screening of high-risk conditions on a population level. 4) Review applications of artificial intelligence in evaluation and reporting of advanced GI/GU malignancies. As the practice of abdominal radiology advances, new quantitative approaches are becoming mainstream, and artificial intelligence (AI) applications are on the horizon, with some entering clinical practice. This lecture series will review abdominal radiology applications of quantitative CT and MRI, advanced applications of PET/MRI, and the use of artificial intelligence in body composition analysis and advanced GI/GU malignancies. We will review quantitative CT and MRI applications for staging liver fibrosis, measurement of liver fat, and radiomics analysis of GI/GU tumors. Advanced PET MRI topics will include current oncologic applications such as neuroendocrine, hepatic, colorectal, and GU tumors. The application of AI for quantitative body composition analysis allows for opportunistic screening of high-risk profiles and conditions on a population level, outperforming previously established clinical reference standards. Learn how these techniques can be used in multi-institutional studies and clinical practice. Finally, learn how AI can be applied to advanced GI/GU malignances to improve reporting accuracy, efficiency, and standardization. Can these AI applications be adapted to LI-RADS, PI-RADS and other difficult workflows?

Abstract Archives of the RSNA, 2021

R5-RCP20

Artificial Intelligence in Radiology: Managing Professionalism Challenges (Sponsored by RSNA Professionalism Committee)

Participants
Zi Zhang, MD, Fort Washington, Pennsylvania (*Presenter*) Nothing to Disclose
Kate Hanneman, MD, FRCPC, Toronto, Ontario (*Presenter*) Speaker, sanofi-aventis Group;Speaker, Amicus Therapeutics, Inc
Tessa S. Cook, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Grant, Siemens AG (ended)Grant, Independence Blue CrossGrant, RSNAGrant, ACR (ended)Grant, NIH MIDRCHonorarium, BJR (Ed board)Honorarium, Sectra (webinar speaker)
Ryan K. Lee, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Rebecca Bromwich, PhD, Ottawa, Ontario (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe key concepts regarding ethical use of data, Algorithms and their clinical application to promote well being and minimize harm; 2) Discuss privacy issues related to AI in radiology, including informed consent and potential safeguards; 3) Examine legal responsibility related to the development and application of AI in Radiology and different liability models for different settings and forms of AI; 4) Assess bias in AI from clinically confounding attributes to technical factors and describe how to minimize the bias from training data to over time use in clinical practice; 5) Discuss the development of interpretable AI Systems for clinical radiology and the elements of decision-making behind classification decisions. Artificial intelligence (AI) is rapidly advancing, which may reshape modern radiology practice. It has also posed many new professionalism related challenges for radiologists. The goal of this course is to discuss how to manage these new challenges related to AI, including ethics, privacy and data protection, data ownership, legal and regulatory, transparency, and bias related issues. This course includes 5 lectures. Attendees will learn how to navigate these new professionalism challenges when applying AI in Radiology.

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Abstract Archives of the RSNA, 2021

Participants
Harriet J. Paltiel, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Pia Maly Sundgren, MD, PhD, Lund, Sweden (*Presenter*) Nothing to Disclose
Edward Lee, MD, MPH, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Matthew R. Wanner, MD, Carmel, Indiana (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Identify the key imaging features of disorders of the pediatric head and neck, airway, gastrointestinal, genitourinary, and musculoskeletal systems requiring immediate clinical attention This case-based session will review must know, dont miss emergent conditions in the pediatric population. An organ system approach will cover the essential imaging features of disorders affecting the head and spine, airway, gastrointestinal and genitourinary tracts, and musculoskeletal system of children.

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Abstract Archives of the RSNA, 2021

W2-CGU04

Prostate MR/Molecular Imaging (Core-Advanced)

Participants

Aytekin Oto, MD, Chicago, Illinois (*Presenter*) Research Grant, Koninklijke Philips NVMedical Advisory Board, Profound Medical IncConsultant, IBM CorporationCo-founder; QMISCo-owner; QMIS

Thomas Hope, MD, San Francisco, California (*Presenter*) Research Grant, Koninklijke Philips NV;Research Grant, Clovis Oncology, Inc;Advisory Board, Ipsen SA;Advisory Board, Blue Earth Diagnostics Ltd;Consultant, Curium SAS;Researcher, Advanced Accelerator Applications SA;

Masoom A. Haider, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

Anwar Padhani, MD,FRCR, Northwood, United Kingdom (*Presenter*) Advisory Board, Siemens AGSpeakers Bureau, Siemens AGAdvisory Board, Lucida Medical LtdStockholder, Lucida medical Ltd

Nelly Tan, MD, Scottsdale, Arizona (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Learn about the latest updates on prostate imaging with special emphasis on MRI and PET imaging.2. Review the quality control efforts for prostate MR and explain the current and future applications of artificial intelligence on prostate imaging.3. Understand the potential roles and added value of PSMA PET and PET MR in the management of patients with prostate cancer. This session aims to provide a comprehensive update on the latest developments on prostate imaging with a special focus on MR and PET imaging. The presentations cover a well-balanced, broad scope from practical, updated tips for optimized prostate MR acquisition and interpretation to emerging techniques such as PET MRI. PSMA PET imaging and its role impacting the management of prostate cancer will be reviewed in addition to other hot topics in prostate MR including quality control efforts and artificial intelligence.

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Abstract Archives of the RSNA, 2021

S2-CMS16

Emergency Ultrasound Pitfalls and Pearls: Challenging Cases

Participants

Deborah J. Rubens, MD, Rochester, New York (*Presenter*) Nothing to Disclose
Michael R. Aquino, MD, MS, Cleveland, Ohio (*Presenter*) Co-author with royalties, Reed Elsevier
Margarita Revzin, MD, Wilton, Connecticut (*Presenter*) Nothing to Disclose
Akshya Gupta, MD, Pittsford, New York (*Presenter*) Nothing to Disclose
Luck J. Louis, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn current applications and limitations in emergency ultrasound imaging.2) Review critical physiology and pathology depicted by ultrasound, with special focus on dynamic imaging. 3) Understand the vital role of ultrasound imaging in optimum emergent patient care This case-based course will highlight ultrasounds vital role in emergent patient care emphasizing right upper and lower quadrant pain, acute musculoskeletal disease, the genitourinary/reproductive system and pediatric abdomen/pelvic presentations. Ultrasound clinical and anatomic correlation will be emphasized, including high frequency and Doppler techniques. Differential diagnoses will include infection, inflammation, neoplasm, ischemia and hemorrhage primarily focusing on diseases requiring acute intervention. Our goal is to provide a broad update in the field while addressing new opportunities and challenges for everyday practice.

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Abstract Archives of the RSNA, 2021

PET/MR Update 2021

Participants

Pamela Woodard, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Helen Nadel, MD, Menlo Park, California (*Presenter*) Consultant, ICON plc;;
Geoffrey E. Johnson, MD, New York, New York (*Presenter*) Nothing to Disclose
Alexander Drzezga, MD, Cologne, Germany (*Presenter*) Research support, Siemens AG Research support, Life Molecular ImagingResearch support, General Electric CompanyResearch support, Eli Lilly and CompanyResearch support, Eisai CompanyConsultant, Siemens AG Consultant, General Electric CompanyConsultant, Bio
Jonathan E. McConathy, MD, PhD, Birmingham, Alabama (*Presenter*) Research Consultant, Eli Lilly and Company;Research Grant, Eli Lilly and Company;Research Consultant, Blue Earth Diagnostics Ltd;Research Grant, Blue Earth Diagnostics Ltd;Research Consultant, General Electric Company;Research support, CytoSite Biopharma;Research Consultant, Canon Medical Systems Corporation;Research Consultant, ImaginAb, Inc;Spouse, Research Consultant, Baird Capital;Spouse, Research Grant, Navidea Biopharmaceuticals, Inc;Spouse, Research Grant, AbbVie Inc
Georges El Fakhri, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss advances in PET/MR technology. 2) To review clinical applications where PET/MR adds value. 3) To illustrate advances in PET/MR with images from the field. This course will provide an update on the status of PET/MR in 2021. This will be a series of lectures targeting research and clinical applications in a hot topic. We will also include clinical pearls and pitfalls as well as a discussion of advances in instrumentation.

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Abstract Archives of the RSNA, 2021

Artificial Intelligence in the Hands of Medical Imaging and Radiation Therapy Professionals Part I: The Current Status of AI in Our Practice (Sponsored by the Associated Sciences Consortium)

Participants

Susie Moseley, BS, RT, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose
Sharon Wartenbee, RT, Sioux Falls, South Dakota (*Presenter*) Nothing to Disclose
Christina Malamateniou, PhD, MA, BSC, MEd, London, United Kingdom (*Presenter*) Nothing to Disclose
Melissa Pergola, RT, Albuquerque, New Mexico (*Presenter*) Siemens Healthineers, Past Employee (left June 2021)

LEARNING OBJECTIVES

1) Discuss the development and common terminology associated with artificial intelligence (AI). 2) Differentiate AI, machine learning (ML), and automation to identify what is and what isn't AI. 3) Discuss stakeholders' opinions regarding how the implementation of AI, ML and automated features will affect clinical practice, workflows, staffing, and patient care in medical imaging and radiation therapy facilities. 4) Identify how artificial intelligence is being used in everyday activities and technologies in medical Imaging. 5) Identify ways of preparing students for a future with artificial intelligence. This is a two-part presentation titled Artificial Intelligence in the Hands of Medical Imaging and Radiation Therapy Professionals. Part I aims to identify the development and terminology of artificial intelligence (AI), machine learning (ML), and automation associated with the radiologic sciences. Additionally, current and proposed patient care practices for AI and ML will be discussed. Part II will cover practitioner trust, the role of education, future applications and effects of AI and ML in shaping the profession, and ethical responsibilities of health care facilities and employees when implementing AI and ML into everyday practice.

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Abstract Archives of the RSNA, 2021

Pediatric Lumps and Bumps: Imaging Differential Diagnosis

Participants
Ricardo Restrepo, MD, Miami, Florida (*Presenter*) Nothing to Disclose
Oscar M. Navarro, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose
Neil Lall, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

To become familiar with a basic and succinct version of the ISSVA classification of vascular anomalies and with the imaging features of most common vascular anomalies (i.e. hemangiomas and vascular malformations) To describe sonographic findings of common pediatric lumps and bumps found in the head and neck.To describe sonographic findings of common pediatric lumps and bumps found below the neck. Lumps and bumps in pediatrics are very frequently encountered in every radiology practice.Most lumps and bumps in the pediatric population are benign and the differential diagnosis changes according to the childs age.This case-based interactive session will focus on the diagnostic approach outlining the importance of clinical information and a review of the most relevant imaging findings of common and unique pediatric lumps and bumps with emphasis on the use of ultrasonography. At the end of this session, radiologists will feel confident providing a differential diagnosis, diagnosing some specific entities and recognizing those that may require further diagnostic workup.

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Abstract Archives of the RSNA, 2021

T1-CRI05

Imaging of Infertility

Participants

Shuchi K. Rodgers, MD, Cherry Hill, New Jersey (*Presenter*) Elsevier, book royalties
Darci J. Wall, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Priyanka Jha, MBBS, San Francisco, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify causes of recurrent pregnancy loss seen on imaging. 2) Explain tubal and ovarian etiologies for female infertility. 3) Describe the indications, limitations, and pitfalls of different imaging tests that evaluate female infertility. This lecture series will present new and standard imaging techniques for evaluating female infertility. The potential structural causes of recurrent pregnancy loss, including Mullerian duct anomalies, synechia, leiomyomas, and polyps, will be presented. Best practice for hysterosalpingogram (HSG) performance using oil or water-soluble contrast and hysterosalpingo-contrast sonography (HyCoSy) will be reviewed. The updated criteria for diagnosing polycystic ovarian syndrome (PCOS) will be presented. Following the session, the attendee should be knowledgeable in the imaging evaluation of female infertility.

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Abstract Archives of the RSNA, 2021

Patient Centered Care: Leveraging Informatics Tools to Engage with our Patients

Participants

Jennifer Kemp, MD, Denver, Colorado (*Presenter*) Stockholder, Scanslated Inc
Dania Daye, MD, PhD, Medford, Massachusetts (*Presenter*) Research Consultant, Sigilon Therapeutics;Research Consultant, Medtronic plc
Tessa S. Cook, MD, PhD, Philadelphia, Pennsylvania (*Presenter*) Grant, Siemens AG (ended)Grant, Independence Blue CrossGrant, RSNAGrant, ACR (ended)Grant, NIH MIDRCHonorarium, BJR (Ed board)Honorarium, Sectra (webinar speaker)
Melissa Chen, MD, Houston, Texas (*Presenter*) Nothing to Disclose
Arun Krishnaraj, MD, MPH, Charlottesville, Virginia (*Presenter*) Nothing to Disclose
Andrew Gunn, MD, Vestavia Hills, Alabama (*Presenter*) Consultant, Boston Scientific Corporation;Speaker, Boston Scientific Corporation;Research support, Penumbra, Inc;Speaker, Terumo Corporation;Consultant, Varian Medical Systems, Inc;;

LEARNING OBJECTIVES

1. Identify methods for radiologists to optimize patient portal usage and engagement and why this is even more important because of the 21st Century Cures Act. 2. Describe how our work product, the radiology report, can be more patient centered.3. Better understand CMS Quality Payment Program and reimbursements for patient centric care through quality metrics and improvement activities. This course is designed to help radiologists better understand how patient centric radiology and informatics can be synergistic despite their seemingly opposite foundations. Radiologists will be given tools and ideas to implement and integrate informatics in ways to improve the patient experience.

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Abstract Archives of the RSNA, 2021

M4-CHN02

Read Like the Experts: Hands-on Staging of Head and Neck Cancer

Participants
Amy Juliano, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Richard H. Wiggins III, MD, Salt Lake City, Utah (*Presenter*) Nothing to Disclose
Philip Chapman, MD, Durham, North Carolina (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand imaging anatomy of the nasopharynx, oropharynx, and larynx.2) Identify pertinent features of squamous cell carcinoma in these areas for diagnosis and staging. This session will provide a hands on experience to learn from the experts on head and neck cancer staging in the Nasopharynx, Oropharynx and Larynx. The session is geared towards those who interpret head and neck cancer imaging and would like a refresher on controversies and pitfalls related to this topic. The flipped classroom format will allow for an engaging learning experience.

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Abstract Archives of the RSNA, 2021

Deep Learning Lab: NLP: Text Classification with RNNs & Transformers

Participants
Kirti Magudia, MD,PhD, Durham, North Carolina (*Presenter*) Nothing to Disclose
Walter Wiggins, MD, PhD, Durham, North Carolina (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

(1) Understand the basic steps required to prepare data for information extraction with natural language processing (NLP) tools. (2) Define the basic terminology of NLP for text analysis (e.g. preprocessing, parsing, tokenization). (3) Train an NLP model to classify chest radiograph reports as 'positive' or 'negative' for abnormal findings. This course will provide participants with the opportunity to learn the basic principles of information extraction from radiology reports by working through a step-by-step example using radiology reports from a chest radiograph data set. Learners will train a model to classify radiology reports as positive or negative for opacity. This session will cover basics of text analysis and concepts such as report parsing and preprocessing of text for NLP. No prior coding or machine learning experience is necessary.

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Abstract Archives of the RSNA, 2021

S1-CPH14

Making Patients and Staff Safer in Interventional Procedures

Participants

A. Kyle Jones, PhD, Houston, Texas (*Presenter*) Nothing to Disclose
Stephen Balter, PhD, New York, New York (*Presenter*) Speakers Bureau, MAVIG, GmbHConsultant, ControlRad Systems, Inc
David Borrego, PHD, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Identify risks to patients and staff from fluoroscopically-guided interventions.2. Where possible, quantify the relative magnitudes of these risks.3. Formulate strategies for managing identified risks. This course will review risks, including radiation-related risks and other risks, to patients undergoing and staff participating in fluoroscopically-guided interventional procedures. Perspective on the magnitude of these risks will be provided, and strategies for managing risk will be discussed. Understanding risks and their magnitude is important for data-driven clinical decision-making, informed consent, and optimization of patient and staff protection.

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Abstract Archives of the RSNA, 2021

R5-CVA08

Imaging of the Pulmonary Arteries: Spectrum of Imaging Findings

Participants

Hamid R. Mojibian, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose
Fernando R. Gutierrez, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Shaunagh McDermott, FFR(RCSI), Boston, Massachusetts (*Presenter*) Nothing to Disclose
Katherine Kaproth-Joslin, MD, PhD, Rochester, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Empty Abstract

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Abstract Archives of the RSNA, 2021

M1-CNR03

Imaging Gliomas: The Good, Bad and Ugly

Participants

Rajan Jain, MD, New York, New York (*Presenter*) Nothing to Disclose
Marion Smits, MD, PhD, Rotterdam, Netherlands (*Presenter*) Speaker, General Electric Company
Ramon Barajas JR, MD, Portland, Oregon (*Presenter*) Nothing to Disclose
Gloria C. Chiang, MD, New York, New York (*Presenter*) Advisory Board, Biogen Idec IncConsultant, Life Molecular ImagingHonorarium, Horizon CME

LEARNING OBJECTIVES

1) Explain the current landscape of glioma imaging and its correlation with tumor genomics. 2) Identify learning strategies to image gliomas post-therapy. Practical issues related to glioma imaging will be discussed in detail.

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Abstract Archives of the RSNA, 2021

Deep Learning in CT Imaging

Participants
Lifeng Yu, PhD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Guang-Hong Chen, PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose
Marc Kachelriess, PhD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

(1) Describe deep learning applications in CT image formation process, including image reconstruction and artifact reduction.(2) Explain current clinical implementations of deep learning methods on CT scanners and how to evaluate these methods. This course will provide an overview of deep learning applications in CT image formation, including image reconstruction and artifact correction. It will also summarize current clinical implementations of deep learning methods on CT scanners and describe how to appropriately evaluate these methods. Potential pitfalls of deep learning methods in CT image formation will be described. There are three lectures in this course:(1) Deep learning in CT reconstruction(2) Deep learning in CT artifact correction(3) Clinical implementation and evaluation

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M2-CNR04

Essentials in Trauma Imaging: Shedding Light on the Dark Side of Neuroradiology

Participants

Tabassum A. Kennedy, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose
Max Wintermark, MD, San Carlos, California (*Presenter*) Consultant, Magnetic Insight, Inc;Consultant, icoMetrix NV;Consultant, Subtle Medical, Inc;Consultant, NOUS Imaging, Inc;Consultant, EMTensor Imaging
Nadja Kadom, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Kathryn Dean, MD, Brooklyn, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. To review the role of neuroradiology and neuroradiologists for emergent neurological conditions.2. To review the imaging modalities available to evaluate emergent neurological conditions.3. To discuss key neuroimaging findings that can be encountered in the emergency setting This course will review the role of neuroradiology and neuroradiologists in the evaluation of emergent neurological conditions. We discuss discuss which imaging modalities are relevant and how they can be used in practice. We will review neuroimaging findings that can be encountered frequently in the emergency setting.

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Abstract Archives of the RSNA, 2021

S1-CGI01

Jeopardy: GI/GU Cases

Participants
John R. Leyendecker, MD, Dallas, Texas (*Presenter*) Nothing to Disclose
Cooky Menias, MD, Phoenix, Arizona (*Presenter*) Royalties, RELX
Frank H. Miller, MD, Chicago, Illinois (*Presenter*) Advisory Board, Bayer AGAdvisory Board, Guerbet
Lejla Aganovic, MD, La Jolla, California (*Presenter*) Nothing to Disclose
Steven C. Eberhardt, MD, Albuquerque, New Mexico (*Presenter*) Nothing to Disclose
Olga R. Brook, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Silvia D. Chang, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose
David Disantis, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Be familiar with the clinical manifestations and/or imaging appearance of uncommon and/or challenging disease entities in the abdomen and pelvis. Rare and challenging abdominal and pelvic disease entities will be presented to a panel of imaging experts as unknown cases using a game format.

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W1-CGI08

Hot Topic: Imaging Biomarkers in Non-alcoholic Fatty Liver Disease

Participants

Bachir Taouli, MD, New York, New York (*Presenter*) Research Grant, Bayer AG;Research Grant, Takeda Pharmaceutical Company Limited;Research Grant, Regeneron Pharmaceuticals, Inc;;

Scott Reeder, MD,PhD, Madison, Wisconsin (*Presenter*) Dr. Reeder has no relevant conflicts. Unrelated to this presentation, Dr. Reeder has ownership interests in Calimetrix, Reveal Pharmaceuticals, Cellectar Biosciences, Elucent Medical, and HeartVista, and the University of Wisconsin receives research supp

Paul S. Sidhu, MRCP, FRCR, London, United Kingdom (*Presenter*) Consultant, Samsung Electronics Co, LtdSpeaker, Samsung Electronics Co, LtdSpeaker, Bracco GroupConsultant, Itreas LtdSpeaker, Siemens AG

Claude Sirlin, MD, San Diego, California (*Presenter*) Research Grant, General Electric Company;Research Grant, Siemens AG;Research Grant, Bayer AG;Research Grant, Gilead Sciences, Inc;Research collaboration, Gilead Sciences, Inc;Research Grant, Koninklijke Philips NV;Research Grant, Pfizer Inc;Consultant, Pfizer Inc;Consultant, Blade Therapeutics, Inc;Consultant, Boehringer Ingelheim GmbH;Consultant, Epigenomics AG;Consultant, IBM Corporation;Consultant, AMRA AB;Consultant, Bristol-Myers Squibb Company;Consultant, Exact Sciences Corporation;Research collaboration, Enanta Pharmaceuticals, Inc;Research collaboration, ICON plc;Research collaboration, Intercept Pharmaceuticals, Inc;Research collaboration, NuSirt Biopharma, Inc;Research collaboration, Shire plc;Research collaboration, Takeda Pharmaceutical Company Limited;Research collaboration, Alexion Pharmaceuticals, Inc;Royalties, Wolters Kluwer nv;Speaker, Medscape, LLC;Stock options, Livivos, Inc;Advisor, Quantix Bio LLC

Octavia Bane, PhD, New York, New York (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the current status of current clinical/pathological diagnosis, prognosis and new trials landscape in NAFLD/NASH, 2) Review the diagnostic performance of non invasive tests for diagnosis of NAFLD/NASH. NAFLAD and NASH are becoming dominant liver diseases in the US and several countries. It is important for the radiologist to be familiar with the clinico-pathological diagnosis and current landscape of therapies in this disease. In this course, we will also review the current noninvasive imaging tests, including ultrasound and MR elastography and MR relaxometry.

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S3-CGI02

LIRADS

Participants

Jeong Min Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Victoria Chernyak, MD,MS, Bronx, New York (*Presenter*) Consultant, Bayer AG
David Fetzer, MD, Dallas, Texas (*Presenter*) Research support, Koninklijke Philips NVResearch support, Siemens AGResearch support, GE HealthcareConsultant/Advisory Board, Philips HealthcareConsultant/Advisory Board, GE Healthcare
Claude Sirlin, MD, San Diego, California (*Presenter*) Research Grant, General Electric Company;Research Grant, Siemens AG;Research Grant, Bayer AG;Research Grant, Gilead Sciences, Inc;Research collaboration, Gilead Sciences, Inc;Research Grant, Koninklijke Philips NV;Research Grant, Pfizer Inc;Consultant, Pfizer Inc;Consultant, Blade Therapeutics, Inc;Consultant, Boehringer Ingelheim GmbH;Consultant, Epigenomics AG;Consultant, IBM Corporation;Consultant, AMRA AB;Consultant, Bristol-Myers Squibb Company;Consultant, Exact Sciences Corporation;Research collaboration, Enanta Pharmaceuticals, Inc;Research collaboration, ICON plc;Research collaboration, Intercept Pharmaceuticals, Inc;Research collaboration, NuSirt Biopharma, Inc;Research collaboration, Shire plc;Research collaboration, Takeda Pharmaceutical Company Limited;Research collaboration, Alexion Pharmaceuticals, Inc;Royalties, Wolters Kluwer nv;Speaker, Medscape, LLC;Stock options, Livivos, Inc;Advisor, Quantix Bio LLC

LEARNING OBJECTIVES

1) Explain the development of a standardized lexicon for liver imaging, and the advantages of its use in scientific publications and clinical practice. 2) Overview the latest scientific evidence supporting use of LI-RADS CEUS and CT/MRI Diagnostic Algorithms. 3) Explain nuances of LI-RADS Treatment Response Algorithm application when using different modalities and contrast agents. This education session covers high-yield concepts in Liver Imaging Reporting and Data System (LI-RADS). The engaging and informative course, taught by internationally renowned experts in liver imaging, consists of didactic lectures that discuss diagnostic and treatment response LI-RADS algorithms, and the standardized lexicon for liver imaging. The course offers learning opportunities for both novice and experienced LI-RADS users, as the faculty will highlight practical tips along with the overview of the latest scientific evidence, current challenges and future directions for all LI-RADS algorithms. The attendees will be introduced to the concept of a unified liver imaging lexicon, and the many advantages its adoption in scientific literature and clinical practice offers. The attendees are encouraged to bring questions and challenge the faculty.

Abstract Archives of the RSNA, 2021

S4-CMS04

Molecular Imaging for the General Radiologist

Participants

Corina Millo, MD, Bethesda, Maryland (*Presenter*) Nothing to Disclose
Justin B. Sims, MD, Indianapolis, Indiana (*Presenter*) Research Grant, Siemens AG
Geoffrey Johnson, MD,PhD, Rochester, Minnesota (*Presenter*) Research Grant, Novartis AG;Research Grant, Pfizer Inc;Research Grant, Bayer AG;Research Grant, MedTrace Pharma AS;Research Grant, Viewpoint Medical Ltd;Research Grant, Clarity Medical Systems, Inc
Andrei Iagaru, MD, Stanford, California (*Presenter*) Research Grant, General Electric Company;Research Grant, Lantheus Holdings;Research Grant, Novartis AG
Olga G. James, MD, Chapel Hill, North Carolina (*Presenter*) Nothing to Disclose
Samuel Almodovar-Reteguis, MD, Orlando, Florida (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Review the physiologic biodistribution of F-18 FDG, patient preparation, pearls and pitfalls in FDG PET/CT imagingEvaluate the role of FDG PET/CT in thoracic imagingEvaluate the role of FDG PET/CT in head and neck, abdomen, and pelvic tumorsReview the role of FDG PET/CT in pediatric imagingLearn the basics of F-18 or Ga-68 labeled PSMA in prostate cancer .

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Participants

Mari Hagiwara, MD, Brooklyn, New York (*Presenter*) Nothing to Disclose
Luke Ledbetter, MD, Los Angeles, California (*Presenter*) Royalties, Reed Elsevier
Michael Iv, MD, Palo Alto, California (*Presenter*) Consultant, Octave Bioscience, Inc
Jack Jennings, MD, Saint Louis, Missouri (*Presenter*) Consultant, Stryker Corporation;Consultant, Boston Scientific
Corporation;Consultant, Becton, Dickinson and Company;Consultant, Teleflex Incorporated;Consultant, Varian Medical Systems, Inc

LEARNING OBJECTIVES

Identify imaging and clinical features that help distinguish tumor from tumor mimics in the neck, skull base, brain and spine. A wide variety of lesions can mimic neoplasms. Recognizing these mimics on imaging can help avoid misdiagnosis, unneccessary patient anxiety and invasive diagnostic procedures. This case based review will cover imaging and clinical features that can help distinguish tumor from tumor mimics in the neck, skull base, brain and spine.

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Abstract Archives of the RSNA, 2021

Unprofessionalism in the Workplace

Participants
Jessica Robbins, MD, Madison, Wisconsin (*Presenter*) Nothing to Disclose
Kristin Porter, MD,PhD, Birmingham, Alabama (*Presenter*) Stockholder, Pfizer Inc;Medical Advisory Board, Bracco Group
Vikas Gulani, MD, PhD, Ann Arbor, Michigan (*Presenter*) Research support, Siemens AG;License agreement, Siemens AG;Spouse, License agreement, Siemens AG
Ann K. Jay, MD, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify strategies to recognize and mitigate unprofessional and disruptive behavior in the workplace. Unprofessional and disruptive behavior in the radiology workplace can be on the spectrum of overt to insidious. In this course, we will explore microaggressions, sexual harassment, professionalism transgressions, and disruptive behaviors due to mental illness. We will discuss how these behaviors may manifest themselves and provide examples of mitigation strategies.

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M3-CIN08

The AI Revolution: Recent Advancements in Computer Vision and Natural Language Processing in Medical Imaging

Participants

Paras Lakhani, MD, Media, Pennsylvania (*Presenter*) Nothing to Disclose
Walter Wiggins, MD, PhD, Durham, North Carolina (*Presenter*) Nothing to Disclose
Sharmila Majumdar, PhD, San Francisco, California (*Presenter*) Research Grant, General Electric Healthcare;Research Grant, Biosplice Therapeutics, Inc;Research Grant, Siemens AG
Jayashree Kalpathy-Cramer, MS, PhD, Charlestown, Massachusetts (*Presenter*) Institutional Research Grant, General Electric Company;Institutional Research Grant, F. Hoffmann-La Roche Ltd

LEARNING OBJECTIVES

1)Review recent advacements in computer vision specific to radiology. 2)Review recent advacements in natural language processing. 3)Understand how machine learning and artificial intelligence can add value to radiology with case examples. This lecture-style refresher course will cover recent advancements in AI in both computer vision as well as natural language processing in medical imaging. Topics will include important applications and use-cases of AI in medical imaging, current state-of-the-art, pearls and pitfalls, challenges of AI implementation, and future directions.

Printed on: 07/01/22

Abstract Archives of the RSNA, 2021

S2-CGU01

Intravenous Contrast Media

Participants

Carolyn L. Wang, MD, Mercer Island, Washington (*Presenter*) Research Grant, General Electric Company
Matthew Davenport, MD, Ann Arbor, Michigan (*Presenter*) Royalties, Wolters Kluwer nv
Robert McDonald, MD,PhD, Rochester, Minnesota (*Presenter*) Consultant, General Electric Company;Research Grant, General Electric Company;Consultant, Bracco Group
Jennifer Mcdonald, PhD, Rochester, Minnesota (*Presenter*) Research Grant, General Electric CompanyScientific Advisor, General Electric CompanyConsultant, General Electric Company

LEARNING OBJECTIVES

1. Learn the ACR-NKF consensus statements for iodinated contrast media2. Learn the ACR-NKF consensus statements for gadolinium-based contrast media3. Learn the clinical importance of gadolinium retention4. Learn how to safely image an atopic patient. Participants will learn modern recommendations for the safe use of intravenous contrast media. Topics include: imaging patients with kidney disease (ACR-NKF recommendations), gadolinium retention, and imaging the atopic patient.

W6-CBR09

Staging for Metastatic Disease in Breast Cancer

Participants

Maxine S. Jochelson, MD, New York, New York (*Presenter*) Speaker, General Electric Company

Lale Umutlu, MD, Essen, Germany (*Presenter*) Consultant, Bayer AG;Speaker, Siemens AG;Research funded, Siemens AG

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

W1-CIR04

Novel Technologies

Participants

Rony Avritscher, MD, Houston, Texas (*Presenter*) Speakers Bureau, Boston Scientific Corporation;Research Consultant, Siemens AG
Sarah White, MD, Milwaukee, Wisconsin (*Presenter*) Consultant, Cook Group IncorporatedConsultant, Guerbet SAResearch support, Guerbet SAConsultant, DB Medical Supplies, IncConsultant, Sirtex Medical LtdResearch support, InSightec LtdSpeakers Bureau, Penumbra, Inc
S. Nahum Goldberg, MD, Efrat, Israel (*Presenter*) Consultant, Cosman Medical, Inc;Consultant, Sarasota Interventional Radiology
Bruno Odisio, MD, Houston, Texas (*Presenter*) Research Grant, Siemens AG;Consultant, Siemens AG;Speaker, Siemens AG;Research Grant, Johnson & Johnson;
Lynne Martin, MD, Stanford, California (*Presenter*) Nothing to Disclose
Reto J. Bale, MD, Innsbruck, Austria (*Presenter*) Research Consultant, Medtronic plc;Research Consultant, CAScination AG;Speaker, Siemens AG

LEARNING OBJECTIVES

1)Describe the latest breakthroughs in agents and devices for image-guided therapies. 2)Understand the use of artificial intelligence and planning software to improve treatment outcomes. 3)Describe the potential outlook for advanced imaging and robotics in the field of interventional radiology The course will review the most recent technological breakthroughs in interventional radiology. The lectures will span advances in hybrid imaging, therapeutic agents and devices, robotics, artificial intelligence and practical uses of ablation software. Participants will be familiarized with the cutting-edge techniques in IR.

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Abstract Archives of the RSNA, 2021

Getting the Biggest Bang for the Buck in Screening: Risk-Stratification

Participants

Kathryn Lowry, MD, Seattle, Washington (*Presenter*) Research Grant, General Electric Company
Courtney Moreno, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
David F. Yankelevitz, MD, New York, New York (*Presenter*) Consultant, Accumetra LLC;Stockholder, Accumetra LLC;Medical Advisory Board, Carestream Health, Inc;Royalties, General Electric Company;Consultant, AstraZeneca PLC;Consultant, Pfizer Inc

LEARNING OBJECTIVES

Discuss current approaches and future directions for the role of imaging in risk-based cancer screening Imaging plays a central role in early cancer detection and mortality reduction. While the benefits of cancer screening are well-known, approaches to cancer screening continue to evolve due to advances in technology and cancer risk prediction. In this didactic session, current and future directions for risk-based cancer screening will be discussed, using examples from breast, lung, and colorectal cancer screening.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

W2-CCA07

Efficient and Focused Cardiac MRI

Participants

Christopher Francois, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose
Tim Leiner, MD, PhD, Rochester, Minnesota (*Presenter*) Speakers Bureau, Koninklijke Philips
James Carr, MD, Chicago, Illinois (*Presenter*) Institutional Research Grant, Siemens AG;Advisory Board, Siemens AG;Travel support, Siemens AG;Institutional Research Grant, Bayer AG;Advisory Board, Bayer AG;Travel support, Bayer AG;Speaker, Bayer AG;Institutional Research Grant, Guerbet SA;Advisory Board, Bracco Group

LEARNING OBJECTIVES

1.) Identify methods for optimizing clinical cardiac MR scan parameters to accelerate image acquisition. 2.) Summarize strategies for standardizing CMR protocols across a large imaging enterprise. 3.) Describe the use of advanced cardiac MR techniques to assess blood flow. This course will cover various aspects performing cardiac MRI using rapid techniques and focused protocols. Specifically, course content will include how accelerated image acquisition methods can lead to cardiac MRI studies being performed in 20 minutes, or less, and enable comprehensive evaluation of blood flow. In addition, the course will explore how using standardized protocols across an imaging enterprise leads to improvements in scanning and interpretation efficiency.

Printed on: 06/28/22

T4-CMS12

Non-traumatic Emergency Thoracic CT Angiography

Participants
Diana Litmanovich, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Stephen Ledbetter, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Rawan Abu Mughli, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand common and differentiating features among the acute aortic syndromes. 2) Review the diagnostic criteria for acute pulmonary embolism and right ventricular dysfunction. 3) Consider the causes and imaging features of non thrombogenic pulmonary embolism. 4) Review common cardiac and coronary causes of acute chest pain in the ED. 5) Review the modern approach to non-invasive cardiac/coronary imaging in the ED. The series of lectures in this session will review the most common use cases for thoracic CT angiography in the non-traumatic setting. Speakers will specifically address acute aortic syndromes, pulmonary embolus, and acute coronary syndrome. Attendees can expect to strengthen their skills in the interpretation of thoracic CT angiography in the setting of non-traumatic chest pain.

Printed on: 06/28/22

T6-CNR05

Molecular Imaging of the Brain: Ready for Clinical Use? (Supported in Part by an Unrestricted Educational Grant from GE Healthcare)

Participants

Jody L. Tanabe, MD, Aurora, Colorado (*Presenter*) Nothing to Disclose
Michael M. Zeineh, MD,PhD, Stanford, California (*Presenter*) Research funded, General Electric Company;Consultant, Biogen Idec Inc;
Tammie Benzinger, MD, PhD, Saint Louis, Missouri (*Presenter*) Research Grant, Eli Lilly and Company;Investigator, Eli Lilly and Company;Investigator, F. Hoffmann-La Roche Ltd;Consultant, Siemens AG;Consultant, ADM Diagnostics, LLC;Speakers Bureau, Biogen Idec Inc;Advisory Board, Biogen Idec Inc;Speakers Bureau, Eisai Co, Ltd;Advisory Board, Eisai Co, Ltd
Javier Villanueva-Meyer, MD, San Francisco, California (*Presenter*) Research Grant, General Electric Company

LEARNING OBJECTIVES

1. Understand indication and pitfalls of amyloid and tau imaging in patients with dementia
2. Understand mechanism and indications for PET tracers used in neurooncology-
3. Understand health economics of NeuroPET in clinical use. Dementia is a growing public health problem and the need for reliable biomarkers is of paramount importance. In this course, the role of amyloid and tau PET imaging biomarkers in the workup of dementias and treatment-related imaging findings will be discussed. Molecular imaging plays an important complementary role to MRI in neuro-oncology and an understanding of the underlying pathogenic mechanisms is needed for optimal interpretation. Neuro PET has the potential to improve diagnosis and inform therapy and prognosis, but if it is to become a clinical tool, it will be necessary to demonstrate its value. The session will conclude with a discussion of cost effectiveness of the technology.

Abstract Archives of the RSNA, 2021

W5-CCA09

State of the Art Coronary CT

Participants
Michelle Williams, MBCHB, BSC, Kelso, United Kingdom (*Presenter*) Speaker bureau for Canon Medical Systems and Siemens Healthineers.
Kristopher W. Cummings, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose
Jonathan Weir-McCall, MBBCh, FRCR, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Explain at least two benefits of the addition of FFRCT to routine coronary CTA in the evaluation of stable chest pain.Understand how to perform qualitative assessment of atherosclerotic plaque and its future utility in clinical practice.Describe the techniques for epicardial fat assessment and their utility in primary and secondary prevention Coronary CT can do much more than assess the presence and size of stenoses in the coronary arteries. This course will feature three lectures covering state-of-the-art techniques that can provide information aboutthe severity of coronary artery disease and future risk ofcardiovascular events, over and above the presence of coronary artery stenoses. It will coverphysiologicalassessment using CT-based fractional flow reserve, anatomical assessment using qualitative and quantitative atherosclerotic plaque assessment and discuss the information availableoutwith the coronary arteries in the epicardial fat.

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Abstract Archives of the RSNA, 2021

W5-RCP17

Meet the Editor: How to Publish and Get Involved with the RSNA Case Collection (RCC)

Participants

Mariam Moshiri, MD, Brentwood, Tennessee (*Presenter*) Nothing to Disclose
Saeed Elojeimy, MD, PhD, Charleston, South Carolina (*Presenter*) Nothing to Disclose
Xin Wu, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Douglas Katz, MD, Mineola, New York (*Presenter*) Nothing to Disclose
Kush Desai, MD, Chicago, Illinois (*Presenter*) Speakers Bureau, Cook Group Incorporated;Consultant, Cook Group Incorporated;Consultant, Koninklijke Philips NV;Speakers Bureau, Becton, Dickinson and Company;Consultant, Becton, Dickinson and Company;Speakers Bureau, Boston Scientific Corporation;Consultant, Boston Scientific Corporation;Consultant, W. L. Gore & Associates, Inc;Speakers Bureau, Medtronic plc;Consultant, Medtronic plc;Speakers Bureau, Penumbra, Inc;Consultant, Penumbra, Inc;Consultant, Shockwave Medical, Inc;Consultant, Cardinal Health, Inc;;;;
Manickam Kumaravel, MD, FRCR, Houston, Texas (*Presenter*) Nothing to Disclose
Keyanoosh Hosseinzadeh, MD, Winston Salem, North Carolina (*Presenter*) Nothing to Disclose
Christopher Walker, MD, Fairway, Kansas (*Presenter*) Author, RELXSpeakers Bureau, Boehringer Ingelheim GmbH
Debbie Bennett, MD, Saint Louis, Missouri (*Presenter*) Speaker, Hologic, Inc;Scientific Advisory Board, Devicor Medical Products, Inc;
Ramesh S. Iyer, MD, Sammamish, Washington (*Presenter*) Nothing to Disclose
Aaron Rutman, MD, SEATTLE, Washington (*Presenter*) Nothing to Disclose
Claudio Silva, MD,MSc,MBA, Santiago, Chile (*Presenter*) Nothing to Disclose
Sarah Bastawrous, DO, Seattle, Washington (*Presenter*) Nothing to Disclose
Priya Sharma, MD, Gainesville, Florida (*Presenter*) Nothing to Disclose
Catherine Phillips, MD, Nashville, Tennessee (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Learn about the mission and objectives of the Case CollectionLearn about the editorial board structureLearn how to submit a case, how to function as a reviewer, and how to successfully publish with the Case CollectionLearn how to get involved with the Case Collection at various levels This course is designed for audiences at all levels (medical student to full faculty in radiology).The course will discuss various opportunities available for RSNA members to get involved with the Case Collection as authors, reviewers, and editorial team members.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

A Symptom-based Approach to Head and Neck Pathology

Participants

Hillary R. Kelly, MD, Boston, Massachusetts (*Presenter*) Investigator, Bayer AG;Institutional research agreement, Bayer AG
Nicholas A. Koontz, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Alok A. Bhatt, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the anatomy involved and appropriate imaging algorithms for work-up of otalgia, vocal cord paralysis, and Horner's syndrome. 2) Identify the pathologic causes of otalgia, vocal cord paralysis, and Horner's syndrome and their associated imaging findings. This symptom-based refresher course session will include three lectures. This high-yield session is geared towards those who interpret head and neck subspecialty imaging exams, and will review key anatomy and pathology of patients presenting with symptoms of otalgia, vocal cord paralysis, and Horner's syndrome.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

R2-CBR10

Minimizing Treatment in Early Breast Cancer

Participants

Lars Grimm, MD, Durham, North Carolina (*Presenter*) Advisory Board, Medscape, LLC;Advisor, Hologic, Inc
Habib Rahbar, MD, Seattle, Washington (*Presenter*) Research Grant, General Electric Company
Kenneth G. Gilhuijs, PhD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe current controversies related to overtreatment of breast cancer. 2) Define radiomics and how imaging-based assays may assist with optimization of early breast cancer treatment. 3) Describe how clinical, pathologic, and imaging signatures may be integrated to assist with treatment de-escalation. In this course comprising of three lectures, we will review current evidence surrounding breast cancer pathogenesis, controversies surrounding early breast cancer detection and treatment, and the emerging role of imaging in optimizing breast cancer treatment through de-escalation of surgery and adjuvant therapies.

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Abstract Archives of the RSNA, 2021

R4-CNPM07

Value-based Payment and Imaging: Where Are We Headed?

Participants

Geraldine McGinty, MD, MBA, New York, New York (*Presenter*) Board member and Stockholder, NextGen Healthcare (NXGN)
Richard Duszak JR, MD, Atlanta, Georgia (*Presenter*) Advisor and Shareholder, Ethos Medical, Inc
Sachin Jain, MD, Noida, India (*Presenter*) Board Member, CSI Inc;Board Member, BioFourmis;Advisory Board, Omada;Advisory Board, LRV Ventures;Clinical Board Member, VA Hospital;Stockholder, Anthem, Inc;Stockholder, Merck & Co, Inc;Stockholder, Vertex Pharmaceuticals Incorporated;Stockholder, General Electric Company;Stockholder, Safeguard Scientifics;Stockholder, Memora Health;Stockholder, Tomorrow Health;Stockholder, Exact Sciences Corporation;Editor, Forbes Contributor;Editor, Healthcare: the Journal of Delivery Science & Innovation;Editor, Harvard Medicine;Editor, American Journal of Managed Care
Vivian S. Lee, MD, PhD, Salt Lake City, Utah (*Presenter*) Employee, Verily Lifesciences LLC;Shareholder, Verily Lifesciences LLC

LEARNING OBJECTIVES

1. Understand current value based payments for imaging2. Identify opportunities for payments and other incentives to drive value in imaging3. Identify barriers to change for value based payments for imaging This session will bring together national thought leaders in a panel session to discuss the current state of value based payments for imaging and future directions that will support goals around access and health equity as well as driving innovation and discovery. Moderators Drs, Rich Duszak and Geraldine McGinty will be joined by Dr. Sachin Jain, CEO of SCAN health plan and a hospitalist as well as Dr. Vivian Lee, a neuroradiologist by training, former health system Dean and CEO and now President of of Health Platforms at Verily Life Sciences, an Alphabet company.

Printed on: 06/28/22

T5-CGI06

Focused/Fast Abdomino-Pelvic MRI Protocols

Participants
Ivan Pedrosa, MD, Dallas, Texas (*Presenter*) Scientific Advisor, Health Tech International;Scientific Advisor, Merck & Co, Inc
Hersh Chandarana, MD, Scarsdale, New York (*Presenter*) As part of institutional Master Research Agreement:Equipment support, Siemens AGSoftware support, Siemens AG
Richard J. Bruce, MD, Madison, Wisconsin (*Presenter*) Shareholder, ImageMover
Kathryn Fowler, MD, San Diego, California (*Presenter*) Consultant, Bayer AG;Research support, General Electric Company;Research Grant, Pfizer Inc;Institutional Grant, MEDIAN Technologies;Consultant, General Electric Company
Jonathan Mezrich, MD, Guilford, Connecticut (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify opportunities to leverage information in the electronic medical record to facilitate protocoling and scheduling of abbreviated MRI exams2) Explain technical developments that enable fast acquisitions and opportunities to maximize efficiency in the reporting of abbreviated MRI exams3) Recognize the importance of engaging referring physicians and the financial and medico-legal implications of abbreviated MRI exams Indications for fast/focused MRI in abdomino-pelvic conditions continue to increase. We will review challenges and opportunities to maximize the efficiency in the implementation of such protocols in a busy clinical practice.

Printed on: 06/28/22

W6-CMK10

Battle of the Titans!: Contrasting Views from Extreme Experts

Participants

William Morrison, MD, Philadelphia, Pennsylvania (*Presenter*) Co-founder, Trace Orthopedics;Patent agreement, Trace Orthopedics;Consultant, AprioMed AB;Patent agreement, AprioMed AB;Consultant, Zimmer Biomet Holdings, Inc;Consultant, Medical Metrics, Inc
Hollis G. Potter, MD, New York, New York (*Presenter*) Research support, General Electric Company;Institutional research agreement, General Electric Company;Stockholder, Imagen Technologies Inc;Consultant, Stryker Corporation
Jacob Mandell, MD, Waltham, Massachusetts (*Presenter*) Royalties, Cambridge University Press
Kenneth Lee, MD, Madison, Wisconsin (*Presenter*) Grant: NFLResearch support, Supersonic ImagineRoyalties, Reed Elsevier
David A. Rubin, MD, Saint Louis, Missouri (*Presenter*) Scientific Advisory Board, ImageBiopsy Lab
Adam Zoga, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify controversies in musculoskeletal imaging. 2) Learn expert opinion regarding hot topics and controversies in MSK radiology In this session, an expert Musculoskeletal Radiologist panel will discuss and debate hot topics and controversies in the field. The session will be a combination of science, expert opinion, and humor. The audience can get involved.

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Abstract Archives of the RSNA, 2021

Data Curation for AI with Proper Medical Imaging Physics Context

Participants
Nicholas Bevins, PhD, Detroit, Michigan (*Presenter*) Nothing to Disclose
Zhihua Qi, PhD, Detroit, Michigan (*Presenter*) Nothing to Disclose
Ran Zhang, PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

(1) The fundamentals of data management in radiology; (2): Common methods for preparing clinical data for AI, including collection, anonymization, preprocessing, and others; and (3) Awareness of dataset bias in training deep neural network models and understanding how it affects a models generalizability. Medical physicists play unique roles in the trend of increasing AI utilization in the field of radiology. High-quality clinical datasets are of critical importance to the performance of AI models in clinical contexts. Neural network models are prone to spurious correlations in training data, or dataset bias, which leads to poor generalization performance. Using COVID-19 detection from chest radiographs as an example, this session will discuss the preparation and use of using well-curated datasets for both model training and testing.

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Abstract Archives of the RSNA, 2021

3D Printing: Clinical Applications (Sponsored by the RSNA 3D Printing Special Interest Group)

Participants

Adnan Sheikh, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, Minnesota (*Presenter*) Consultant, Medtronic plc;Speaker, Medtronic plc;Consultant, Merit Medical Systems, Inc;Speaker, Merit Medical Systems, Inc;Consultant, Landauer Inc;Speaker, Johnson & Johnson
Lumarie Santiago, MD, Houston, Texas (*Presenter*) Nothing to Disclose
David Ballard, MD, Saint Louis, Missouri (*Presenter*) Nothing to Disclose
Justin Ryan, PhD, San Diego, California (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Understand the preferred source imaging exam for 3D printing in breast diseases. 2. Appreciate the importance of multi-modality correlation during the segmentation process as a means to identify possible limitations in segmentation accuracy. 3. Recognize the impact of the intended use of 3D printed breast models in their design and post processing.4. Summarize current and emerging abdominal applications in 3D printing Review literature and consensus use recommendations for abdominal clinical applications of 3D printing. We shall review the workflow for 3D printing of breast diseases and review the preferred source imaging exam for 3D printed breast models. We will demonstrate how to use multi-modality correlation between breast MRI, mammography and other breast imaging studies to ensure accuracy of segmentation. We will address possible sources of error during the segmentation process and how to address them. We shall discuss how the intended use impacts model design including the anatomy to be included, planes of articulation, print ratio, post processing and material selection. The integration of temporal data in the creation of a 4D breast model will also be discussed.

Printed on: 06/28/22

W4-RCP19

Engaging the Mid-career Radiologist: Challenges, Retention and Opportunities (Sponsored by the RSNA Professionalism Committee)

Participants
Kate Hanneman, MD, FRCPC, Toronto, Ontario (*Presenter*) Speaker, sanofi-aventis Group;Speaker, Amicus Therapeutics, Inc
Brandon Brown, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Tara Catanzano, MD, Springfield, Massachusetts (*Presenter*) Nothing to Disclose
Brent Wagner, MD, Tucson, Arizona (*Presenter*) Nothing to Disclose
Cheri Canon, MD, Birmingham, Alabama (*Presenter*) Royalties, The McGraw-Hill Companies

LEARNING OBJECTIVES

1.To identify challenges facing the mid-career radiologist2.To discuss opportunities and strategies for retention and engagement of mid-career radiologists including both academic and private practice perspectives 3.To evaluate faculty development programming for the mid-career radiologist Mid-career physicians are often defined as those who are more than 5 years beyond the completion of their training and more than 5 years from planned retirement. For many radiologists, the mid-career phase will span the majority of their working career. Mid-career radiologists may experience unique challenges including stagnation, lack of support and fulfillment at work, unclear path to more senior leadership positions, and increased academic productivity expectations. Although many institutions and groups have developed support systems and faculty development programs targeted to early-career faculty, there is very limited programming to support mid-career faculty. Therefore, there is a significant unmet need to support radiologists in this significant phase of their career.This session will focus on challenges facing the mid-career radiologist, and opportunities and strategies for retention and engagement including both academic and private practice perspectives.

Printed on: 06/28/22

M1-CPD03

Neonatal Imaging: A Primer for the NICU

Participants
Judy Squires, MD, Pittsburgh, Pennsylvania (*Presenter*) Nothing to Disclose
Ricardo Faingold, MD, Toronto, Ontario (*Presenter*) Nothing to Disclose
Bernard F. Laya, DO, Taguig, Philippines (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review neonatal lung diseases and the role of imaging in evaluating.2) Examine the vital role of imaging in the diagnosis and management of neonatal intraabdominal pathology, including necrotizing enterocolitis.3) Review basic transfontanelle brain ultrasound imaging protocols, with normal and abnormal examples, including the role of advanced ultrasound techniques. In this neonatal imaging lecture course, learners will hear from 3 neonatal expert radiologists about chest, abdomen, and brain imaging techniques. Recent imaging advances will be highlighted to allow dissemination of the most up to date and high-yield information for learners to make direct improvements in their practices.

Printed on: 06/28/22

M1-CMS05

Review and Update on Blunt and Penetrating Thoracic Trauma

Participants
Scott Steenburg, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Nupur Verma, MD, Gainesville, Florida (*Presenter*) Nothing to Disclose
Demetrios Raptis, MD, Frontenac, Missouri (*Presenter*) Nothing to Disclose
Mari Nummela, MD, Helsinki, Finland (*Presenter*) Stockholder, BBS-Bioactive Bone Substitutes PLC

LEARNING OBJECTIVES

1.Understand the importance of bullet/projectile tract in the setting of penetrating thoracic trauma. 2. Describe clinically relevant rib cage injuries, and the difference between clinical and radiological chest wall instability. 3. Distinguish lung injuries in blunt trauma from non-traumatic parenchymal findings. 4. List the CT appearances of traumatic aortic injuries. This session will provide a core review of blunt and penetrating thoracic trauma with updates on new concepts. Blunt aortic, lung, pleural, and chest wall injuries, as well as penetrating trauma will be reviewed.

Printed on: 06/28/22

W5-CNR08

Neuroradiology Reporting Do's and Don'ts

Participants

Wende Gibbs, MD, Scottsdale, Arizona (*Presenter*) Nothing to Disclose
C. Douglas Phillips, MD, New York, New York (*Presenter*) Nothing to Disclose
Jenny K. Hoang, MBBS, Baltimore, Maryland (*Presenter*) Spouse, Employee, Merck & Co, Inc
Adam Flanders, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Recognize the importance of structured reporting and checklists in reducing errors and improving communication with physician colleagues, patients and payers.2. Appreciate the inherent value of structured reporting in the routine training of AI models with existing clinical data.3. Understand the value of reporting templates and macros in radiology resident education. Course Description: This session will focus on the advantages and pitfalls of structured reporting format and standardization of language in radiology reporting with examples in Neuroradiology. There are few topics more controversial than the style of our reports, and no topic is more vital. The radiology report is the radiologists' final product. Thus, the perceived value of the report is a major measure of radiology's value.

W3-CNPM14

Engaging Patients: Opportunities and Challenges in Lung Cancer Screening

Participants

Matthew Cham, MD, Kenmore, Washington (*Presenter*) Nothing to Disclose
Arun Krishnaraj, MD, MPH, Charlottesville, Virginia (*Presenter*) Nothing to Disclose
David F. Yankelevitz, MD, New York, New York (*Presenter*) Consultant, Accumetra LLC;Stockholder, Accumetra LLC;Medical Advisory Board, Carestream Health, Inc;Royalties, General Electric Company;Consultant, AstraZeneca PLC;Consultant, Pfizer Inc
James L. Mulshine, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose
Anita McGlothlin, BS, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. To describe Shared Decision Making (SDM) and its role in lung cancer screening CT. 2. To illustrate the current pitfalls in the implementation of SDM. 3. To explore ways in which SDM can be improved to better serve its patient-centered purpose. Shared Decision-Making (SDM) has been mandated by CMS for Lung Cancer Screening CT since 2015. Although SDM is intended to be patient-centered, inconsistent and suboptimal decision aids have led to a reduced uptake of lung cancer screening. Two recent reports found only a 2% to 4% uptake of lung cancer screening among the at-risk population. Many patients opt against screening when provided with shared decision-making using currently available suboptimal decision aids. For shared decision-making to become effective and truly patient-centered, decision aids must contain accurate information. Additionally, a fair and balanced public policy effort must be made to offer lung cancer screening to those at high risk. This multi-disciplinary case discussion is presented from the perspectives of a radiologist, a pulmonologist, and a patient advocate, emphasizing the importance of collaboration in SDM and Lung Cancer Screening. ?This session aims to increase physician awareness of the flaws in the current implementation of SDM, to address these flaws, and to carry out these improvements in clinical practice.

R4-CPD10

Advanced Pediatric CT Techniques

Participants
Erica Riedesel, MD, Atlanta, Georgia (*Presenter*) Nothing to Disclose
Edward Lee, MD, MPH, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Ladonna J. Malone, MD, Aurora, Colorado (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand advanced techniques in evaluation of pediatric cardiovascular disease by CT. 2) Identify clinical applications of Dual Energy CT to incorporate into pediatric radiology practice. 3) Learn up to date imaging techniques and characteristic imaging findings of pediatric congenital and acquired thoracic disorders Using a combination of case-based learning and lecture, this course will focus on advanced techniques in pediatric CT including cardiac CT, dual energy CT, and techniques in CT angiography.

Printed on: 06/28/22

M1-CCH03

Lung Cancer Screening

Participants
Denise R. Aberle, MD, Los Angeles, California (*Presenter*) Investigator, Johnson & Johnson;Research Grant, Johnson & Johnson
Jared D. Christensen, MD,MBA, Durham, North Carolina (*Presenter*) Advisory Board, Riverain Technologies, LLC
Terrance Healey, MD, North Scituate, Rhode Island (*Presenter*) Nothing to Disclose
Caroline Chiles, MD, Winston-salem, North Carolina (*Presenter*) Advisory Board, AstraZeneca PLC

LEARNING OBJECTIVES

1) Explain the revisions to lung cancer screening eligibility in the US.2)Implement tools for tracking lung nodules identified at screening CT.3)Recognize the challenges in applying Lung RADS to atypical lung lesions. 4)Understand how radiologists can optimize the risk: benefit ratio in their lung cancer screening patients Following an interruption in lung cancer screening as a result of COVID-19, CT screening for lung cancer screening has resumed at a rapid pace, with estimates of 1 million screens in the US this year. This course will bring the audience up to date on screening eligibility, and why these revised criteria are important. Follow-up of positive screens is critical in the detection and management of early stage lung cancers, and we will review the options that screening clinics have to ensure that this follow-up occurs. Lung-RADS, a tool designed to standardize reporting and management guidelines, is a living document, and the changes currently under review by the Lung-RADS committee will be discussed. CT screening for lung cancer can reduce lung-cancer specific mortality, but this benefit must be weighed in each patient against potential risks. We will describe the steps radiologists can take to mitigate the risks associated with CT screening.

Sub-Events

M1-CCH03   Moderator/Presenter

Participants
Debra Dyer, MD, Greenwood Village, Colorado (*Presenter*) Consultant, AstraZeneca PLC;Consultant, IASLC;Consultant, Guardant ;Clinical Advisory Board, IMIDEX Inc

LEARNING OBJECTIVES

1) Explain the revisions to lung cancer screening eligibility in the US.2)Implement tools for tracking lung nodules identified at screening CT.3)Recognize the challenges in applying Lung RADS to atypical lung lesions. 4)Understand how radiologists can optimize the risk: benefit ratio in their lung cancer screening patients Following an interruption in lung cancer screening as a result of COVID-19, CT screening for lung cancer screening has resumed at a rapid pace, with estimates of 1 million screens in the US this year. This course will bring the audience up to date on screening eligibility, and why these revised criteria are important. Follow-up of positive screens is critical in the detection and management of early stage lung cancers, and we will review the options that screening clinics have to ensure that this follow-up occurs. Lung-RADS, a tool designed to standardize reporting and management guidelines, is a living document, and the changes currently under review by the Lung-RADS committee will be discussed. CT screening for lung cancer can reduce lung-cancer specific mortality, but this benefit must be weighed in each patient against potential risks. We will describe the steps radiologists can take to mitigate the risks associated with CT screening.

Abstract Archives of the RSNA, 2021

AI in Breast Imaging

Participants

Maryellen Giger, PhD, Chicago, Illinois (*Presenter*) Advisor, Emalex Biosciences, Inc;Stockholder, Hologic, Inc;Royalties, Hologic, Inc;Shareholder, Quantitative Insights, Inc;Co-founder, Quantitative Insights, Inc;Shareholder, QView Medical, Inc;Royalties, General Electric Company;Royalties, MEDIAN Technologies;Royalties, Riverain Technologies, LLC;Royalties, Canon Medical Systems Corporation
Fredrik Strand, MD,PhD, Stockholm, Sweden (*Presenter*) Speaker, Lunit Inc
Constance Lehman, MD,PhD, Boston, Massachusetts (*Presenter*) Institutional Grant, General Electric Company;Institutional Grant, Hologic, Inc;Co-founder, Clairity, Inc.

LEARNING OBJECTIVES

1. Develop critical thinking and understand terminology in the evaluation of AI systems for breast cancer screening and diagnosis.2. Attain a realistic appreciation for the opportunities and challenges in the implementation of AI in clinical practice. Build your knowledge with top experts in evaluating, implementing and understanding the wider impact of AI systems in breast cancer screening and diagnosis. There will be three lectures and a final panel discussion. We will cover the path from performing critical evaluation of AI systems, to understanding the implications of initial results from pioneering clinical AI studies, and to exploring opportunities and challenges when implementing AI in routine clinical practice. In the final panel discussion, all presenters are available to discuss important topics brought up by the participants, including feedback on their own AI projects.

Printed on: 06/28/22

S1-CRI01

Obstetric Emergencies

Participants
Tara A. Morgan, MD, San Francisco, California (*Presenter*) Nothing to Disclose
Beverly G. Coleman, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Peter M. Doubilet, MD, PhD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Jill Langer, MD, Villanova, Pennsylvania (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify normal first trimester ultrasound findings and review diagnosis of pregnancy failure. 2) Describe the findings of ectopic pregnancy including non-tubal locations. 3) Understand the role of ultrasound and common findings in emergency in second and third trimester pregnancies. This course will teach the normal and abnormal findings seen on ultrasound throughout pregnancy from the first to third trimesters. In the first trimester, identification of whether an intrauterine pregnancy is present and whether the ultrasound appearance is normal has a critical impact on patient management. Ultrasound criteria can be applied to determine when a failed intrauterine pregnancy is present. Similarly, abnormal findings can be present that affect pregnancy prognosis but do not meet criteria for failure and are important to differentiate. Ectopic pregnancy in the first trimester is a clinical emergency and can present with a variety of ultrasound morphologies and locations which will be reviewed in detail. Emergencies in the second and third trimester, although rare, need rapid and accurate diagnosis to prevent maternal and fetal morbidity and mortality. This course will review the role of ultrasound in the second and third trimester, common pathologies and their ultrasound appearance.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

T4-CHN04

Horse or Zebra: Case-based Review of Common Mimics in Head and Neck

Participants
Jennifer Gillespie, MBBS, Brisbane, Australia (*Presenter*) Nothing to Disclose
Deborah Shatzkes, MD, New York, New York (*Presenter*) Nothing to Disclose
Christine M. Glastonbury, MBBS, San Francisco, California (*Presenter*) Author with royalties, Amirsys Reed Elsevier
William T. O'Brien Sr, DO, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the key imaging features of some common pathologies (horses) in the Head and Neck. 2) Display examples of potential mimicking diagnoses (zebras) in an interactive Q&A format. 3) Review the imaging features that should raise suspicion for an alternative diagnosis to these common Head and Neck pathologies. An interactive, case-based session hightlighting the difference between common lesions in the Head and Neck and other rarer lesions that may mimics these pathologies.

Printed on: 06/28/22

DLL24

Deep Learning Lab: Pneumonia Detection Model Building

Participants

Felipe C. Kitamura, MD, PhD, Sao Paulo, Brazil (*Presenter*) Consultant, MD.ai, IncSpeaker, GE Healthcare

Ian Pan, MD, Brookline, Massachusetts (*Presenter*) Consultant, MD.ai, Inc;Consultant, Centaur Labs;Consultant, Diagnósticos da América SA (Dasa);Consultant, CoRead AI

LEARNING OBJECTIVES

Empty Abstract

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Gynecologic - Case-based Multidisciplinary Review

Participants

Aoife Kilcoyne, MBBCh, Boston, Massachusetts (*Presenter*) Royalties, Wolters Kluwer nv;Author, Wolters Kluwer nv

Stephanie Markovina, MD, PhD, Saint Louis, Missouri (*Presenter*) Research Grant, GlaxoSmithKline plc

Fiona Simpkins, MD, Miami, Florida (*Presenter*) Research funded, AstraZeneca PLC;Research funded, Instil Bio, Inc;Research funded, Repare Therapeutics, Inc

Lilie Lin, MD, Houston, Texas (*Presenter*) Investigator, AstraZeneca PLC

LEARNING OBJECTIVES

1. Describe the surgical treatment and systemic therapies for gynecologic cancers based on standard of care current treatment strategies. 2. Describe the use of radiotherapy techniques used for the adjuvant and definitive treatment of gynecologic cancers. 3. Identify key imaging findings and avoid pitfalls when reading MRI and PET CT for gynecologic cancers. This is a case based, multidisciplinary review of gynecologic malignancies including uterine cervical and endometrial cancer, vulvar cancer and ovarian cancer.

Printed on: 06/28/22

M3-PL02

Plenary Session: Radiology in the Value-Based Healthcare Arena: Player or Pawn?

Participants
James Brink, MD, Boston, Massachusetts (*Presenter*) Board of Directors, Accumen Inc

LEARNING OBJECTIVES

Dedication of the Plenary Lecture to the Memory of E. Robert Heitzman, MD (1927-2020)

The COVID-19 pandemic has heightened the need for quality healthcare at an affordable cost that is accessible to all. If we choose to enter this arena whole-heartedly, our future state is one in which healthcare stakeholders worldwide understand the critical role that radiology plays in advancing quality care at an affordable cost for disease prevention, detection, management, therapy, and monitoring. Similarly, radiologists understand uniformly the importance of their role in each of these domains and leverage tools that enhance their ability to provide subspecialized expertise to patients, the medical community, and the public at large, without limitations imposed by demographic or socio-economic status. To achieve these goals, the impact of radiology services on patient outcomes and quality of life must dominate the dialogue about legacy and novel technologies for imaging and image guided therapy. Diagnostic and technical efficacy are requisite inputs to studies involving diagnostic and therapeutic impact, patient outcome, and socio-economic benefit rather than as primary end points themselves. Radiologists are champions for health equity and are recognized for democratizing their services while embracing innovation that brings imaging advances to the population at large. Personalized imaging care integrates diagnostic data from all sources and leverages predictive analytics to anticipate and remedy future decrements in health and well-being. Owing to the relatively high cost of radiology services amid rapidly rising health care costs, methods must be developed and honed to ensure that imaging and image guided therapy services are used appropriately based on evidence-based guidelines. Tools that ensure uniform adoption of such principles through automation or semi-automation are uniformly distributed throughout the medical community worldwide. Adoption and use of the tools necessary to achieve these goals must be embraced by all members of the medical community, including those who interact with patients primarily and direct their care.

Printed on: 07/08/22

Abstract Archives of the RSNA, 2021

Plenary Session: Addressing the Continued Exclusion of Black Physicians in the US Radiation Oncology Workforce

Participants

Iris Gibbs, MD, Stanford, California (*Presenter*) Accuray Incorporated (honoraria for lectures)

LEARNING OBJECTIVES

Radiation Oncology continues to rank among the least diverse specialties by gender and race/ethnicity. Despite the overall doubling of radiation oncology residents in the United States between 1974 to 2016, the number of Black residents in radiation oncology remains alarmingly low at 23 in 2016 across 91 ACGME programs representing a drop from 31 in the 42-year period. More disturbingly, trends in Black radiation oncology faculty representation show steady declines since 2006 while Black faculty in academic medicine overall is slightly increasing. Furthermore, leadership positions in radiation oncology are nearly devoid of Black individuals. These trends are not likely to improve until strategies to confront structural racism, provide access to early exposure to the field, improve opportunities for leadership and eliminate other barriers to entry are addressed. Over the past year, issues of racial justice, racial health disparities and representation have been catapulted to institutional awareness and public discourse. The purpose of this presentation is to discuss strategies toward eliminating barriers to Black representation in radiation oncology.

Sub-Events

W5-PL05   Introduction of Dr. Gibbs

Participants

Sarah S. Donaldson, MD, Stanford, California (*Presenter*) Nothing to Disclose

Printed on: 07/08/22

M6-RCP50

Image Interpretation Session

Participants

David M. Yousem, MD, Evergreen, Colorado (*Presenter*) Royalties, Reed ElsevierSpeaker, MRI OnlineBoard Member, MRI OnlineExpert Witness Service, Individual Proprietor
Marion Smits, MD, PhD, Rotterdam, Netherlands (*Presenter*) Speaker, General Electric Company
Edward Lee, MD, MPH, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Donald L. Resnick, MD, San Diego, California (*Presenter*) Nothing to Disclose
Angela D. Levy, MD, Washington, Dist. of Columbia (*Presenter*) Nothing to Disclose
Stella Kang, MD,MSc, New York, New York (*Presenter*) Royalties, Wolters Kluwer nv

LEARNING OBJECTIVES

1) Identify key abnormal findings on radiologic studies that are critical to making a specific diagnosis. 2) Construct a logical list of differential diagnoses based on the radiologic findings, focusing on the most probable differential diagnoses. 3) Determine which, if any, additional radiologic studies or procedures are needed in order to make a specific final diagnosis. 4) Choose the most likely diagnosis based on the clinical and the radiologic information. This session will employ an expert panel to discuss unknown cases in the fields of neuroradiology, musculoskeletal radiology, pediatric imaging, genitourinary imaging and gastrointestinal radiology. The material will include plain radiography, ultrasound, CT and MRI imaging with an overall theme of self-induced and/or iatrogenic disease. The expert readers will provide insights into how they approach clinical cases, pearls and pitfalls during the creation of a differential diagnosis, and keys to a final diagnosis in a light-hearted entertaining format.

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

LEARNING OBJECTIVES

Dedication of the 2021 RSNA Meeting Program to the Memory of Sanjiv S. Gambhir, MD, PhD (1962-2020) and Lawrence W. Bassett, MD (1942-2020)AAPM WelcomeChicago Radiological Society Welcome

The impact of COVID-19 has been far reaching, affecting using every aspect of our personal and professional lives. Our lives are different, the way we work is different, and even our thinking has been changed by all that we have experienced. Whether we are leading departments, on the frontlines caring for our patients, or anywhere in between, we have been required to rethink and reimagine everything - what we do, how we do it, and what truly matters to us. It is essential that we learn from the experiences of the past two years. Having responded to the short-term challenges, today we find ourselves considering the road ahead to envision the future state of our profession. As the crisis recedes, our work requires a shift from defense to offense, from reactivity to proactivity. We already have new priorities and soon will have new habits. The pandemic has uncovered a myriad of issues in our profession, from inequities in patient access to care to inefficiencies in our workflows. It would be a wasted opportunity to revert to previous operations unreflectively. Rather, we need innovative ways to conduct our work more effectively and empathically. We have already unveiled new ideas and new technologies that redefine what it means to be a radiologist. Using the tenets of quality-based and patient-focused care, we are creating unique paths forward, with collaboration, civility, inclusiveness, and diversity at our core. It is critical, now more than ever, to engage each other worldwide in finding global solutions to the challenges that face the medical imaging community. We also must ensure that our academic and society leaders reflect the diverse community we represent and strive to provide an equitable and inclusive community that serves the needs of all of our members, and ultimately provides better care to our patients.

Sub-Events

S5-PL01   Redefining Radiology: The Road Ahead

Participants
Mary Mahoney, MD, Cincinnati, Ohio (*Presenter*) Royalties, Reed Elsevier;Editorial Advisory Board, Wolters Kluwer nv

S5-PL01   Service Fanatics - How to Deliver Safe, High-Quality, Patient-Centric Care

Participants
James Merlino, MD, Cleveland, Ohio (*Presenter*) Nothing to Disclose

S5-PL01   Introduction of Dr. Mahoney

Participants
Brent Wagner, MD, Tucson, Arizona (*Presenter*) Nothing to Disclose

Printed on: 06/28/22

T3-PL03

Plenary Session: Ensuring an Inclusive, Respectful Workplace

LEARNING OBJECTIVES

*This session is only available for live viewing and will not be available on-demand. Dr. Michele H. Johnsons lecture: RSNA dedicates this plenary lecture to the memory of David B. Fraser, MD (1932-2020). Dr. Christine Poraths lecture: RSNA dedicates this plenary lecture to the memory of O. Wayne Houser, MD (1929-2020).

Incivility is prevalent in organizations, and it's getting worse. The costs of incivility are rising, too. Christine Porath will discuss the varied ways incivility wrecks performance and robs the bottom line. She will explain what civility buys you-and what you can focus on to be more effective. She will also share recommendations for what leaders should do to enhance their influence and craft a more respectful and thriving work environment.

Sub-Events

T3-PL03   **Excellence, Respect and Responsibility in Radiology: Challenging Barriers**

Participants
Michele Johnson, MD, New Haven, Connecticut (*Presenter*) Medical Advisory Board, iSchemaView, Inc

T3-PL03   **Mastering Civility**

Participants
Christine Porath, Redondo Beach, California (*Presenter*) Nothing to Disclose

Printed on: 07/08/22

W3-PL04

Plenary Session: Exciting Radiology Game Show: What's Your Emergency? Life in the STAT Lane

Participants

Suzanne Chong, MD, Superior Township, Michigan (*Presenter*) Nothing to Disclose
Mark P. Bernstein, MD, New York, New York (*Presenter*) Nothing to Disclose
Krystal Archer-Arroyo, MD, Decatur, Georgia (*Presenter*) Nothing to Disclose
Eric Roberge, MD, Fox Island, Washington (*Presenter*) Nothing to Disclose
Scott Steenburg, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose
Savvas Nicolaou, MD, Vancouver, British Columbia (*Presenter*) Institutional research agreement, Siemens AG;Stockholder, Canada Diagnostic Centres
Summer Kaplan, MD, MS, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose
Sanjeev Bhalla, MD, Saint Louis, Missouri (*Presenter*) Advisory Board, Precisa Gravimetrics AG
Clint W. Sliker, MD, Baltimore, Maryland (*Presenter*) Nothing to Disclose
Jorge Soto, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose
Michele Johnson, MD, New Haven, Connecticut (*Presenter*) Medical Advisory Board, iSchemaView, Inc
Margarita Revzin, MD, Wilton, Connecticut (*Presenter*) Nothing to Disclose
James Lee, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1)Identify traumatic and nontraumatic emergencies. 2)Prioritize workflow scenarios. 3)Resolve practice management conflicts. *ER stands for Exciting Radiology!* Using a game show format, two teams of emergency radiologists will tackle a spectrum of traumatic and non-traumatic cases, solve clinical workflow scenarios, and address practice management issues. All in a fast-paced, multi-tasking manner representative of life in the ER STAT lane. Be part of the fun and join a virtual third team to compete with the two teams on stage.If youre a radiologist, emergency radiology is most likely part of your life, day and/or night, and increasing in volumes. Interested in ER?Love ER? This game is for you.

R3-CPH01

RSNA/AAPM Symposium: Together We Can Make a Difference

Participants

Guang-Hong Chen, PhD, Madison, Wisconsin (*Presenter*) Nothing to Disclose
James Dobbins III, PhD, Durham, North Carolina (*Presenter*) Inventor, General Electric Company;Inventor, Mirion Technologies, Inc;
Cynthia McCollough, PhD, Byron, Minnesota (*Presenter*) Research Grant, Siemens Healthcare GmbH
Joel Fletcher, MD, Rochester, Minnesota (*Presenter*) Research Grant, Siemens AG;Research Grant, Pfizer Inc;Research Grant,
Takeda Pharmaceutical Company Limited;Consultant, Takeda Pharmaceutical Company Limited;Research Grant, NEXTRAST,
INC;Consultant, Medtronic plc;Consultant, Johnson & Johnson;Consultant, GlaxoSmithKline plc;Consultant, Boehringer Ingelheim
GmbH

LEARNING OBJECTIVES

1. Learn the importance of partnership between radiologists and medical physicists;2. Learn the experiences from leaders in the
field how to work together to make a difference to advance medicine. Special Remarks by Mary C. Mahoney, MD, President, RSNA.
Highlight successful collaboration between AAPM and RSNA for imaging technical development and clinical translations.

Printed on: 06/28/22

IR26

The Clinical Educator Track for Faculty Promotion/Advancement

Participants

Jennifer Gould, MD, Saint Louis, Missouri (*Presenter*) Spouse, Consultant, Entellus Medical, Inc;Spouse, Speaker, Entellus Medical, Inc;Spouse, Researcher, Entellus Medical, Inc;Spouse, Investor, Frontenac Surgery Center;Spouse, Investor, Twin Cities Surgery Center;Royalties, Reed Elsevier

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

IR23

Statistics II

Participants

Jaydev K. Dave, PHD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Koninklijke Philips NV;Equipment support, Lantheus Holdings;Equipment support, General Electric Company;Research Consultant, Curvebeam LLC;Medical Advisory Board, Rayscan

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Abstract Archives of the RSNA, 2021

IR28

Research Workshop II

Participants
Alessia Guarnera, MD, Rome, Italy (*Presenter*) Nothing to Disclose
Stavros Charalambous, Heraklion Crete, Greece (*Presenter*) Nothing to Disclose
Milda Dedelaite, MD, London, United Kingdom (*Presenter*) Nothing to Disclose
Joshua Shur, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose
• Maria Del Carmen De Benavides De Benavides, Madrid Espana, Spain (*Presenter*) Nothing to Disclose
Anna Kaminska, Warsaw, Poland (*Presenter*) Nothing to Disclose
Urszula Wegner, MD, Ilford, United Kingdom (*Presenter*) Nothing to Disclose
Andrea Garza, MD, Monterrey, Mexico (*Presenter*) Nothing to Disclose
Yohana Mateo, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose
Maria Lucia Brun, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

Printed on: 06/28/22

IR30

International Program Opportunities

Participants

Claudio Silva, MD,MSc,MBA, Santiago, Chile (*Presenter*) Nothing to Disclose

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

IR02

Skills: Designing and Planning Clinical Research

Participants

John Eng, MD, Cockeysville, Maryland (*Presenter*) Nothing to Disclose

Printed on: 06/28/22

IR04

Machine Learning in Radiology and Essentials of Developing and Implementing the Research Project

Participants

Katherine Andriole, PhD, Branford, Connecticut (*Presenter*) Nothing to Disclose

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Building a Laboratory

Participants

Maryellen Giger, PhD, Chicago, Illinois (*Presenter*) Advisor, Emalex Biosciences, Inc;Stockholder, Hologic, Inc;Royalties, Hologic, Inc;Shareholder, Quantitative Insights, Inc;Co-founder, Quantitative Insights, Inc;Shareholder, QView Medical, Inc;Royalties, General Electric Company;Royalties, MEDIAN Technologies;Royalties, Riverain Technologies, LLC;Royalties, Canon Medical Systems Corporation

Printed on: 06/28/22

IR15

Conducting Clinical Research

Participants

Johan G. Blickman, MD, PhD, Hingham, Massachusetts (*Presenter*) Consultant, Siemens AG

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

IR03

Oral Presentation of Scientific Research

Participants
Michael L. Richardson, MD, Seattle, Washington (*Presenter*) Nothing to Disclose

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Participants
Mayankkumar Patel, MBBS, Himmatnagar, India (*Presenter*) Nothing to Disclose
Yoshiaki Ota, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose
Prossy Bibangambah, Mbarara, Uganda (*Presenter*) Nothing to Disclose
Maximiliano Klug, MD, Ramat Gan, Israel (*Presenter*) Nothing to Disclose
Julio Marin Concha, MD, Grosse Pointe Woods, Michigan (*Presenter*) Nothing to Disclose
Omer Onder, MD, Ankara, Turkey (*Presenter*) Nothing to Disclose
Cristina Marrocchio, MD, Trieste, Italy (*Presenter*) Nothing to Disclose

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

IR05

Preparing an Original Research Paper

Participants

Shadpour Demehri, MD, Baltimore, Maryland (*Presenter*) Research support, General Electric Company;Research Grant, Carestream Health, Inc;Consultant, Canon Medical Systems Corporation

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

IR29

Radiology Research: Deductions from the Literature and How They May Be Applied to Your Research

Participants

Richard D. Hichwa, PhD,MS, Iowa City, Iowa (*Presenter*) Nothing to Disclose

Printed on: 06/28/22

IR32

Importance and Development of Clinical Collaborations

Participants
Elizabeth A. Krupinski, PhD, Atlanta, Georgia (*Presenter*) Institutional research collaboration, Hyperfine Research, Inc;Institutional research collaboration, Microvascular Therapeutics, LLC;Consultant, Circle Cardiovascular Imaging Inc;Consultant, Centerstone, Inc.

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Abstract Archives of the RSNA, 2021

IR10

Pearls of Becoming an Academic Radiologist

Participants

Musturay Karcaaltincaba, MD, Ankara, Turkey (*Presenter*) Speaker, Pfizer Inc;Speaker, Bayer AG;Speaker, General Electric Company

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

IR25

Quality & Safety Research

Participants

Matthew Davenport, MD, Ann Arbor, Michigan (*Presenter*) Royalties, Wolters Kluwer nv

Printed on: 06/28/22

Abstract Archives of the RSNA, 2021

Practical Tips for Building a Research Career

Participants

Scott Reeder, MD,PhD, Madison, Wisconsin (*Presenter*) Dr. Reeder has no relevant conflicts. Unrelated to this presentation, Dr. Reeder has ownership interests in Calimetrix, Reveal Pharmaceuticals, Cellectar Biosciences, Elucent Medical, and HeartVista, and the University of Wisconsin receives research supp

Abstract Archives of the RSNA, 2021

IR35

Designing a Research Question Workshop

Participants
John Eng, MD, Cockeysville, Maryland (*Presenter*) Nothing to Disclose
Richard D. Hichwa, PhD,MS, Iowa City, Iowa (*Presenter*) Nothing to Disclose

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Abstract Archives of the RSNA, 2021

IR12

Statistics I

Participants

Jaydev K. Dave, PHD, Philadelphia, Pennsylvania (*Presenter*) Research Grant, Koninklijke Philips NV;Equipment support, Lantheus Holdings;Equipment support, General Electric Company;Research Consultant, Curvebeam LLC;Medical Advisory Board, Rayscan

Abstract Archives of the RSNA, 2021

IR31

Faculty Tracks for Imaging Scientists

Participants

Elizabeth A. Krupinski, PhD, Atlanta, Georgia (*Presenter*) Institutional research collaboration, Hyperfine Research, Inc;Institutional research collaboration, Microvascular Therapeutics, LLC;Consultant, Circle Cardiovascular Imaging Inc;Consultant, Centerstone, Inc.

Printed on: 06/28/22

IR07

Research Ethics

Participants

Jocelyn Chertoff, MD, Lebanon, New Hampshire (*Presenter*) Director, Varex Imaging Corporation

Printed on: 06/28/22

IR21

Population Health, Radiology and Big Data

Participants

Safwan Halabi, MD, Chicago, Illinois (*Presenter*) Advisor, Bunkerhill Health;Advisor, McKesson Corporation;

Printed on: 06/28/22

IR14

International Efforts in Academic Radiology

Participants

Alexander A. Bankier, MD, PhD, Worcester, Massachusetts (*Presenter*) Consultant, DAIICHI SANKYO Group;Consultant, Olympus Corporation

Daria Kifjak, MD, Vienna, Austria (*Presenter*) Nothing to Disclose

Printed on: 06/28/22

IR33

Commercial Partnerships, IP, and Technology Transfer

Participants

Kevin Koch, PhD, Brookfield, Wisconsin (*Presenter*) Research Grant, General Electric Company;Patent holder, General Electric Company;Research Grant, Siemens AG;Advisor, VasoGnosis Inc;Stockholder, VasoGnosis Inc

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Abstract Archives of the RSNA, 2021

IR11

Health Policy and Health Services Research and Patient Engagement

Participants
Ruth C. Carlos, MD, MS, Ann Arbor, Michigan (*Presenter*) In-kind support, Reed Elsevier;Editor, Reed Elsevier;Travel support, General Electric Company

QI04-C
Quality Improvement Reports Wednesday Poster Discussions

Sub-Events

QI04-C2   Improving Pre-procedure Lead Times In Pre And Post-procedure Care Area

Awards
Quality Improvement Reports Award
Identified for RadioGraphics

Participants
Pratik Rachh, MD,MBA, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

In September 2019 our Academic Medical Center conducted a procedural Value Stream Analysis (VSA) and identified 6 Rapid Improvement Events (RIE's) focused on improving overall workflow for procedural patients. It was noted that there were significant delays in patient care related to workflow in the Pre and Post-Procedural Care Area (PPCA). The purpose of this project was to identify waste processes, brainstorm, and implement solutions for rapid improvement leveraging Lean process improvement principles.

METHODS

Team, Scope and Pre-work: A multidisciplinary team of leaders and frontline clinicians from Radiology and Anesthesia was formed to solve this complex problem. The project was facilitated by two radiology quality improvement managers. Project scope included workflows for procedural patients from the time of arrival in the PPCA to disposition. A five-day workshop was planned in November 2019. Two months prior to the workshop, the team started meeting on a weekly basis to collect baseline data, conduct time studies, and understand the current state by spending time in the gemba.Goal: At baseline (August 2019), 45% of patients were PPCA ready (time from arrival to marked procedure ready) within 60 minutes of their arrival. The goal of the PPCA RIE was to have 80% patients PPCA ready within 60 minutes of arrival.5 Day Workshop: On Day 1-2 of the workshop, the team was given training on foundational concepts of Lean, value add and non-value add processes, and wastes in processes. Then the team reviewed baseline data, process mapped the process, and identified areas of improvement. On Day 2 the team started brainstorming solutions. On Day 3 the team spent most of their time in the PPCA implementing several tests of change. Day 4 of the workshop the team continued working on the changes and started drafting Standard Work documents for future state workflow. On Day 5 the team reported out to Radiology and Enterprise leadership their work, and laid out 30-60-90 day plans to follow-up on pending items.Observations and Actions: Some of the key observations included nurses frequently moving in and out of the patient bays to retrieve forms and supplies. There was considerable heterogeneity in the amount and time of EMR documentation among nurses. The team sought to create 5S zones, standard work for placement of supplies and forms, and streamlining EMR documentation. During the 5 day RIE event and in the following weeks 9 interventions were proposed and tested .

RESULTS

The target goal was tracked for the subsequent 14 months post-implementation. 10 of the 14 months saw 80% or more PPCA patients in ready status within 60 min of arrival .

QI04-C3   Recommendations For Additional Imaging: A Novel Characterization Scheme For Ensuring Appropriate Follow-up

Participants
Jack Renfrew, MD, phoenix, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

To measure the rate of recommendations for additional imaging (RAI) in radiology reports, the rate of compliance with recommendations for additional imaging (CRAI), and any improvement in compliance with notification of the ordering provider when RAI was not done.

METHODS

We developed a method of coding all radiology cases that parallels the American College of Radiology's Breast Imaging Reporting and Database System (BI-RADS), trained a group of radiologists in its use, developed an automated, computerized method to analyze reports to determine whether recommended imaging was performed, and developed a HIPAA compliant method of alerting the ordering physician when recommended imaging was not performed. We analyzed whether the notification of failure to image was acted upon.

RESULTS

Radiologists coded 237,917 reports with 3,558 RAI (1.50%). RAI varied across modalities with a high of 4.09% for CT and a low of 0.51% for radiography. Of the 3,444 RAI due for follow-up, 1,378 were done (40.0%) and 2,066 (60.0%) were not. We sent HIPAA compliant notifications to ordering physicians in cases of noncompliance, after which 450 further imaging studies (21.9%) were

performed increasing overall compliance to 53.4%.

QI04-C4   Working "Around The Clock" To Improve Shoulder MRI Patient Positioning

Participants
Jonathan Pierce, MD, Cleveland, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the quality of shoulder MRI as it pertains to patient positioning at our institution before and after performing an educational intervention with MRI technologists in order to improve diagnostic image quality and interpretation of shoulder pathology.

METHODS

MRI exams of the shoulder performed at our institution during a 1 month period of time were identified. Patient positioning was retrospectively reviewed by 4 independent radiologists - 2 fellowship trained musculoskeletal radiologists (6 years and 14 years of experience, respectively), a PGY-4 radiology resident, and a PGY-3 radiology resident. Positioning (internal rotation, external rotation, or neutral) was determined based on the location of the bicipital groove relative to superimposed clock positions, in relation to the long axis of the scapular body. Clock positions and associated quality of the supraspinatus and subscapularis tendons were independently assessed and classified as "ideal," "intermediate," or "not ideal" depending on whether the tendons were viewed in plane on respective sagittal and coronal sequences. An educational intervention (PowerPoint presentation) was then performed with MRI technologists in order to detail appropriate patient positioning and explain why certain anatomy and pathological processes are better assessed on shoulder MRI when the shoulder is in external rotation. Live and recorded options were available. The MRI technologists were then surveyed regarding their impression of the presentation. Following the intervention, an additional population of MRI exams will be reviewed in order to determine whether the educational intervention resulted in an increased number of patients with ideal positioning during MRI acquisition.

RESULTS

A total of 130 exams fit the inclusion criteria. Pre-intervention results showed that all 4 readers agreed that 9:00 and 11:00 to 1:00 were not ideal. Additionally, all readers agreed that the 9:30 and 10:30 were intermediate (less ideal for the subscapularis and supraspinatus, respectively) and that 10:00 was the ideal position. By pooled average, 72.31% of cases were not ideal, 13.85% were intermediate ideal, and 13.85% were ideal.

QI04-C6   Clinical Decision Support (CDS) Implementation Decreases Reimbursement Denials For Lower Extremity Venous Doppler Ultrasound Exams

Participants
Micah G. Cohen, MD, Bryn Mawr, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To decrease the rate of reimbursement denial by Centers for Medicare and Medicaid Services (CMS) for lower extremity venous doppler ultrasound exams related to inappropriate imaging utilization, after implementation of a CDS mechanism at the point of exam ordering by the referring clinician.

METHODS

Total number and percentage of CMS reimbursement denials for lower extremity venous doppler ultrasound exams were derived over a six-month period both before (July-December 2020) and after (July-December 2021) implementation of a CDS mechanism at the point of exam ordering by the referring clinician. Reimbursement denials were further stratified into categories pertaining to reason for denial, namely denials which were related to clinician documentation/inappropriate utilization, and those which were not. Relative frequencies of denials pertaining to documentation/inappropriate utilization, in number of denials/1000 exams, were tabulated for the control and experimental groups, prior to and after CDS implementation, respectively, and a Chi-Square test was performed to assess for statistical significance.

RESULTS

There were 588 total denials out of 3,870 lower extremity venous doppler exams which were billed prior to CDS implementation (15.2%). There were 488 total denials out of 3,565 lower extremity venous doppler exams which were billed for after implementation (13.6%). Of the 3,870 exams prior to implementation, 47 denials were related to clinician documentation (12.14 denials/1000 exams). Of the 3,565 exams after implementation, 24 denials were related to clinician documentation (6.73 denials/1000 exams). This corresponds to a reduction of 44.5% of denials related to documentation after implementation of CDS, with a Chi-Square value of 5.6402 (p=.017553).

QI04-C7   Use Of AI-enhanced PET Algorithms. A Validation Study Using The NEMA Body And The ACR/Esser Phantoms.

Participants
Eduardo Tinois, MSc, Campinas, Brazil (*Presenter*) Consultant, Bayer AG

PURPOSE

Throughout the evolution of diagnostic imaging, techniques to improve the signal-to-noise ratio have been taking advantage of computational solutions such as artificial intelligence. For PET scan images, the company Subtle Medical proposes, with its deep learning algorithm, to reduce image noise, obtaining the same quality standard with a decrease in the time and/or dose used in the original acquisition. The purpose of this work is to evaluate the application of the Subtle Medical (SM) processing algorithm in images obtained from simulators through objective parameters, observing its possible correlations with the processing performed in the installation (PT) equipment, PET/CT Siemens Biograph Horizon, in order to validate the safe use of the SM in clinical images.

METHODS

We used the body phantom recommended in performance tests for PET equipment, whose preparation methodology is in line with NEMA NU-2012 publication in the lesion/background ratio of 4:1, where the lesions have spherical shapes with diameters of 10mm, 13mm, 17mm and 22mm; 28mm and 37mm. Acquisition parameters followed the NEMA and clinic protocol of the radiative facility.

The initial specific activity was 0.14 mCi/kg and acquisitions were performed with time intervals in between, simulating concentrations of 0.12; 0.10; 0.08; 0.070; 0.06; 0.04 and 0.02 mCi/kg. The processing of the images was performed in the PT and SU software, and then the quantification of the coefficient of recovery (CR) and of variation (CV) of the hot and cold lesions and of the lung simulator was performed in both protocols adopted. It was also used the ACR/ESSER simulator in order to verify the discrepancies obtained for the parameter Standard Uptake Value (SUV) in the PT and SM processes. The device was prepared according to specifications of the American College of Radiology, "PET phantom instructions for evaluation of PET image quality." (2006) (ACR) and acquisition parameters followed ACR and clinical protocol. The initial specific activity was 0.14 mCi/kg and acquisitions were performed with time intervals in between, simulating concentrations of 0.12; 0.10; 0.08; 0.070; 0.06; 0.04 mCi/kg. Image processing was performed in PT and SM, and for both protocols and processing, quantification of the maximum, average, and minimum SUV of the bottom, bone, air, and water simulating inserts were performed.

RESULTS

For the body phantom, in both NEMA and clinical protocols, when comparing the PT and SM processing, a greater reduction in CR and CV was observed in hot and cold lesions in the SUV. Through linear regression and correlation analysis, it was observed that the SU does not introduce randomness in the CR with very strong correlation coefficient for the hot and cold lesions in both NEMA and clinical protocols. For the ESSER simulator, we observed maximum SUV values above those recommended by the ACR and average SUV within the established limits for both PT and SM processing.

QI04-C-HC1 Interviewing In A Pandemic: A Survey Of Radiology Residency Applicants Following The 2020-2021 Virtual Interview Season

Participants
Matthew Mader, MD, Kansas City, Kansas (*Presenter*) Nothing to Disclose

PURPOSE

As a public health policy response to the COVID-19 pandemic, the American Association for Medical Colleges strongly encouraged universal transition to a virtual interview setting for the 2020-2021 residency application cycle (AAMC, 2020). The consequences of this transition on the application process and match outcomes are unknown.Considering the financial and temporal constraints of traditional travel interviews, the virtual format may allow applicants to cast a wider net. Conversely, a surge in applications suggests increased competition for limited interview slots (Hammoud, et al., 2020). It is uncertain whether the ostensible limitations of virtual interviews may introduce applicant bias to the ranking of home versus external programs.

METHODS

A questionnaire was tailored to characterize the impact of the virtual interview process. Following NRMP Match Week, the questionnaire was distributed to our institution's radiology residency program applicants. Responses were anonymous.Demographic information, application statistics, expenses, online resources used, as well as perceptions of the virtual interview format were evaluated. Likert scale responses were provided to assess factors influencing the application and ranking process.

RESULTS

245 applicants were invited to complete the survey, yielding 48 complete responses. Demographics are detailed in Table 1. Application, interview, and expense statistics are summarized in Table 2.In preparation for interviews, most respondents reported visiting official program websites (N=38, 79%). Many also visited online forums and databases, including Reddit (N=32, 67%), AMA-FREIDA (N=24, 50%), and Doximity (N=23, 48%).Program location was identified as a key factor in rank selection, with 96% (N=46) of respondents citing this as important or very important.A major question of our study was whether the transition to virtual interviews made a significant impact on preferences and match outcomes. Chi-squared or Fisher's exact tests were conducted to compare two groups: those who ranked their home program highest (N=13) versus those who ranked an external program highest (N=35). Results are presented in Table 3.

QI04-B

Quality Improvement Reports Wednesday Poster Discussions

Sub-Events

QI04-B2   The Epidemiology Of CT In An Irish Paediatric Emergency Department

Participants
Johnny O'Mahony, MBBCh,MRCS, Dublin, Ireland (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the epidemiology of CT scans in an Irish Pediatric Emergency Department. In recent years, there has been a global movement towards more judicious use of computed tomography (CT) imaging in an attempt to reduce exposure of pediatric patients to ionizing radiation. In addition to the health risks involved, there are economic and resource utilisation implications. CT overuse may also result in further costs and longer patient stays due to the need to investigate incidental findings. The CT utilisation rates across national jurisdictions vary widely due to a number of structural, process and outcome related factors. There is no currently no published data describing the epidemiology of CT from an Irish Pediatric Emergency Department in a pediatric tertiary referral centre.

METHODS

We performed a retrospective study by searching the Irish National Integrated Medical Imaging System (NIMIS) for CT imaging studies performed at the request of the paediatric emergency department physicians from Our Lady's Children's Hospital Crumlin for the years 2018-2020 inclusive. These scans were then categorised into "working hours", i.e. 9am to 5pm Monday to Friday, excluding public holidays, and "out of hours". The scan reports were also analysed to ascertain if the scan had yielded a "positive" finding, i.e. evidence of pathology that would change the patients management or disposition (e.g. fit for discharge or needing to be admitted for specialty care). These data were tabulated and analysed using Microsoft Excel.

RESULTS

984 scans in total were identified, 275 in 2018, 336 in 2019 and 373 in 2020. Of these, an increasing proportion were performed out of hours over the timeline of the study period (49.1% in 2018, 54.5% in 2019 and 57.6% in 2020). The proportion of scans performed that yielded a positive result also increased each year within the study period, going from 26.5% in 2018, to 29.2% in 2019 and 30.2% in 2020.

QI04-B3   Eliminating Post-contrast Acute Kidney Injury (PC-AKI) In Patients With Advanced Kidney Disease: Guideline Adherence And Quality Improvement In Its Prevention

Participants
Raman Akif, MD, Leiderdorp, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Without rigorous analysis in the patient population allegedly most susceptible for post contrast acute kidney injury (PC-AKI), guidelines have historically relied on expert opinion and (sub)analyses conducted in the context of larger studies with patients with an estimated glomerular filtration rate (eGFR) of 30 ml/min/1.73m2 or greater. As to contribute to the advancement of more appropriate, patient-centered decision making in the field of PC-AKI prevention, this study provides an in-depth evaluation of the implementation of post-contrast acute kidney injury guidelines in patients with severely decreased renal function and renal failure (i.e., an eGFR 15-29 mL/min/1.73m2 and <15 mL/min/1.73m2, respectively). We intended to assess the degree of adherence in cases of contrast-enhanced computed tomography scans (CECTs) based on quality indicators as described in Dutch the PC-AKI guidelines. Additionally, we aimed to contribute to contemporary discourse surrounding the efficacy of hydration in the prevention of post-contrast acute kidney injury with recommendations regarding contrast medium safety protocols.

METHODS

A single center observational cohort study was conducted. Primary analysis evaluated protocol adherence outcomes related to contrast administration in CECTs such as per-protocol kidney function assessment, adherence to hydration protocols, and the incidence of PC-AKI, defined as an increase in serum creatinine (sCr) of 25% or an absolute increase >0.5 mg/dL both temporally and causally related to contrast administration. All included cases and related variables were verified by manual case review. Double robust analysis consisting of propensity score matching and conditional logistic regression was used to evaluate the efficacy of hydration in the prevention of PC-AKI.

RESULTS

713 CT-scans from 500 patients were included for primary analysis regarding protocol adherence. Aspects related to the period preceding contrast administration (i.e., pre-contrast kidney function assessment and intravenous volume expansion on the day of contrast administration) largely adhered to guideline recommendations. Among 713 cases, 556 (78%) received intravenous hydration on the day of contrast administration, of which 347 cases involved per-protocol 1.4% hydration with sodium bicarbonate (70% of hydrated cases). Overall adherence regarding the timing of pre-contrast kidney function assessment was uniformly high (710 out of 713 cases, 99.5%). Notably, evaluation of post-contrast kidney function assessment revealed a significant difference in

post-contrast kidney function assessment adherence between the outpatient and inpatient cohort (34% (N = 64 / 190) versus 94% (N = 355 / 377), respectively [P = <0.001]). Additionally, a large discrepancy was found between serum Creatinine (sCR)-based PC-AKI and PC-AKI based on manual case review (117 vs. 27, respectively). Of the 27 cases in which PC-AKI was deemed likely, only one involved an outpatient CT scan as opposed to 26 inpatients (P = 0.010). Furthermore, Initial findings in an unadjusted comparison of patients stratified based on whether intravenous hydration was administered (N = 446) suggested a significant difference in sCr-based PC-AKI and emergent renal replacement therapy = 30 days after contrast administration (P = .000 and 0.048, respectively). Nearest neighbor propensity score matching of 148 cases further underlines the necessity of accurately determining contrast-induced nephropathy in patients with advanced kidney injury as much of what is considered PC-AKI is largely confounded by its known risk factors.

QI04-B5   Women In Radiology: A Perspective From A European Country

Participants
Silvia Cayon Somacarrera, MD, Madrid, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To carry out an analysis of the situation of women radiologists in Spain and comparing it to that of the United States, where there is abundant data and studies.

METHODS

We carried out a survey among main Spanish hospitals (>300 beds), with a response rate of 60% (70 hospitals out of 118). In the survey, we asked for the number of women in each of the following positions: radiology department chairs from 2000 to 2020, current section chiefs, radiologists, residents and residency programme directors. In addition to the survey, data provided by the Spanish Society of Radiology (SERAM), the European Society of Radiology (ESR) and the National Board of Radiology were also included. All data included the total number and a disaggregation by gender. We obtained the following data from SERAM: - Current residents, first year residents from 2000 to 2020, residents' representatives from 1990 to 2020- Current radiologists, current radiologists in each radiologysubspecialty, radiologists from 2000 to 2020, awarded radiologists from 1988 to 2020 (Profession Award, Research Award, Spanish Radiology Foundation Awards and Gold Medals). - Board of directors of SERAM from 1916 to 2020, board of directors of each subspecialty society from 2000 to 2020, SERAM congress scientific committees from 1957 to 2020. - Radiología (Spanish Journal of Radiology): chief editors from 1912 to 2020. From the National Board of Radiology: presidents and vicepresidents from 1985 to 2021.The ESR data included the number of current women ESR members and women participants in the 2019 ESR congress.The following data were acquired from other public sources, also divided by gender, that included all medical specialties: - Medical residents in Spain in 2020. - Medical residents from 2009 to 2020, divided by specialty core (surgical, medical, others). - First year medical residents from 2015 to 2020. We reviewed literature data from the US in order to detect trends in gender disparity among Radiology physicians workforce and compared it to data from Spain and Europe.

RESULTS

Women represent 55% of current Radiology workforce in Spain, being this proportion higher than in Europe (40%) and the US (26%). In Spain, from 2010 to 2020, the average percentage of female radiology residents is 60%, while in the US this percentage decreases to 26-29% in the last years. We detected a drop in the presence of women as we moved into 'leadership positions': current radiology residents (56% women), current radiologists (55% women), current section chiefs (42%) and current department chairs (23%). This was also patent when analyzing the board of directors of SERAM, in which only 11% and 33% of presidents and vicepresidents, respectively, have been women. The same trend is followed in the SERAM congress scientific committees where only 25% presidents and vicepresidents have been women. Similarly, inequalities have been found in representation of women in the editorial committees of journals. In 2017, only between 19% and 37% of the editorial boards of the journals Radiology, AJR, Academic Radiology and Journal of the American College of Radiology were women. In Spain, none of the chief editors of the Spanish Journal of Radiology ('Radiología') has ever been a woman. In Spain, another remarkable fact concerning gender inequalities is found in awarded radiologists: only 13% of 'Gold Medallists', the highest distinction awarded by SERAM, have been women, the first one ever in 2002. The percentage of feminization found in the total group of medical residents in Spain is approximately 65%, while in the radiology residents it reaches an average of 56%. Within radiology departments, most feminized subspecialties are, in decreasing order: paediatric radiology (59%), breast (58%), cardio-thoracic (57%), gastrointestinal-genitourinary (57%), emergency (56%), musculoskeletal (52%), neuroradiology (38%) and interventional radiolo

QI04-B6   Reducing Child Distress And Improving Satisfaction Using 3D-printed Scanners In Pediatric Cross-sectional Imaging

Participants
Mark Rocco, BS,MD, Arabi, Louisiana (*Presenter*) Nothing to Disclose

PURPOSE

Pediatric patients and their caregivers undergoing cross-sectional imaging procedures have been shown to benefit from Certified Child Life Specialists, whose role in radiology includes preparation prior to imaging exams. Child Life Services that employ the use of mock scanners have been shown to improve imaging quality, compliance, and reduce the need for sedation. We propose that pre-exam preparation with a functional mock 3D-printed scanner with light and sound capability will reduce child distress and improve caregiver and technologist satisfaction.

METHODS

Physical 3D printed CT and MRI scanner models were created using Meshmixer and Cura stereolithography software. Models were printed using an Ender-5 and Ender-5 plus FDM 3D printer. The models were scaled to accommodate average-sized action figures and doll toys. Scanner beds are functional. Additionally, standard electronic components were obtained and assembled to enable both light, movement, and sound capability, offering realistic volume and quality of various MRI sequences.

RESULTS

After a short survey, high satisfaction rates were obtained and expressed by the Certified Child Life Specialists team and cross-sectional imaging technologists in our Pediatric Radiology Department. The mock scanner toy function system was easily integrated into standard Child Life protocols.

QI04-B7   Efficacy Of Pineapple Juice As A Negative Oral Contrast Agent In Magnetic Resonance Cholangiopancreatography

Participants
Alba Pugliesi, MD, Ludwigsburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

-to illustrate the role of MRCP in biliary pathologies -to show our MRCP protocol-to optimize the MRCP protocol with the use of high natural manganese content Juice (pineapple juice)

METHODS

MRCP Indications:MRCP is very useful to: -Avoid unnecessary ERCP (pancreatitis / perforation)-Indispensable to evaluate biliary obstructions due to choledocholithiasis, iatrogenic strictures, cholangiocarcinoma or pancreatic carcinoma.The quality of magnetic resonance cholangiopancreatography (MRCP) images is frequently degraded by high signal from the gastrointestinal tract. Most signallers containing ferromagnetic, ferrimagnetic or superparamagnetic compounds used are poorly tolerated by the patients and lead to nausea, flushing, abdominal pain, vomiting. Pineapple juice (PJ) is an oral natural negative contrast agent that we have been using in MRCP for more than a year valuating the quality of magnetic resonance cholangiopancreatography (MRCP) images higher, usually degraded by high signal from the gastrointestinal tract.Benefits pineapple juice:-Very good compatibility-No undesirable effects - 92% taste very goodOur MRI protocol:1) PRE-Injection -Multiplanar localizer -2D coronal T2-w single-shot FSE -3D axial FS T1-w in- and out of phase GRE w -3D coronal heavily T2-w FSE respiratory triggered MRCP at high resolution - 2 glasses high natural manganese and/ or iron content Juice (pineapple, raspberry)INJECTION 0,025 mmol/kg body weight/0,1 ml/kg, 1-2 ml/s, 18-20 G, bolus triggering2) POST INJECTION -3D axial FS T1-w GRE arterial, portal venous and delayed phase with higher spatial resolution -Diffusion-weighted imaging (axial) -2D Axial T2-w FSE -3D axial and coronal fat-suppressed T1-w GRE performed at 15-30 min after contrast injection.Standard pancreas protocol combined with pineapple juice induced MRCP provides morphological and functional details of pancreatic parenchyma and pancreatic duct showing a better visualization of the ductal system.

RESULTS

Our evaluation demonstrated that PJ shortened T2 relaxation time and hence decreased T2 signal intensity on a standard MRCP sequence to a similar degree to a commercially available negative contrast agent. Electrothermal atomic absorption spectrometry assay demonstrated a high manganese concentration in PJ of 2.76 mg/dl, which is likely to be responsible for its T2 imaging properties.

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Abstract Archives of the RSNA, 2021

Sub-Events

QI02-B2 New Development And Clinical Evaluation Of A Patient Face Recognition System (PFRS) In The Radiology Department

Participants
Hiroyuki Ota, Kashiwa, Japan (*Presenter*) Nothing to Disclose

PURPOSE

Patient misidentification can cause result in serious incidents in medical operations. In fact, twelve incidents have occurred in our radiology department in the last five years. Facial image recognition systems have been used in many fields to assist with proper identification. The purpose of this study is to develop a Patient Face Recognition System (PFRS) based on facial recognition technology, and to apply it to the authentication flow during CT imaging examinations for clinical evaluation.

METHODS

The PFRS (P-FAS01, Canon Lifecare Solutions Inc., Kawasaki, Japan) consists of a camera for registering face images paired with authentication application software. The system is linked to the radiology information systems (RIS) and with a surveillance camera in the CT scan room. The target patient registers his/her face image when checking in at the CT reception desk and links this image to the examination order information in the RIS. When the patient enters the CT scan room, the face image is compared with the surveillance camera image, and the face information is judged to be matched (successful authentication) based onan authentication score from the facial feature extraction software. System performance was evaluated with 153 patients (mean age 64 years, male/female ratio 1:0.68) who agreed to participate in this study. The authentication success rate was calculated based on the authentication score. In addition, regression analysis was performed on the correlation between basic patient information (Age and BMI) and the authentication score.

RESULTS

The facial recognition system was implemented smoothly for all target patients. Among the patients, 144 patients were successfully authenticated, and the authentication success rate was 94.1%. The mean and standard deviation of the authentication scores of the successful cases were 628 and 131, respectively. There were 9 unsuccessful authentications, including 3 cases in which the authentication score did not reach 450 (authentication scores: 420, 437, and 447), and the remaining 6 cases were not scored. No correlation was found between basic patient information and authentication scores. (Age: R=-0.18, BMI: R=-0.02) Patient authentication in preparation for imaging examinations is a fundamental tasks. However, there are several reasons why misidentifications may occur which can lead to inadvertent errors, including the use of hats, masks and sunglasses, and other causes. Patient authentication is based on double-checking, and cases of unsuccessful authentication provide an incentive to alert the operator staff.

QI02-B3 Clinical Importance Of Secondary Imaging Interpretations In A Cancer Hospital And Its Impact On Patient Management.

Participants
Mayur Virarkar, MD, JACKSONVILLE, Florida (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this prospective study was to evaluate the quality of outside hospital imaging and associated reports submitted to us for reinterpretation related to clinical care at our tertiary cancer center. We compared the initial study interpretations to that of interpretations performed by subspecialty-trained abdominal radiologists at our center and whether this resulted in a change in patient treatment.

METHODS

We performed an institutional review board-approved prospective, single-institution study of 915 consecutive outside computed tomography (CT) and magnetic resonance (MR) abdominal imaging studies that had been submitted to our institution between August 1, 2020, through November 30, 2020. The assessed parameters included the quality and accuracy of the report, the technical quality of the imaging compared to that at our institution, the appropriateness of the imaging for staging or restaging, usage of oral and IV contrast, and CT slice thickness. Clinical notes, pathologic findings, and subsequent imaging were used to establish an accurate diagnosis and determine the effect on clinical treatment. Discrepancies between the initial and secondary interpretations were identified independently by a panel of radiologists to determine changes in treatment. The effects of discrepancies on treatment were evaluated based on current treatment guidelines.

RESULTS

Of 744 CT (81%) and 171 MR (19.0%) outside imaging studies, 65% had suboptimal quality compared to the images at our institution, and 31% were inappropriate for oncological care purposes. Only 21% of CT studies had optimal slice thickness of < 3 mm. Of the available outside reports provided, 34% had discrepant findings. Discrepancies between secondary and initial

interpretations were identified in 131 studies. Of the 88 confirmed discrepant studies, 42 patients (48%) had a change in treatment based on the secondary interpretation.

QI02-B4   Improving Patient Follow-Up Imaging Using Artificial Intelligence

Participants
Jung Yun, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To improve patient compliance rates for follow-up imaging recommendations by implementing a natural language processing (NLP) algorithm and a tracking and reminder system that: (i) identifies patients who require follow-up imaging based on radiology reports; (ii) organizes follow-up recommendations by due date; and (iii) reminds patients of due or overdue recommendations.

METHODS

Our institution mails letters to patients with actionable findings in their radiology studies within 20 days of the examination to comply with the Patient Test Result Information Act (PA Act 112). All diagnostic radiology reports generated at our institution from January 1, 2020 through April 30, 2021 that complied with PA Act 112 were processed through a NLP algorithm (Within Health, Brooklyn, NY) to determine the recommended radiologic examination and the recommendation due date, which is based on a time interval that is either specified in the report or assumed to be 3 months from the date of the examination if no time interval was provided. The compliance range is the period in which a completed follow-up examination was deemed compliant with the recommendation and is defined in accordance with the American College of Radiology as the period that begins 30 days before and ends 60 days after the due date. The expiration date is defined as 60 days after the due date. Recommendations with completed follow-up examinations within the compliance range were deemed compliant. An automated tracking and reminder system (Within Health, Brooklyn, NY) was used to determine if follow-up imaging was scheduled or completed. The control group had an experimental period from January 1-February 28, 2021 and included all recommendations with expiration dates in this period. The intervention group had an experimental period from March 1-April 30, 2021 and included all recommendations with expiration dates in this period. A baseline compliance rate was calculated as the percentage of recommendations with completed or scheduled follow-up examinations at the beginning of the experimental period for the control and intervention groups. The at-risk population was defined as the number of recommendations at the beginning of the experimental period that did not have an associated completed or scheduled examination. Patients in the at-risk population of the intervention group received a short message service communication at the beginning of the intervention experimental period that encouraged them to speak to the ordering provider about actionable findings. Up to three additional notifications were sent to these patients unless the follow-up examination was either completed or scheduled. Patients in the at-risk population in the control group did not receive any communication during the control experimental period. The final compliance rates were calculated as the percentage of recommendations with completed or scheduled follow-up examinations at the end of the experiment period for each group. The percentage of recommendations in the at-risk-population that became compliant by the end of the experimental period was also calculated. In addition, the differences in the compliance rates and percentages of compliance rate change between the beginning and end of the experimental periods were also calculated. Fisher's exact test and chi-squared test were performed to compare the increase in compliance between the control group and intervention group. Statistical significance was set at P < 0.05.

RESULTS

The control group consisted of 364 recommendations and the intervention group consisted of 438 recommendations. At the beginning of the experimental period, 100 recommendations in the control group were compliant with a baseline compliance rate of 27.5% and 137 recommendations in the intervention group were compliant with a baseline compliance rate of 31.3%. The at-risk population was 264 recommendations in the control group and 301 recommendations in the intervention group. At the end of the experimental perio

QI02-B5   Assessing The Value Of Standardized Radiology Teaching Modules On Education Of Rotating Medical Students.

Participants
Nahill Matari, MS, Alpine, New Jersey (*Presenter*) Nothing to Disclose

PURPOSE

Medical students rotating through radiology are easily overwhelmed by the large amount of new information they are inundated with as the usual medical student curriculum does not include focused instruction in basic radiology. As educators while teaching medical students about radiology is important, it is also important to measure the effectiveness of the instructional methods. The purpose of this study is to demonstrate the effect of a standardized set of teaching modules on medical students' understanding of fundamental radiology principles.

METHODS

A standardized set of six teaching modules on fundamental radiology topics was developed for third and fourth year medical students rotating through our department to enhance their radiology training. Teaching modules in thoracic, gastrointestinal, genitourinary, ultrasound, musculoskeletal, and neuroradiologic imaging were created and presented to the medical students with the sessions moderated by radiology residents. A quiz consisting of ten questions testing fundamental radiology concepts was given to the students before and after the didactic series. Quiz scores were analyzed with descriptive statistics (mean, standard deviation, and confidence intervals) and a paired sample T-test to evaluate for statistical significance.

RESULTS

The average quiz scores of third (n=6) and fourth year medical students (n=11) significantly improved after the teaching modules. Third year medical students scored an average of 61.7% prior to the didactic series and 80.0% afterwards (P = 0.0001) while fourth year medical students scored 67.3% before and 79.1% after the series (P = 0.003). Quiz scores of the total population of medical students increased on average by 14.1%, 95% CI [8.6, 19.6] (Table 1).

QI02-B6   Tulip - The Ultrasound Labelling Improvement Project : A Quality Improvement Initiative To Decrease Specimen Labelling Errors

Awards
Quality Improvement Reports Award

Participants
Nirvikar Dahiya, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

Specimen labeling related errors occur in all healthcare settings and may include wrong labels, incomplete samples, or wrong specimen media. These can delay treatment, result in the wrong treatment, or require repeat procedures. An increase in the number of specimen-related errors in the MCA Radiology Ultrasound Division was identified after a period of increasing clinical volumes and a new electronic health record, despite multiple smaller interventions. A multidisciplinary team was convened to address this issue consisting of radiology process improvement specialists, ultrasound radiologists, ultrasound technologists, and radiology nurses. The group utilized DMAIC process improvement framework for this project. The baseline rate of specimen-related errors in the prior 6 months was .35 errors per 100 cases performed. The aim of this project agreed upon by the group was to decrease all specimen-related errors by 29% from a rate of .35 to a rate of .25 per 100 ultrasound procedures by May 1, 2021 without increasing turn-around-time for procedures.

METHODS

The baseline improvement measure was the number of specimen-related errors reported through the radiology Safety Event Reporting Form (SERF) system monthly per 100 Ultrasound procedures performed. The baseline balancing measure was the median turnaround time (TAT) in minutes, from the start of the procedure to the end of the procedure as documented in the electronic health records.The number of specimen-related errors by event type were reviewed collectively. A process map was generated through observation, which included specimen collection and handling. A failure modes effect analysis (FMEA) tool was used to pinpoint high risk process steps where errors could occur. Improvement ideas for the highest risk steps were evaluated using an Impact-Effort Grid.

RESULTS

Improvement ideas were generated using the Impact-Effort Grid and implemented including several major changes involving utilization of the electronic health record. Workflows were standardized between the ultrasound technologists, radiologists, and nursing staff. Physical changes are being implemented in the procedure rooms to ensure that all staff can access relevant information at the time of the procedure, and labels can be easily printed when needed. A control plan was finalized and implemented with monthly audits. Initial data (6 weeks) has shown zero specimen labelling events since the improvement phase began. There have been several good catches identified where potential errors were caught due to new changes in the workflow.

QI02-B8 Improving Operational Efficiency In Outpatient Radiology Using Artificial Intelligence

Awards
Quality Improvement Reports Award

Participants
Rajendra P. Kedar, MD, Tampa, Florida (*Presenter*) Nothing to Disclose

PURPOSE

Healthcare in general, and Radiology in particular, is suffering from ever-increasing costs and lowering reimbursement rates. We see that there has been a paradigm shift in many other industries around us, in the name of efficiency improvements: Agile methodologies in Information Technology, automation, and electro-mechanical systems in manufacturing, autonomous cars, Robo-advisors in finance, etc. It is very apparent to us that we risk becoming obsolete if we don't keep up with the new advances. Outpatient Radiology is a high fixed-cost business, where the marginal cost of performing an additional scan on an already existing machine is relatively low. Given that the machines are our most expensive resources, utilizing them to their maximum potential becomes necessary. This is not very dissimilar to an airline, where the capital-intensive nature calls for the highest operational efficiency. The reality for us is that over one-third of the available capacity of these machines is not utilized. This happens due to a variety of different reasons, most of them outside our control: Patient's no-shows, cancel or reschedule at the last minute, arrive late, etc. While there are a variety of technologies available to prevent some of these, such as reminder services, these factors cannot be completely eliminated. There are other factors on top of these, which contribute to making the capacity itself unavailable, such as unexpected maintenance, technologist calling off last-minute due to sickness, etc.

METHODS

The airlines seem to have a good handle on the problem. As per the Bureau of Transportation, on average, US Airlines had about 85% of the available seats occupied in 2019. We notice that they have solved the problem utilizing three different approaches: Having customers pay even in case of a no-show, asking for additional payment to reserve a specific seat (slot), and having smart overbooking models to predict, and pre-emptively fill, the capacity that would have been wasted otherwise. We, up until now, had not been able to do any of this, for various reasons. Starting last year, we have made significant headway in solving this problem. We brought on the power of Artificial Intelligence, which helps us predict the capacity that is about to go unutilized. We are able to couple that with a patient outreach module, which contacts the patients, offering capacity that is updating in real-time, and if the patient opts to come in, updates their appointment time in our RIS; all without any manual effort on our part. The process is so seamless and efficient that most of our operational staff don't even know that it is running in the background. All we see is the increased traffic of patients going in and out of the facility. As we made this change, we were able to monitor each and every patient who accepted the predicted slot, and we were able to compute the efficacy of the approach.

RESULTS

This approach has increased our overall machine utilization somewhere in the region of 600 to 800 basis points throughout our system. In the process, we were also able to tackle a related problem - obtaining the prior authorization of patients. Ensuring that a patient visit meets the prior auth requirements set out by payors and is ready to be scanned used to be a very manual process for us. We now have the capability to automate this process for more than 80% of our patient visits. This not only drastically reduces the manual errors in the process but also helps reduce the manual workload, and hence, personnel-related costs, by as much as 50%, for that department.

QI02-B9 Fast And Efficient Serial Tumor Assessment Without The Need For Dictation

Participants
David J. Vining, MD, Houston, Texas (*Presenter*) Royalties, Bracco Group;CEO, VisionSR, Inc;Stockholder, VisionSR, Inc

PURPOSE

Serial tumor assessment is often tedious and time-consuming when processing multiple exams containing numerous lesions. Furthermore, human and/or transcription error introduced during dictation may result in the reporting of incorrect measurements and/or image locations. To expedite the process and eliminate error, we interfaced an interactive multimedia reporting system to a PACS so that DICOM images and measurements can be input directly into a report without the need for dictation.

METHODS

We developed an interactive multimedia reporting system that uses an application-programming interface (API) to transmit DICOM images and data (i.e., metrics, series & image numbers) into a report as a radiologist measures tumors in a PACS display. After baseline tumors are recorded, the radiologist labels each finding with metadata to describe its anatomy and diagnosis. During subsequent exams, the radiologist performs the following steps to create links between serial findings: (1) the radiologist "activates" a prior annotated finding in the interactive report by clicking on it during an edit mode, (2) he/she measures a corresponding new finding in the PACS display, (3) the radiologist presses a speech microphone function button to initiate data transfer that is linked to the activated finding, and (4) the process is repeated for each finding that is being assessed. There is no need to dictate any description about the finding unless desired as the prior finding's metadata is transferred to the new finding and any measurement data is incorporated via the PACS interface. In the absence of additional dictation, automated text is generated to describe the finding, for example, "Metrics only recorded. The Liver, segment 6 - Metastasis measures 10 x 20 mm on image 50 of series 2." The new data are displayed in a graphical timeline along with any corresponding prior linked data. Findings designated as target lesions are used in the calculation of disease response criteria, including RECIST and/or immune-related response criteria.

RESULTS

Substantial time-savings averaging greater than 10 sec/finding is achieved using the automated process as it eliminates the need for redundant dictation of measurements and related image/series numbers for incorporation into the multimedia report. This time-savings is cumulative depending on the number of findings contained in a report. We have found that the system is efficient enough to allow for the capture of more findings per report so that our cancer-related reports contain disease measurements for 5 times or more the number of findings reported in a conventional radiology report, depending upon the number of findings present. Furthermore, the direct transmission of DICOM data into a report eliminates human and/or transcription errors when reporting tumor assessments.

QIO2-B-HC1 The Sonographic Murphy Sign: Does Analgesia Matter? A Single Center Retrospective Study Demonstrating Increased False Negative Diagnoses (missed Acute Cholecystitis) After Opioid Analgesia.

Participants
Elianna Goldstein, MD, Tripler Army Medical Center, Hawaii (*Presenter*) Nothing to Disclose

PURPOSE

There is an absence of diagnostic radiology based research on the impact of premedication on the sonographic Murphy sign (SMS). The SMS is defined as maximal tenderness elicited when the transducer probe is pressed over a sonographically localized gallbladder. Controversy exists regarding the diagnostic accuracy of the SMS when patients are given pain control medications prior to their right upper quadrant ultrasound. This study addresses the effect of opioid analgesia on the SMS and on final radiologic diagnosis with comparison of sensitivity and specificity of the SMS for acute cholecystitis with or without opioid analgesia. This study also addresses radiology/emergency department/pathology diagnostic concordance or discordance for acute cholecystitis.

METHODS

This study consists of a retrospective cohort chart review to test the null hypothesis: that assessment of the SMS is similar in patients who received and did not receive prior opioid analgesia. The study was conducted at diagnostic radiology residency program with a Level II, tertiary care emergency department. The attending radiology staff are board-certified or eligible and the emergency staff are board-certified. Ultrasound examinations were performed by experienced technologists all of whom had at least 7 years of experience. The research subjects consisted of 686 adult patients who presented to the emergency department with unspecified abdominal pain and had either a right upper quadrant or gallbladder ultrasound during the study period from January 1, 2018 to September 1, 2019. 29 of these ultrasound exams were repeat exams from patients who had been previously scanned at least once during the study period for a total of 715 ultrasound exams for 686 individual adult patients. 23 patients scanned had no gallbladder at the time of the exam, 9 patients had no annotation of present or absent SMS, and 1 patient had pathology done at an outside hospital; these patients were therefore excluded. 682 ultrasound exams were analyzed. Null hypotheses were tested regarding prior opioid analgesia and false positive and false negative radiologic exams. The null hypotheses that the sensitivity and specificity of the SMS did not change with prior opioid analgesia versus no prior opioid analgesia was also tested for radiographic diagnosis, emergency department diagnosis, and pathologic diagnosis.

RESULTS

Reject the null hypotheses that opioid administration does not affect the SMS (p &lt .001 with 2x3 chi square test). False positive radiologic diagnosis is not significantly affected by opioid administration (p=.0936, 2x2 chi square test). This represents 25 cases of false positive diagnosis of acute cholecystitis. False negative radiologic diagnosis is significantly affected by opioid administration (p &lt .0219, 2x2 chi square test). This represents 22 cases of radiologic missed cholecystitis. Premedication with opioids prior to ultrasound was significantly affected by a pathologic diagnosis of acute cholecystitis versus other diagnoses (p &lt .0001, 2x2 chi square test). The sensitivity and specificity of positive SMS are 41.4% and 91.5%, respectively. Accept the null hypothesis that opioid analgesia does not affect the sensitivity and specificity of the SMS for pathologic acute cholecystitis (p=.500 and p=.575, respectively, chi square test). Accept the null hypothesis that opioid analgesia does not affect the sensitivity and specificity of the SMS for pathologic acute cholecystitis (p=.500 and p=.575, respectively, chi square test). Accept the null hypotheses that opioid analgesia does not affect the sensitivity and specificity of the SMS for radiologic, emergency department, or pathologic acute cholecystitis, and that there is not significant difference in final diagnosis between radiology and emergency department (p=.736), radiology and pathology (p=.427) and pathology and emergency department (p=.704).

Abstract Archives of the RSNA, 2021

Sub-Events

QI03-C3   Incorrect Count Intra-Operative Radiographic Protocol Quality Improvement

Participants
Abigail R. Cogman, DO, Salt Lake City, Utah (*Presenter*) Nothing to Disclose

PURPOSE

A retained surgical foreign body (FB) is considered a "never event" by the Joint Commission and Department of Health and Human Services. In the event of an incorrect surgical count, an intra-operative radiograph (IOR) is performed. Inadequate communication between surgery and radiology regarding the nature of the missing item could lead to misdiagnosis/misinterpretation of a retained FB on the IOR. This project aims to increase patient safety by improving communication, thus reducing the chance of this never event.

METHODS

A multi-disciplinary team of radiologists, surgeons, OR nursing team, and radiology technologists addressed the problem related to incorrect count IOR. One challenge was that radiologists did not know what a missing object looked like. A decision was made to take a radiograph of the missing object when the count was off. The policy was approved by the peri-operative executive committee. To measure the new policy's impact on radiologists' confidence, a two set survey was administered to radiologists (N=60), the first set without and later set with a radiographic example of the missing object. Radiologists were asked if the FB is present on IOR and to rate their confidence level on a scale of 1-5, 5 being the most confident. The total survey completion rate was timed.

RESULTS

There were similar rates of the accuracy of FB detection. However, the survey results illustrated that the number of radiologists rating their confidence at 4 or 5 increased from 42% to 85% with the addition of the missing object's radiograph. The time spent completing the survey was also decreased by an average of 25% with radiographic examples.

QI03-C4   Impact Of Breast Imaging Nurse Navigation On Care Timeliness, Compliance And Retention

Participants
Melissa Tannenbaum, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

The healthcare landscape continues to move towards value-based care models. The purpose of our study was to determine the impact of breast imaging nurse navigation (NN) on patient care time metrics, compliance, and care retention at our academic medical center after biopsy.

METHODS

An IRB-approved retrospective review of patients who underwent breast core biopsy was performed before (5/1/17-6/30/17) and after (5/1/19-6/30/19) the implementation of a breast imaging nurse navigator position at an academic medical center. Patients with breast aspirations, inpatients, and patients with stage 4 disease were excluded. In patients with multiple biopsies, the first biopsy was considered the index biopsy. Time points collected included core biopsy date, finalized pathology report date, result communication date, initiation of care post-biopsy date (another biopsy, clinic visit, MRI), and surgery date (when applicable). Follow-up recommendations were collected and classified as 6 month imaging follow-up, additional biopsies, breast MRI, breast care center appointment, and surgery. Compliance with recommendations was also captured. Other data collected included who contacted the patient with results (breast imaging staff including NN, referrer, other), breast pathology (benign, atypia, cancer) and patient demographic data (age, race/ethnicity, language, insurance type, and education level). Calculated time metrics included time from biopsy date to finalized pathology report, time from finalized pathology report to biopsy result communication, and time from result communication to recommended follow-up. Compliance was defined as those who arrived for follow-up appointment within one month. Care retention was defined as those patients with cancer diagnosis who underwent breast surgery at the home institution.

RESULTS

413 patients comprised our study population (mean age 54 years). 51% (210/413) were before (pre-NN) and 49% (203/413) were after (post-NN) nurse navigator implementation. 60% (248/413) patients identified as white, 17% (71/413) as Asian, 13% (55/413) as black/African American, 5% (21/413) as Hispanic/Latino, and 4% (18/413) as other/not specified. 81% (334/413) spoke English and 19% (79/413) were non-English speaking. 65% (268/413) had private insurance and 35% (145/413) had other insurance (Medicare, Medicaid, other). Incidence of cancer was 27.6% (58/210) in the pre-NN group and 20.2% (41/203) in the post-NN group. There was no significant difference in time from finalized pathology report to communication of results pre-NN vs post-NN, with median of 1 day. This was true regardless of language, race, or insurance. The patient was directly contacted to discuss biopsy results by breast imaging in 3% (6/210) pre-NN compared to 73% (148/203) post-NN (p<0.0001). In cases where breast imaging did not contact the patient directly, the patient was contacted with results by the referrer. Language did not impact

likelihood of being contacted with results by imaging. The median time from result communication to recommended follow-up and the time from biopsy date to surgery were significantly longer post-NN compared to pre-NN (14 vs. 7 days, p<0.0001; and 68 vs 49 days, p<0.0001, respectively). This remained when analyzed in patients with and without cancer. There was good compliance with our recommendations in both groups, 89% pre-NN and 88% post-NN (p=0.7). Those with private insurance were more likely to be compliant with recommendations (p=0.015). There was greater care retention at our institution post-NN (85%; 35/41) compared to pre-NN (78%; 45/58) though the difference was not statistically significant.

QI03-C6 A Performance Monitoring Framework Implementation At A Public Hospital's Radiology Department To Regularly Evaluate Performance Metrics Of A Chest Radiograph AI Model

Participants
Ivan Ho Mien, MBBS, PhD, Singapore, Singapore (*Presenter*) Nothing to Disclose

PURPOSE

Machine learning systems are increasingly showing potential for achieving clinical expert level performance. As such, there are growing efforts to deploy these systems in radiology practice. Accordingly, there is increasing recognition of the necessity to monitor performance of machine learning models after deployment in actual clinical workflow. Specifically, good performance on retrospective trial datasets does not guarantee acceptable future performance in routine real-world practice. This could be due to factors such as source data drift and changes in disease prevalence. Therefore, end-users relying on AI models need the ability to regularly and conveniently evaluate model performance relative to required specifications. Only then can they be informed about performance degradations and trigger the necessary model removal, revision, or refresh in a timely manner. To this end, we designed and implemented a performance monitoring framework to monitor the performance of a deep learning-based chest radiograph (CXR) classification model over time. Our approach enables collection and analysis of longitudinal model performance data and enables better visibility and greater reliability for end-users.

METHODS

We deployed a CXR classification system for triaging of studies with urgent findings at a major public hospital's radiology department. The system accepts CXRs from PACS as inputs and generates positive or negative inferences on 14 different labels specified in the publicly available CheXpert dataset. Our performance monitoring system first collates lists of CXRs forwarded to the AI system in 24-hour periods, then randomly samples 20 CXRs from each period for evaluation against their ground truth labels. These labels were obtained by manual annotation of sampled CXRs with the aid of their accompanying radiology reports. We computed performance metrics including accuracy, sensitivity, and specificity over time and visualized the results on a Shewhart control chart. To alleviate the burden of manual ground truth annotation, we also implemented the publicly available CheXpert natural language processing (NLP) enabled labeler to efficiently generate image labels. We then compared the manually and automatically generated labels with the AI model predictions. After implementation, we also surveyed end-user radiologists to assess their perception on the impact of our performance monitoring tools on their workflow and the reliability of the deployed AI system.

RESULTS

Our performance monitoring framework was able to integrate with existing healthcare IT and imaging infrastructure at our radiology department. Further, the graphical dashboard in our framework provided synoptic visual feedback on performance of the deployed model over time when conducting quality control and audits. End-users expressed increased reassurance and confidence operating alongside the AI model in the knowledge that a performance monitoring system is in place. Although image labels generated by automated NLP labelling are currently not as good as manual annotations, they do enable more efficient and passive performance monitoring for a higher volume of images.

QI03-C7 Leveraging 3D CAD Divergent Ray Simulation Tools To Improve Design, Accuracy And Evaluation Of A Radiographic Marker That Estimates Head Of Bed Angle In Portable Chest X-rays

Participants
Javier Mendez, BS, Bethesda, Maryland (*Presenter*) Nothing to Disclose

PURPOSE

Chest x-ray (CXR) examinations are performed daily on most intensive care unit (ICU) patients throughout the world. Portable CXR (pCXR) examinations are performed on patients in their hospital bed when they cannot be transported to the radiology department for an upright (erect) posteroanterior and lateral CXR. Radiologic technologists (RT) are required to place a lead radiographic marker indicating the left or right side of the patient. To optimize interpretation of the images, it is imperative to know the head-of-bed angle (HOBA) to evaluate serious conditions across serial pCXRs obtained over time, especially when differentiating effusions from consolidations (like pneumonia). Technologists frequently include a marker (in addition to the left or right) to indicate HOB position, e.g., "erect", semi-erect or "supine". However, these subjective arbitrary markers are not clinically useful due to lack of agreement on what angles to apply them. Therefore, pCXR interpretation by radiologists and intensive care physicians would be improved (and patient care as a result) with markers that objectively record HOBA. A marker prototype, X-clometer, was developed to mitigate this systematic deficiency of objective HOBA data. However, it was initially designed by experimentation without taking into consideration the divergent nature of the X-rays, which negatively impacted accuracies, especially in the outer edges of the cassette (sometimes up to 30° off). We redesigned the original prototype to significantly improve precision of HOBA estimation by simulating the pCXR environment with divergent X-rays using 3D CAD software.

METHODS

The pCXR system simulation (pCXRSS) includes the X-ray cassette, the pinhole-like X-ray source, the X-clometer, and the divergent X-rays from the X-ray source through the center of the rolling ball at selected angles (projection rays). The projection rays were simulated for 0°, 30, 45°, 60°, and 90° HOBA. Simulation was performed for a 43.2cm x 35.6cm X-ray cassette with the upper right corner of the inclinometer region of the X-clometer positioned within the field-of-view at 2cm and 2.5cm from the top and right edges of the cassette, respectively. The simulated X-ray source was centered and placed at 127cm distance in respect to the cassette. However, the system can be adopted to any cassette size/orientation, as well as the X-ray source and the X-clometer locations.Another major modification was rotating the channel's (tubular structure that provides a path for the ball to roll) plane of reference by 45° in respect to the cassette. Rotating the channel towards the X-rays allows to improve distribution of the markers. This allowed a more granular reading of the ball position in the 60° to 90° range, further improving accuracy of the HOBA estimation.pCXRSS was implemented in both Solidworks ®(Dassault Systèmes SolidWorks Corporation, Waltham, MA) and Fusion 360 (Autodesk Inc, San Rafael, CA).

RESULTS

The X-clometer (publically available on the NIH 3D Print Exchange) was evaluated by an experienced radiologist and several technologists. Preliminary results obtained with a chest phantom and clinical examinations at participating centers indicate an agreement between the HOBA recorded by the X-clometer on radiographs and physical inclinations of the bed set and recorded by the RT. Recently, a team of five RTs used the X-Clometer during clinical examinations over a period of two weeks. As a quality measure, HOBA recorded with the X-Clometer on 25 radiographs were within 5° of the manually noted HOBA on the hospital bed inclinometer.

QI03-C8   Quality And Cost Assessment For The First One Year Of A Radiology-based 3D Printing Section

Participants
Prashanth Ravi, PhD, Cincinnati, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Three-dimensional (3D) printing is increasingly performed within radiology departments for anatomic models, with limited printing of surgical guides. There is considerable anecdotal evidence that 3D printing adds value for specific clinical scenarios. However, to our knowledge there are no specific Quality Improvement (QI) reports that detail the quality delivered to a medical center. The 3D Printing section is new in comparison to the traditional sections in a radiology department, and thus quality metrics can be defined during program creation. In theory, these metrics could be shared across organizations to improve the overall quality of this new service offered by radiologists working in hospitals and medical centers, also known as at the Point of Care (PoC).

METHODS

This project was proposed by the department QI program, but was also reviewed by the institutional human research committee, after which the need for written informed consent was waived. All activities during the first one year of the 3D Printing Section structured within an academic radiology department were prospectively collected during a weekly institutional-wide 3D printing meeting. This meeting included all members of the radiology-based team, plus referring clinicians and as needed industry and/ or other representatives. Quality was a separate component of each meeting; these prospectively collected data were retrospectively reviewed for this project. As applicable, data was entered into the ACR/RSNA 3D printing registry, with separate databases maintained internally by the laboratory leadership. Quality points were defined for each service, and these were evaluated weekly. All laboratory costs (human resources, hardware, software, and materials) were tallied, so that the quality metrics could be assessed with respect to the first 1-year of costs of launching a medical 3D printing program with a radiology department at the PoC.

RESULTS

All minutes were captured from the 3D Printing Section weekly meeting, with formal quality assessment. There were additional ad hoc meetings outside of the weekly meetings - in general these meetings did not generate minutes and the data from these meetings were excluded from this QI project analyses. There was a roughly 3 month period of COVID-19 specific 3D printing (see run chart); these minutes and data were excluded from this QI project. The HR included one part-time radiologist and one full-time engineer. Four other radiologists consistently contributed to the QI project. Six referring physicians consistently provided QI feedback in the form of Likert scores and intraoperative measurements and/or photographs. The lab used one major commercial segmentation package plus several additional ad hoc software tools (e.g. for traditional 3D visualization and virtual reality). These were used when either requested or considered necessary by the radiologist. The laboratory 3D printed 88 patient specific models among those evaluated for segmentation, and provided 35 educational models as requested. Data from all patient specific models was captured for the ACR/RSNA 3D printing registry. The following areas were identified for QI: data transfer, volumetric image quality, segmentation, print failure, entry into the electronic medical record (EMR), Likert data feedback from referring clinicians, and model delivery. Data transfer quality was improved by documenting the best imaging series (e.g. thin section CT images) in the 3D printing report. Three patients did not have adequate image quality; specific 3D printing imaging protocols improved quality. There were 5 segmentation QI opportunities, and these decreased in monthly frequency during the 1-year evaluation with experience and feedback. Print failure is common, and specific costs associated with this QI opportunity were assessed. EMR reporting was improved with incremental integration of reports into the hospital-based system. Feedback from requesting physicians was problematic early in the first one year of the 3D printing

QI03-C-HC1 Sustainable Reduction In Complete Abdominal Ultrasound Downcoding Following Introduction Of Structured Reporting

Participants
Eric Pepin, PhD, MD, Farmers Branch, Texas (*Presenter*) Nothing to Disclose

PURPOSE

Complete abdominal ultrasound reporting requires inclusion of eight imaging elements: common bile duct, gallbladder, inferior vena cava, kidneys, liver, pancreas, spleen, and upper abdominal aorta (CPT® 76700). Reports including fewer than eight elements are downcoded to limited abdominal ultrasound (CPT® 76705), resulting in several negative outcomes, including lost revenue, potential for unnecessarily repeated exams, possible missed findings, time cost by radiologists and billers addressing reporting shortcomings, possible delays in patient management and compromised patient care, and dissatisfaction of referring clinicians. It was proposed that implementation of a structured report template including prompts for the required imaging elements would reduce the percentage of complete abdominal ultrasound studies that are downcoded to limited abdominal ultrasound studies by a statistically significant amount by the end of the first year.

METHODS

Retrospective analysis by L.A. and the Billing and Coding department at an academic medical center of Q4 2016 complete abdominal ultrasound studies determined the rate of down-coding for incomplete reporting. Subsequently, a mandatory structured report was created for complete abdominal ultrasound reports with input from radiology faculty and residents. Within the dictation software (PowerScribe 360; Nuance, Burlington, MA), the template was set to automatically populate in the report document when a complete abdominal ultrasound study was opened for interpretation. Billing and collection data were analyzed at monthly intervals for 5 months following implementation and also for quarterly comparisons 1-year and 2-years post implementation to determine the percentage of down-coded exams. A Pearson's Chi-squared test was used to determine statistical significance at the 95% level.

RESULTS

During FYQ2 2016, 26.6% (300 of 1128) of orders for complete abdominal ultrasound were downcoded to limited abdominal ultrasound due to reporting inadequacies. In the first full month following template implementation, the down-coding rate was 10%. The down-coding rates for FYQ2 in 2017 and 2018 were 2.6% and 3.1% respectively (p<0.01). At a difference of 0.22 RVU per exam for facility and non-facility services, the total quarterly fiscal impact was approximately $37,900 USD retained using 2017 Medicare reimbursement levels. The quarterly report addenda rate decreased by 64% in FYQ2 2017 and by 53% in FYQ2 compared to FYQ2 2016 (p<0.01).

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Sub-Events

QI01-A1   Improving Timely Post-procedural Documentation In The Electronic Health Record After Interventional Radiology Procedures

Participants
Albert C. Li, MD, Livingst, New Jersey (*Presenter*) Nothing to Disclose

PURPOSE

The medical record is the principal means of communication among healthcare providers in matters related to patient care and documentation should always be timely. According to an American hospital regulatory agency, The Joint Commission (TJC), when a high-risk procedural report cannot be immediately entered into the medical record, a progress note of brief contents is to be entered to the medical record before the patient is transferred to the next level of care as required by TJC. Such immediate post-procedural documentation is also supported by several American radiologic professional societies. The interventional radiologists were routinely documenting the procedure; however, it often was not documented prior to transfer to the next level of care. This project sets to address this deficiency.

METHODS

Aim was to obtain 85% compliance of timely post-procedural documentation in the electronic health record (EHR) by the interventional radiologist on all interventional radiology procedures prior to transfer to the next level of care within 4 weeks of implementation. A "SmartText," which is an EHR shortcut that allows customized text to populate a document, was created 4 weeks prior to implementation, tested by 3 interventional radiologists, and made available to all interventional radiologists. An email explaining the project scope and timeline along with detailed instructions and screenshots was sent to all interventional radiologists 2 weeks prior to implementation. After implementation, weekly emails to all interventional radiologists and key hospital stakeholders evaluated deidentified data and incorporated plan-do-check-act cycles. The weekly progress email served as an encouraging reminder.

RESULTS

Baseline immediate post-procedural documentation was 0%. By implementation, documentation increased to 95%. Documentation reached 100% by week 1 and was sustained through the final week of data collection.

QI01-A4   Using AI And Natural Language Processing To Identify Imaging Follow-up Recommendations

Awards
Quality Improvement Reports Award

Participants
Adam Kirell, MENG, New York, New York (*Presenter*) Employee, Within Health

PURPOSE

Half of all diagnostic follow-up recommendations are delayed or missed, resulting in 80,000 excess deaths per year, $40B in unnecessary services and readmissions, and $20B in lost hospital revenue. Radiology practices have limited visibility into the quantity and quality of follow-up recommendations. This study looks at the effectiveness of using AI for digital tracking of follow-up recommendations.A natural language processing (NLP) algorithm (Within Health) will accurately classify radiology reports with recommendations for imaging follow up, and extract key data. The NLP algorithm will maintain > 90% true positive rate and process reports with less time and effort when compared to manual tagging.

METHODS

The NLP rules based algorithm analyzed 1392 radiology reports dictated by board certified radiologists at a single academic hospital system. Rules (Table 1) were applied to each report to determine if the report contained a recommendation for further imaging. The reports were manually tagged by 3 staff members trained on NLP rules. The output from the NLP algorithm and processing time was compared to those from the manually tagged reports.

RESULTS

The NLP algorithm identified 872 reports that contained imaging recommendations and 520 reports that did not contain imaging recommendations. Manual review demonstrated 738 radiology reports containing imaging recommendations and 654 without. Of the 738 manually tagged positives, the NLP identified 725 (98.2%). Of the 654 reports that were manually tagged negative, the NLP identified 507 (77.5%) (Table 2). NLP processing time was 0 hours. Manually tagged processing time was 4 minutes per report (93 hours).

QI01-A5 Improving The Quality Of Follow-up Recommendations For Incidental Abdominal Aneurysms

Awards
Identified for RadioGraphics
Quality Improvement Reports Award

Participants
Natasha Larocque, MD, Hamilton, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

National guidelines currently exist providing evidence-based management recommendations for a variety of incidental radiologic findings. However, penetration of these practices is relatively low on the local level. In order to improve implementation of this practice in our department, we proposed development of institutional guidelines that would be based on national guidelines with the feedback of local referring physicians. The purpose of this project is to use a gap analysis of national versus institutional guidelines to:1) Identify recommendations that can be developed and instituted at our hospital2) Assess impact of standardized institutional recommendations on imaging follow-up and specialist referrals

METHODS

A gap analysis between national and our institutional guidelines was performed. We identified abdominal aneurysm recommendations as a gap that could be improved with standardized institutional guidelines. In collaboration with our vascular surgery department, we developed evidence-based institution-specific guidelines for the management of abdominal aortic, renal, and splenic artery aneurysms. Macros containing these guidelines were then programmed into our dictation software. An educational session discussing these new recommendations was provided to the radiology department prior to implementation. The new abdominal aneurysm recommendations were implemented on February 1, 2021. A retrospective chart review was conducted for February 1-April 30, in 2019, 2020, and 2021 to assess the frequency of use of our new recommendations over a similar time frame, and to assess the impact on imaging follow-up and specialist referral.

RESULTS

Abdominal aortic aneurysms (AAA): In 2019, 2020 and 2021 a total of 90, 75 and 103 incidental AAAs were identified respectively. Reports recommended correct follow-up for AAAs in 8 (9%) cases in 2019, 13 (17%) cases in 2020 and 39 (38%) cases in 2021. In 2019 and 2020, 8 (9%) and 9 (12%) patients in these respective years had new vascular surgery consultations for AAA management following their scan. In 2019 and 2020, 15 (17%) and 13 (17%) patients in these respective years had imaging follow-up to re-assess the AAA.Splenic artery aneurysms (SAA): In 2019 and 2020, 46 and 25 incidental SAAs were detected, with 3 (7%) and 0 (0%) reports describing the correct follow-up in the respective years. Preliminary data from February and March 2021 detected 42 SAAs, with 12 (29%) reports containing correct follow-up recommendations.Renal artery aneurysms: In 2019 and 2020, 16 and 8 cases of RAAs were detected, with 0 (0%) reports describing the correct follow-up for 9 and 5 cases (in the respective years) that required follow-up due to size greater than 1.0 cm. Preliminary data from February and March 2021 identified 9 RAAs with 1 (17%) report including correct follow-up recommendations.

QI01-A6 Appropriateness Of Ultrasound Requests For Evaluation Of CT Detected Incidental Thyroid Nodules (ITNs)

Participants
Uzoma Nnajiuba, MBBS, Liverpool, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

An ITN is a thyroid nodule not previously detected or suspected clinically but detected on imaging. Improvements in quality of imaging and fear of litigation has led to an increasing number of ITNs being detected on CT. However, there is significant variability in how these are reported by radiologists owing to a paucity of guidance from professional organisations. The nature of thyroid US means that there is a low threshold for performing invasive fine needle aspiration (FNA) on indeterminate nodules. Once FNA is performed it can be difficult to confirm benignity on cytology, thus triggering an anxiety inducing process of repeat FNA and ultimately diagnostic hemithyroidectomy with associated morbidity, which frequently reveals a benign lesion. This is in the context of thyroid cancer, which typically has an indolent course, even if confirmed, and especially if detected incidentally. The authors observed a high rate of US requests for evaluation of CT detected ITNs in their regional head and neck unit. They therefore sought to establish whether these US referrals were justified and how many of the ITNs proved to be malignant on cytology.

METHODS

A search was performed on the hospital RIS for all US or US + FNA requests generated from CT studies between 01/01/17 and 01/01/20. This produced 40 results. The CT study of each case was then reviewed to assess whether the referral was appropriate using the best available guidance in the literature, primarily the American College of Radiology (ACR) 2015 White Paper for Incidental Thyroid Nodules and the British Thyroid Association (BTA) 2014 Guidelines for the Management of Thyroid Cancer. An US referral was deemed appropriate if the CT appearances of the ITN were suspicious by the ACR criteria or the BTA criteria or were judged by the authors, one of which was a subspecialty head and neck radiologist with >5 years experience, to be suitably atypical for some other reason not stated in the guidelines. The authors also recorded the original indication for the C; whether the CT appearances represented a nodule or goitre; whether the reporting radiologist had explicitly recommended US evaluation; the US findings (U Classification), any subsequent FNA performed and the cytology results.

RESULTS

Of the 40 CTs, 20 described a thyroid goitre, 17 described a thyroid nodules, 2 described multiple nodules and 1 described some ill-defined low attenuation change. This is problematic as the available guidance applies on to thyroid nodules and not goitres. Further evaluation with US was explicitly recommend by the radiologist in 24 reports while 15 did not recommend US evaluation and the remaining scan report advised clinical correlation +/- US. Therefore a significant proportion of US requests were being made from non-radiologists without radiology recommendation. The authors deemed 20 US referrals to be appropriate, 17 inappropriate and were undecided on 3 cases. The undecided cases were those where the indication of the study was cancer related and therefore the authors were unsure whether detection of an ITN on CT in such cases would warrant US evaluation, even if the nodule did not meet ACR or BTA criteria. On US, 34 of the referred thyroids had benign (U2) appearances while 6 were U3 or greater and therefore underwent FNA. Of the 6 thyroid nodules aspirated, 5 were benign on cytology (Thy2) while one was an indeterminate follicular neoplasm (Thy3f) requiring diagnostic hemithyroidectomy to establish malignant potential. The patient with the Thy3f lesion was elderly and died from unrelated causes before any further investigation could occur.

QI01-A7   Improving Image Quality of Intrahepatic Portal Veins With Dual-energy Spectral CT Imaging Andadaptive Statistical Iterative Reconstruction

Participants
Jun Yao, Ankang, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the clinical value of dual-energy spectral CT imaging and adaptive statistical iterative reconstruction (ASIR-V) in improving image quality of portal veins.

METHODS

Forty patients undergoing abdominal CT angiography of the portal veins using dual-energy spectral imaging mode on a GE Revolution CT were prospectively collected. The 120 kVp-like images were first reconstructed with 40% ASIR-V to simulate the conventional imaging condition in the control group. The spectral monochromatic images at 40-70 keV (intervals of 10 keV, 4 levels) were reconstructed in combination with 40%, 60%, 70%, 80% ASIR-V (4 levels) to generate 16 image sets in the study group. The CT numbers and their standard deviation (SD) of the intrahepatic portal vein were measured to calculate signal to noise ratio (SNR) and contrast to noise ratio (CNR). The subjective image quality was evaluated by two radiologists using a 5-point scoring system. The results were analyzed with one-way analysis of variance, paired sample t-test and Mann-Whitney U test.

RESULTS

CT values of intrahepatic portal vein increased with the decrease of photon energy. portal vein CNR and SNR at 40 keV reconstructed with 80% ASIR-V (7.20±2.62, 11.76±3.40) reached the maximal, similar to that at 50 keV with 80% ASIR-V (6.34±2.30, 11.44±3.29), and higher than those at 120 kVp-like images (2.42±0.96, 6.15±1.66) (all P<0.05). Images at 50 keV with 80% ASIR-V yielded a maximal subjective image quality score.

QI01-A8   Analysis Of True Time Burden When Adding Anesthesia And Contrast To Pediatric MRI: An Institutional Experience

Participants
Alain E. Sherman, MBA, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Administration of anesthesia and gadolinium-based contrast agents adds time to magnetic resonance imaging (MRI) examinations and may pose unknown risks to pediatric patients. In addition, there is a growing body of literature in pediatric MRI showing that contrast may not be necessary for a variety of indications (e.g., sacroiliitis, inflammatory bowel disease, musculoskeletal infection). Furthermore, non-sedated MRI has been shown to be successful in pediatric age groups for acute brain, abdominal, and musculoskeletal imaging, indicating that many children can tolerate the procedure without the need for sedation. The present study sought to examine the time burden of anesthesia and intravenous contrast in pediatric MRI examinations. This information is essential to understand the true burden to the healthcare system, including overutilization of resources, costs, and, most importantly, risk to patients.

METHODS

A retrospective analysis of all pediatric MRI examinations (body, musculoskeletal, neuro) requiring anesthesia or intravenous contrast at a tertiary children's hospital over a two-year period (2018-2019) was performed. Step-by-step procedural workflow was analyzed, including early arrival, patient wait times, pre-procedural evaluation, IV placement, anesthesia care, contrast administration, pre- and post-contrast imaging. Mean time added by anesthesia care and contrast were calculated and presented as a percentage of total encounter duration.

RESULTS

Exams with anesthesia (N=4,688), comprised 19% of the total number of MRI examinations (N=24,125). Exams with IV contrast (N=9,373), comprised 38% of the total. The mean time added to the examination due to anesthesia care was 85 minutes, which comprised 65.2% of the average encounter. The mean total MRI encounter time including anesthesia care, was 131 minutes.

QI01-A9   Diagnostic Errors In Neuroradiology, Physician Experience Level And Tumor Board Participation At A Single Tertiary Academic Center

Participants
Michael Baggett, MD, Sacramento, California (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study is to quantify and correlate the diagnostic error rates in radiological interpretation with the experience of the attending neuroradiologist reading the case at a tertiary academic medical center.

METHODS

The Neuroradiology Quality Assurance Database of diagnostic errors made by attending neuroradiologists in our institution was searched for misses from 2014 - 2020. Frequency of attendance at Head and Neck (H&N), Brain, and Pediatric Neuroradiology (PN) Tumor Boards (TB) as the presenting radiologist was collected. Post-fellowship years of clinical practice (CPY) and frequency of TB attendance were considered separate metrics of a radiologist's experience. Radiological errors were categorized as Total (T), H&N, Skull Base (SKB), Brain or PN diagnostic errors. Diagnostic error rate/1,000 interpreted studies, per attending neuroradiologist within each category was correlated with frequency of TB participation and with CPY using Spearman's rank correlation coefficients.

RESULTS

607 exams contained a diagnostic error. Spearman's rank correlation coefficients between Total TB participation and T, H&N, SKB, Brain error rates were: -0.89 (p=0.0002); -0.81 (p=0.002); -0.66 (p=0.03); -0.82 (p=0.002); respectively. Spearman's rank correlation coefficients between CPY and T, H&N, SKB, Brain and PN error rates were: 0.05 (p=0.88); 0.08 (p=0.82); 0.28 (p=0.41); -0.10 (p=0.77); -0.16 (p=0.63), respectively. Spearman's rank correlation coefficients between H&N TB and H&N, SKB error rates were: -0.79 (p=0.004); -0.65 (p=0.03). The Spearman's rank correlation coefficient between Brain TB attendance and Brain error

rates was -0.75 (p=0.008).

Sub-Events

QI05-B1   The Introduction Of Cone Beam Computed Tomography (CBCT) In A District General Hospital

Participants
Dhurrika Raveendran, BDS, Southend-On-Sea, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

CBCT images are increasingly becoming a vital tool for assessment and planning of various Oral & Maxillofacial surgery procedures, offering low-dose exposure and ease of acquisition. CBCT scans are particularly useful for pre-operative assessment and surgical planning prior to surgery enabling clinicians to use minimally invasive approaches. Prior to the introduction of a CBCT scanner at Southend University Hospital, patients who required CBCT scans following assessment by the Oral and Maxillofacial Surgery Department were referred externally to a local practice. Outsourcing of CBCT scans increased wait times and resulted in higher costs to the hospital. To overcome these issues, a new CBCT scanner was installed at Southend Hospital and radiographers were provided with training allowing the provision of a new service to patients. With the introduction of a CBCT device at Southend University Hospital, this project evaluates the quality of service provision, compliance and impact on the management of various oral surgical procedures. This project aims to determine whether the use of CBCT scans in the Oral and Maxillofacial surgery department at Southend University Hospital complies with the SEDENTEXCT guidelines. The aims and objectives are: • To determine whether CBCT scans were requested in accordance with SEDENTEXCT guidance. • To assess the diagnostic value of CBCT scans taken at Southend University Hospital. • To evaluate the impact the images had on the planning of various Oral & Maxillofacial surgery procedures.

METHODS

A retrospective review of 147 electronic records for all CBCT scans conducted between October 2019 and November 2020 was carried out. Data was collected in relation to patient demographics, indications for CBCT images, quality of CBCT scans and treatment plans before and after the CBCT scans were taken. A significant impact on treatment plan was identified for the following cases: • Surgical intervention vs conservative management • Open vs closed exposure of tooth • Surgical removal vs Exposure of impacted tooth • Removal vs Coronectomy of mandibular third molar • Change in the quantity of teeth that require removal.

RESULTS

98.6% of the CBCT scans requested were justified appropriately in accordance with the SEDENTEXCT guidelines and were commonly requested for pre-surgical assessment of unerupted teeth (38%), assessment of cysts (20.4%) and where radiograph suggests a direct inter-relationship between a mandibular third molar and ID canal for surgical planning of management (32.7%). In 30.6% of cases a significant impact was identified in treatment plan. Typically, scans requested between October 2019 and November 2020 were completed between 6.25 and 47.1 days, however, in March 2020 the number of days on average between scan request and acquisition increased to 81.2 days, likely due to the impact of the restrictions enforced in relation to the COVID-19 pandemic. The CBCT images reviewed fell short of the standards set by the SEDENTEXCT guidelines with 89.8% of scans were deemed diagnostically acceptable and 10.2% considered diagnostically unacceptable. Scans were considered diagnostically unacceptable mainly due to missing anatomy (60%) or movement artefact (33.3%).

QI05-B2   Virtually Yours! 5Th Annual Chicagoland Radiology Virtual Expo Planning And Execution: A Success Story

Participants
Kirti M. Kulkarni, MD, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Due to the COVID-19 pandemic and remote working requirements in spring of 2020, the core committee members of the 5th Chicagoland Radiology Expo decided to plan for their first virtual version of the meeting for medical students. The Radiology Expo originated in November 2016 as an initiative from the Department of Radiology Diversity Committee at the University of Chicago, to improve the pipeline for and career advancement of women and other underrepresented minorities in medicine (URiMs) in radiology. Its success garnered much deserved attention from the ACR Commission for Women and Diversity, and in subsequent years, the Expo focused on introducing medical students to the fields of radiology and radiation oncology early on in their schooling. Although the Expo format was transformed to a virtual platform, our mission to demonstrate radiology's central role in medicine, connecting with and inspiring the medical students remained the same. The planning and execution were unique and challenging in many ways and this abstract showcases the intricacies of creating a virtual event catered to medical students across the world.

METHODS

Core committee members convened in May 2020 and divided the relevant Expo tasks broadly into 4 categories: (1) Funding & Sponsorship; (2) Program Content, with designated Chair to invite subspecialty speakers and to design breakout sessions; (3) Publicity, with team members promoting the event via social media, as part of a rigorous marketing campaign including direct correspondence with medical school Dean's offices across the nation; and (4) Resident and Fellow volunteering. Slack, a digital

platform was used for effective communication between the team members. The core committee members worked closely with IT team to design the event website, which included recorded content describing the Expo's mission and intended impact. The Expo was held 9am-2pm, Saturday, Nov 14, 2020 (www.chicagoradiologyexpo.org). Lineup of speakers included an opening keynote presentation by Dr. Richard Gunderman from Indiana University and closing remarks by Dr. Geraldine McGinty, President of the ACR. With our educational exhibits, students could experience interactive case-based read out sessions with radiologists. Panel discussions focused on topics such as diversity, work life balance, and pearls and pitfalls in residency application in these fields. One-on-one speed advising sessions were integral in fostering early connections between students and radiologists. A virtual exhibit hall encouraged relevant vendors to showcase products utilizing live and recorded presentations. Analytics data was obtained at the backend of the website hosted on Wix.com, the creative website building platform for the event. The data focused on online traffic generated a month before through 15 days after the event, while also surveying geographic distribution of attendees.

RESULTS

During the period of October 1-December 1, 2020, a total of 1897 visitors explored the website; on Expo day, approximately 586 visitors accessed the site, of which 59% were new visitors and 41% were returning visitors. 9.2% were international students from as far as India and Turkey. Out of 12 plenary and breakout events, the top two most popular were: Opening Keynote Address on Radiology: Past, Present, and Future; and Panel on Application Pearls.

QI05-B3 Applying Lessons Learned In Implementing Automated Workflows In An Academic Pediatric Radiology Department

Participants
Marla Sammer, MD, Houston, Texas (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study is to share the lessons we learned in implementing vendor developed software driven partially automated workflows in our institution. Specifically, we deployed a partially automated workflow in the body section in March of 2019 and then analyzed the body section implementation process following go-live. Before go-live in the neuroradiology section, we defined discrete phases were improvements could be made based on the body section analysis, and applied these lessons to the implementation in neuroradiology in December of 2020.

METHODS

Following implementation of a partially automated workflow in the body section, a review was conducted of the implementation process by stakeholders including clinical leaders and users in multiple sections in Radiology, Radiology informatics, in-house Information Services (IS), and the software vendor. In review, we identified 5 discrete phases where improvements could be made: Planning, Building, Testing, Data Analysis, and Full Operationalization. Within each phase, metrics for success were then defined. These were used in designing the subsequent go-live project plan in the neuroradiology section.

RESULTS

Contributions of the established team including Clinical Radiology stakeholders, Radiology informatics, in-house IS, and the vendor to post go-live analysis is essential to improving subsequent processes. Customizing the go-live to address the nuances of a specific division is a labor intensive process which requires individuals who are both technically savvy and have medical knowledge. However, lessons learned in one section can be applied to another. Examples of identified areas of improvement from the initial implementation include iteratively testing the system prior to activation to improve trust, buy-in and customization. Additionally, one of the biggest adjustments in using a software driven automated worklist management system is the acceptance of a culture change with regard to reading workflow. Radiologists accustomed to self-selecting studies immediately as they appear on PACS need to adapt to some loss of autonomy; conversely others who typically contribute less will need to grow accustomed to the expectation of higher volumes. There will be late adopters not accepting the technology, and operating the software product on a limited basis in the background without interrupting workflows allows for data gathering. Data analysis is essential to iteratively improve the user experience and provide data driven feedback to radiologists; for example, based on feedback from the body section, we built a distribution simulation program using real data to experiment with different algorithm options prior to implementation in neuroradiology. Full operationalization of the software solution requires a coordinated effort by physician leaders and users, informatics leaders, the vendor support, and information services to successfully implement.

QI05-B4 Direct MRI Scheduling: Improving Patient Access To Imaging Care In An Underserved Patient Population

Participants
Shlomit Goldberg-Stein, MD, Manhasset, New York (*Presenter*) Nothing to Disclose

PURPOSE

To improve access to imaging care in an underserved, at-risk, primarily Hispanic and Black patient population with 80% of patients having Medicare/Medicaid as their primary insurance.

METHODS

An IT solution was implemented to enable MRI scheduling at the point of care in subspecialty clinics, a program we entitled MRI Direct Scheduling (MDS). This eliminates the need for patients to separately contact the Access Center for an imaging appointment and enables patients to leave their clinic visit with an imaging appointment time and with relevant screening and preparatory information already relayed to the patient. We felt this would help address existing barriers to imaging care including language and health literacy challenges associated with the need for patients to initiate an inbound call to the Access Center for scheduling, to appropriately respond to the MRI screening questions, and finally to understand any preparatory information over the phone. A standardized MDS training program was developed to support scheduling staff at the clinics. MDS was then implemented at four free-standing urban outpatient imaging facilities within a four-mile radius and with a total of seven MRI units. MDS was piloted by the Orthopedics Dept in December 2017. Descriptive statistics were collected on MDS utilization in 2017-2020 (note: 2020 data was impacted by COVID-19 outpatient volumes). Logistic regression model was applied to identify demographic factors significantly associated with MDS utilization (p<0.05).

RESULTS

25% of all Orthopedic MRI exams were scheduled through MDS indicating a high level of engagement with the program. Orthopedic

MRI volume growth of 39% and 38% accounted for the total MRI growth in 2018 and 2019, which saw an overall growth of 6% and 8% in MRI, respectively. MRI Orthopedic volume at our institution increased year-over-year in 2017 by 14%, in 2018 by 16%, and in 2019 by 16%. Ease of access to appointments was identified by Orthopedics leadership as a cause for this improvement in volume capture. Non- Hispanic White patients were 15% less likely to utilize Direct Scheduling compared to Hispanic and Non-Hispanic Black patients (p<0.01), even after controlling for age, indicating the target population was engaged with MDS. We also found that patients who utilized MDS were, on average, 5 years younger than patients using the traditional scheduling pathway (p<0.001).

QI05-B6   Performance Evaluation Of Artificial Intelligence-based Technology For Fast And Accurate Bolus-tracking Process In CT Angiography

Participants
Jie Liu, Zhengzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

Process of bolus-tracking scans before CT angiography usually include monitoring location selection and region-of-interest (ROI) placement to generate time-density curve (TDC) triggering the CTA scan. In this study we aimed to evaluate the performance of an artificial intelligence-based technology (SmartPlan, GE Healthcare) for fast and accurate bolus-tracking process compared with manual operation by technicians.

METHODS

Two hundred CTA scans including the abdominal, pulmonary aorta and coronary CTA performed using the SmartPrep triggering technique were prospectively collected. The monitoring location for placing ROI by CT technicians for dynamic contrast-enhancement monitoring in bolus-tracking scans and TDC generated in the ROI were recorded as the control group; The scout scans and time-resolved images were then imported into the SmartPlan software to automatically determine the monitoring location for placing ROI and to generate TDC, and the results were recorded as the experimental group. The consistency and time consuming of the location selection and the peak value of TDC curve triggering the scan between the experimental and control groups were analyzed using paired sample t-test. P < 0.05 was considered statistically significant.

RESULTS

There was significant difference in monitoring position between the experimental group and control group (P<0.05). However, monitoring locations differences were found no real clinical impact due to physicians' personal judgement variation. There was no difference in the peak value of TDC curves between the experimental group (167.99±25.54) and the control group (169.61±30.98), (P=0.784).Time consuming were found significant decreased by 19.94 second in the experimental group compared with that in the control group(P<0.05)

QI05-B7   Pediatric Trauma CT: A Quality Initiative For A Better Patient Care

Participants
Gabor Volford, MD, Szeged, Hungary (*Presenter*) Nothing to Disclose

PURPOSE

To comply with the 2013/59/Euratom Basic Safety Standards Directive continuous monitoring of dose exposure data is mandatory. The standard clinical practice at our trauma center for paediatric CT exams requires protocols adapted to patient size and clinical indication. Recently, a new feature of our dose management system (Dosewatch™, GE, Milwaukee) was installed, which automatically raises an alert any time a paediatric patient is scanned with an optimizable protocol. The objective of this project was to implement a quality initiative to assess compliance and resultant radiation dose reduction with child-sized and optimized paediatric CT protocols.

METHODS

Paediatric CT meta data were retrospectively collected from January 2020 to March 2021 (Phase 1) at one trauma center institution. The exams which triggered an alert for optimizable protocol utilization were flagged, root cause analysis was put in place and appropriate solutions identified and implemented from April 2021 (Phase 2). Specifically the quality framework put in place for Phase 2 consisted of the following steps: 1. Justification of the ordered CT based on clinical indication prior performing the exam by engaging the radiologist; 2. Revision of the existing and implementing new paediatric protocols where needed; 3. Radiation Doses for Pediatric Patients established by "Child-Sizing" CT Scanning Parameters and available on site to the technologist; 4. Continuous training of the technologist (patient centering, scan length); 5. All pediatric exams are revised monthly by the dose management team (chief radiologist, radiographer and medical physicist) and optimization process is put in place if needed. The meta data collected before and after the quality initiative were analysed in terms of: % of optimizable protocols used on paediatric patients; median dose metrics (CTDIvol and DLP) and number of irradiations. The meta data were stratified per clinical indication and class age (0.-years,1-5 years,5-10years,10-15 years, 15-18 years). Only clinical indications with at least 20 exams were considered for this study.

RESULTS

A total of 337 exams' metadata was collected (age range 0-17 years) during Phase 1 and meta data collection is ongoing for Phase 2. The following clinical indications were identified: head and C-spine trauma (n=94 (27,9 %), lower extremities trauma (n=74, 22%), head trauma (n=66, 19,6%), upper extremities trauma (n=32, 9,5%) and whole-Body Trauma (n=14, 4,2%). While median dose level was still below European Dose Reference Levels, 95% of the Phase 1 exams were scanned using an optimizable protocol. Root cause analysis revealed the following reasons: concern about insufficient image quality, compliance with paediatric traumatologists expectation. Median CTDIvol/ DLP per clinical indication during Phase 1 varied in function of age: 25.9-40.8 mGy/490-951mGycm (head trauma); 41.3-45.9mGy/996-1546 mGycm (head and neck trauma); 1.18-10.5mGy/15-158mGycm (upper extremities trauma); 3.8-7.3mGy/124-318mGycm (lower extremities trauma). Preliminary results after the implementation of corrective actions show an average dose reduction of CTDIvol and DLP of 49.6% and 64.1% respectively for the most frequent clinical indication (head trauma). For lower extremities protocols preliminary results do not show an important reduction, mostly because of the well optimized low dose extremities protocols and less important differences in the size of the image anatomy, thought more statistical data need to be collected to confirm this hypothesis.

QI02-A

Quality Improvement Reports Monday Poster Discussions

Sub-Events

QI02-A1 Application Of Double Low-dose Contrast Agent And Optimal Gemstone Spectral Imaging In Head CT Angiography

Participants
Xin Huang, Xi'an, China (*Presenter*) Nothing to Disclose

PURPOSE

Our study aims to evaluate the image quality and feasibility of adopting double low-dose contrast medium (CM) and optimal gemstone spectral imaging (GSI) to perform head CTA.

METHODS

A prospective study was performed in 54 patients receiving CTA of the head with a 256-slice CT system (GE Revolution, GE Healthcare, USA). Patients were randomized into two groups with a volume of either 40 mL of CM (Lopamidol, 370 mg of iodine per mL) injected at a rate of 4.5 mL/s (General-Dose Group) or 25 mL of CM injected at a rate of 3.0 mL/s (Low-Dose Group). The following scanning methods of the two groups were conventional imaging and GSI respectively. The images were reconstructed and the data were sent to the working station for analysis. The CT value of basilar artery (BA), middle cerebral artery(MCA), and intracranial artery intracranial (ICA) were measured in monoenergetic images from 55 to 65 keV as well as conventional 100 kVp images. Qualitative assessment of monoenergetic images using maximum intensity projections (MIP) and multi-planar reformat (MPR) was performed by an independent reader for vascular enhancement on a 4-point scale (1-poor, 4-excellent).

RESULTS

Compared with conventional 100 kVp images, there was significant difference between the CT value of BA, MCA and ICA in 55 keV reconstructed images ($P < 0.05$). For qualitative scores of conventional and monoenergetic images, 60 ± 5 keV reconstructed images rated was substantially similar with 100 kVp images.

QI02-A2 Establishing A Peer Learning Program In Emergency Radiology

Participants
Eric Schmidt, Worcester, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To implement a peer learning program in our emergency department (ED) radiology division and evaluate its effectiveness as a continuing education tool and a replacement for peer review. Peer learning is an alternative to peer review inspired by non-punitive error reporting and the just culture patient safety model. It takes inspiration from other safety conscious industries such as aviation, which features a non-punitive venue for error reporting to promote participation and a focus on process improvement to mitigate consequences of inevitable human error. Key to the peer learning model in radiology is a separation of learning and process improvement from performance evaluation, which reduces fear and defensiveness and promotes participation and learning. The central component is the peer learning conference, where submitted cases are presented to the division, key teaching points are discussed, and process improvement ideas are solicited. Cases are typically identified during routine review of prior imaging, which yields increased error identification compared to traditional peer review and does not require dedicated time. We adapted previously described peer learning conference models to our setting, an ED radiology division, and evaluated its effectiveness.

METHODS

Our peer learning program represents a division with 11 faculty and one fellow and annual volume of 200,000 studies, within an academic department of 81 clinical faculty with annual volume of one million. Cases are reported using the Conserus peer learning software from Change Healthcare, commercially available software that allows one-click PACS integration for reporting and tracking of learning opportunities with minimal workflow interruption. Cases are categorized during reporting as great calls, perception or cognition errors including satisfaction of search, interesting follow up, or reporting or other technical issue. Radiologists across all divisions identify cases, allowing interdisciplinary feedback on the work of our ED radiologists. Cases are presented at a bimonthly remote videoconference attended by ED radiology faculty. Five to 15 cases are selected from the pool of submissions; selected cases present a valuable learning opportunity or demonstrate an opportunity for process improvement. To evaluate the conference's effectiveness as a learning tool, a short survey of ED radiology faculty with Likert scale scoring was administered initially and again after six months.

RESULTS

Cases submitted favored interesting followup (32%), perception error (27%), and great calls (23%) with process improvement opportunities only 5%. Submission rate increased roughly twofold over one year of use. Of these, cases selected for conference favored perception errors (46%), with great calls (17%) and process improvement opportunities (15%) the next most common categories. Cases were from a variety of anatomical regions with abdominal (35%) and musculoskeletal (29%) being the most common. A Likert scale survey focused on the effect of peer learning conference on learning and performance outcomes, and

average scores increased from 3.2 initially to 4.7 after six months.

QI02-A3   DICOM Lake: A Big Data Approach To Monitor PACS Protocols

Participants
Paulo E. Kuriki, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

To perform a MR study, many parameters must be provided, such as repetition time, echo time, matrix size, slice thickness, number of averages (NEX), etc. Usually, these parameters are stored in groups called protocols. Depending on the type of study ordered, the imaging technician will select one of these protocols and acquire the images based on pre-defined parameters. Those parameters can be adjusted to increase the image quality or reduce the scan time. Finding a perfect balance can be a tough trade-off, even harder when a company has more than one scanner. Every time a study is performed, all these technical parameters come along attached to each DICOM image in pieces of information called data elements (DICOM Tags). When a study is sent to a PACS, these data are stored with all images. But giving the nature of a PACS and its purpose to serve mainly as an image repository, analyzing these metadata can be a challenge. DICOMweb is a relatively new technology that enables one to connect to the PACS using a REST API. Through it, it is possible to query and retrieve images or only metadata. Using Business Intelligence (BI) techniques, one can easily analyze all this data, identifying incorrect parameters and optimizing protocols in large scale. The aim of this study is to (1) develop an automatic pipeline to extract DICOM tags from the PACS using DICOMweb; (2) store those metadata in a data warehouse and (3) use BI techniques to identify protocols with potential to improvements.

METHODS

We developed an automatic pipeline using Airflow and DICOMWeb that queries our PACS through QIDO-RS daily. All metadata is then retrieved performing WADO-RS requests. DICOMWeb responses usually come in a nested json format. Those responses need to be flattened and theirs DICOM tag numbers converted to friendly names. Then, converted data is normalized and stored in a data warehouse server. Using BI Tools, reports are generated daily and submitted to radiology chiefs.

RESULTS

As a Proof of Concept (PoC), we retrieved metadata from 11,249 lumbar spine MR studies, totalizing 70,874 series acquired in 63 scanners from our company. All data were anonymized and stored in a data warehouse. We chose to analyze the Number of Averages (NEX) from each series, as this is known as having direct impact in study time length. We identified 282 series in the protocols of 54 scanners with potential to be optimized. Those protocols were adjusted according to radiologists' orientations and mean of NEX was decreased from 1.80 to 1.09. The optimized studies were then reviewed and validated by radiologists. By the end of the optimizations, the study mean time length was decreased by 39% without loss to clinical accuracy.

QI02-A4   Utility Of Intraoperative Radiographs To Exclude Foreign Body In Patients With Elevated BMI And Normal Surgical Counts

Participants
Michael Jin, MD, Coram, New York (*Presenter*) Nothing to Disclose

PURPOSE

Inadvertent retained foreign objects during the course of an intraabdominal or thoracic surgery is a significant but preventable cause of patient morbidity and mortality. Intraoperative radiographs are often performed for exclusion of retained foreign bodies in situations where there are incorrect counts. However, our institution maintains a policy of performing intraoperative radiographs in all patients with a Body Mass Index (BMI)>35, regardless of concern for retained objects. This policy was instituted as a result of a surgical case in which there was a retained foreign body in a patient with elevated BMI with correct surgical count. This policy has been in effect for at least nine years and has contributed to more intraoperative radiographs being performed, increased radiation, longer anesthesia times, and significant interruption of Radiologist workflow, as it requires an attending or senior resident to review the images prior to the patient being closed and transported out of the operating room. We were unable to find a similar policy at other institutions.1 Our study investigates the utility of intraoperative films in patients with BMI>35 performed in an academic hospital.

METHODS

All intraoperative images obtained in a two-year interval from January 1st, 2018 to December 31st, 2020 were evaluated in a retrospective study. The studies were categorized by indication (patients with BMI>35, level 1 trauma, incorrect surgical count) and cross-compared. Cases positive for misplaced surgical foreign body were correlated with indications to determine the added value of the intraoperative film.

RESULTS

487 intraoperative images were examined in this study (133 for patients with BMI>35, 9 for level 1 trauma, 345 for incorrect count). Of the 133 intraoperative imaging ordered for patients due to BMI>35, there was no positive case of retained foreign body. Similarly, no cases for level 1 trauma revealed inadvertent foreign body retainment. However, 21 of the 345 orders for incorrect surgical count indication were positive for misplaced surgical foreign body (6.09%) regardless of the patient's BMI.

QI02-A5   System Approach To Prevent Lost Studies And Improve Radiology Report Turn Around Time

Participants
Jacob Schick, BS, Millersville, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

MR Pelvis examinations may represent studies of the prostate to be read by body imaging (BI) radiologists. They may alternatively represent examinations of the thigh musculature to be read by musculoskeletal (MSK) radiologists. In our PACS and Radiology Information System (RIS), there was no way to differentiate these examinations as they are classified by the same CPT code. By default, the MR pelvis studies were listed on only the BI work list. Including them on the MSK work list would have clogged it up. This resulted in "lost" MSK MR Pelvis studies which did not receive timely reports. Some of these examinations had preliminary reports with substantiative changes made days later when found by the attending. The goals of this project were to create a solution to prevent "lost" exams, improve report turn around time (RTAT), and improve patient care.

METHODS

A pre-intervention list of 3 months of MR pelvis studies was obtained from the RIS. Audit logs were reviewed for each study to determine time to first view by BI and by MSK radiologists, time of report completion, time of preliminary report, and time of final signature. Mean times for time from completion to first MSK view and time to final report were calculated. Studies with delays in reporting resident misinterpretation were recorded. First intervention: an MSK reserve flag was placed in the PACS work list for the BI radiologists to use when they found an MSK study on their work list. The flag moved these studies onto the MSK reserve work list. After this intervention, another 3 months of data was analyzed. A second intervention was implemented where the technologists completing the studies and residents reading the studies were asked to also place the reserve flag. Additionally, if a BI radiologist placed a reserve flag on an ED or inpatient case, they were required to call or instant message an MSK attending to alert them of the study that needed urgent interpretation. After this, another 3 months of data was analyzed.

RESULTS

There was a significant improvement (p=0.0018) in time to view by MSK from pre-intervention mean of 1015 minutes (n=107) to post-intervention mean of 500 minutes (n=127). There was also a significant improvement (p=0.0033) in time to view inpatient and ED cases from 927 minutes to 357 minutes. Time from study completion to final signature also improved from a mean of 1764 minutes to 838 minutes, though not statistically significant (p=0.08). There were 5 cases of delay in reporting resident misinterpretation pre-intervention and none post intervention. Time to view overnight preliminary reports improved by 198 minutes after intervention.

QI02-A6   Prostate MRI With Recall System For Contrast: Effect On Efficiency And Cost Savings

Participants
Silvia D. Chang, MD, Vancouver, British Columbia (*Presenter*) Nothing to Disclose

PURPOSE

During the COVID-19 pandemic, prostate MRI scans had to be limited to urgent cases and most exams were deferred to a later date which exacerbated an already existing backlog of referrals with a waitlist of one year. A bi-parametric protocol without gadolinium was, therefore, implemented to maximize the use of resources with the establishment of a recall system for gadolinium, if necessary. The aim of this audit was to review the efficacy of this system.

METHODS

The bi-parametric prostate MRI protocol was instituted in the Radiology Department commencing July 27, 2020, for all patients excluding: post-treatment prostate cancer cases, patients with hip prosthesis or a pacemaker (due to expected suboptimal diffusion-weighted imaging (DWI) and logistical challenges respectively), and those who were commuting from out-of-town (more than 2 hours commute from the hospital owing to the subsequent difficulty in recall). These excluded patients were scheduled with the full protocol with gadolinium. The bi-parametric protocol consisted of axial, sagittal, and coronal T2-weighted sequences, DWI sequences with low and intermediate b-values to generate the apparent diffusion coefficient (ADC) map, and an acquired high b value DWI sequence with b value of 1500. These T2 and DWI sequences are in accordance with the Prostate Imaging and Reporting Data System version 2.1 (PI-RADS v 2.1). After the interpretation of the bi-parametric study, patients with a PI-RADS 3 lesion in the peripheral zone (PZ) or suboptimal scan for another reason requiring gadolinium were recalled to have the contrast-enhanced sequence. This was performed without additional sequences unless the DWI was suboptimal in the initial study, it was also repeated. A method was devised to code this recall system in the Picture Archival Communication System (PACS). The patient information was securely emailed to the MRI supervisor and an MRI booking clerk maintained a list of the patients that were recalled. An audit was subsequently done to determine the efficacy of the system.

RESULTS

A total of 1066 prostate MRI scans were performed from July 27, 2020, to April 19, 2021, out of which 157 were performed with gadolinium upfront and were excluded from the analysis. Amongst the 909 bi-parametric scans, only 52 (5.7%) were recalled for gadolinium. Out of these 52 cases, 11 (21.2%) were recalled owing to suboptimal DWI and the rest of the 41 cases were PI-RADS 3 lesions in the PZ (78.8%). The patients were recalled as early as the next day and 39 (75%) patients had their subsequent contrast scan within 2 weeks of the initial scan. On the assessment of post-gadolinium imaging, 29 (55.8%) were upgraded to PI-RADS 4 and 17 (32.7%) patients were not upgraded and remained as PI-RADS 3 lesions. Six patients (11.5% of 52, 0.66% of total) were pending for the subsequent scan at the time of audit. The recall system avoided gadolinium administration in 857 patients, saving 68,560 USD in direct costs. This includes the price of the gadolinium contrast and the material required for intravenous injection which equates to 80 USD per patient). The allotted MRI acquisition time for the additional contrast sequence was 6 minutes table time (this excluded the time taken in getting the patient on the table) for which routine institutional billing is 260 USD per patient. Thus the total cost for scan time and cost for contrast together was 340 USD per patient. Hence a total of 291,380 USD was saved in contrast & scanner time costs. This recall system is also beneficial to the patients in that they can be scheduled out of hours at times when physicians are not available to supervise contrast thereby decreasing the waiting times. By November 2020 within 4 months of implementing the protocol, the waiting time of 1 year had decreased to 2-3 weeks. Before COVID-19, the number of scans performed was 16-18 patients per week, currently increased to 28 patients per week after the institution of the bi-parametric protocol with the recall system. Obviating cont

QI02-A7   Engaging Advanced Practice Providers To Improve Patient Care And Drive Productivity In A Radiology Consult Practice At A Comprehensive Cancer Center

Participants
Mayur Virarkar, MD, JACKSONVILLE, Florida (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the effects on efficiency and patient care of the addition of advanced practice providers (APPs) to an abdominal radiology consult service.

METHODS

In this prospective study, the focus was on radiologist productivity and patient care for 3 months before and 3 months after integration of APPs into our abdominal radiology consult service. Radiologist productivity was measured according to RVUs/shift and the change in professional billing by the number of imaging studies interpreted by radiologists. The patient care metrics measured were prescribed protocol to patient appointment lead time and number of same-day prescribed imaging protocol changes.

RESULTS

We observed significant increases in the mean RVUs/shift (15.2 ± 0.9 versus 6.2 ± 1.8; P = .02), number of studies read per shift (10.1 ± 0.5 versus 4.4 ± 1.5; P = .003), revenue per shift hour ($756.20 ± $55.40 versus $335.40 ± $132.60; P = .007), and protocol prescription to patient appointment lead time (39.3 ± 6.7 days versus 16.3 ± 2.9 days; P = .005) after APP integration into the workflow. We also saw significant decreases in the mean prescribed CT (19.3% ± 0.6% versus 3.3% ± 0.6%; P = .001) and MRI (11.7% ± 0.6% versus 8.30% ± 0.12%; P = .011) protocol changes made on the same days as patient appointments in the post-APP integration workflow.

QI02-A8   Development Of A Communication And Tracking System For Incidental Imaging Findings Using Radiology Assistants, Electronic Communication And Clinical Decision Support

Participants
Christina LeBedis, MD, Newton, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

To describe the development and evolution of a system for communication and tracking of incidental imaging findings at an urban academic safety net hospital using radiology assistants, electronic communication and clinical decision support over a 5-year period.

METHODS

Based on feedback from residents in our institution's Diagnostic Radiology training program citing workflow inefficiencies and hindrance to education, we identified the need for a dedicated assistant to communicate incidental findings detected on imaging studies. Simultaneously, lack of follow-up of incidentally detected imaging findings was recognized by our institution as a potential source for delay in diagnosis and medicolegal liability. Based on these factors, our institution funded a single full-time radiology assistant dedicated to communication of incidental findings in 2016. A system for flagging outpatient imaging studies with incidental findings by radiologists was created using PowerScribe 360. These studies were routed to the radiology assistant, who communicated the findings and recommendations to the ordering provider using Epic Inbasket messaging with a standard message template. An acknowledgement response from the ordering provider was required by the provider to close the communication loop. If not acknowledged, an escalation notification was sent to the ordering provider's supervisor. A second assistant was funded 2 years later based on the success of the incidental findings communication program and increasing volume of studies. A survey was sent to radiology residents and faculty before and after assistant implementation to assess daily time spent communicating with providers. In May 2021, we will transition our radiology information system (RIS) from GE RIS to Epic Radiant. This transition will allow for automated, instant communication of incidental findings, thereby eliminating the need for manual messaging by a radiology assistant. This system upgrade will allow us to expand our practice of notification to include studies obtained in the emergency department and inpatient setting. Simultaneously, manual acknowledgment from the ordering providers via inbasket messaging will be eliminated and replaced with discrete options within an Epic "Best Practice Advisory" (BPA), allowing for both message acknowledgment and ordering of recommended imaging studies with clinical decision support. Furthermore, we identified the top 12 most common incidental findings at our institution and built discrete referral pathways, with support from clinical and radiology subspecialists for each respective incidental finding. Finally, all overdue follow-ups will be tracked, and reminder messages will be sent to the ordering provider by the radiology assistants until completion of the recommended study is completed or justification for lack of completion is documented. Tracking of incidental findings in a spreadsheet will be replaced by a centralized database within Epic Radiant.

RESULTS

An initial baseline survey prior to implementing the first radiology assistant was completed by 16 attending radiologists and 30 radiology residents. After implementation of the radiology assistant program, 12 attending radiologists and 16 radiology residents completed the survey.Prior to the radiology assistant, daily communication times reported by residents were as follows: less than 30 minutes in 10% (3/30), 30 minutes to 1 hour in 70% (21/30), and greater than 1 hour in 20% (6/30). After implementation of the radiology assistant, daily communication times reported by residents were as follows: less than 30 minutes in 81.3% (13/16), 30 minutes to 1 hour in 18.8% (3/16), and 0% (0/16) greater than 1 hour, reaching statistical significance (p<0.001). Prior to the radiology assistant, daily communication times reported by attending radiologists were as follows: less than 30 minutes in 38% (6/16), 30 minutes-1 hour in 50% (8/16), and greater than 1 hour in 12.5% (2/16). After implementation of th

QI02-A-HC1   The Feasibility Of A New Built-in Specimen Radiography Solution For The Optimization Of Stereotactic Breast Biopsy Workflow

Participants
Olena Weaver, MD, Houston, Texas (*Presenter*) Consultant, General Electric Company;Research Grant, General Electric Company

PURPOSE

Specimen magnification radiography (SMR) is integral to stereotactic breast biopsy (SBB) workflow and is critical for the evaluation of retrieved tissue specimens. SMR is especially important for visualization of targeted mammographic microcalcifications within a specimen. The quality, efficiency, and speed of acquiring SMR are crucial, because its results affect the decision-making process and may alter the course of the procedure. The duration of SMR directly affects total procedure time, which influences the patient experience. Moreover, patient motion may occur while SMR is being acquired, since the breast remains in compression. SMR is often a rate-limiting and workflow-disrupting step of SBB. Some facilities perform SMR on dedicated mobile units housed within procedure rooms. This necessitates investment in capital equipment and requires additional space, unit handling time, and digital storage and transfer solutions. Other facilities use separate stationary mammography systems, which impedes workflow, as an extra suite must be kept available for SMR, limiting patient throughput in the facility. A built-in SMR function on a biopsy-enabled 2D/3D mammography system may mitigate this issue.

METHODS

We are describing our experience with implementing a new, FDA-cleared, built-in Sample Imaging feature on Pristina SerenaTM biopsy option for Senographe PristinaTM (GE Healthcare, Buc, France), which enables SMR on the same detector plate as the patient's breast, while the patient is still under compression. The SMR option consists of a combination of add-on software and hardware. The hardware is a manually operated collimator plate, designed to focus the x-ray beam to a small window in one corner of the detector plate to one side of the breast, limiting the exposure to the breast to scattered radiation only. SMR results from a single 2D radiographic acquisition performed with +15° or -15° angulation, depending on the position of the biopsy attachment and

the needle, without changing the biopsy setup. At present, the SMR feature is most feasible for the horizontal position of the detector plate; however, custom solutions for a vertical plate position are being developed. We performed stereotactic breast biopsies utilizing the built-in specimen radiography option, and subsequently imaged the specimen with either a dedicated portable specimen radiography unit or a stationary mammography system. The ability to visualize microcalcifications was compared between the built-in and conventional specimen radiography methods.

RESULTS

The built-in specimen radiography option can be effectively utilized within the stereotactic breast biopsy workflow. The learning curve for using this method by radiologists is steep, and the image quality produced by the built-in solution is at least noninferior to that produced by conventional methods.

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Sub-Events

QI01-B2   Optimizing Radiation Dose For Scanograms For Low Dose Chest CTs For Lung Cancer Screening

Participants
Josh B. Moosikasuwan, MD, Bronx, New York (*Presenter*) Nothing to Disclose

PURPOSE

To reduce the radiation dose utilized for the AP and lateral scout or scanogram portion of low dose chest CTs used for lung cancer screening.

METHODS

The mA was incrementally decreased from the factory presets of 50/100 mA to 10/20 mA for the AP/lateral scanograms. At each incremental decrease, both the technologist and radiologist determined whether there was any adverse effect on setting up the anatomical boundaries just above the lung apex and just below the posterior costophrenic angles, and on the automatic dose modulation and image quality of the subsequent helical portion of the exam. Then, 30 consecutive patients who had a prior low dose chest CT with the original scanogram factory settings performed within the past 4 years on a 64-detector CT scanner were scanned with the reduced dose 10/20 mA AP/lateral scanograms on that same scanner. The mAs for the scanograms, and the CTDIvol and the dose length products (DLPs) for the helical portion of the chest CTs for these 30 patients were analyzed. Statistical analysis was performed using paired t-test.

RESULTS

At each incremental decrease of mA, there was no adverse affect on the CT exam. In the 30 patients analyzed, all of the lungs were included on the helical portion. The average mAs used for these 30 patients for the reduced dose AP, lateral and total (AP+lateral) scanograms were 35±4, 84±6, and 119±19, compared with 201±35, 401±70, and 603±105 for prior CTs done using factory presets, resulting in an approximate dose reduction of 5x. The average CTDIvol for the helical portion of the CT was 3.4±1.2 mGy for both CTs done with scanograms with and without the dose reduction (p value=0.68), indicating that the dose reduction for the scanograms did not affect the automatic dose modulation used during the helical portion. The average DLP for the 30 CTs done with the reduced dose scanograms was 126±46 mGy cm, which was lower compared with the 139±48 mGy cm for those done with regular dose scanograms; this was unexpectedly statistically significant (p value=0.002), suggesting an additional benefit of this quality improvement initiative from improved technique used by the CT technologists from scanning less of the abdomen or neck.

QI01-B4   Shared Management Strategy For Division Leadership In Radiology: Effects On Productivity, Turn-around Time, And Physician Engagement

Participants
Elisabeth Garwood, MD, Worcester, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

Shared leadership strategies, particularly in complex settings, have demonstrated a positive impact on team effectiveness and performance when compared to traditional, hierarchical leadership models. Although team approach and shared responsibility are familiar and common concepts within radiology, shared leadership is relatively novel and little guidance exists for healthcare professionals on how to effectively implement this concept.

METHODS

We transitioned from a hierarchical to a shared leadership model following a musculoskeletal (MSK) radiology division chief vacancy. A shared leadership model was developed by classifying all responsibilities into four broad categories, dividing the roles and responsibilities of a traditional division chief among four faculty members with complementary skill sets: 1. Workflow and Information technology, 2. Musculoskeletal interventional and diagnostic ultrasound service, 3. Education, 4. Quality and Operations.Performance indicators of clinical productivity, academic productivity, turn-around time, moonlighting expenditures, faculty retention, and educational engagement were collected at several time points during the shared leadership model, aggregated for the first fiscal year under this model (10/2019 to 10/2020) and compared to the immediate preceding year under hierarchical leadership (9/2018 to 9/2019).

RESULTS

With shared leadership, we achieved improved efficiency according to the performance metrics of increased clinical productivity, increased academic productivity, reduced moonlighting expenditures, and faster turn-around time, and fostered an environment of high physician engagement.

QI01-B5   Reduced Contrast Agent Volume Using A Heart-rate Dependent Scanning Protocol In Coronary Computed Tomography Angiography For Patients With Chronic Obstructive Pulmonary Disease

Participants
Peiji Song, Jinan, China (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study was to evaluate the feasibility of a personalized CT scanning protocol that was tailored to patients' heart rate and free-breathing for coronary CTA of patients with chronic obstructive pulmonary disease (COPD).

METHODS

A total of 400 patients with chronic obstructive pulmonary disease (COPD) who need to undergo the coronary CTA were prospectively randomized into two groups (patients with vascular occlusion were excluded). For each patient in Group A (n = 200), a total of 70mL contrast agent was injected with a rate of 5 mL/s. The routine auto-trigger protocol was applied by setting the ascending aorta threshold as 80 HU.For each patient in group B(n=200): free-breathing after trigger for scanning and monitoring level was placed on ascending aorta; scans were performed with injection of 30mL contrast agent (Iopamidol 370mgI/ml) with a rate of 5 mL/s and the scan timings were set according to patients' heart rate (HR): HR> 80 bmp, scanning trigger timing: 14-17S after the injection of contrast agent and initiated manually with a delay of 2 s;HR=60-80bmp, scanning trigger timing: 20-23s after the injection of contrast agent and initiated manually with a delay of 2 s. HR<60bmp, scanning trigger timing: 26-29 after the injection of contrast agent and initiated manually with a delay of 2s. All the CTA scans were completed on a 16cm-detector CT in one heartbeat. The CT values of left anterior descending artery (LAD), left circumflex artery (LCX) and right coronary artery (RCA) were measured. Two experienced radiologists evaluated the image quality using a 5-point scale (1-unassessble to 5-excellent

RESULTS

No difference was found between the two groups in the CT values of RCA (382.3±95.3 vs. 369.1±77.0 HU), LAD (384.9±80.2 vs. 375.4±65.9 HU), or LCX (385.4±93.9 vs. 372.0±74 HU; p > 0.05). Subjective ratings of image quality (Table 2) were not statistically different between the two groups (p > 0.05).

QI01-B6 Mind Your T's And Z's: Discovery And Correction Of Dual Energy X-ray Absorptiometry Cross-calibration Bias

Participants
Samuel Fahrenholtz, PhD, Scottsdale, Arizona (*Presenter*) Stockholder, Nanox.

PURPOSE

Dual energy x-ray absorptiometry (DXA) is the standard of care for screening and diagnosis of osteoporosis, as well as treatment response monitoring. Diagnosis of osteoporosis relies solely on the numerical values calculated during the exam. Inaccurate T-scores will directly lead to misdiagnosis of osteoporosis with potential over treatment or under treatment. Cross-calibration bias is an underrecognized source of error that can directly influence T-scores and treatment decisions.The International Society of Clinical Densitometry (ISCD) provides practical guidance for maintaining the accuracy and precision of clinical DXA. Accuracy and precision are principally maintained through frequent phantom measurements and occasional technologist precision assessments. Patients are additionally recommended to return to the same DXA unit to maintain longitudinal precision. However, consolidation of healthcare is increasing the frequency of a single patient being scanned on multiple scanners over years, making cross-calibration critical. Our practice includes two DXA scanners on two campuses, and a single patient may be scheduled at either location. Our referring physician colleagues had noticed increasing variation in T-scores in patients with multiple prior studies and questioned the presence of a potential technical defect.

METHODS

To confirm the DXA discrepancy, we looked at patients with multiple scans and compared bone mineral density (BMD) changes at our site compared to partner healthcare sites. A data discrepancy was identified, but not the error source. Therefore, our team of physicists, radiologists, technologists, and a referring physician evaluated a series of proposed error sources and associated solutions. First, we asked the vendor to evaluate the two units. Second, we did a technologist precision assessment -- the test-retest procedure to establish the least significant change (LSC). Third, we estimated the frequency of patients that change scanners at longitudinal monitoring. Fourth, we evaluated the quality of patient positioning in images. Fifth, we evaluated the cross-calibration between the two DXA units by ten repeated measurements of a single vendor phantom at both units.

RESULTS

Our initial comparison to two partner healthcare sites confirmed the DXA discrepancy. Listing the possible problems and solutions, first, our vendor's assessment stated the two units were operating correctly. Second, the result of the precision assessment was that our technologists' LSC values were within ISCD recommended limits. Third, we found that in a cohort of 20 patients with multiple longitudinal scans, 15 patients had switched DXA units at least once. Fourth, our evaluation of patient position errors in images did not explain the discrepancy. Fifth, our evaluation of the cross-calibration of the two units definitively indicated a discrepancy of 3.8%.

QI01-B7 Standardization Of Pediatric Renal/Bladder Ultrasounds Within A Radiology Group Practice

Participants
Rebecca Scalabrino, DO, Jackson, New Jersey (*Presenter*) Nothing to Disclose

PURPOSE

Prompt accurate diagnosis of significant uropathies is necessary to prevent long-term complications such as diminished renal function and identify candidates for early intervention. Lack of standardized terminology and reporting metrics often leads to high inter-interpreter variability in dictation reports and confusion amongst clinical teams. A radiology group practice implemented a novel pediatric renal/bladder ultrasound technologist worksheet and dictation template with the goal of facilitating detailed standardized communication and identifying high risk patients while avoiding unnecessary expenditure of healthcare resources.

METHODS

Primary retrospective data collection/analysis included 81 pediatric renal/bladder ultrasounds performed over a 12-month period at 5 affiliated sites. A literature review of current guidelines of pediatric genitourinary ultrasound imaging was performed. Based on the literature review, which included a landmark multidisciplinary consensus statement, a new ultrasound technologist worksheet and

radiologist dictation template were constructed. Key features included avoiding nonspecific descriptors such as "hydronephrosis" and detailing the severity of urinary tract dilation (UTD) using empirically based sonographic findings such as the anteroposterior renal pelvis diameter (APRPD). Ultrasound technologists and pediatric radiologists were briefed on the new templates, which included a PowerPoint presentation. Following successful implementation, an additional retrospective data analysis of 40 pediatric renal/bladder ultrasounds was performed from the same 5 affiliated sites over a 6-month period to remeasure key metrics.

RESULTS

Pre and post-implementation data analysis revealed a significant increase in the percentage of finalized reports which included an accurately measured APRPD, as well as an appropriate standardized description of UTD by pediatric radiologists. Specifically, this included the mention of pelviectasis and/or caliectasis as opposed to nonspecific descriptors such as "hydronephrosis" or "collecting system fullness". One unexpected finding was a slight decrease in the percentage of ultrasound technologists using appropriate descriptors of UTD post-implementation.

QI01-B8 Notification Of Incidental Imaging Findings And The Value Added To Healthcare

Participants
Adriano Tachibana, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

Since 2016, our institution has created and has improved the "Follow-up Program for Relevant Incidental Findings", which consists in a close follow-up of patients who discovered incidental imaging findings while performing exams mainly during their visit to the emergency department. The program helped many patients to monitor, diagnose and stablish an early treatment of many diseases including malignant tumors, and demonstrated focus on continuous improvement on quality of care, patient safety and aggregated healthcare value.Personalizing care and making the patient aware of the importance of engaging in their own health care can guarantee better outcomes. However, few studies aimed to quantify these benefits. The main objectives are to demonstrate the degree of patient compliance with our recommendations, the final outcomes of the incidental findings, possible impacts on prognosis and a cost analysis of complementary diagnostic procedures in order to perform a cost-effectiveness analysis.

METHODS

We analyzed data from 2019 and 2020 that included: number of patients in the program, number of patients communicated and informed about the findings, outcomes (benign, malignant, still in follow-up and lost follow up or exams performed in another service) and financial impact based on how much was expended in our institution for diagnostic purposes. We chose the referred period due to a new methodology for process improvement that was implemented in 2019 and remained constant throughout 2020.

RESULTS

During the studied period, 195 patients were included, 172 were contacted and communicated about the findings. Among the patients contacted, 69 (40.1%) had benign findings, 19 (11%) were malignant, 36 (20.9%) are still in follow-up or investigation and 48 (27.9%) were considered indeterminate (lost contact or investigation was performed in another service with unknown results). The global Sars-CoV-2 pandemic should be considered to decrease the number of exams performed in 2020, consequently reducing the number of incidental findings. The higher percentage of patients with ongoing follow up and indeterminate findings also can be related to the pandemic. Diagnostic investigation was made at our hospital in 94 patients (48%). Costs of the complementary investigation included laboratory tests (3,117 tests), imaging exams (121 - Computed Tomograph /43 - Magnetic Resonance Imaging / 76 - Ultrasound / 201 - X-Ray / 29 - PET-CT), biopsies (12), and other diagnostic procedures (33 - endoscopy or colonoscopy / 36 - cardiac exams / 9 - scintigraphs) have the total value of R\$ 936,635.17 (US\$ 174,592.26) over the two years. The mean value invested to diagnose each malignancy was US\$ 9,189.07.

QI01-B9 Which One Are We Talking About? Assignment Of Numerical Addresses To Distinguish Findings In The Same Anatomical Location And/or Image

Participants
David J. Vining, MD, Houston, Texas (*Presenter*) Royalties, Bracco Group;CEO, VisionSR, Inc;Stockholder, VisionSR, Inc

PURPOSE

The identification and communication of information about image findings located in the same anatomical location and/or image can be challenging (e.g., when describing metastases in the same pulmonary lobe or liver segment). We devised a solution that automatically assigns numerical "addresses" (i.e., identifiers) to individual image findings within an interactive multimedia report to facilitate clear and accurate communication.

METHODS

We developed an interactive multimedia reporting solution that records key images and voice descriptions of image findings, tags the images with metadata using natural language processing to indicate the anatomical location and radiological diagnosis of each finding, and assembles a multimedia report with related information linked in timelines. A timeline represents a "finding" which comprises one or more "items" (i.e., key images). Multiple findings located in the same anatomical location and/or image can be difficult to distinguish because of the assignment of the same metadata (e.g., Right upper lung + Metastasis), thus we created a solution that distinguishes findings by automatically assigning a numerical address to each finding based on when it is first recorded in the report. The concept is similar to assigning a numerical street address to describe a precise location.

RESULTS

The interactive multimedia reporting system is in use at our institution. The concept of applying numerical addresses to image findings is beneficial for the distinction of multiple lesions that exist in the same anatomical location and/or image, particularly for use in surgical planning or when correlating lesions that have undergone local therapy (e.g., ablation or stereotactic radiosurgery). This simple yet powerful concept facilitates clear communication and eliminates ambiguity that often exists in conventional radiology reporting.

QI01-B-HC1 Efficacy Of Implementing A Combined Online And Hands-on Basic Ultrasound Curriculum For 3rd Year Medical Students.

Participants

Timothy Wulfestieg, DO, Aiea, Hawaii (*Presenter*) Nothing to Disclose

PURPOSE

Ultrasound (US) is a ubiquitous modality, with increased clinical use in medical resident education. Despite its emergence, many medical schools lack a formal curriculum.1 Medical students rotating through this project's medical center did not have an ultrasound curriculum, which impacted learning potential on rotations involving hands-on US procedures (i.e. emergency room and internal medicine). Utilizing national recommendations, this project sought to implement a basic resident-run US curriculum for third year medical students, with the goal of providing foundational knowledge and nascent confidence with point of care ultrasound usage.

METHODS

In the fall of 2020, a partnership was established between the radiology residency of our tertiary care center and a local medical school with the goal of implementing a basic hands on US curriculum. The developed material was based on the SRU/AMSER national curriculum recommendations, and included topics of US fundamentals and normal anatomic imaging. Fundamental subjects included: advantages and disadvantages of US, physics, sonographic probes, image optimization, modes of US, safety, terminology, and artifacts. Reviewed normal sonographic anatomy included: neck vasculature, thyroid, heart, liver, biliary tree, pancreas, epigastric vasculature, spleen, kidneys, lungs, tendons, musculature, and dynamic venous compression. A large group didactic was presented online, and a month later four, 4-hour small group hands-on sessions were completed at the hospital's Simulation Center. Each hands-on session consisted of three demonstration tables with a volunteer radiology resident patient, 2-4 medical students per table, and 2-3 floating instructors (which included both attending and resident instructors). The radiology resident volunteers and instructors were provided a brief review of the curriculum prior to the hands-on sessions to ensure uniform student guidance. The efficacy of the online lecture was measured with a twelve question pre- and post-test, administered via an online survey website, which utilized anonymized test IDs. The students also completed an exit survey after the hands-on portion. Statistical analysis of the tests was performed with SAS and Microsoft Excel software, and included tallies, mean, standard deviation, Wilcoxon signed rank and McNemar's tests for statistical significance. All students were exposed to three US machines: FujiFilm Sonosite Edge II, Sonosite MicroMaxx, and handheld Butterfly Network IQ probe.

RESULTS

A total 32 students took the pre-test, while only 23 students also took the post-test. Analyzing the 23 student cohort, the average pre-test score was 41%, and average post-test score 80%. The highest pre-test score was 8 of 12 correct, and the highest post-test score was 12 of 12 correct. The worst pre-test score was 1 of 12 correct, with the lowest post-test score improving to 5 of 12. All the above are statistically significant with a p-value <0.001. The pre- and post-data was also paired and analyzed for performance based upon topic of ultrasound. The students had greatest pre-existing knowledge of the differences between US and CT, with 96% correct pre-test and 100% correct post-test. In contrast, initially 0% selected "megahertz" as the frequency of US imaging, which improved post-test to 70% correct. Complete comparative data is provided in Figure 1 (see included PDF). The hands-on exiting surveys used a 5-point scale (5 representing the best score), with average scores of 4.9 and 5.0 regarding overall rating of the course and to what degree the student's would recommend the course to their peers. The pre- and post-tests offer one limitation of the study, as the same test was utilized for both. This was by design, as the pre-test was used as a mechanism to prime attention, and the post-test as an opportunity to enforce repetition. Another limitation involves the robustness of results provided, as generally only one question of each topic was

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Sub-Events

QI03-B2   Optimizing Usage Of Pre-procedural Antibiotics In Interventional Radiology Procedures.

Participants
Xavier Mohammed, MD, Charlottesville, Virginia (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to (1) determine how historic peri-procedural antibiotic usage at a single institution was significantly different from available guidelines, (2) measure whether the rate of procedural related infectious complications changed after the implementation of local multi-specialty developed guidelines, and (3) quantify the change in cost of peri-procedural antibiotic usage before and after implementing guidelines.

METHODS

Institutional antibiotic guidelines were established with available national guidelines and related literature in a multidisciplinary fashion with infectious disease, pharmacy, and interventional radiology. A graphical local guideline was created to help guide treatment teams on antibiotic use. Following local institutional review board approval, retrospective review was then performed after initiation of the guideline for two temporally identical 7 month cohorts: one before guideline implementation (2019) and one after (2020). Procedural volume, type of procedure, and use of antibiotics was recorded.

RESULTS

Prior to implementation of guidelines (2019), a total of 1506 procedures were performed using peri-procedural antibiotics out of 4000 total procedures (37.65%). With specific attention to central line placement, 586 procedures utilized peri-procedural antibiotics out of 1698 overall line placements (34.51%). There were 5 central line associated bloodstream infections (CLABSI) events out of all central line placements (0.29%). After implementation of guidelines (2020), a total of 806 procedures were performed using peri-procedural antibiotics out of 4083 total procedures (19.74%). 175 procedures utilized peri-procedural antibiotics out of 1478 overall line placements (11.84%). There were 4 CLABSI events out of all central line placements (0.27%). The difference in number of patients in the pre-guideline arm and post-guideline arm for both total procedures and central line placements was not statistically significant (p=0.59 and p=0.3 respectively). The number of patients receiving peri-procedural antibiotics, both in the total procedure and sub-group of central line placements, decreased significantly over the two study periods. The overall usage of antibiotics dropped 17.91% (37.65% to 19.74%) with an odds ratio of 2.46 (95% CL 2.22-2.72, p<0.001), and dropped 22.67% (34.51% to 11.84%) in the sub-group of central line placements with an odds ratio of 3.95 (95% CL 3.27-4.77, p<0.001). Additionally no statistically significant change in CLABSI rate was observed before and after implementing guidelines to the central line placement groups; the rate of CLABSI was 0.29% before, and 0.27% after (p=0.89). Finally, there was a 35% decrease in total cost of antibiotics for all patients receiving peri-procedural antibiotics before and after the implementation of the guidelines.

QI03-B3   Innovating Care Delivery In Radiology Using A Results Clinic To Manage Completion Of Imaging Follow-up

Participants
Debra Whorms, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Radiologists routinely recommend imaging follow-up for unexpected actionable findings. However, closing the loop on these findings often creates an additional cognitive burden for our physicians and advanced practice provider (APP) colleagues who order imaging. Furthermore, literature has shown that when there is a mismatch between the clinical specialty of the ordering physician/APP and the body region in which the finding is located, there is an increased risk of incomplete or missed follow-up. We sought to innovate care delivery for patients with incidental findings by introducing an enterprise-wide collaboration between the departments of Radiology, Medicine, and Surgery, to facilitate the management of imaging follow-up and help more patients complete recommended, clinically indicated imaging. The first use case for the Results Clinic (RC) was closing the loop on the follow-up of incidental pulmonary nodules (IPNs). IPNs, which are ubiquitous in the general population and predominantly benign, represent a particular burden. Non-adherence to IPN follow-up can contribute to delayed diagnosis and treatment, poor patient outcomes, and legal and economic impacts. Pulmonologists are unnecessarily burdened with referrals for management of likely benign IPNs, decreasing access for patients who need high specialty pulmonology care.

METHODS

The RC was deployed in a limited scope, to coordinate follow-up of IPNs in patients followed by our colleagues in Urology, Otorhinolaryngology, and Neurosurgery. The RC dashboard updates daily, and uses structured templates for lung nodule reporting in our practice to identify patients with IPN follow-up recommendations. Connections to data streams from our electronic medical record (EMR) and radiology report database are used to automatically determine if patients have completed recommended follow-up in our health system. Patients diagnosed with lung cancer or on hospice care were deemed ineligible for a consult to the RC, since

they were already actively being managed. For patients with incomplete follow-up, the RC notifies the referring physician/APP and offers to manage the follow-up. If the referring physician/APP chooses to consult the RC, an APP in the Department of Medicine connects with the patient to arrange a virtual visit to discuss the need for follow-up. If the patient elects to have further care in our health system, a follow-up chest CT is ordered according to Fleischner Society guidelines. The RC facilitates the patient's completion of their follow-up exam, and manages the patient until the nodule is characterized as benign or deemed to require further clinical management. In the latter case, the patient is then referred to Pulmonology or Thoracic Surgery for biopsy or surgical resection. Throughout the process, the original referring physician/APP is kept abreast of the next steps in the follow-up. If the patient does not complete the recommended follow-up, the RC makes a series of attempts to connect with the patient. If these are unsuccessful, the RC discharges the patient from their care and notifies both the patient and their referring physician/APP.

RESULTS

During the first 2 months of implementation, 61 patients with IPNs and incomplete follow-up were identified, and their referring physicians/APPs were contacted. The RC was consulted to manage the follow-up for 13 (21%) patients. The RC consult was declined for 6 (10%) patients, either because they were being managed by their primary care physicians or because the follow-up was no longer clinically relevant (e.g., the patient was on hospice). No response was received after two electronic prompts and one phone call for 9 (15%) patients. Of the 13 patients referred to the RC, 9 (69%) have scheduled or completed their telemedicine visits. 1 patient declined follow-up for their nodule, and 1 patient could not be contacted.

QI03-B4   Impact Of An Automated Screening Management Platform On Completion Of Imaging-based Screening

Participants
Debra Whorms, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Hepatocellular carcinoma (HCC) is the fourth leading cause of cancer-related death worldwide, and approximately 6,000 patients in our health system alone are at risk for HCC. The American Association for the Study of Liver Disease (AASLD) guidelines recommend screening at-risk patients with abdominal ultrasound every 6 months. However, our pilot work demonstrated a wide range of rates of compliance with HCC screening in our health system, from 15-20% in patients followed by primary care physicians (PCPs) to 60% in patients followed by hepatologists. The literature indicates that 5-year survival for patients with late-stage HCC is only 2.4%; yet more than 60% of patients are diagnosed at this stage. Identifying patients at risk for HCC in the electronic medical record (EMR) is a non-trivial effort; fundamentally, patients with cirrhosis or chronic hepatitis B infection should be screened, but there are more than a dozen additional criteria required to accurately identify these patients in the EMR. Both physician and patient barriers to screening completion exist. We chose to identify and intervene upon physician barriers that lead to decreased screening in this at-risk population.

METHODS

Using an algorithm that combines natural language processing of radiology reports with complex queries of the EMR, we created a dashboard to identify patients at risk for HCC and determine their screening status. Compliance with screening was defined as any liver imaging (abdominal ultrasound, abdominal MRI, or liver protocol CT) within the preceding 7 months (recommended time interval + 1 month grace period). We piloted the manual creation of pended orders in the EMR for screening abdominal ultrasounds for patients at risk for HCC and overdue for q6 month screening. A small pilot in one PCP practice was well received, so we expanded to a total of 7 intervention practices and designated 1 control practice whose patients were not enrolled in the intervention. We also developed an automated system to use the dashboard, identify patients with upcoming PCP appointments, and automatically pend screening orders to their outpatient encounters in the EMR without any human intervention. Upon opening the encounter, the PCP would be alerted to the presence of the pended order, which was accompanied by a detailed explanation, and prompted to sign or cancel the order. PCPs who canceled orders were contacted for feedback as to why they felt screening was not appropriate. We evaluated the satisfaction of clinicians who participated in the initial single practice pilot, and studied the trend of signed orders in the intervention practices vs. the control practice.

RESULTS

A baseline of January 1, 2019 was designated against which to compare numbers of at-risk patients, numbers of patients with signed screening orders, and numbers of patients with screenings completed. The single-practice pilot was conducted in August 2019, and the additional 6 practices were onboarded in November 2019. By December 1, 2019, all 7 intervention practices were active in our system, representing a total of 1084 at-risk patients. There were 35 at-risk patients in the control group. The attached figure summarizes the number of signed orders for the control practice (red) and intervention practices (green) from January 2019 through April 2021. From January 2019 through November 2019, between 36-50% of the at-risk patients in the control practice and 40-48% in the intervention practices had a signed HCC screening order. From December 2019 through March 2020, the number of signed screening orders dropped to 30-36% for the control practice and increased to 46-49% for the intervention practices. The COVID-19 pandemic may have impacted the trends between April and June 2020, when many elective imaging appointments and PCP visits were canceled or rescheduled. During this time, 39-42% patients in the control practice and 42-47% patients in the intervention practices had screening orders signed. Since July 2020, the number of patients with si

QI03-B5   Improving Report Times Of On Call Breast Ultrasounds

Participants
Peter Duden, MD, Charlottesville, Virginia (*Presenter*) Nothing to Disclose

PURPOSE

Inpatient and emergency department breast ultrasound studies are relatively infrequent and may present a workflow dilemma to on-call residents and staff. At our institution, residents give these studies preliminary reports, and either clinical instructors or Breast Imaging attendings generate final reports. It has been shown that absence of a defined protocol has led to delays of more than 24 hours in final interpretation, thereby diminishing value to referring providers and possibly contributing to suboptimal patient care (Eberhardt, 2018).This abstract details a practice quality improvement (PQI) project implementing a written directive for on-call breast ultrasound studies. The directive details the workflow from the Radiology resident's initial preliminary report to the final report signed by the clinical instructor or Breast Imaging attending, as well as transfer of assigned overnight studies by reading room coordinators to department-specific daytime attending worklists. Primary endpoints considered were preliminary report and final signature turnaround times, focusing on studies from the emergency department (ED).

METHODS

This retrospective study included 45 women who received breast ultrasounds in the ED during "after-hours," defined as outside the normal business hours of 8am-5pm, Monday through Friday, from July 2019 through November 2020. Of these 45 patients, 15 received ultrasounds following the implementation of a new, written protocol in July 2020 informing on-call residents when to contact Breast Imaging clinical instructors, and to whom they should send their preliminary interpretations for final signature.The protocol states that breast ultrasounds performed on patients in the ED between the hours of 9pm and 6am (overnight) should be sent to Musculoskeletal (MSK) clinical instructors for final signature, and to Breast Imaging clinical instructors between 5pm and 9pm on week nights, and from 8 am to 5 pm on weekends.To further standardize this process, reporting templates were entered into the Picture Archive and Communication System (PACS) to assist residents with generating preliminary reports. Average time elapsed between preliminary report and final signature were computed. A comparison of the average time elapsed before and after protocol implementation for each ED study final signed by either MSK clinical instructors (or other non-Breast Imaging attendings) or Breast Imaging clinical instructors/attendings was done using a t-test with Welch's correction, which does not assume equal variance or standard deviation.

RESULTS

Following implementation of our protocol, there was a statistically significant overall decrease in the average final signature time to only 4 hours 36 minutes in the post implementation group (n = 23) compared to an average final signature time of 15 hours 35 minutes in the pre implementation group (n = 30) with a p-value of 0.01. Only one study following protocol implementation exceeded 14 hours in final signature time lapse (44 hours), compared to 15 studies previously, with 85 hours being the maximum time lapse. There was no significant difference in average preliminary report times pre and post-implementation where they remained under 65 minutes for each cohort of studies, with the overall pre-implementation average being 30 minutes, and the overall post-implementation average being 55 minutes.

QI03-B8   First Experience With A Centralized Regional Clinical And Dose Management System

Participants
Alberto Perez-Rozos, MSc, Sevilla, Spain (*Presenter*) Nothing to Disclose

PURPOSE

Andalusian is a region in the south of Spain with a population of 8,5M habitants. The analysis of the CT equipment installed in the Andalusian public Health Service in 2016 indicated marked aging, exceeding the recommendations in this regard (average life 10 years). They lacked some technology obsolescence including dose reduction systems (iterative reconstruction, dose modulation in organs ...) and the ability to record doses to a centralized system, therefore using more radiation than was necessary for the studies.For these reasons we develop the project "Energy Footprint", which involves the installation of 68 (57 replacement and 11 expansion) CT equipment in 25 hospitals and in a period of six moths, with the goal of standardize technical and clinical performance, homogenize technical protocols, and improve image quality and radiation dose.

METHODS

The project incorporates a singular facility called "Advanced Center for Diagnostic Imaging" (CADI) that will centralize the exploitation of data, training, availability and productivity and will coordinate homogenization of technical protocols and dose reduction efforts. CADI's start-up and design is carried out by a specific committee.Dependent on the CADI Committee, two main working groups are set up focused on the standardization of protocols and dose management, made up of radiologists, medical physicist and radiographers from the 24 centers involved.The main objective of the working groups is reduce the variability of clinical practice by harmonizing the examination protocols by creating a library of corporate protocols based on evidence and clinical indications with adequate optimization of dose and image quality.In every center or radiation protection area is created the "local committee for dose and protocols management" as an executive task group to implement the recommendations and resolutions from the regional committee. The members of this local task group are radiographers, radiologists and medical physicists. More than 200 professionals are involved in the different task groups of the projects.

RESULTS

In the first moths of the project more than 80% of the CT have been installed and connected to CADI systems.Medical physicist have validated dosimetry indicators, including CTDI, DLP, and dose to organs calculations. A system of alerts for outliers radiation dose have been set up and validated. Automated analysis of defined indicators have been setup for more than 30000 CT studies/moth.A centralized management system for technical protocols has been used to homogenize nomenclature and technical parameters for protocols.Task group for Clinical protocols has the responsibility of define steps to validate protocols and standardize nomenclature. First findings of this task group include:• Detected a great variability of nomenclature of the same protocols between the different centers.• Definition of a common nomenclature creating a first list of protocols (starting with neuroimaging).• Need to include new protocols appropriate to the evidence and clinical indications• Need to establish a guideline to identify the needs of protocols, assessment, design, and implementation.Task group for Radiation Dose has the responsibility to validate dose estimation procedures, trazability of dose indexes, dose reporting procedures, conduct the radiation dose management system, and perform the analysis and monitoring of doses associated with clinical procedures.

QI03-B9   Implementation Of Common Data Elements In An Interactive Multimedia Reporting System

Participants
David J. Vining, MD, Houston, Texas (*Presenter*) Royalties, Bracco Group;CEO, VisionSR, Inc;Stockholder, VisionSR, Inc

PURPOSE

The RSNA defines common data elements (CDEs) as "standardized sets of questions and allowable answers used to express observations in diagnoses" (https://www.radelement.org/). CDEs are a vital component of structured reporting as they provide details about a disease using standardized medical terminology that can be indexed, searched and transmitted across electronic medical record systems. However, widespread adoption and implementation of CDEs remains limited. We have developed an interactive multimedia reporting system that provides a framework for using CDEs in an interactive multimedia reporting environment.

METHODS

We developed an interactive multimedia reporting system that records key images and voice descriptions of image findings, tags the images with metadata referenced to an ontology (i.e., controlled vocabulary) using natural language processing, and assembles a

multimedia report with related information arranged in graphical timelines. The metadata that tags each finding consists of Anatomy term and Pathology (i.e., diagnosis) terms. The automatic labeling of a finding with Anatomy and Pathology terminology triggers the display of an associated CDE menu that informs and guides a radiologist about what details to describe about a particular diagnosis. As the radiologist dictates additional description of a finding, the natural language processing system searches the transcribed text for CDE elements to populate the appropriate fields in the multimedia report. The framework that supports the CDEs allows for menus of questions and answers to be constructed with pick lists of single or multiple-choice answers, or it may consist of fill-in-the blank fields that allow for the input of free-form text and/or metrics. CDEs may be applied to the Anatomy OR Pathology terms separately or in combination as an Anatomy-Pathology term pair as this schema allows for versatility in the application of CDEs. The ontology used to label image findings consists of hierarchies of Anatomy and Pathology terms, and CDEs applied to a parent term within the hierarchies may be transmitted to a child term (i.e., inheritance) or blocked by design. CDEs applied to a particular anatomical structure, for example "muscle," may be transmitted to all occurrences of muscle terminology (i.e., transference).

RESULTS

The ontology used in the reporting process currently consists of 1794 Anatomy terms and 21,821 Pathology terms (diagnoses). A total of 1387 CDEs have been implemented in the system, including CDEs referencing the American College of Radiology's RADS reporting schema (https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems) and the RSNA's RadElement repository. The principles of inheritance and transference of CDE properties provide for an efficient way to manage and maintain the ever-growing CDE library.

QI03-B-HC1 Automated Detection Of Knee X-ray Laterality Marker Errors Using Machine Learning

Participants
Anders Lenskjold, MD,MMedSc, Portuguese Cove, Nova Scotia (*Presenter*) Research grant, Radiobotics;Consultant, Radiobotics;Consultant, MindSea;Consultant, Copenhagen Game Lab

PURPOSE

Severe consequences can arise from radiologic reports of the wrong anatomical side (laterality). For radiographic examinations of the extremities, patients and healthcare providers depend on the correct laterality description to prescribe proper treatment plans, including surgeries. Humans can identify laterality mismatches with little or no effort and sense if something does not add up. To the best of the authors' knowledge, existing computer algorithms do not have the same heuristic ability. The purpose of this study is to identify mismatches between the anatomical structure, radiographic markers, and DICOM tags (Digital Imaging and Communications in Medicine) of knee radiographs and develop an automated machine learning (ML) tool to detect the mismatches, including analyzing the laterality of the anatomical structure on plain radiographs of knees.

METHODS

We re-analyzed plain lateral knee radiographs of consecutive patients in 2017 from production PACS with Danish Patient Safety Authority approval for quality improvement purposes to identify mismatches between the radiographic markers, the anatomical structures of the knee, and DICOM tags. Obvious mismatches had already been detected and removed in the clinical setting. Therefore, the dataset only represents the undetected mistakes. We used a commercially available CE-approved and FDA-off-labeled machine-learning-based product to determine the anatomical laterality of the lateral radiographs based on the orientation of the patella. National Danish standards have patella on the right side of the femur in the left-sided images and vice versa. We used the ML-based product as the reference standard in the analyses. The study team manually identified and annotated the radiographic markers for later training and validation of an automated machine learning tool. We flagged images with 1) missing markers, 2) mismatch between markers, 3) unclear labeling including flipped lead markers, and 4) mismatch between ML laterality, markers, and DICOM tags. The proposed quality improvement tool is in a developing phase by the research team in collaboration with an ML health tech company.

RESULTS

A total of 676 plain lateral knee radiographs from 508 imaging studies were analyzed. The ML tool for laterality detection achieved an accuracy of 99.9 % (675/676), and 6.1 % (41/676) of the images had visible orthopedic hardware known to potentially perplex machine learning algorithms. The dataset had a balanced 'left' and 'right' laterality representation of 51.9 % (351/676) and 48.1 % (325/676), respectively. We found 5.5 % (37/676) of images with no markers, and one radiograph had both 'left' and 'right' markers in the same image. Furthermore, 5.9 % (40/676) of images used ambiguous lead labeling, such as flipped and cropped markers. We found rotated lead markers (> 90 degrees) in 21.0 % (142/676) of all images. While they are not ideal for uncomplicated radiologic readings, we did not categorize them as mislabels in this study.In 13.2 % (89/676) of all images, our approach flagged a mismatch between markers and anatomical laterality from the ML-product's reports. In 14.8 % (75/508) of the analyzed studies, the radiology department would have to reassess the patient to determine the correct laterality. When considering mismatches with DICOM tags, we found a 21.2 % (143/676) mismatch between markers, anatomical laterality, and DICOM tags. We saw a majority of the mismatches in the left-sided DICOM tags.

Sub-Events

QI05-A1   **Evaluation Of The Role Of The Breast Imaging In The Management Of Patients With A B1 Histopathological Outcome**

Participants
Aishah Azam, BSC,MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

A B1 outcome at histopathology is whereby the biopsy sample is inadequate or normal breast tissue has been sampled. The rate of B1 outcomes varies across different centers with rates ranging from 0.4-17% (1). A high B1 rate can lead to over-investigation and undue stress for patients whereas a low B1 rate can lead to a false assurance and high rate of missed cancers. The aim of this project was to assess the pathway of patients with a B1 histopathological outcome and provide meaningful suggestions to ensure appropriate management.

METHODS

Retrospective data was collected on patients who underwent a breast biopsy between January 2019 and January 2020 with a histopathological outcome as B1. Data recorded included patient demographics, clinical suspicion, ultrasound report, other imaging acquired at the time, and the formal histopathological report. The initial ultrasound was then further analyzed to characterize the lesion type, whether any radiological diagnosis was suggested, the number of biopsies obtained, and whether the images of the needle through the lesion was saved in 2 planes. The findings of subsequent investigations were also recorded.

RESULTS

Approximately 9.3% of patients who underwent a breast biopsy in 2019 had a B1 histopathological outcome (134/1442 patients, age range: 20-92). 68% of these cases were targeting symptomatic lesions in patients, and 32% were incidental areas picked up by the radiologist (based on 2nd look MRI; mammogram/US findings). In terms of lesion types that had a B1 outcome; 60/134 cases biopsied were well-defined masses, 42 cases were ultrasound areas of distortion, 20 cases were complex cysts, 7 cases were intraductal lesions, 3 cases were microcalcifications and 2 cases were lymph nodes. 84% of the cases had imaging in at least one plane, and 56% demonstrated imaging of the needle through the lesion in 2 planes. 101/134 cases underwent at least 2 core biopsies at the time of initial evaluation, with 15/134 only undergoing one biopsy. 18/134 cases did not record the number of biopsies performed. 83% had a suggested radiological diagnosis with 94% as these benign lesions and 6% of these as potential malignant lesions. Although a significant majority of these were suggested as benign, only 13% of the reports said a B1 outcome would be acceptable. In total 50/134 cases were re-called for a repeat biopsy (37%). Of these 34/50 patient initially had images saved in 2 planes and the remaining with either no images saved or in 1 plane only (4 and 12 respectively). 18/50 cases remained as B1 on repeat biopsy, 27 cases were upgraded to B2, 1 case was upgraded to a B3 lesion and 4 cases were upgraded to malignancy (3%). The 4 cases that were upgraded to malignancy each had suspicious examination findings, high risk clinical history or suspicious imaging findings on alternative imaging modalities. 2/4 of these patients didn't have the number of cores included in the ultrasound report, and 2 of these patients had imaging in 1 plane only. 84/134 of the patients initially diagnosed with B1 had no repeat biopsy. For 26/84 of these cases the ultrasound was repeated and there were no concerning imaging features so biopsy was felt unnecessary. Of the remaining 58 cases, 21 cases were prospectively reported by the radiologist as a B1 outcome being acceptable so no further repeat imaging was required. 37/58 cases were retrospectively reviewed along with clinical information and the B1 outcome was deemed acceptable by the Radiologist and the patient was reassured and discharged.

QI05-A2   **Deep Learning Diagnoses And Grades Childhood Adenoidhypertrophy With High Precision**

Participants
Sheng He, PhD, Taiyuan, China (*Presenter*) Nothing to Disclose

PURPOSE

Investigating and evaluating the feasibility, accuracy, and reliability of deep learning artificial intelligence (AI) methods to automatically measure adenoid hypertrophy in children from nasopharynx lateral radiographs.

METHODS

Radiograph images were manually annotated and divided into training, validation, and test datasets. Training and validation groups were used to train the multi-class U-Net and ResUNet deep learning image segmentation methods, then both methods were used to segment the test set images. The test set results for both segmentation methods were compared to determine which one had the best performance, and the best one was used to automatically measure Adenoid/Nasopharyngeal (A/N) ratios via Matlab measuring model. These ratios were compared to A/N values manually measured by three different physicians: chief, attending, and resident, where chief physician results were considered the "gold standard"

RESULTS

ResUNet demonstrated better test set segmentation performance compared to U-Net, and obtained overall more accurate A/N

measurements than that for attending and resident physicians. This was applicable for both normal, as well as moderately and pathologically hypertrophic adenoids, where ResUNet had 93.75%, 93.02%, and 96% accuracy, respectively, compared to 100%, 83.72%, and 96% for attending physicians, as well as 68.75%, 69.77%, and 84% for residents. Furthermore, ResUNet measured A/N in less time than for any manual physician measurement.

QI05-A3   Critical Findings In The Era Of Chaos

Participants
Maria Rueda, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

PURPOSE

Physician-to-physician communication as part of patient safety has been emphasized by the Joint Commission. In our institutional Radiology Department operational standards, we have established which critical findings and imaging reports not expected in a diagnostic image performed in emergency care, hospitalized, or ambulatory patients need to be communicated immediately to the attending physician within one hour of imaging acquisition. Critical finding reports in daily studies is an essential aspect of our quality improvement; therefore, for us, the completion of this standard needs to achieve 100% each month. Nonetheless, in the era of COVID-19, it has been hard to keep up with these standards given the uprise of ICU studies. This work aimed to create strategies to optimize critical finding reports and ensure our standard operational completion.

METHODS

Every month, we conduct statistics on critical finding completion. After seeing a drop in this standard completion in three consecutive months, we decided to use the ¨5 WHY¨ and the fishbone strategies to solve this problem. We first asked radiologists why they thought critical finding reports were not being completed. After identifying the problem, we worked on creating a structured critical finding report to improve accessibility. We also made email follow-ups each month when essential findings were not reported within the hour to understand specific circumstances.

RESULTS

At the beginning of the pandemia, critical finding reports dropped from 100% to 80% in April, March, and June 2020. After performing a survey, many radiologists argued uncertainty, fear and stress were the leading cause of distraction. After creating the structured report finding Radiologists found it easier and more accessible to inform. Additionally, after the email follows ups we encountered specific scenarios. In the ICU routine chest x-rays in COVID patients, critical findings could not be reported within the hour because of the higher volume and shortage of staff. This particular case, especially in the night shift critical findings report, was declared the next day by the thoracic radiologist.

QI05-A5   Implementation Of A Smart CDS Tool For Improved Lumbar Spine MRI Ordering.

Participants
Gregory Parker, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Medicare has elected to reduce inappropriate imaging, such as MRI of the lumbar spine (MRI-LS) for nonspecific low back pain through clinical decision support (CDS). Yet, CDS can only generate an appropriateness score when a structured indication is selected and high rates of free-text order entry have been observed. We evaluated the effect of an AI tool that suggested structured indications for MRI-LS orders on appropriateness scores by ordering provider type.

METHODS

In October 2020 our urban tertiary care academic medical center updated our CDS with an AI tool that automatically suggested structure indications for free-text only order indications. We compared all orders for MRI-LS placed by APPs and physicians at our main orthopedic outpatient clinic between 11/2019-2/2020 (i.e. before the automated prompt was implemented) and 11/2020-2/2021 (i.e. after the prompt was implemented). Providers who did not order at least one MRI-LS during both the before and after study period were excluded. Differences in the order scores and provider type before and after AI tool implementation were compared using Chi Square.

RESULTS

Only 22 out of 75 (29%) of orthopedic providers entered at least one MRI-LS order during the both the pre- and post-intervention study periods; this included 10 APP and 12 physicians. There was no overall change in the appropriateness score before and after use of the tool (p=0.397). The number of orders outside of guidelines was significantly different before (34/354, 10%) and after (48/314, 15%) the AI tool was implemented (p=0.0256). The majority of orders were appropriate and did not change before (273/354, 77%) and after (223/314, 71%) implementation of the tool (p=0.0719). Inappropriate orders comprised 3% of all orders before (11/354) and 2% after (6/314) implementation of the tool (p=0.327). APPs were more likely to order appropriate studies with the AI tool than MDs (p=0.0003), and less likely to order studies outside of guidelines (p=<.0001).

QI05-A7   Quality In Musculoskeletal Radiology: Can We Measure The 'Perfect' Report?

Participants
Dhiren Shah, MBBS, FRCR, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Defining and improving the quality of reports is notoriously difficult in radiology. The largely subjective nature of an individual radiologist's reports, influenced by individual training and experience, makes consistency and agreement on quality almost impossible to achieve. Whilst reporting guidelines and recommendations may include structured frameworks, quality metrics are sparse and rarely subspecialty focused. Although a report is the primary communication between the radiologist and referrer, radiologists rarely receive any direct training in quality. The ultimate measure of quality is end-user satisfaction; however, teleradiology and remote reporting - hastened by the coronavirus pandemic - have diminished the opportunities where such feedback can be obtained, and duly used to drive up report quality. We therefore propose a method of establishing a quality dashboard among a group of radiologists in a department by using the most pertinent of all metrics: end-user feedback, which in the case of our QI study, pertains to specific feedback from an orthopaedic surgeon regarding what they value in MRI knee reports.

METHODS

A senior orthopaedic knee surgeon with 8 years consultant experience was asked to provide quality metrics with weighted importance (rated from 1 to 10) for MRI knee reports performed for trauma. Knee MRI scans were used as these were the most frequently performed of all musculoskeletal MRI studies, and hence had the greatest potential for quality improvement from the widest number of radiologists. Nine metrics were identified as important from the orthopaedic perspective: certainty; answering the clinical question; readability; report length; suggesting additional management; timeliness; lack of spelling errors; sentence structure.Thereafter, the degree to which each metric could be satisfied in a report was agreed upon by consensus of the authors. The maximum score for each parameter was the weighted rating listed by the surgeon. For example, timeliness was rated 4/10 in importance and hence only assigned a maximal value of 4 in the scoring system.A series of 50 MRI adult (age 18 to 50) knee scans for investigation following trauma, performed at two out of three hospitals in our acute hospital group from January to April 2018, were scored. Subsequently, a 'Quality in Radiology Seminar' was delivered by a musculoskeletal radiologist to an audience of 20 staff and resident radiologists, introducing quality concepts, with particular reference to report style, communication, and quality metrics. A repeat assessment of 50 MRI adult knee scans performed during March to April 2021 was undertaken.(The original proposed date of March to April 2020 for the second part of the study was postponed, due to the change in service use in London hospitals during 2020, which were seriously affected by Covid-19).

RESULTS

In the initial series, answering the clinical question and suggesting further management were done well, however important metrics including certainty and readability scored less than 75%. Equivocal phrases such as 'indeterminate for' and 'possibly' were utilised, and there was lack of separation of the report into logical and easily readable sections. A number did not mention relevant negatives such as 'bone marrow signal' and 'posterolateral corner structures', possibly due to the general brevity of reports. Only 14% of reports were verified within the 48-hour target set.The repeat assessment demonstrated significant improvement in the majority of the metrics, with certainty improving from 7.3 to 9.3 (maximum possible 10), timeliness from 0.6 to 2 (maximum possible 4), and total score improving from 38.5 to 44.8 (maximum possible 54). Reports were on average longer (199 versus 165 words), likely reflecting inclusion of more relevant negatives, although repetition of findings was seen.

QI05-A-HC1 The Transition To Peer Learning

Participants
Christopher G. Roth, MD,MS, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

The purposes of this project are to create a peer learning system that preempts the punitive impact and rote nature of traditional peer learning and maximize peer learning opportunities.

METHODS

We developed an API layered on the PACS to substitute for 1) the prior report review window and 2) the traditional peer review process conducted through the ACR RadPeer system in our department. This system anonymizes the report and replaces the traditional scoring system with a consensus-based assessment system developed by our Peer Review Committee, which includes the following categories: Great Call!; Concur, Constructive Feedback and Discrepancy. Submissions are entered during the delivery of care without an impact on workflow efficiency. The system features an administrative dashboard for the peer review physician to assign a second reviewer, render final adjudication after second review and then provide feedback to the reviewee all at the PACS point-of-care.We compared the peer review/learning submissions and department median prior to and after implementation for the entire department to assess engagement and we compared the number of feedback communications provided quarterly. We also surveyed the faculty to assess their satisfaction with the new peer learning system.

RESULTS

Total peer review/learning submissions increased from 6115 and 6451 for the 2 quarters preceding implementation to 8426, 8310 and 9150 for the 3 quarters following implementation. The department median increased from 80 and 96.5 for the 2 pre-implementation quarters to 112, 127 and 136.5 for the 3 post-implementation quarters. Feedback data and survey result data are unavailable at this time.

Abstract Archives of the RSNA, 2021

Sub-Events

QI04-A1 Surge In Remote Reading Due To The COVID-19 Pandemic And The Need For Optimized Remote Reading Environments

Participants
Spencer Martens, BA, Chicago, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

With the need for social distancing and increased workplace safety requirements during the COVID-19 pandemic, many radiologists began interpreting studies remotely on home workstations. The initial aim of this study investigates how ambient light levels in remote reading environments affect radiologists' ability to detect low contrast image features.

METHODS

To understand factors that impact an individual's ability to detect low contrast image features in their remote environment, radiologists were asked to provide their remote reading room layout noting the position of their workstation relative to other light sources. We developed a 10-bit test pattern on PACS to assess minimum detectable contrast at display background gray values of 0%, 4%, 10%, 20%, 60%, and 98%. The pattern was displayed at fixed display window width/level settings of 1024/512. Letters of varying contrast were randomly placed on the backgrounds, and participating radiologists reported the lowest contrast letter they were able to detect. They also provided the time of day, sunlight conditions, and display monitor used.

RESULTS

Initial data was collected from 20 UChicago radiologists. Multiple trends limiting ability to detect low contrast image features emerged including but not limited to: 1) high ambient light levels in remote reading environment due to window or light fixture sources shining on monitor; 2) sunny conditions during study interpretation without black-out curtains; 3) consumer grade display monitors.Physicians who failed to optimally detect low contrast letters at background gray values of 0% and 4% were provided a calibrated lux meter and asked to make alterations to their remote reading environment including room layout, blackout curtains, and monitor position. Limited re-test data from select physicians following room setup alteration reflect promising increases in low contrast image feature detection with ambient light values corrected to 75 lux or below.

QI04-A2 Comparison Of The Image Quality Of Brain CT Angiography In Deep Learning Reconstruction, Filtered Back Projection, And Hybrid Iterative Reconstruction

Participants
Daehyun Hwang, MD,PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

PURPOSE

Advancements in the development of deep learning reconstruction (DLR) have led to better outcomes including low radiation exposure and excellent imaging quality. Several studies have utilized DLR in the abdominal, chest, and brain CT imaging and cardiopulmonary CTA and found better imaging quality compared to other image reconstruction algorithms. asset:$ResourceStore:/Source/merops/fragments/ID0EYHAE.xmlHowever, no study has investigated the application of deep learning image reconstruction to brain CTA protocols. Our study aimed to assess the image quality of brain computed tomography angiography by comparing deep learning reconstruction with filtered-back projection (FBP) and hybrid iterative reconstruction (HIR).

METHODS

A total of forty-three consecutive patients underwent brain CTA with a protocol consisting of a tube voltage of 120 kVp, tube current of 150 mAs, 0.5 second gantry rotation time, and 0.5 mm slice thickness. The slice interval was 0.25 mm implemented by the double slice technique. Images were reconstructed using three different algorithms: FBP, HIR, and DLR. The image noise, CT attenuation value (HU), signal-to-noise ratio (SNR), and contrast-to-noise ratio (CNR) were measured in the right and left cavernous segment of the internal carotid artery (ICA), right and left vertebral artery, basilar apex, right and left M1 segment of a middle cerebral artery and used for the objective assessment of the image quality among three different image reconstructions (Fig. 1). To perform these measurements, one investigator placed the ROIs in the exact same location of the same patient in all image algorithms including the FBP, HIR, and DLR images. The images were subjectively evaluated by two neuroradiologists (each with reading experience longer than five years).

RESULTS

Objective analysis: In all patients, the average noise was 19.80±5.57, 16.51±6.00, and 10.95±3.77 in the FBP, HIR, and DLR analysis, respectively (p < 0.001). The amount of noise reduction with the use of DLR was approximately 33.68% and 44.70% compared with HIR and FBP, respectively. There was no significant difference in the attenuation of the thalamus, and right and left cavernous segments of the ICA in all image reconstructions. The CNR was significantly higher in the DLP (34.28±15.42) than HIR (18.90±7.68) and FBP (15.62±5.74) in all patients (p < 0.001), resulting in an average improvement of 44.86% and 54.43% compared with HIR and FBP, respectively. Similarly, the SNR was significantly higher in the DLP (30.27±14.45) than in HIR

(13.51±5.38) and FBP (16.28±7.12), representing an average increase in the SNR by 46.22% (DLR vs. HIR) and 55.37% (DLR vs. FBP) (p<0.001) (Fig. 2). Subjective analysis: The subjective image quality scores of DLR were significantly higher compared to those of the HIR and FBP (p<0.001) images. The interobserver agreement for subjective image analysis obtained a k value of 0.77 representing a good coefficient. Increased number of cortical branches and well-demonstrated lacerum and cavernous segments of ICA in the DLR. In addition, the excellent vessel delineation wall and sharp vessels were more evident in DLR than in HIR and FBP (Fig. 3). Furthermore, both observers judged the quality of the images to be highest with DLR than with FBP and HIR after assessing two sample images of patients with surgically clipped and coiled aneurysms by reducing blooming artifacts (Fig. 4 - 5).

QI04-A3 Can Artificial Intelligence (AI) Completely Replace Human Reader In Mammography Screening Program? A Retrospective Evaluation With Digital Mammography (DM) And Digital Breast Tomosynthesis (DBT)

Participants
Esperanza Elias Cabot, Cordoba, Spain (*Presenter*) Nothing to Disclose

PURPOSE

To investigate whether the use of AI alone as a screening tool could achieve similar sensitivity with an acceptable recall rate, in comparison to different screening scenarios with radiologists: single reading of DM, double reading of DM, single reading of DBT and double reading of DBT.

METHODS

A consecutive cohort of 15,999 DM/DBT screening exams (with 113 cancers, including 15 interval cancers) was retrospectively collected from a previous trial study (Tomosynthesis Cordoba Screening Trial) comparing DM and DBT in a paired cohort. Each DM and DBT screening exam was independently double read by radiologists without consensus. All of the included exams were processed by an AI system Transpara®(version 1.7.0, ScreenPoint Medical BV, Nijmegen, Netherlands). The most suspicious findings detected by the system are marked in every exam and are assigned a score between 1 and 100 indicating the increasing likelihood that a visible cancer is present in the mammogram. Only cancer lesions correctly localized by AI were considered true positives. The stand-alone performance of the AI system was independently computed for DM and DBT exams in terms of area under the receiver operating characteristic curve (AUC, ROC) (95% confidence intervals). The screening recall rate and sensitivity were compared between each original screening setting and the fully-automated AI at different cutoff points using a paired data McNemar test at a significance level alpha of 0.05.

RESULTS

The AI system achieved an AUC of 0.942 (0.914-0.965) for DBT and AUC of 0.927 (0.894-0.957) for DM. During the original single human reader with DM, 498 women were recalled (3.11%, 95% CI) and 66 cancers were detected (sensitivity 58.41%). In the AI autonomous scenario (cutoff 82), 218 women were recalled (1.36%, 95% CI) and 69 cancers were detected (sensitivity 61%). Difference in recall rate -1.75%. During the original double human reader with DM, 808 women were recalled (5.05%, 95% CI) and 76 cancers were detected (sensitivity 67.26%). In the AI autonomous scenario (cutoff 76), 406 women were recalled (2.54%, 95% CI) and 77 cancers were detected (sensitivity 68.14%). Difference in recall rate -2.6%. During the original single human reader with DBT, 482 women were recalled (3.01%, 95% CI) and 87 cancers were detected (sensitivity 76.99%). In the AI autonomous scenario (cutoff 65), 1474 women were recalled (9.21%, 95% CI) and 88 cancers were detected (sensitivity 77.88%). Difference in recall rate +6.2%.During the original double human reader with DBT, 707 women were recalled (4.42%, 95% CI) and 92 cancers were detected (sensitivity 81.42%). In the AI autonomous scenario (cutoff 57), 2671 women were recalled (16.69%, 95% CI) and 93 cancers were detected (sensitivity 82.30%). Difference in recall rate +12%.

QI04-A4 Trainees Unite: The First National Interventional Radiology Trainee Research Collaborative

Participants
Indrajeet Mandal, Reading, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Interventional Radiology has developed into one of the most rapidly growing specialties in Medicine. As the field expands, it is vital to ensure our practice is evidence-based. Trainee-led research collaborative have been shown to be a highly successful model of producing high-quality, multi-centre research projects. Trainee collaboratives were first proposed in the UK over 10 years ago in surgery. Since then, many other specialties have created their own trainee research collaboratives. The Royal College of Radiologists (RCR) in the United Kingdom formed the first trainee research collaborative in radiology - RADIANT - in 2019. Academic interventional radiology is still within its infancy. Generating interest in an academic career amongst trainees is vital to ensure that the future of the specialty continues its culture of innovation in an evidence-based manner. We created a new national trainee research collaborative in interventional radiology. To our knowledge, there are currently no national or international trainee research networks in interventional radiology.

METHODS

The UK National Interventional Radiology Trainee Research (UNITE) Collaborative was created in January 2021. Members of the British Society of Interventional Radiology Trainee Committee (BSIRT) and Interventional Radiology Juniors (IRJ) group collaborated on this joint venture. The aims of the group were to increase interest in academic interventional radiology and to run undertake multi-centre research projects.Launching the collaborative first consisted of forming a steering committee. This committee included members from both BSIRT and IRJ and included trainees across multiple stages of training. An advisory panel was selected, which consisted of active researchers in the field. Further working groups were created for each individual project run under the initiative. Proposals for a multi-centre research project were submitted by members of the BSIRT and IRJ groups. After consideration by the UNITE steering committee and advisory panel, studies were selected for implementation on a national scale. The first project selected was the Multicentre Audit of Cholecystostomy and Further intervention (MACAFI) Audit, a retrospective cohort study looking into the outcomes of cholecystostomy for acute cholecystitis. A second study - RADFEM - was also selected. This study is a national survey-based study looking into vascular access techniques amongst UK interventional radiologists performing mechanical thrombectomy for stroke.Additionally, a monthly journal club was established to generate interest in academic interventional radiology. High impact papers within interventional radiology were selected for discussion. Each session consisted of a trainee presentation of the paper, followed by a multi-disciplinary panel discussion. Feedback was collected through an online form distributed to attendees after each session and response rate (RR) calculated. Attendees were asked to rate how strongly they agreed or disagreed with a series of statements about the session.

RESULTS

The MACAFI Audit has recruited a total of 100 collaborators at 60 sites so far. Data collection is currently in progress. The anticipated mean dataset size is 30 patients per site, resulting in a predicted raw dataset size of 1800 patients. The RADFEM study protocol has been published, and the project is in progress.The first 3 journal club sessions (January 2021-March 2021) received a total of 190 attendees. A total of 63 responses was received (RR=33%). A total of 90% agreed or strongly agreed with the statement "The session was a good way to keep up with latest evidence"; 79% agreed or strongly agreed with the statement "The session taught me to critically appraise"; 78% agreed or strongly agreed with the statement "I am more likely to consider a career in academic IR".

QI04-A5   A Deep Learning Reconstruction Algorithm (dlir): Assessment On Low-dose CT Image Quality And Diagnostic Accuracy Ofarteriosclerotic Occlusive Disease

Participants
Yilin Chen, Fuzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the effects of a state-of-the-art deep learning image reconstruction (DLIR) algorithm on low-dose CT image quality of patients with arteriosclerotic occlusive disease

METHODS

Seventy-eight patients underwent lower extremity arterial CT angiography on Revolution CT platform (GE Healthcare) . Four sets of CT images were reconstructed with ASiR-V 50%,and three levels of DLIR (DLIR-L,DLIR-M,DLIR-H) with 0.625mm slice thickness and 80kVp low-dose scanning voltage. The Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) as well as standard deviation(SD) values of lower extremity artery branches(Iliac Arteries, Femoral arteries, Popliteal Arteries and Anterior Tibial arteries) were measured with the same region of interest (ROI) tThe overall image quality include subjective noise, sharpness, artifacts and diagnostic confidence were independently assessed by two radiologists using a five-point scale from 1 (unacceptable) to 5 (excellent). We used Dunnett T3 test to test the SNR, CNR and SD, and we compared image quality scores with Wilcoxon test. The measurements between the four groups were analyzed using SPSS20.0, with $P<0.05$ indicating statistically significant difference.

RESULTS

SNR, CNR and SD values illustrated a progressive image quality performance as DLIR strength increases ($P <0.01$) . SNR, CNR and SD values of DLIR-L, DLIR-M as well as DLIR-H were better than ASiR-V, and images in DLIR-H group showed the lowest SD and the highest SNR and CNR among the four reconstruction algorithm groups.($P <0.05$). As for the subjective analysis, the image quality scores of DLIR-med and DLIR-high tended to be better in terms of small vessels compared with ASiR-V ($p <0.05$). Furthermore, DLIR-H achieved the best scores including SD, CNR, SNR and overall image quality scores among four reconstruction algorithm groups ($P <0.05$).

QI04-A6   Improved Operational Support For Advanced MRI Through Coordinated Real-Time Physicist Collaboration

Participants
Puneet Sharma, PhD, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

As MRI utilization continues to grow, there is greater importance to improve workflow efficiency, while maintaining high image quality, consistency, and patient satisfaction. Our large academic institution relies on clinical MR physicists for protocol optimization, dedicated technologist training, and radiologist collaborations to support the advanced cross-sectional MR imaging, which averages over 250 exams per day. This diversity of MRI exams often requires escalation and resolution of complex quality and safety issues, in order to ensure continued imaging benefit and value. The prevailing method for radiologists and MR personnel to address recurring or immediate technical challenges with MR physicists are through email correspondence, phone call, or imaging feedback reports. These approaches introduce significant delays and are impractical for proximate questions related to patient scanning, especially when physicist availability is uncertain. The purpose of this quality initiative is to improve the communication reliability and efficiency between radiology staff and MRI physicists for addressing significant technical concerns during daily clinical routine. Accordingly, we propose a new communication workflow, termed "Physicist-of-the-Day" (POD), which enables direct instant messaging with specially designated MRI physicists. We expect the novel workflow to allow more immediate collaboration and resolution to radiologist and staff inquiries.

METHODS

Our institution employs three MRI physicists, each, serving 26 MRI systems across a 30-mile geographic radius. The existing physician scheduling system, Qgenda (Atlanta, GA, USA), was leveraged to establish specific scheduling for the MRI physicists during weekday hours. A total of 10 hrs per day (50 hrs per week) was designated for scheduling, with each day divided into two "shifts": a) 8am - 12pm; and b) 12pm - 6pm. Since one physicist was 25% committed to Radiation Oncology duties, the weekly target share was distributed as {13.6, 18.2, 18.2} hrs among the three physicists. Each week, the physicists collaborated to establish their upcoming Qgenda schedule, accounting for the appropriate distribution and other availability constraints. Our department recently implemented Microsoft Teams (Redmond, WA, USA) as a tool for internal communications and other reference material, such as file sharing, imaging protocols, and project collaborations. All Qgenda schedules were posted weekly on an MRI-specific "Team", consisting of all department radiologists, MR technologists, supervisors and managers. For instant communication, we encouraged all MRI-Team members to use the chat feature to share images and request consultation from designated POD physicists during assigned hours. After hours requests were directed to a physicist group channel. The MRI-Team also allowed video or audio sharing on applicable workstations, along with issue tagging. All chat solicitations during POD were categorized, as relating to: a) imaging protocols, which includes sequence modifications or optimization tasks; b) image quality/artifacts/education; c) safety, which includes scanning constraints and medical devices. In addition, the physicists categorized the solicitor (radiologist/technologist), and whether issue resolutions occurred the same day. Since most prior solicitations with the physicists were ad hoc, no relevant communication data were available for direct comparison. However, a formal imaging feedback log between radiologists and MR supervisors has existed, which aimed to collect and distribute notifications via automated weekly emails. We collated frequency and response rate from this database as a measure of prior performance.

RESULTS

A total of 349 shifts and 1730 hours (48.1 hrs/wk) were scheduled between August 2020 and April 2021 using Qgenda and MS Teams, with a weighted distribution of 13.6, 16.8, and 17.7 hrs/wk among the three physicists. Over this span, 130 POD requests (3.6 per week) were made to th

QI04-A7   Measuring Improvement In A Multinational Healthcare Organization

Participants
Chryssa Paraskevopoulou, Athens, Greece (*Presenter*) Nothing to Disclose

PURPOSE

The aim of this study is to present the impact of the introduction of organizational clinical standards in a multinational healthcare organisation in the improvement of patient safety through clinical audit. This study seeks to assess whether actions taken have had tangible benefits and as such, retrospective reviews and assessments are embedded as standard approaches.

METHODS

A suite of clinical safety standards was introduced at Group level in 2018 to harmonise approaches and embed best practice, moving away from the prior approach where standards were developed at individual country business level based on local requirements. At the time of implementation, audits were undertaken to benchmark initial compliance to the new higher standards such that any subsequent progress could be analysed. The first comparative survey was undertaken between October to December 2020 involving 187 diagnostic imaging centres in 11 European countries. Self-assessment questionnaires, comprising of 39 questions aligned with the initial 2018 benchmarking exercise, covering: incident reporting and analysis of unintended and accidental radiation exposures, justification of imaging examinations using ionising radiation, contrast media management and Magnetic Resonance (MR) safety, were distributed to assess compliance with a 95% standard. Results were compared to those collected in 2018 to evaluate the level of improvement through continuous education of the personnel.

RESULTS

The average overall compliance was 97% compared to 80% in 2018. All centres (100%) performed incident reporting and analysis of unintended and accidental radiation exposures compared to 92% in 2018. Compliance to justification of imaging examinations using ionising radiation was 96% compared to 74% in 2018, contrast media management 95% (70% in 2018) and MR safety 99% (83% in 2018).

QI04-A-HC1 Reading Room Assistance Pilot: Improving Radiologist Workflow

Participants
Michael Hoy, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Clinical work in the radiology reading room is often interrupted by phone calls. The effects of interruptions have been shown to increase errors in many hospital settings. Yu et all found that on call radiologists are interrupted as frequently as every 4 minutes by telephone calls. Burnout is an important factor in maintaining staff viability and effectiveness, and is an identified problem based on the most recent faculty survey at our institution, with the high frequency of phone calls and distractions being a known dissatisfier for physicians. Most phone call interruptions are not urgent, do not require immediate communication and are amenable to less immediate and distracting forms of communication. A preliminary assessment reveals that a substantial proportion of calls emanates from technologists and do not require immediate communication and are amenable to alternative forms of communication. Other frequent communications originate from clinicians requesting a preliminary interpretation or clarification and the vast majority are not emergent. We incorporated the use of a 3rd-party company to provide "reading room assistance" (RRA) to field the phone calls that were previously directly targeting the reading rooms and physicians/radiologists delivering patient care interpreting imaging studies involving the assimilation of massive data requiring maximal concentration and focus. The initial pilot study involved RRA staff directing calls to the appropriate people, and prioritizing communicating with radiologists in the body reading room via an electronic messaging tool. Our specific aim was to decrease phone calls to the reading room by 50% within the first quarter. Our secondary aim was to improve workflow and satisfaction measured by physician survey results, with technologist results as the balancing measure.

METHODS

A resident assigned to "protocoling duty" recorded the phone calls he or she received during the day before and after implementation of reading room assistance. We also sent out a survey to all radiology housestaff and attendings and technologists before implementation, in order to assess attitudes toward workflow. Repeat surveys after implementation were delayed by COVID-19 and are currently being distributed. We recorded 18 days of phone calls prior to implementation of the reading room assistants, as well as 20 days of phone calls after implementation. The incoming phone calls were broadly classified into protocol related, wet reads, contrast related and miscellaneous subtypes.

RESULTS

The average number of phone calls to the reading room before our intervention was 34.7 ± 4.7. The average number of phone calls to the reading room after our intervention was 20.7 ± 2.2. Using a two sample T-test, there was a significant difference between the two groups. The p-value is < .0001. The result is significant at p < .05. The largest percentage of the phone calls were protocol related, accounting for 60% (94/157) of all phone calls to the reading room before intervention and 45% (49/110) post intervention.

Abstract Archives of the RSNA, 2021

Sub-Events

QI03-D1   Hepatocellular Carcinoma Surveillance At A Quaternary Centre In The United Kingdom - An Assessment Of Local Adherence And Deviations To European Association For The Study Of The Liver And American Association For The Study Of Liver Diseases Guidance

Participants
Tavleen Gill, MBBS,BSC, Southall, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

This study evaluated a quaternary centre, auditing adherence and identifying key deviations to EASL guidelines for the surveillance/diagnosis of at-risk patients for Hepatocellular Carcinoma. European Association for the Study of the Liver published the "EASL Clinical Practice Guidelines: Management of hepatocellular carcinoma" in 2018 in the Journal of Hepatology. It outlines the gold standard for HCC surveillance and nodule investigation pathways with which we compare our quaternary centre. American Association for the Study of Liver Diseases published the "Diagnosis, Staging, and Management of Hepatocellular Carcinoma" Practice Guidance in 2018 in Hepatology Journal. We use this to allow further comparison and contextualise deviations from EASL.

METHODS

This quality improvement project directly compared surveillance/investigation pathways with EASL guidance. Incidence rates of correct follow up vs. deviation were measured, alongside time interval between investigation stages. This allowed for an understanding of appropriateness and timeliness of the HCC surveillance programme. Standards were set at 100% adherence, as EASL guidance would be considered the gold standard for a specialist programme in the UK. This would mean all nodule seen on USS surveillance should be investigated following the EASL pathway as described in the Clinical Practice Guidelines. The authors present a retrospective cohort study. At risk adults commencing ultrasound surveillance for HCC at a specialist Quaternary Unit in the United Kingdom, between 01 Jan 2015 to 30 June 2015 were identified. The data underwent inclusion/exclusion criteria to identify a cohort of 140 individuals with 1010 scans over a 5-year period (2015-2020). Sequence and time intervals between initial surveillance imaging and further imaging/biopsy were assessed.

RESULTS

USS detected nodules <1cm were appropriately followed-up in 74.3% of cases, (mean 133.0 days, median 108.5 days). Nodules >1cm were appropriately followed-up in 93.7% of cases, with CT and MRI used as 1st modality 28.6% and 71.4% respectively. CT (mean 28.4 days, median 23.0 days); MRI (mean 56.7 days, median 41.0 days). Indeterminate nodules at first modality imaging were appropriately followed-up for second modality in only 26% of cases (mean 48.8 days, median 46.0 days).Total nine biopsies were undertaken (mean 80.7 days, median 66.0 days). Three malignant diagnoses (33%), six benign pathology (67%). The results are summarised in Figure 1, where EASL practice guidance is assessed for adherence and deviations from our local data.

QI03-D2   Multidisciplinary Cardiology Imaging Reporting Team: Initial 10-month Experience In A Tertiary Cardiology Hospital During COVID-19 Pandemic

Participants
Claudio Mesquita, MD,PhD, Niteroi, Brazil (*Presenter*) Speakers Bureau, SERVIER;Speakers Bureau, Pfizer Inc

PURPOSE

Integrating multiple specialties in a single meaningful report requires coordinated multispecialty collaboration. To meet this need, we developed a new strategy: a cardiovascular integrated report. In this report, we provide the first analysis of this experience in a tertiary cardiology hospital during the COVID-19 pandemic.

METHODS

The Multidisciplinary Cardiology Imaging Reporting Team (MCIRT) includes specialists in cardiovascular medicine, cardiovascular surgery, echocardiography, nuclear medicine, and radiology. MCIRT is organized as a team discussion that meets weekly in-person or online (as COVID-19 pandemic social distancing rules determine) and generates a single integrated report of cardiovascular imaging studies as demanded by requesting physicians or by the imaging team. We prospectively obtained clinical, diagnostic aspects, and decision-making data during the first 10 months of experience. Clinician satisfaction was evaluated by direct feedback.

RESULTS

In 10 months, there were 56 clinical cases that were reported as an integrated one. Coronary artery disease (CAD) was the most common etiology demanding integrated reports (23 cases - 41%), most frequently including coronary CT angiography and myocardial perfusion scintigraphy. The second commonest disease was cardiac infectious endocarditis (IE) in 8 cases (14%). The other diagnosis reported were cardiac amyloidosis (CA - 5), dilated cardiomyopathies (5), myocarditis (4), valvopathy (3), hypertrophic cardiomyopathy (2), pulmonary hypertension (2), coronary fistula (1), COVID-19 complication (1), cardiac tumor (1) and pacemaker complication (1). In two cases a direct decision of cardiac surgery was made during MCIRT meeting. The online

discussion was limited because of internet instability in less than 5% of cases. The impact on decision-making and clinician satisfaction was significant.

QI03-D3 Addressing Delays And Deficiencies In Radiology Workflows Through Measurement Of CT Timestamp Accuracy

Participants
Neil Bhatia, Atlanta, Georgia (*Presenter*) Nothing to Disclose

PURPOSE

Patient safety events related to timestamp discrepancies between the imaging modality, the PACS, and the EMR prompted this quality improvement project. We focused on the specific modality of CT due to the importance of timely CT imaging for high acuity indications such as cerebrovascular accidents and the relative frequency of CT imaging, since imaging turn-around-time is often a key performance indicator for health systems. Incorrect timestamps associated with imaging modalities may contribute to radiologist worklist derangements that can subsequently result in delayed treatments and ultimately adverse patient outcomes. This project identified and quantified timestamp deviations associated with CT machines at one large academic hospital and proposed and implemented interventions to address these deviations.

METHODS

The problem statement was as follows: as of January 11, 2021, there is an average time stamp deviation of 12 minutes and 30 seconds between scanner time and coordinated universal time (UTC) across 5 CT machines in the inpatient and clinic settings at a single hospital site, providing inaccurate data about the time to care for patients. Our goal was to have the time-stamp deviation between the modality and UTC to be less than 60 seconds on 100% of CT scanners by March 1st, 2021. The baseline state and improvement states were established by undertaking a manual audit of the 5 CT scanners. The timestamp deviation was calculated by subtracting the time associated with each scanner from the UTC as shown on a cellular device. Baseline was established over 2 audits conducted 3 months apart in time. Technologist perceptions of the problem and other contributing factors were explored during the audits. A fishbone analysis of these factors was generated. The problem was presented at Radiology Department-wide meeting. A focus group was convened after this presentation to brainstorm solutions. Proposed solutions included manual correction of timestamps by technologists as part of their daily workflow and an automated approach that would configure each scanner to refer to a network time protocol (NTP) service. The test of change was implemented based on the automated approach. Partnering with a contracted imaging service company, each scanner was manually configured to refer to the NTP service, which was to subsequently be managed by institutional information services. Reconfiguration of each scanner required a short reboot of about 15 minutes. Times were arranged with managers at affected sites to minimize impact to patient care. A third manual audit was then conducted post-intervention to determine the effect of our automated solution on timestamp deviations. Box-and-Whisker plots were created showing the mean and distribution of timestamp deviations across each of the 3 audits.

RESULTS

The data from each audit quantified the magnitude and direction of timestamp deviations for each CT machine. The initial audit demonstrated that 4 out of 5 machines showed timestamps that were in the future relative to UTC. Two scanners were at least 20 minutes ahead of UTC. One out of 5 displayed a time in the past or behind relative to UTC. The mean timestamp deviation was 8.8 minutes with a standard deviation of 13.1 minutes. The second audit showed that 2 scanners were at least 20 minutes in the future. Two other scanners had no timestamp deviation, and 1 scanner was unable to be accessed for auditing. The mean timestamp deviation for the second audit was 12.5 minutes with a standard deviation of 14.6 minutes. The post-intervention audit of the 5 scanners revealed no timestamp deviations relative to UTC.

QI03-D5 Trainee And Faculty Perceptions Of Remote Pacs Workstations And Next Steps In A Large Academic Medical Institution

Participants
Srini Tridandapani, MD, PhD, Birmingham, Alabama (*Presenter*) Co-founder, CameRad Technologies, LLC;Spouse, Co-founder, CameRad Technologies, LLC;Officer, CameRad Technologies, LLC;Spouse, Officer, CameRad Technologies, LLC

PURPOSE

Remote workstations were rapidly deployed in our academic radiology practice in late March 2020 in response to the COVID-19 pandemic. Surveys of the radiology trainees and faculty were conducted seven- and thirteen-months following workstation deployment to assess the impact on radiology education and faculty wellness, as well as assess the desired trajectory of remote work in academic setting.

METHODS

Surveys were distributed via email to all trainees and all radiology faculty in October 2020 and April 2021, with a two-week deadline for completion. The April survey is currently still open for responses at the time of the submission of this abstract. Questions were primarily multiple choice with 5-point Likert scale with a few free text responses.

RESULTS

In October 2020, 81% (n=39/48) of trainees, 44% (n=22/50) of on-site faculty, and 89% (n=25/28) of remote faculty responded to the survey. The majority of trainees (51%, n=20/39) reported remote work had a negative impact on education, greatest among lower level residents (p<.001). The majority of radiologists with remote workstations (78%, n=18/23) reported improved sense of wellbeing and lower stress levels (88%, n=22/25) as a result of access to remote work options. A simple majority of trainees (49%, n=19/39) and a majority of faculty (63%, n=29/46) desired to see remote work expand in the October survey. Only 7% of faculty (n=3/46) and 24% of trainees (n=9/39) desired to see remote work discontinue. In preliminary data from the April 2021 survey, 40% (n=19/48) of trainees, 34% (n=17/50) of onsite faculty, and 75% (n=21/28) of remote faculty have responded. The majority of trainees (58%, n=11/19) report that remote work has had a negative impact on education. The majority of radiologists with remote workstations (81%, n=17/21) still reported improved sense of wellbeing and lower stress levels (71%, n=15/21) as a result of access to remote work options. An overwhelming majority (90%, n=19/21) of those with remote workstation state it is a high or very high priority to have access to a remote workstation in the future. A majority of onsite faculty (59%, n=10/17) were interested in obtaining access to a remote workstation. While the majority of faculty (66%, n=25/38) continued to advocate for expansion of remote work, only 21% (n=4/19) of trainees maintained this view. However, the majority of trainees (58%, n=11/19) voted for remote work continue for those with access. The majority of trainees in both surveys reported high to very high interest in access to a remote workstation in their future jobs.

Knowledge Is Power: How To Educate Your Patients About Breast Biopsy Markers

Participants
Tiffany Chan, MD, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

To determine if providing a patient-friendly biopsy marker educational handout would improve patient knowledge and comfort with receiving a marker clip. Biopsy markers serve many purposes regardless of whether the biopsy result is benign, high risk, or malignant. However, during the informed consent of breast biopsies performed at our institution, we frequently encounter concerns from patients regarding biopsy markers. These extensive conversations would delay procedural start time, disrupt clinic workflow, and result in the patient declining the biopsy marker.

METHODS

An informational handout about biopsy marker clips was developed to address commonly encountered questions during the informed consent process. An IRB-exempt, prospective, 4 question questionnaire was then created with responses utilizing the 5 point Likert scale. At all clinical sites that offered biopsies, the handout was provided to each biopsy patient to read while awaiting consent with the physician. The technologist would collect each survey upon completion. A spreadsheet was created to record questionnaire responses. Incomplete surveys were excluded. A paired T test and Wilcoxon non parametric test were used for statistical analysis.

RESULTS

141 completed forms were included in the analysis.Questions 1 and 3 were identical and asked the patient, "Please rate your understanding about Breast Biopsy Markers from 1-5, with 1 being Least Knowledgeable' and 5 being Most Knowledgeable", before and after reading the handout, respectively. The mean score for Question 1 was 2.59 (95% confidence interval: 2.34 - 2.84, standard deviation 1.52). The mean score for Question 3 was 4.26 (95% confidence interval: 4.1-4.4, standard deviation 0.95). The difference in the mean score between Question 1 to Question 3 was an increase by 1.67 (95% confidence interval: 1.44-1.91, with standard deviation 1.42). This was statistically significant ($p<0.001$). Questions 2 and 4 were identical and asked the patient, "Please rate your comfort level of receiving a Breast Biopsy Marker during today's biopsy, from 1-5, with 1 being 'Least Comfortable' and 5 being 'Most Comfortable'", before and after reading the handout, respectively. The mean score for Question 2 was 3.4 (95% confidence interval: 3.2-3.6, standard deviation 1.42). The mean score for Question 4 was 4.20 (95% confidence interval: 4.03-4.37, standard deviation 1.04). The difference in the mean score between Question 2 to Question 4 was an increase by 0.8 (95% confidence interval: 0.61-0.99, standard deviation 1.15). This was statistically significant ($p<0.001$).

QI03-D7 **Improving Acute Imaging Workflow In A Large Multi-tertiary Teaching Hospital**

Participants
Ammaarah Said I, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

The role of imaging is becoming increasingly vital to the management of inpatients (IP) and those presenting to emergency departments (ED). Time taken in studies being performed and reported is crucial in ensuring patients are managed promptly and thus targets for treatment, discharge and admission are met, maintaining patient safety. Therefore, it is vital to ensure acute radiology services are as efficient and streamlined as possible. As such, we aimed to evaluate and improve the acute radiology service provided in a multi-tertiary London hospital (a non-major trauma centre). We aimed to address delays in scanning, reporting, communication and documentation of urgent findings, as well as improving imaging workflow patterns.

METHODS

All acute cross sectional imaging performed over a two week period (01/09/20 to 11/09/20) and all whole body trauma imaging performed over a six month period (06/04/20 to 20/09/20) was acquired from electronic patient records. Preliminary analysis was undertaken to assess current practice. National and local reporting targets and trauma reporting standards for major trauma centres were used to inform targets. The following standards were agreed upon:Trauma Related Standards:[A] All trauma head CT studies should be reported within one hour of being scanned (as per national guidelines 'NICE Head Injury' 2019)[B] All whole body trauma CT studies should have a primary survey within five minutes of being scanned (as per national guidelines 'Standards of practice and guidance for trauma radiology in severely injured patients,' 2nd edition RCR, 2017)[C] All whole body trauma CT studies should have a full report within one hour of being scanned (as per 'Standards of practice and guidance for trauma radiology in severely injured patients,' 2nd edition RCR)[D] All whole body trauma CT studies should have the final report reviewed by a consultant radiologist within 24 hours of the radiology trainee report (as per local guidelines)Non-trauma related standards:[E] All non-trauma ED body CT studies should be reported within two hours of request (as per local guidelines)[F] All IP CT studies should be reported within four hours of request (as per local guidelines)After primary data collection the following interventions were implemented:1. An automatic primary survey template for body trauma scans2. A 'trauma protocolling' button to highlight trauma scans on reporting lists3. Encouraged reporters to document communication of urgent findings4. Encouraged radiographers to inform reporters once trauma body scan performed5. Increased number of acute reporters during peak hours6. A twice daily radiographer-radiologist handover to schedule non-urgent scans to off peak timesSubsequently, we conducted another cycle of data collection and analysis to review the impact of these interventions. Whole body trauma data was collected over a two month period (20/12/20 - 22/02/21), whilst other reporting data was collected over a one week period (15/03/21 - 19/03/21).

RESULTS

[A] CT Head reporting improved from 81% to 84% compliance with reduction in median time from scan to report from 33 minutes pre-intervention to 27 minutes post-intervention[B] The number of primary surveys released increased from 12% to 72%, however average time taken increased from 24 to 32 minutes[C] Average time to issue final reports for whole body trauma CT remained static from 1 hour 11 minutes to 1 hour 15 minutes[D] Average time for consultant review of whole body trauma CT reports improved from 5 hours 45 minutes to 4 hours 43 minutes[E] ED reporting improved from 61% to 69% compliance with static median reporting times of 1 hour 43 minutes to 1 hour 42 minutes[F] IP reporting improved from 52% to 54% compliance with median reporting times of 3 hours 48 minutes to 3 hours 51 minutesThe communicati

QI03-D8 **Sonographer And Resident Driven Quality Improvement Curriculum For First-year Radiology Residents**

Participants

Brian Blumhof, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Radiology offers a plethora of imaging modalities, but unique among these, ultrasound is highly dependent upon the user to produce high quality images. Radiology residents quickly develop the ability to interpret images, but independently acquiring diagnostic quality sonographic images remains a concern among trainees. The aim of this quality improvement (QI) project is to produce a resident and sonographer driven educational ultrasound curriculum to improve overall resident confidence and technical skills in acquiring diagnostic ultrasound images.

METHODS

Eleven first year radiology residents participated in a six-month ultrasound scanning curriculum, held after clinic hours, which utilized standardized patients, sonographer driven scanning lessons, and a supplemental written curriculum. Participating residents completed subjective confidence surveys and objective scanning skills examinations prior to the course, at the course mid-point, and at completion. Residents rated their overall scanning confidence utilizing a 5-point Likert scale. Objective scanning skills examinations tested each resident's ability to produce diagnostic quality ultrasound images. These exams were observed and graded by a research sonographer and specific image quality metrics were assessed.

RESULTS

To date, data of two consecutive subjective surveys completed by all participating residents and two consecutive objective examinations completed by 91% of residents has been analyzed. Interval pre- and post-intervention data for multiple outcomes were compared using the Wilcoxon signed ranks test along a Likert scale, with initial analysis showing no statistically significant change in a balancing measure assessing resident satisfaction with time spent learning radiology outside of work hours. There was improvement in residents' overall subjective confidence to adequately perform and document an ultrasound examination (p=0.006) as well as specifically with renal (p=0.005) and gallbladder (p=0.006) studies. Objective data showed that, as a cohort, residents demonstrated improvement in ability to perform and document transverse axis gallbladder examinations (p=0.023) with trend toward significant improvement in long-axis gallbladder examinations (p=0.111). Final data analysis is pending.

QI03-D9   **Interventional Radiology Patient-centric Procedural Videos: A Quality Improvement Project Designed To Increase Patient Understanding**

Participants
Zak Boggs, MSc,MS, Columbus, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Interventional radiology (IR) procedures continue to evolve and regularly employ the latest device technologies and image-guidance for performance of minimally-invasive complex interventions, which are often abstract to patients and the lay public. This quality improvement project aimed to evaluate patient procedural understanding and then attempted to improve understanding and awareness through the creation of patient-centric educational videos.

METHODS

This is a single-center prospective study conducted at a tertiary academic medical center from September 2020 to May 2021. This study was considered exempt by our Institutional Review Board and was conducted with patient consent. Patients undergoing port placement, tunneled central line placement, port removal, chemoembolization, radioembolization, or ablation procedures were shown the corresponding procedural video prior to their intervention, and subsequently offered a voluntary survey in the peri-procedural area. The 13-question survey utilized a 5-point Likert scale to assess patient understanding of anatomy/body structures, risks, benefits, and alternatives, as well as basic demographics and overall understanding of the aforementioned IR procedures. The physician then addressed any questions or concerns with the patient face-to-face. Baseline data was established from 115 patient surveys administered prior to video creation, and data is presented in a run chart. After video creation and implementation, an additional 114 patients were surveyed.

RESULTS

Of the 114 patients surveyed post-video implementation, 64% (n=73) had a high school education, 18% (n=20) graduated from college, and 18% (n=21) had a graduate degree. All patients spoke English as a primary language. Sixty-six percent (n=75) of the patients had never undergone the same procedure before. Patient average understanding ratings were based on a 5-point Likert scale. Pre versus post video viewing average ratings are as follows: 3.5 versus 4.7 (p < 0.01) for understanding of the involved anatomy, 3.6 versus 4.7 (p < 0.01) for understanding of procedure risks, 4.0 versus 4.8 (p < 0.01) for understanding of procedure benefits, and 3.6 versus 4.8 (p < 0.01) for overall procedure understanding.

Sub-Events

QI03-A1 **Utilizing Patient Portal To Allow Self-scheduling Of Screening Mammograms To Maximize Utilization Of Available Capacity And Enhance Patient Experience**

Participants
Julie Limfueco, BSN, Lakewood, California (*Presenter*) Nothing to Disclose

PURPOSE

Utilizing our Epic Patient Portal to allow patients to self-schedule screening mammogram appointments, in order to provide a more efficient process. Our department originally piloted patient self-scheduling for ultrasound procedures beginning in November 2020. This project was highly successful, and a decision was made to implement self-scheduling for screening mammography. By using the patient portal, patients avoid phone calls to our busy call center and have increased visibility for appointment availability, resulting in increased patient satisfaction and a reduction of unfilled appointment slots on our breast imaging schedule.

METHODS

Working with our IT analysts, appointment templates were created and made available to patients in our Epic Patient Portal, MyChart. Appointments can be made via a "ticket scheduling" process where the patient receives a notification that an order has been placed for a screening mammogram and they are directed to schedule directly in the MyChart portal. Patients are also able to "direct schedule" annual screening mammograms based on due date, without the need for a physician order. Patients are presented with all available appointment times, for any applicable locations, to schedule at their convenience. Logic has been built into the process to validate authorization status and ensure that appointments are appropriate for locations provided. The screen shots below illustrate the process from the patient's perspective. We have built in specific questions that guide the process and determine if self-scheduling is appropriate for the visit. Patients with issues or conditions not appropriate for self-scheduled screening mammograms are directed to call our call center to complete the scheduling process. We have built-in logic that restricts availability by payor for our off-site clinics that have payor based restrictions.

RESULTS

We have seen high numbers of active participation for all areas currently using our self-scheduling process, with a corresponding increase in screening mammography volumes.

QI03-A3 **Direct Access And Skill Mix Can Reduce Telephone Interruptions And Imaging Wait Times: Improving Radiology Service Effectiveness, Safety And Sustainability**

Participants
Christopher Watura, FRCR,MBChB, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

The most common telephone calls during radiology reporting have been shown to be those for requesting scans to be vetted. These types of calls are not always necessary in routine circumstances. Radiology backlogs due to the ever increasing demand for imaging and the subsequent anxious wait times endured by patients have been compounded by the COVID-19 pandemic. Recent 'Getting it Right the First Time' and Sir Mike Richard's reports emphasise that there has never been a more important time to streamline radiology workflow and maximise utilisation of existing resources, such as the digitised systems for requesting imaging tests and skill mix. Furthermore, telephone interruptions may be associated with a higher chance of an error in a report.We aimed to take characterisation of these telephone calls an important step further, by actually trialling concepts for reducing them and simultaneously observing the effect on imaging wait times.

METHODS

Prospective study conducted at a teaching hospital in two cycles, pre and post-interventions.In each cycle, radiology registrars were asked to record all incoming calls to the 'hot' phone over a 1 week period (10 reporting sessions) during in-hours (9am-5pm), using a pre-prepared spreadsheet.Average wait time between scan request and completion was calculated for the each cycle using data exported from PACs.Excel was used for statistical analysis.The interventions were conceptualised based on our results from the first cycle (below). The actions were twofold:1. Created new flow diagrams to allow radiographers to accept routine requests for plain CT head and CT KUB scans, in- and out-of-hours. Timeframes for performing the scans dependent on the clinical risk factors present and indications for when a radiologist should still be contacted to vet and protocol a scan were clearly stated.2. Sustained communication of the new pathways with all stakeholders, including radiologists, service leads and junior medical staff.To establish awareness of the new protocols, we communicated with stakeholders, including radiologists, service leads and junior medical staff, in a variety of settings.

RESULTS

Data collection forms were returned for 8 of the 10 reporting sessions pre- and post-intervention (80% response rate). Not all calls were recorded, due to the time constraints on reporting radiologists who also had to fulfill their other duties.Requests for scans to

be vetted were the most frequent reason for calls, comprising 71% (87/122) pre-intervention. 69% (60/87) of vetting was for CT. Of these, CT heads were most frequent (23%). CT KUBs were also common (10%).92% (112/122) of calls were from junior clinicians.After intervention, calls for vetting CT heads reduced by 30% and for vetting CT KUBs by 100%. The number of CT heads performed pre- and post-intervention was 123 and 117 respectively, and for CT KUBs this was 27 and 20.The mean average wait time between CT head request and scan completion pre- and post- intervention was 5.2 and 3.2 hours respectively, demonstrating a 40% reduction. Calculating change in wait time for CT KUB requests was of limited value, as some of these are scheduled as outpatient studies.Radiologists, radiographers and referrers reported a high level of satisfaction with the improved reporting environment and organisational efficiency.

QI03-A4   Clinical Correlation: Establishing A Diagnostic Radiology Patient Consultation Service

Participants
Shira Steinberger, MD, New York, New York (*Presenter*) Nothing to Disclose

PURPOSE

To increase radiologists' visibility and value by establishing a diagnostic radiology consultation program. To confirm patients' desire for radiologic consultations and assess the impact on smoking cessation, no show rates, patient anxiety, and health literacy.

METHODS

Through a partnership with the Mount Sinai Pulmonary fellows clinic, we established a diagnostic radiology consultation program. We installed a PACS within a consultation room and cardiothoracic radiology fellows and senior residents conducted one-on-one encounters to review chest CT's with patients. Pre and post imaging surveys assessed patient understanding of imaging results, anxiety levels, willingness to stop smoking, and the role of the radiologist. Measurable metrics including future appointment compliance and smoking cessation rates were tracked. Pre and post surveys were distributed to patients seen in pulmonary clinic who did not undergo an image review consultation as a control group. 84 patients enrolled in this ongoing study, 48 image review consultations and 36 controls.

RESULTS

26% of image review patients and 13% of controls were current smokers. 45% identified as Hispanic and 21% as African American. 44% of image review patients and 28% of controls did not know their CT scan results prior to their appointment. On post image review, 98% had a good understanding of their CT scan results. After radiologic consultation 77% had an increased desire to stop smoking, in comparison to 56% of controls. 67% of patients had decreased anxiety after reviewing their CT scan. Pre image review, 77% identified radiologists as physicians, increasing to 90% post image review. 95% wanted to meet with a radiologist again to review future imaging. 100% found meeting with a radiologist helpful. On 6 month follow up, 8% of image review patients quit smoking compared with 0% of controls.

QI03-A5   A Quality Improvement Program To Improve The Communication Of Clinically Important Findings On CT And MR Enterography

Participants
Ryan Bailey, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

PURPOSE

Radiology reports have inherent variability, as they are read by different radiologists with differing levels of focus in inflammatory bowel disease. This variation may result in a report which is more difficult to interpret or overlooks salient findings. In the setting of inflammatory bowel disease, magnetic resonance (MRE) and computed tomography enterography (CTE) provide important information for clinical decision making. We sought to standardize enterography reports at our institution in a collaborative effort between radiology and gastroenterology. Our goal was to ensure that specific diagnostic criteria utilized to guide clinical management were consistently and clearly communicated to the referring clinician, thereby improving patient care.

METHODS

After identifying stakeholders within the radiology and gastroenterology departments, we created a scoring questionnaire which included both subjective and objective measures of report clarity, efficacy, and inclusion of pertinent findings. Subsequently, 50 consecutive patients who underwent CTE and 30 consecutive patients who underwent MRE from 2/1/2020-3/15/2020 were identified. The original reports were first reviewed by the stakeholder gastroenterologists on our team and scored with the questionnaire. Following analysis of our baseline data, we reviewed the available literature and collaboratively developed a structured reporting template. Two blinded experienced gastrointestinal radiologists re-interpreted these studies utilizing the new template. The new reports were divided and reviewed by the same three stakeholder gastroenterologists, and, when possible, the studies were reviewed by the ordering physician. The same questionnaire was used for evaluation of the new reports. Scores for both the old and new reports were recorded in a secure internal database.

RESULTS

At baseline, we found that 40 reports (50% of total) were missing findings deemed clinically important by the reviewing gastroenterologists. In addition, subjective measures of referring clinician satisfaction regarding report clarity and ability to extract pertinent findings varied widely with poor average scores of 7.6/10 and 7.1/10, respectively. Following implementation of the standardized reporting template, inclusion of all clinically pertinent data was achieved in 77 reports (96.3%). Subjective measures of referring clinician satisfaction also improved significantly, scoring 9.9/10 for both report clarity and ability to extract pertinent findings (p&lt0.01 for both). Most importantly, new information included in the standardized reports would have resulted in a change in clinical management for 20 patients (25% of total).

QI03-A6   Generation And Implementation Of Inter-Departmental Workflow Interventions Between Interventional Radiology And Medicine

Participants
Michael Jin, MD, Coram, New York (*Presenter*) Nothing to Disclose

PURPOSE

Communication failure accounts for the majority of unexpected adverse patient events. Interventional Radiology (IR) is responsible

for performing many types of procedures in the inpatient setting, therefore a streamlined workflow between IR and Medicine teams must exist to ensure both rapid and accurate communication. At our university hospital, there have been incidents where the internal medicine staff were unable to contact IR regarding procedure details, including time of procedure and complications that arose during procedures; this is indicative of communication breakdown between these two teams. Such inefficiency in correspondence can result in discharge delays, prolonged NPO times, and disruption to patient treatments, ultimately leading to patient frustration and creating the potential for increased patient morbidity. Intervention in communication and workflow patterns surrounding IR procedures has shown potential to decrease NPO times, and improve other areas by extension. We aim to enhance IR and Medicine workflow as a means to increase patient satisfaction, decrease NPO periods, and improve patient outcomes after IR interventions.The goal of this study is to improve communication and establish an efficient workflow between IR and Medicine departments. Our objectives are to identify failure modes and barriers to communication, devise interventions to solve these problems, revise the current workflow procedures, and later assess whether these interventions were effective at improving procedural timing and patient experiences.

METHODS

We employed Six Sigma DMAIC methodology to conduct QI and facilitate timely and accurate communications between Medicine and IR teams. This process entails defining, measuring, analyzing, improving, and controlling problems within a process. Pre-intervention, a 6-point questionnaire was given to medicine residents to assess perception of the timeliness of IR procedures and the impact of IR procedures on discharge times and duration of NPO status. Multidisciplinary meetings amongst IR, Medicine, and informatics teams were conducted to identify failure modes in the current workflow and appropriate strategies were implemented to address these existing obstacles.

RESULTS

Results of the preintervention survey (n = 29) reflected delays in IR procedure times after placement of orders, with 79% of participants responding that it took 2 or more days for the IR procedure to occur. Further, 55% responded that IR procedures play a role in delaying discharge in 25% of patients, with an additional 35% responding that IR procedures delayed discharges in 50-75% of patients. Of delayed discharges, 45% of participants answered discharge was delayed to next afternoon, and 31% answered a delays were of two or more days. The average NPO duration was 8-24 hours for each procedure ordered. Based on our intervention process map of the current workflow, 3 critical failure modes were identified: 1) communication breakdown regarding time and potential delay in procedure, 2) prolonged NPO duration for procedures, and 3) lack of post-procedure documentation. Pursuant to these results, we are in the process of implementing a bidirectional dashboard system within the EMR to address communication barriers with the aim of having procedural delays of an hour or more being updated by radiology nursing staff on the dashboard. Additionally, the IR post-operative policy was revised to mandate documentation entry within 24 hours of the procedure. Finally, a meeting is to be held between IR and Medicine teams to discuss these new interventions as well as provide general information and brief written guidelines of required NPO times of common IR procedures.

QI03-A7   Implementing QATrack+ QC Database For Report Generation And Data Analysis

Participants
Min Yang, MS, Oklahoma City, Oklahoma (*Presenter*) Nothing to Disclose

PURPOSE

QATrack+ is a free and open-source online form-based data-entry and database application that can be used to collect data from medical physics surveys and store the information in the cloud or on a dedicated server, in house. Current physics survey reports in many departments are saved as Excel and pdf files. Large amounts of time and effort are required to extract the information from years of Excel data to perform desired data analysis such as image quality and dose trends to improve patient care. Incorporating the available integrated scheduling system may reduce unintended missed surveys and the multiplatform (computer/tablet/smartphone) functionality will be useful providing access to and comparing to prior year's results. Native reports generated from QATrack+ may not be adequate to file as final reviewable/distributable medical physics survey reports (for diagnostic work); however, data can be extracted and Excel-type spreadsheets or pdf reports can be automatically generated using python scripting and packages.

METHODS

Implementation of a working server system is explored, by adding applicable tests for diagnostic annual and acceptance surveys. Useful data extraction is investigated utilizing the QATrack+ API (Application Programming Interface). QATrack+, Python coding and LibreOffice were combined together to automate the interface interrogation for the server and provide appropriate data constructs to produce professional level reporting and final documentation.

RESULTS

Investigation of the online system provides a customizable selection for testing requirements. Many individual tests can be re-used or modified for multiple modalities or survey types. Surveys are reviewed and approved by appropriate groups on the server/database, and the QATrack+ JSON API is used to access or export data. Python code was created to selectively extract data from the server and provide information in a usable format for report generation. The data was organized and placed in LibreOffice Calc utilizing an appropriate template (an Excel-type spreadsheet, with variable placeholders). The automatically generated spreadsheet survey report results in a final report nearly identical to current practice forms (Excel spreadsheets) and can be accessed using LibreOffice or Excel.

QI03-A8   Machine Learning Based On Multi-label Classification For Determination Of Urinary Stone In Vivo With Mixed Compositions

Participants
Xian Li, Guangzhou, China (*Presenter*) Nothing to Disclose

PURPOSE

To predict the composition of urinary stones by using parameters analysis of Revolution energy spectrum CT and machine learning based on multi-label classification modeling. The scan of Revolution energy spectrum CT was taken before operation, and the infrared spectroscopy analysis after operation was used as the gold standard.

METHODS

291 composition labels were retrospectively collected from 159 patients, which included 96 male and 63 female patients, aged 10-

291 composition labels were retrospectively collected from 159 patients, which included 96 male and 63 female patients, aged 16-87 years (median, 56 years). All patients performed preoperative energy spectrum CT scan (switching tube voltage: 80 kVp~140 kVp, tube current: 260 mA). Multiple single energy CT images (40 keV~140 keV) were produced, and the energy spectrum analysis was conducted on the output 70 keV single energy image in the AW 4.6 workstation. The stone composition prediction was formulated as a multi-label classification problem, which was modeled with the extracted ESA features as input and solved by the open source tool kitsscikit-multilearn and MEKA. Tenmulti-label classification methods (e.g., binary relevance methods, label powerset methods, pairwise and threshold methods, updateable methods) were tested, and the ten-fold cross-validation and the discriminative accuracies (ACC) were reported. These patients underwent removal surgery operation of urinary stone at the First Affiliated Hospital of Guangzhou Medical University. All the stone samples were sent for composition analysis by infrared spectroscopy techniques, and the results were used as the gold standard for stone composition. The composition labels included single or mixed compositions, including carbapatite (calcium phosphate, CP), calcium oxalate monohydrate (COM), calcium oxalate dehydrate (COD), uric acid (UA), and struvite (STR).

RESULTS

Multiple parameters were obtained, including the effective atomic number (Zeff), the mean CT values (40 keV~140 keV), and various based densities in material separation image (e.g., water, iodine, brushite, cysteine bone, fat). 733 measured data were analyzed, which had 308 ESA features totally. Four multi-label classification methods were found to demonstrate overall classification ACC>80%. The best overall classification ACC of 87.4% was achieved by the Label Combination (LC) method, followed by the Fourclass Pairwise (FW) method with ACC of 83.6%. For each composition, the LC method yield CP (87.4%), COM (90.2%), COD (85.8%), UA (96.6%0, and STR (95.1%) were observed. On the other hand, the FW method scored CP (87.4%), COM (89.8%), COD (82.5%), UA (96.5%), and STR (95.2%) were detected. Moreover, the RAKEL (CP 87.4%, COM 89.9%, COD 82.0%, UA 96.2%, and STR 95.0%) and MULAN method (CP 85.9%, COM 90.0%, COD 85.0%, UA 95.8%, and STR 95.0%) obtained the overall ACC of 83.5% and 82.9%, respectively. No statistical differences were found between the four methods. Prediction accuracies for the UA and SRT were higher than other methods.

QI03-A-HC1 Reference Implementation Of A Learning Healthcare System To Optimize Supplemental Breast Cancer Screening

Participants
Lisa R. Stempel, MD, Glencoe, Illinois (*Presenter*) Nothing to Disclose

PURPOSE

Each year 37 million American women are screened for breast cancer and yet the optimal use of supplemental screening for woman at higher risk of breast cancer remains unclear. A learning healthcare system (LHS) that draws knowledge from each patient's experiences is a potential strategy for evaluation and iterative refinement of risk-based breast cancer screening guidelines. A LHS consists of an iterative cycle of guideline modeling, guideline implementation, and data analyses to inform guideline refinement. In this program we create a reference implementation of a LHS for breast cancer supplemental screening.

METHODS

The LHS is implemented at the Rush University System for Health Breast Imaging Center in Chicago, IL. First, we developed local recommendations for risk-based supplemental screening based on national guidelines. Risk assessment is recommended for woman without a personal history of breast cancer (PHBC) ages 25-75. Supplemental automated whole breast ultrasound (ABUS) is recommended for woman with dense breasts and MRI for woman at high risk or for those with a PHBC that have a hereditary cancer gene mutation, dense breasts, or were diagnosed at age less than 50. In July 2020, we implemented a comprehensive program to prospectively assess breast cancer risk in all eligible patients presenting for a mammogram and decision support for risk-based supplemental screening recommendations. Structured clinical documentation at the point of care enables downstream data analytics to assess the distribution of the patient population, adherence to recommendations and the supplemental screening cancer detection rate.

RESULTS

From July 20, 2020 to April 20, 2021, 18815 patients presented for mammograms. Figure 1 summarizes the risk-based population distribution and eligibility for supplemental screening. 46% of patients were eligible for supplemental screening (12% MRI, 34% ABUS).

QDP-QI

Pre-recorded Quality Improvement Reports

Sub-Events

QDP-QI-1   Back To The Future: Improving Reading Of Screening Mammograms With A Batched Workflow Utilizing A Live Reading Room Transcriptionist

Awards
Quality Improvement Reports Award

Participants
Wahida Rahman, MD, Ann Arbor, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

Screening mammograms contribute to a large workload in the breast imaging department. At our institution, an average of 500-600 offline screening mammograms are performed each week. Timely issuance of the final radiology report is important to provider and patient satisfaction. Staffing shortages and clinic holiday closures led to the accumulation of a backlog of unread screening mammograms with a peak report turnaround time of 198 hours. Additional off-hours staffing did not provide immediate relief to the backlog, thus requiring more robust and efficient workflows of interpreting screening mammograms.

METHODS

To create a more efficient, but less onerous and sustainable method of providing timely reads on screening mammograms, we increased the number of uninterrupted, batch reading screening mammogram shifts (S). In this shift, the radiologist was assigned on average 50 screening mammograms and was provided the assistance of a live reading room transcriptionist. The transcriptionist reviewed the electronic medical record including patient intake information and sent completed, draft reports for the radiologist's signature. Weekly department screening mammogram report turnaround times were obtained. Radiologist survey data were also collected to evaluate time for study interpretation in the new batch screening workflow to compare it to the traditional interrupted workflow. The total number of studies and time for interpretation was recorded for each shift. The radiologists also rated the level of fatigue and distraction during their shift using a 10-point survey scale, 10 representing high levels. To account for differences in interpretation of conventional 2D digital mammography and tomosynthesis studies, each DM study was awarded 1 point and each tomosynthesis study 2 points. There were 3 study groups - radiologist assigned to the uninterrupted batch screen reading with assistance of a live transcriptionist (S), interrupted reading with a trainee but no transcriptionist (T), and interrupted reading without a trainee or transcriptionist (N). Linear mixed effects regression was used to assess the relationship between independent transcriptionist and trainee usage, and the dependent variables, fatigue and distraction rating. Separate models were fit for the fatigue and distraction outcomes. Assignment type and points were included as covariates, and a random effect for rater was included to account for heterogeneity among raters.

RESULTS

Prior to the intervention, the mean report signing turnaround time ($\pm$ SD) was 83.3 $\pm$ 46.6 hours. Turnaround time decreased to 53.0 $\pm$ 34.7 hours after the intervention. The average number of S shifts ($\pm$ SD) increased from 2.2 $\pm$ 1.5 to 5.1 $\pm$ 1.1 after the intervention. Average number of weekly offline screening mammogram examinations ($\pm$ SD) before and after the intervention was 589.2 $\pm$ 116.7 and 523.8 $\pm$ 94.3. The average time ($\pm$ SD) to read each study point in the N, T, and S groups was 3.0 $\pm$ 0.7, 2.4 $\pm$ 0.8, and 2.9 $\pm$ 1.0 minutes, respectively. The distraction rating ($\pm$ SD) for N, T, and S groups was 6.3 $\pm$ 2.6, 4.8 $\pm$ 2.7, and 2.3 $\pm$ 1.7 and the fatigue rating ($\pm$ SD) was 5.5 $\pm$ 1.5, 4.2 $\pm$ 2.9, and 2.6 $\pm$ 1.3, respectively. Distraction and fatigue were significantly lower in the S group compared to the N group ($p < 0.00003$, $p < 0.0002$, respectively).

QDP-QI-12   Appropriate Imaging Of The Pregnant Patient: Bump In The Road

Participants
Preethi Raghu, MD, San Francisco, California (*Presenter*) Nothing to Disclose

PURPOSE

As a Level 1 trauma center, we have well-established protocols for imaging pregnant patients in the critical/trauma setting. However, guidelines for imaging pregnant patients in the non-trauma setting were non-standardized and varied by institution, which created confusion for ordering clinicians. They desired a timely imaging diagnosis without excessive need for urine or serum pregnancy testing, as well as clarity and consistency on how to inform patients of the potential risks to the fetus. Herein we detail our experience with a multidisciplinary quality improvement initiative to streamline the process of imaging pregnant patients outside of the trauma setting. After several incidents of inappropriate cross-sectional imaging of these patients noted by radiology, as well as reports of delayed throughput noted by the ER, we embarked on this multipronged process improvement effort.

METHODS

Although there are theoretical potential risks to the fetus with various imaging modalities of the abdomen and pelvis, this information is gleaned from a small number of retrospective reviews on the topic, as a randomized controlled trial would not be feasible in this clinical cohort. We performed an extensive review of the literature to understand and consolidate best available information to help guide our ordering colleagues. Then, we held several multidisciplinary focus sessions to brainstorm and implement

a new workflow regarding these issues. Our multidisciplinary team included various stakeholders:1. CT/MRI technologists, who were placed in the uncomfortable position of getting a verbal confirmation of pregnancy status in patients who had altered mental status or needed an interpreter, both of which exacerbated delays and errors.2. Radiologists, who had the responsibility of intervening on inappropriate imaging performed on these patients, but often these errors were only found retrospectively.3. ED physicians, who often noted delays in throughput due to institutional requirement for serum or urine pregnancy test in all premenopausal patients. They also wanted guidance on informed consent for imaging pregnant patients.4. Obstetricians, who operated using guidance from ACOG, and sometimes ordered these exams as consultants in the ER.5. Risk management, who provided insight on patient-facing forms such as the informational sheets and informed consent form, to ensure patient accessibility and fulfillment of medicolegal regulations. Using guidance and verbiage from ACR, ACOG, and various institutional guidelines, we crafted an informed consent form for use in specific cases as detailed below. Additionally, we created a graphic information sheet detailing radiation risk with simple terminology for our patients. These sheets are being translated into multiple languages and will be readily accessible at key locations within the emergency department.

RESULTS

The new proposed workflow for our institution below clarifies the aforementioned issues:1. Any female patient ages 12-52 years old requires just a verbal yes/no documentation of pregnancy status by the ordering provider prior to any imaging.2. If CT abdomen/pelvis or MRI of any body part is requested, a serum or urine pregnancy test must be on file given the potential risks to the fetus if patient is later found to be pregnant. For example, low-dose protocols, noncontrast exams, and shortened exam length can be considered if patient is known to be pregnant beforehand.3. If CT involving the abdomen or pelvis is requested despite positive pregnancy test, a signed informed consent is obtained by the ordering provider.4. For all exams using ionizing radiation in a pregnant patient, an information sheet is handed to the patient explaining potential risks and radiation dose in simple terms. In addition to incorporating this workflow into a clinical algorithm for ordering clinicians, we also modified the official institutional guidelines on imaging of

QDP-QI-13 The Image Of COVID-19 In A Public Radiology Service In The State Of Sao Paulo: An Overview

Participants
Mario Abizaid, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

PURPOSE

The Coronavirus pandemic (Sars-Cov2) is already considered humanity's worst health crisis in the modern age, with about 3.2 million deaths and 153 million cases in the world, causing irreparable social, human and financial impacts. Brazil appears on the list as the 3rd place in number of cases, with 14.8 million people infected, behind only India, with 19.9 million, and the 2nd place in number of deaths, with 408 thousand deaths, behind only the USA, with an estimated human loss of about 577 thousand lives, until the date this was written. The estimate of infected and deaths directly competes with the impact on health systems, with the exposure of vulnerable populations and groups, the economic support of the financial system and the population, the mental health of people in times of lockdown and the fear of illness and death risk. In this scenario, it is speculated that there was a massive reduction of the world GDP per capita in about 4.2% in the year of 2020, with regional variations, being the worst falls in China (34.7%) and in the USA (4, 9%). Following the global trend, Brazilian GDP decreased by about 4.1% in 2020, with progressive reductions in the year 2021, which represents a loss of around 6 billion dollars in the year 2020 alone. In contrast to the negative figures, public health expenditures increased considerably in this period, and, added to the abrupt drop in tax collection estimated at about 6.9%, totaling an estimated loss of approximately $ 106 billion in public money, a crisis took place in an attempt to balance the fall in resources with the increase in spending demand. Thus, some health sectors such as radiology had their budgets drastically reduced, in an attempt to direct spending to sectors considered to be of greatest urgency (Intensive care beds, respirators, emergency rooms, supplies and drugs), causing a fall without precedents in the number of imaging tests performed. The work aims to illustrate how the pandemic impacted the performance of exams in one of the largest public services in the state of São Paulo, the Diagnostic Imaging Service II (SEDI II), and to measure the damage and the consequences of this impact.

METHODS

The study is based on comparative analysis data from a teleradiology service that brings together five medium and high complexity hospitals in the state of São Paulo, Brazil. From the careful analysis of these data, graphs and tables were developed in order to demonstrate in a pictorial way the impact of the SARS-COv-2 pandemic on the public health system. The service keeps tracks of all COVID cases by unit, age group, sex and behavior over time through an online panel available to all staff (data base exemple).

RESULTS

A data survey was was filled with all the exams that took place in the State Service of Diagnostic Imaging II (SEDI II), which is responsible for 6 large health establishments in the state of São Paulo. With the analysis of the data it was possible to observe a significant drop in the absolute number of exams, in most modalities, except in the computed tomography (CT) modality, which followed a behavior that was contrary to the others. In 2019, SEDI II performed 390,959 exams (chart A), including Computed Tomography, Mammography, conventional and contrasted X-ray, Magnetic Resonance, Bone Densitometry and Ultrasonography. This number dropped to 363,133 (chart B) in 2020, representing a 10% drop in the total number of tests, resulting in a drop never seen before in the service, and which could have been worse had it not been for the increase in the number of requested CT scans. Among the CT scans performed in 2019, 14,743 scans were of the Chest modality, with a huge increase to 35,948 in the year 2020 (chart C), which represents an increase of about 143%, which was caused by the increased incidence of Coronavirus infection that year. Regarding the total number of CT scans performed, 140,745 were made in 2019, and 155,094 in 2020, resulting in a 10% increase in the absolute value, which can be att

QDP-QI-14 Technetium Pyrophosphate Scintigraphy: Changes To Our Practice

Participants
John Archer, MD, Boston, Massachusetts (*Presenter*) Nothing to Disclose

PURPOSE

We aimed to implement a standardized 99mTechnetium pyrophosphate (99mTc-PYP) imaging protocol for cardiac transthyretin (ATTR) amyloidosis using 3-hour planar and SPECT/CT in accordance with a multi-society group updated protocol recommendations in response to false positives due to blood pool at 1 hour imaging (addendum pending publishing), and reduce reporting errors describing technique by updating our system dictation templates.

METHODS

We used a plan-do-study-act model to implement the new imaging protocol at two academic hospitals and update our system dictation templates to reduce errors in reporting technique. Informational presentation on these changes was distributed to nuclear medicine technologists, residents, fellows, and attending physicians in July 2020. Adherence to the new protocol and frequency of report technique errors were evaluated.

RESULTS

From January 1, 2019 to June 30, 2020, a total of 73 exams were performed at two academic hospitals, with protocols determined by the 2016 ASNC practice parameters. During this time, 97.3% of patients received SPECT/CT imaging, with 43.1% imaged at 1 hour, and 54.2% imaged at 3 hours. Overall, 44.4% of patients were imaged at 1 hour only. The most common interpretation was "Strongly Suggestive" (51.4%), followed by "Not Suggestive" (33.3%), and "Equivocal" (15.3%). Technique reporting errors were common, occurring in 75.3% of all reports. The failure to modify the system template to document the correct technique was the most common source of technique reporting errors. Following implementation of the new imaging protocol, all patients received planar and SPECT/CT imaging at 3 hours. A decrease in "Strongly Suggestive" interpretations (29.2%) and an increased in "Not Suggestive" interpretations (58.3%) was observed. A decrease in technique reporting errors was observed, seen in 8.3% of reports following the implementation of the updated system dictation templates.

QDP-QI-15 Improving The Tracking And Management Of Actionable And Incidental Imaging Findings

Participants
Rekha Mody, MD, Cleveland, Ohio (*Presenter*) Nothing to Disclose

PURPOSE

Demonstrate the increase in activities taken towards resolution of actionable imaging findings secondary to implementation of standardized imaging reporting templates, Epic alert tags and best practice alerts (BPAs), closed loop Result Tracking functionality and integration with existing Epic Healthy Planet primary care dashboard for enhanced care coordination creating a high reliability safety framework.

METHODS

We implemented a structured 4-click standardized imaging report template for radiologists to be included after the impression field with multiple key elements: Acuity rating-actionable or incidental acuity ratings to differentiate between urgent and critical findings. Imaging finding with an associated 4 character routing code and schema to classify findings by organ-system. Recommended imaging exam-with the recommendation provided matching 1:1 with the exact Epic order to ensure the recommended imaging exam is actually performed. A suggested time range for follow-up. We then developed specific interfaces for each recommendation and time frame to allow for the result to be tracked through radiant-like functionality within Epic and drive downstream workflows. Each interface begins a hard-wired information cascade within Epic with enhanced Epic notification functions including special icon alerts within chart review and provider in-basket and BPA/storyboard alerts with embedded imaging order links, aiding providers to more easily order the recommended imaging exam. Also, extractions into Epic after visit and discharge summary reports and MyChart allow providers seeing patients for emergent problems to be alerted of actionable results on discharge and for patients to be reminded to follow-up. We also created a safety framework supported by a workforce of licensed independent providers (LIPs) to help manage the actionable imaging findings in a coordinated fashion. Using the existing Epic Healthy Planet dashboard structure, we integrated results tracking functionality into the dashboard of patients with actionable findings and created a time-based criteria for follow-up easily visualized by color coding columns to create a coordinated system of divided and centralized responsibility. If the provider who ordered the study with an actionable result does not take action, primary care providers can resolve recommendations for patients on their care team and subspecialty providers can provide faster care leading to increased access and decreased time to treatment. As a final layer in the safety framework, a group of primary care providers monitors the global list via specified this time based metric to ensure that patients with actionable results do not slip through the cracks. This integrated solution follows the patient through completion of the recommended imaging test and also cohesively approaches the management of actionable results and the workflows that might need to occur after imaging findings are identified as important and in need of possible management beyond follow up imaging such as a biopsy or subspecialty referral.

RESULTS

The imaging institute began using a standardized reporting template for lung nodules meeting Fleischner criteria at the end of 2018. Over a nearly two year period, from that time to the implementation of the new reporting template for all actionable findings, approximately 20,902 lung or other abnormalities were flagged. However, at this time there was no process in place to track and monitor whether appropriate follow-up of these potential actionable findings were performed and there was no understanding of the distribution of findings by organ system. A retrospective analysis of a small subset of patients with key words search text string including versions of "recommended" demonstrated less than 20% of recommended follow-up imaging was actually performed in the time period prior to the structured templates for reporting actionable or incidental findings. Since the implementation of the new radiology structured reporting, approx

QDP-QI-16 Evaluating The Readability Of Online Educational Materials Targeted To Radiology Patients

Participants
Nancy Phu, BS, San Jose, California (*Presenter*) Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the readability of online radiological information accessible to patients from recognized educational resource websites, academic institutions, and large private practice groups. In a world moving towards patient-centered and patient-directed healthcare, online access to medical records and exam reports has allowed patients to play a more active role in governing their health. This is particularly relevant in radiology where diagnoses are most often communicated through a written report rather than direct interaction. One barrier to this is the limited health literacy in the general population. The average reading grade level for an American is at 7-8th grade, whereas studies in 2014 and 2019 showed popular patient-centered radiology information to be written at the 10th-14th grade level. If common patient resources/reports can be matched to the comprehension level of the patient, better patient autonomy and outcomes can be achieved.

METHODS

Three websites from each source of information provider (institutional resource, academic health institution, and private practice group) were selected for analysis. Radiologyinfo.org, Choosingwisely.org, and Imagegently.org are three common/popular

informational websites, created and vetted by the American College of Radiology (ACR) and Radiological Society of North America (RSNA). The top three academic institutions, Stanford University, University of Pennsylvania, and Washington University at St. Louis were selected based on the extent of their research grant funding, from the published 2017 rankings released by the Blue Ridge Institute for Medical Research. The largest private practice groups, Radiology Associates of North Texas, Radia, and Advanced Radiology Services, were listed on Radiology Business. For each information provider, we sampled the text found on their patient information landing page with the Readability Test Tool, Test by Direct Input feature from Webfx.com to measure their readability metrics. We compared readability scores (Flesch-Kincaid reading ease, Flesch-Kincaid grade level, and automated readability index) and text statistics of the landing page content on RadiologyInfo.org with similar pages from recognized health institutions and private practice groups. Texts originating from titles, subtitles, and hyperlinks were excluded from the study.

RESULTS

The average Flesch-Kincaid grade level of each category was found to be institutional website: 15th, academic institution: 17th, and private practice group: 14th, with Stanford's content being regarded with the highest grade level (20th) and ImageGently's content the lowest grade level (11th). The averages of the Flesch-Kincaid reading ease were institutional website: 22.5, academic institution: 15, and private practice group: 28.3, with Stanford having the lowest reading ease (3.2) and RANT having the highest (40.2).Each webpage had a variable amount of text content, with Radia providing the most information on each imaging modality and RadiologyInfo providing the least text on their patient information landing page. The institutional websites had an average of 159 words, of which 29% words were considered complex. There was an average of about 28 words in each sentence. Academic institutions had an average of 301 words, of which 29.82% were considered complex words. There was an average of 24 words in a sentence. Private practice groups had an average of 458 words, of which 23.03% were considered complex words. There was an average of about 21 words in a sentence.

QDP-QI-17   Automated Radiology Report Impression Generation Through Natural Language Processing (NLP) Model.

Participants
Abhi Jain, DO, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

To demonstrate non-inferiority of customized radiology report impressions generated by a natural language processing (NLP) algorithm.

METHODS

A retrospective random selection of 120 radiology reports of computed tomography (CT) scans of the chest, abdomen, and/or pelvis performed at our institution from 2015-2020 were processed through an NLP algorithm (Rad AI, Berkeley, CA). The baseline NLP algorithm was initially trained on approximately 50 million radiology reports. The algorithm was subsequently fine-tuned to the style of individual radiologists at our institution by analyzing their historical reports. Thus, using the findings section of the report, the NLP algorithm attempts to generate a radiology report impression that is clinically relevant and accurate while also adapted to the style of each individual radiologist. The only difference between the radiologist-generated and NLP-generated reports was the impressions.Four attending radiologists and three first-year radiology residents were presented either all or a random subset of the 120 radiology reports for grading. Reports that were dictated or finalized by any of the reviewers were excluded. The radiologist-generated and NLP-generated reports were presented at the same time, side-by-side in a random fashion with the reviewer blinded to the source of the report. Each impression was graded on a scale of 1-5. Grade 1 included impressions that were "completely irrelevant or gibberish". Grade 2 included impressions that were "relevant, but not usable, either due to accuracy or wording". Grade 3 included impressions that were "usable as is but are worded weirdly or needs something changed". Grade 4 included impressions that were "really good, but there are ways it could be better". Grade 5 included impressions that were "great and likely cannot be improved further". The reviewer also indicated whether they preferred one impression over the other or if there was no preference. Impressions with grades 3-5 were deemed usable in a report and impressions with grades 1-2 were unusable for reports. A z-test was used for statistical analysis.

RESULTS

A total of 590 evaluations were assessed from 120 reports. The average grade for the radiologist-generated impressions (baseline) was 3.95 (SD 0.87) and the average grade for the NLP-generated impressions (experiment) was 3.90 (SD 0.83) with p= 0.197. The unusable rate, impressions with grades 1-2, was 7.63% for the NLP-generated impressions and 7.46% for the radiologist-generated impressions. Amongst the usable reports, those with grades 3-5, there was a 36% preference for radiologist-generated impressions, a 32% preference for NLP-generated impressions, and a 32% for no preference. For usable reports with the same grade, there was a 13% preference for the radiologist-generated impression, a 9% preference for the NLP-generated impression, and 78% for no preference.

QDP-QI-18   Combined Flipped And Traditional Classroom Learning Experience For Gi Radiology Education

Participants
Faryal Shareef, MD, Phoenix, Arizona (*Presenter*) Nothing to Disclose

PURPOSE

Flipped classroom learning is an approach to education in which students are assigned didactic material to be learned independently, followed by classroom time which is dedicated to the application and critical thinking of the material learned. We combined flipped classroom with traditional lectures in GI radiology education and studied resident's feedback for a month-long GI curriculum during the COVID 19 pandemic. We hypothesized that this method of teaching would combine both resident's internal motivation and ability to self-direct their learning with reinforcement of the learning material in class by case-based exercises, overall leading to higher retention of material presented.

METHODS

22 radiology residents participated in a month of lectures covering GI topics with both flipped and traditional lecture styles. The flipped model consisted of independent learning through the assignment of GI Videos from the 2020 Society of Abdominal Radiology (SAR). This was followed by online faculty run GI conferences with review of material learned independently as well as information assimilation via peer problem solving through cases. Residents subsequently completed surveys about their learning experience. A semi-anonymized evaluation (registration of PGY level only) using the Likert scale was used. The survey included questions in regards to forms of learning, satisfaction, and retention of material.

RESULTS

22 residents participated in the study with 31.8% PGY2, 9.1% PGY3, 22.7% PGY4, and 36.4% PGY5 participation. In regards to learning style, all 22 residents selected visual learner (100%) and 54.5% of residents selected solitary learning style. 63.6% residents rated the independent learning materials as excellent and 36.4% as good or adequate. No resident rated the content as poor. Overall residents felt like completing the assigned homework was convenient with more than half (68.2%) rating convivence as good or excellent and 31.8% rating it as poor. Residents overall reported feeling little pressure to complete the assignments, with 59.1% of residents reporting minimal to no pressure and only 4.5% reporting very high pressure. The percentage of subjective material retention overall was 62%, with PGY2's reporting 55% subjective retention and PGY 5's reporting 68%. 100% of PGY2 learned new material from the assigned homework whereas 25% of the PGY 5's did not feel they learned anything new. Overall 86% of residents recommended flipped classroom learning, including 100% of PGY2's.

QDP-QI-19   A Single-Centre Audit Of The ACR BI-RADS 3 Assessment Category Utilization

Participants
Jessica Common, MD, Hamilton, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate 24-month outcomes of breast lesions assessed at our centre as probably benign (Breast Imaging Reporting and Data System [BI-RADS] category 3) with an expected malignancy rate of <2%.

METHODS

All female patients with a mammographic and/or ultrasound finding assessed as BI-RADS 3 at our institution between January 1-December 31, 2017 were included. Sensitivity and cancer yield were calculated at 24 months.

RESULTS

Among 517 women (median age, 52 years; range, 13-89 years) with a BI-RADS 3 assessment, 349 completed 24 months of follow-up (68%). 168 women were lost to follow-up (32%). A total of 30 lesions were biopsied at or before 24 months, and 6 were classified as malignant (cancer yield, 6 of 349 women [1.7%]; positive biopsy rate, 6 of 30 women [20.0%]). No lesions downgraded to BI-RADS 1 or 2 were classified as malignant at 24 months (false negative, 0; sensitivity, 100%).

QDP-QI-2   Implementation Of Comprehensive Unit-based Safety Program For The Prevention Of Catheter Associated Bloodstream Infections

Awards
Identified for RadioGraphics
Quality Improvement Reports Award

Participants
Ravi Chanthriga Eturajulu, BSC,MBA, Kuala Lumpur, Malaysia (*Presenter*) Nothing to Disclose

PURPOSE

The growing use of peripherally inserted central catheters (PICC) has led to the recognition of the risk of central line-associated bloodstream infections (CLABSIs). Comprehensive Unit-Based Safety Programs (CUSP) are purported strategies for the reduction of CLABSIs. CUSP can improve teamwork and safety culture and help clinical teams learn from mistakes through the integration of safety practices into daily work. This study, therefore, aims to evaluate the implementation of CUSP for the reduction of PICC-associated bloodstream infections (BSI).

METHODS

CUSP was implemented with team-based approach at a medical imaging department of a teaching hospital in collaboration with staff members from infection control department. At the organizational level, a clinical quality assurance (CQA) committee was formed and goals of reducing hospital acquired infections (HAI) announced. At the unit level, the CUSP model was applied using an implementation science framework. Infrastructure to support quality improvement efforts was initiated by creating a coordinating team and engaging clinical department staff, which included radiologists, radiographers, medical doctors, and nurses. Performance data was transparently shared during CQA-HAI meetings. The duration of the study was 18 months, which included the pre intervention (from October 2019 to June 2020) and post intervention (from July 2020 to March 2021) phases. During this duration, all PICC insertion requests from a surgical ward were included in this study. During the post intervention phase, all PICC insertions conducted at the medical imaging department were evaluated to determine infection control practices and BSI events. A series of interventions was implemented with changes in the workflow including patient education (pre and post procedure) using a PICC patient information leaflet, staff training and awareness of CUSP model, implementation of chlorhexidine bath prior to PICC procedure, chlorhexidine skin antisepsis, hand hygiene and maximal sterile barrier precautions. In addition, a silver alginate coated dressing together with a PICC stabilization device was used to standardize dressing as routine care. Safety rounds was established 24 hours and 48 hours post PICC procedure by the medical imaging team comprised of medical doctor, radiographer, and nurse to check on the PICC line. A monitoring checklist comprised of signs of complications, local anomaly, presence of general signs of fever or painful infusion, general cleanliness, and patient awareness of line care was observed and documented into the checklist. Process evaluation was carried out by recording the total number of safety rounds, attendance, problems identified, and interventions administered. Progress evaluation was done by the CUSP team and CLABSI rates measured based on the number of PICC-associated BSI per 1,000 central line days preceding CUSP implementation. A central line care bundle compliance checklist to document daily monitoring was implemented at the surgical ward level. The infection control practitioners monitored the events of PICC-associated BSI rates and the compliance to the care bundle. As part of monitoring progress, the multidisciplinary CUSP team met regularly to review the PICC-associated BSI events and discussed issues with implementation of central line bundle and compliance to the intervention elements. Any new scientific evidence or research relevant to the project was disseminated amongst the team members. Corrective actions were continued until desirable results were achieved.

RESULTS

102 PICC lines were inserted during the pre-intervention (n=34) and post intervention (n=68) phase of this study. Following CUSP intervention, PICC-associated BSI rates had reduced from 3.4 per 1,000 central line days pre-intervention to 2.7 per 1,000 central line days post-intervention. Correspondingly, BSI rate had reduced from 8.8% to 5.9%.

QDP-QI-20   Re-envisioning On-call Radiology Resident Workflows: Impact On Residents' Experiences

Participants
Shara Kim, MD, Hamilton, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

At many teaching hospitals, radiology residents are responsible for providing preliminary interpretations on overnight cases which are actionable by referring clinicians. This independent experience allows residents to work on important skills such time management, triaging, protocolling, and communication and has been identified as a valuable learning experience. At our institution, there are total of 26 radiology residents responsible for on-call coverage of 4 teaching hospitals, 1 community hospital, and 2 urgent care centers which include pediatric, trauma and stroke subspecialty care. A resident survey within our program demonstrated a desire for more detailed and personalized feedback during these independent on-call periods. Unfortunately, providing personalized feedback to on-call residents is difficult for many reasons including a high volume of cases, need to maintain reasonable turn-around times, spatial separation from attending radiologists, and differences in scheduled work hours. However, providing timely and relevant feedback is a critical component of medical education and is a core competency in radiology residencies. Prior studies have shown that automated tools such as report change comparison can help to facilitate meaningful feedback, motivate residents to compare reports more frequently, and increase satisfaction. Our aim was to minimize barriers to providing effective feedback and improve overall learning experience for on-call residents.

METHODS

Graduated changes were made to the on-call workflow using the A3 thinking process, which is a structured problem-solving method focused on continuous improvement. Root cause analysis was performed using a Fishbone diagram (Figure 1) to identify factors contributing to decreased resident satisfaction on the quality of on-call report feedback. Interventions were developed to target the most readily modifiable root causes, which included: workflow reorganization to match the daytime workflow, use of structured report templates, and implementation of an automated report comparison function. Anonymous online surveys were conducted pre- and post-implementation to evaluate resident satisfaction. The pre-implementation survey also assessed resident's opinions on the need for change and gathered input of what changes the residents felt would be beneficial to improve learning experience. Four question types were used, including multiple choice questions, multi-answer questions allowing multiple responses, five-point Likert scale questions and free-text responses. Results were analyzed quantitatively using percentages and qualitatively for emerging themes.

RESULTS

22 out of 25 and 15 out of 21 residents during different academic years responded to the pre-implementation and 7-weeks post-implementation surveys, respectively. There was strong support from the residents to redevelop the on-call reporting workflow to improve feedback on the pre-implementation survey. 82 percent strongly agreed that receiving feedback on on-call reports was an important part of their development and learning as a radiology trainee. 91 percent agreed that following up on the final reports to review any discrepancies and misses was a form of receiving feedback. Residents agreed or strongly agreed that they would like more detailed feedback on follow up recommendations (77 percent) and report content (82 percent). Recurring themes for barriers that made follow up of on-call reports difficult included poor home accessibility and lack of an easily accessible list of all on-call preliminary reports. Some of the suggestions to improve the process of following up on-call reports included use of more structured report templates and implementation of a graded disagreement system. The post-implementation survey results were overall positive. 87 percent agreed or strongly agreed that the changes were beneficial to overall call experience and learning. Residents also either agreed or strongly agreed that the changes provided more detailed feedback on follow up recommendations (60 percent), report syntax (67 percent) and report content (60 percent). 55 percent felt they received adequate on-call feedback post-implementation compared to 23 percent pre-implementation. 73 percent agreed or strongly agreed that the report comparison function was beneficial. 40 percent agreed or strongly agreed that the use of structured templates was helpful to compare reports while 40 percent were neutral to this change. Post-implementation respondents identified technical barriers as the main ongoing inconvenience to case follow-up.

QDP-QI-3   A CT Quality Control Audit Program Based On Automated Analysis And Alerts

Participants
Emi Eastman, BA, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

A continuous quality control (QC) program is an essential part of computed tomography (CT) quality assurance to ensure patient safety and consistent clinical performance. The American College of Radiology (ACR) requires that the continuous QC program be monitored by a Qualified Medical Physicist (QMP). In a clinical setting with multiple sites and scanners, this monitoring activity often entails a constant, detailed, and laborious review of records by a medical physicist. The purpose of this study was to minimize the amount of human review time by developing a self-regulating program to monitor CT QC results that can detect and report both missing and out-of-tolerance results.

METHODS

To transition from physical to digital records, we created a set of electronic forms using Microsoft Excel for technologists to use to record the QC results. The forms were stored on a cloud drive that both technologists and physicists have access to. The forms incorporate limits specified by both the vendors and the ACR for each of the QC tests. The daily test record includes CT number, noise, the presence of artifacts, and uniformity. The weekly test includes SMPTE pattern check. The monthly test includes visual inspections of the console and gantry, laser alignment, and vendor-recommended quantitative tests such as spatial resolution, contrast scale, slice thickness, and low contrast resolution. These digital forms are reviewed automatically by a Python-based program at a user-defined frequency. Our institution used the program daily to search the forms for out of tolerance results—either a warning or failure depending on the specified upper and lower limits— and weekly to identify missing entries. When an out-of-tolerance result is detected, the program sends an email alert to a group of defined users. The program also maintains a record of all out-of-tolerance results detected throughout the month in a separate file. The Pandas library was used for all data manipulation, while the Pywin32 library was used to create copies of the original files for our records and send out email alerts. The program automatically runs at our defined frequency using Windows Task Scheduler on a desktop computer. The accuracy of the program was evaluated for 16 weeks, and the results were compared to human performance of the same task. In addition, the total number of missing records were compared before and after the implementation of the automated QC program to evaluate the behavior change of the technologists performing the QC.

RESULTS

The results of a manual review of the QC records agreed with the results reported in the email alerts with the accuracy of 100%. For our enterprise health system with 16 CT scanners, implementing the automated program saves 60 minutes of a medical physicist's time per week, or 50 hours per year. In addition, the program detected missing entries that the human review did not capture. After the first two weeks of implementation, the number of missing QC results detected each week decreased from 12 and 14 in the first and second week, respectively, to a median of 2 each week for the following 14 weeks. The continuous and detailed monitoring by the program in combination with the routine, weekly follow-up by the physicists led to more timely QC entries by the technologists and an overall decline in missing QC records.

QDP-QI-4   An Automated CT Protocol Reformatting Program For Protocol Documentation And Review

Participants
Emi Eastman, BA, Los Angeles, California (*Presenter*) Nothing to Disclose

PURPOSE

The American College of Radiology (ACR) and the Joint Commission (TJC) require the ongoing review and management of computed tomography (CT) protocols by a team of radiologists, physicists, and technologists. Manually reviewing a single protocol across multiple scanners is a laborious task and is aggravated by the large amount of protocols on each CT scanner. For institutions with multiple CT scanners from different vendors, acquiring protocols and comparing parameters is complicated by vendor-specific naming conventions, variable protocol templates, and immutable documents. The purpose of this study was to develop a software solution that automatically reformats the protocol files exported from CT scanner consoles into a consolidated, vendor-independent format to facilitate and expedite the protocol review process.

METHODS

Some institutions have opted to manually create a protocol book containing all of the acquisition and reconstruction parameters. This would be a tremendous task for the more than 1000 protocols across 16 CT scanners at our hospital. We proposed taking advantage of the exported protocol files (in either CSV or XML formats) to create a digital protocol book that is updated regularly. Since these files are not reader- nor print-friendly, a Python script-based program was created to identify and store values for the following parameters: tube potential (kV), tube current (mA), automatic exposure control reference, pitch, minimum and maximum tube current (if applicable), tube rotation time (sec), collimation, computed tomography dose index (CTDI), CTDI notification value (if applicable), dose-length product (DLP), slice thickness, slice interval, displayed field of view (DFOV), reconstruction kernel, and iterative reconstruction algorithm setting. The program was created for and tested on protocol export files from multiple Siemens, GE, Canon (formerly Toshiba), and Philips scanners. Each value was extracted from the exported protocol files, and calculations were automatically performed when needed to account for differences in reported parameters between vendors (e.g. Philips reports mAs, while GE reports mA). An additional Python program was written to identify changes between two sets of protocols from the same scanner exported at different points in time. The program highlights any changes in parameters for each protocol, identifies protocols that have been renamed, identifies new protocols, and identifies the deleted protocols. Both programs primarily use the Pandas library for data manipulation and the xlsxwriter library to apply formatting to the resulting Excel worksheets.

RESULTS

The consistent, vendor-neutral format accelerates the identification of relevant protocol parameters, speeding up protocol documentation and expediting the review process. By maintaining an organized set of protocols with information directly from the scanners, we reduce the risk of human entry errors present when manually entering values into a protocol book. The additional protocol comparison program automatically identifies changes in protocols between two points in time, allowing the protocol management team to quickly review the changes for accuracy.

QDP-QI-5   One Stop Shop: Comprehensive Quality Improvement Screenings For Patients Eligible For Low-dose Lung CT And Colonoscopy In A Mammography Setting

Participants
Leah Marcantel, RN,BSN, Lake Charles, Louisiana (*Presenter*) Nothing to Disclose

PURPOSE

Over 2020 and 2021, many health systems across the country have identified increasing lung cancer and colon cancer screenings as a system quality initiative. Christus Ochsner is no exception. Most systems however, put this initiative primarily in the primary care setting. While that is effective, primary care can get very busy and can have variations in workflow across different clinics. This study looks at if patients are being missed for low-dose lung CT and standard of care colon screenings and whether or not we can improve patient capture and uptake to those programs by screening in the mammography setting due to its high patient volume.

METHODS

Patients coming in for a screening mammogram are given a simple questionnaire to complete. They are then flagged if they meet national guideline criteria for low-dose lung CT and colon screenings. A nurse navigator then reaches out to these patients to get them scheduled for the appropriate services.

RESULTS

Over a 7-week period, 1,519 patients were screened with our questionnaire while getting a screening mammogram. There was no negative feedback from the patients about the length or complexity of the survey and all completed the questionnaire without assistance. 88 patients (5.8%) met criteria for low-dose lung CT and 237 patients (15.6%) were out of date with their standard of care colon screenings. Of the patients that were contacted for low-dose lung CT, 50% were already being followed through their primary care provider but 50% were new patients and all were interested in getting the low-dose lung CT. Of the patients that were contacted for colon screenings, 53% were already being followed through their primary care provider but 47% were new patients. Of the newly identified patient group, 30% opted for a FIT test while the remaining 70% opted to schedule a colonoscopy.

COVID-19 Inspired Move To Transperineal Ultrasound-guided Prostate Biopsy Eliminates The Risk Of Post-procedural Sepsis.

Participants
Jack Power, MRCPI, DUBLIN, Ireland (*Presenter*) Nothing to Disclose

PURPOSE

Sepsis related to transrectal ultrasound-guided (TRUS) biopsy is increasing worldwide because of the increasing prevalence of multi drug resistant bacteria. Transperineal ultrasound-guided prostate (TP) biopsy has been shown to reduce the risk of sepsis but, traditionally, has required patients to undergo a general anaesthetic which entails its own risk, as well as using valuable theatre time. More recently, an approach under local anaesthetic, in an outpatient setting, has been described. The COVID-19 global pandemic forced a temporary suspension of many elective services at our institution including TRUS. Motivated by a desire to conserve resources and avoid hospital admissions for TRUS-related complications, this opportunity was used to introduce outpatient TP biopsy under local anaesthetic to patients with a high clinical suspicion of prostate cancer. As our services reopened we transitioned completely to TP for all prostate biopsies.This presentation compares post-procedural sepsis rates of outpatient transperineal prostate (TP) biopsy, with our previous years' experience of transrectal ultrasound-guided prostate (TRUS) biopsy.

METHODS

Audit approval was received through the hospital ethics committee. Four hundred ninety patients who underwent TP biopsy from April 2020 to April 2021, across two sites, were included in the audit. Patients' mean age was 62, with a median PSA of 6. Over 90% of patients had a multi-parametric prostate MRI prior to biopsy. Patients were referred from either urology clinics or a rapid access prostate cancer service. Standardised procedure involved taking 12 18-gauge samples, 5 from the peripheral gland on either side and 1 from the transitional zone on either side. If a target was identified on pre-procedure MRI, additional samples were taken. All patients were followed up the day after their procedure with a phone call and were then reviewed with biopsy results in clinic 2 weeks post procedure. Complications, including post-procedural sepsis, urinary tract infection (UTI), urinary retention, significant rectal or urinary haemorrhage were recorded, as was length of hospital stay, if admitted. Definitions for post procedural infection and sepsis were defined prior to commencement.These results were compared with 590 who underwent TRUS biopsy in the year 2019.

RESULTS

There were 0/490 cases of postprocedural sepsis in the TP group. There were 2/490 (0.4%) cases of urinary retention, with both patients presenting to the ED and being then managed in the community. In the TRUS group 23/590 (3.9%) were diagnosed with sepsis (8 blood culture confirmed, 15 clinically diagnosed). 9/590 (1.5%) were diagnosed with UTIs requiring oral antibiotics, 1/590 (0.17%) went into acute urinary retention and 1/590 (0.17%) had a severe rectal bleed requiring hospitalisation.Direct comparison of post-procedural sepsis rates between TRUS biopsy (23/590) and TP biopsy (0/490) using a Chi-Square contingency table found the results to be statistically significant (Chi squared: 17.692 with 1 degrees of freedom; P<0.0001).

QDP-QI-7 **Building A High Reliability Safety Net For Incidental Finding Follow Up: Fully Automated, Electronic Information Transfer Bridge From The Radiology Report To A Community Practice Office Level Report**

Awards
Quality Improvement Reports Award

Participants
Pamela T. Johnson, MD, Baltimore, Maryland (*Presenter*) Intellectual property, AgileMD;Future royalties, AgileMD

PURPOSE

Incidental findings are commonly discovered on CT and MRI and may require additional characterization with an alternative radiology test or surveillance imaging to confirm benignity. Many radiology practices incorporate standardized management recommendations in report impressions, derived from American College of Radiology white papers, Fleischner Society and other nonradiology specialty society guidelines, to facilitate management by the ordering provider. The challenge rests in ensuring that patients undergo recommended follow-up imaging months to years later. Existing solutions include assigning a radiology staff member to oversee the list of patients with incidental findings that require follow up and intervene if the recommended imaging test is not performed in the time interval advised.We previously developed a solution to ensure that emergency department (ED) patients are informed of incidental findings. If reported while the patient is in the ED, the recommended follow up test is listed in the ED After Visit Summary (AVS). If the recommendation was added to the report after the patient is discharged from the ED, it is transferred to a report in Epic managed by an ED nurse who communicates the information to the patient.For the ambulatory practice, where primary care providers may manage multiple patients with a variety of incidental findings, we decided to create a more innovative solution. The goal was to enhance the incidental finding report in Epic by1) mapping the recommendation to the office from which the original examination was ordered2) compiling a report listing all the patients in that practice who need follow up imaging and3) facilitating the tracking of recommendation completion

METHODS

Radiology and medicine providers designed a report for Epic that includes the patient's name and medical record number, the incidental finding identified that required additional imaging, the exam that needed to be scheduled and the date by which the subsequent exam should have been performed.To facilitate electronic information transfer, the existing standardized recommendation macros were enhanced so discreet data elements are transferred to Epic from Powerscribe through an HL7 interface. Within the voice dictation system, additional custom fields were added to the existing template as pick lists items that tie to the selections built out in the Epic. The voice dictation system would add these fields to the bottom of the reports at HL7 CE segments. We then updated the existing HL7 Engine processing rule for ORU messages received from the dictation system to not only add the ST segments for Incidental Findings but also to convert the newly created CE segments to ST segments before they are sent into the EMR/HIS by the HL7 engine. The follow up time interval is listed as a "due date" and the recommended imaging test as an IMG code in the office level report.On the community practice receiving end, the reports are filtered to only show the user orders originating from the practice office. This is done by checking that the original ordering department matches their login department. The discrete recommendations can be tracked with newly created report that the provider's staff can monitor to ensure that the necessary follow up imaging or referral is performed in the recommended time period.

RESULTS

The platform was piloted for thyroid nodules and abdominal aortic aneurysm (AAA) surveillance in 3 practices and successfully communicated the information from the radiology dictation to each office level report. Office administrators are able to access the report to ensure that the exam is conducted by the due date or that the physician declined the recommendation (Figure 1). Once the follow up imaging test is performed, the patient is automatically removed from the list.Following roll out we identified the need for enhancements, including the ability for the ordering physician to easily dismiss the order if

QDP-QI-8   Raising The Bar In Imaging Stewardship: Electronic Determination Of Appropriate Patient And Exam Selection

Participants
Pamela T. Johnson, MD, Baltimore, Maryland (*Presenter*) Intellectual property, AgileMD;Future royalties, AgileMD

PURPOSE

Effective January 2021, CMS requires providers to consult appropriate use criteria (AUC) delivered by a CMS-approved clinical decision support mechanism (CDSM) in the electronic medical record (EMR) when ordering advanced imaging (CT, MRI, Nuclear Medicine) in 8 Priority Clinical Areas (PCA). To focus on the PCAs with high caliber evidence, our institution became a CMS approved Qualified Provider Led Entity (QPLE) in 2019 designated to develop AUCs, which are integrated into the EMR using an approved CDSM.While use of a CMS approved CDSM obviates prior authorization for Medicare patients, many commercial payers still require traditional prior authorization processes for advanced imaging, which includes documentation of medical necessity. Accordingly, our AUCs were designed to (1) ensure that the provider selected the most efficacious imaging test for the suspected clinical condition and (2) confirm that a patients' history and physical exam findings reflect a reasonable likelihood of the pathology in question.Described here is the evidence identified in the literature and rules for MRI orders in hip and shoulder pain. This report focuses on common MRI indications in the ambulatory setting: suspected rotator cuff or SLAP injury in patients with shoulder pain, and suspected labral tear, femoral acetabular impingement (FAI) and ischiofemoral impingement in patients with hip pain.

METHODS

Multiple searches of the literature from 1990 to present were performed by an informationist in conjunction with subject specialist to identify research investigations, systematic reviews, meta-analyses and clinical practice guidelines evaluating the utility of MRI in patients with shoulder pain or hip pain. Results from the search strategy were screened in duplicate by two radiology faculty, followed by the same process for full text review. From each publication, one or more rules about imaging appropriateness and patient selection criteria were extracted into evidence tables. Each publication was graded using Oxford Centre for Evidence Based Medicine Levels of Evidence. A multispecialty physician team that included orthopedic surgeons, radiologists, and internal medicine physicians used the evidence to design exam and patient selection criteria.

RESULTS

Literature reviews revealed strong evidence with respect to hip and shoulder MRI appropriateness in these conditions, as detailed in evidence tables. However, high caliber studies identifying reliable physical exam findings for the conditions were lacking. Accordingly, available evidence and consensus clinical expertise were synthesized to define patient selection criteria for each condition.HIP MRIDiagnostic Test Appropriate Use Rules 1. Hip radiographs should be undertaken prior to MRI (ideally with modified Dunn)2. MRI is highly effective for diagnosing ischiofemoral impingement3. MRA is highly effective for diagnosing labral pathology and cartilage lesion4. Imaging with a 3T MR is better than 1.5T MR for evaluating labral and chondral pathology5. Consider diagnostic injection in suspected FAI, especially for low sensitivity, low prevalence situations6. Diagnostic arthroscopy may still have a role in the absence of MRI diagnosis for hip pathologyMRI Medical Necessity Rules In addition to groin or buttock pain, patients must be <50 years of age and have 2 of the following indicators:Radiographic indicators1. absence of joint space narrowing2. Cam or Pincer3. crossover sign or ischial spine sign4. OS acetabulae Clinical indicators 1. pain at the end of hip range of motion2. reproducible groin pain on hip flexion/adduction/internal rotation3. "positive" response to an intra-articular injection4. prior hip arthroscopy or open hip procedureSHOULDER MRIDiagnostic Test Appropriate Use Rules1. Radiographs should be pe

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Abstract Archives of the RSNA, 2021

Sub-Events

QI04-D1   The Dax Probe "a Game Changer" Quality Improvements For Ceus In Patients With Large Bmi And Gross Fatty Liver

Participants
Christine Merrill, Calgary, Alberta (*Presenter*) Nothing to Disclose

PURPOSE

Although Contrast Enhanced Ultrasound (CEUS) is safe, readily available and is widely accepted by patients, the obesity epidemic and fatty liver have proven to be a huge technical challenge to ultrasound, and most specifically to CEUS, Penetration of far field structures and the ability to image them has proven to be difficult with greater clinical impact in CEUS than in standard gray scale imaging. The current presentation addresses a major technical limitation in CEUS related to penetration and imaging at depth, including bubble resolution, sensitivity and destruction. It will focus on the DAX probe technology by Siemens and how it overcomes these issues, creating a significant positive clinical impact in management/diagnosis and treatment for patients in an obesity epidemic.

METHODS

50 patients, with BMI over 40, undergoing a standard liver ultrasound in our facility were selected for this evaluation. All patients underwent a standard liver greyscale and CEUS examination. Following a failed attempt at US/CEUS, the scan was repeated with the DAX probe, including both greyscale and CEUS images. Images were collected and qualitative side by side comparisons were made between the conventional curvilinear abdominal probe and the DAX probe, a specialized probe designed for imaging at depth. Comparison between images were made to assess image quality. The images were evaluated by the following criteria. Bubble sensitivity, the ability of the probe to see the microbubble as a finite dot. Bubble destruction, the ability of the probe to maintain bubbles over time, in the near and far field. Penetration, the ability to visualize the liver/lesion in the far field at greater than 10cm depth. Specific evaluations include: 1. Depth of penetration in the early Arterial Phase (AP), at 1min and at 4min, following the injection of a microbubble contrast agent. Including Depth assessment at 5 to 10cm, 10 to 12cm, and greater than 12cm. 2. Resolution of known liver masses through the liver parenchyma; Including, those not identified, those identified sufficiently for measurement, and those identified sufficiently for arterial and PVP enhancement . 3. Duration of bubble life allowing for continued clinical evaluations in the Portal Venous Phase (PVP) Including: Yes, ability to determine washout and No, inability to determine washout.

RESULTS

BMI and fatty liver have independent negative impact on depth resolution and penetration. Patients with BMI > 40 all showed reduced penetration, with the majority showing penetration only to 5-10cm on the standard probe. DAX uniformly improved this penetration, such that patients with BMI < 30 showed penetration to over 12 cm as a standard. In patient with BMI > 30, visualization at depth greater than 10cm was variable. Liver mass resolution with the DAX probe, and its ability to determine Arterial Phase Hyper enhancement (APHE) and washout, produced dramatic results converting 75 percent of non diagnostic scans on standard probes into diagnostic quality exams. Significant improvement in image quality was achieved in most patients. Including the addition of many cases that were clinically non diagnostic, without the advantage of DAX imaging.

QI04-D2   Improving Communication: The End Of The Pager Is Nigh

Participants
Natasha Akhlaq, MD,BEng, Ottawa, Ontario (*Presenter*) Nothing to Disclose

PURPOSE

The use of antiquated technology such as pagers and fax machines still encompasses much of the communication with physicians at our institution, particularly between radiologists and out-of-institution clinicians. This mode of communication results in significant barriers causing misunderstandings and delays in patient care. Although the physical pager itself may have been replaced with a mobile app, the premise remains the same requiring the use of a switchboard to contact a radiologist where it may be unknown if the radiologist is on service or even has received the page. It moreover results in an interruption of workflow for the radiologist. Physicians or other allied health professionals desiring to contact a radiologist may refrain from doing so unless absolutely needed because of these factors which contributes furthermore to the disjointed and often one-sided communication. The aim of this project was to provide not only a simple communication method for non-emergent cases in order to reach radiologists, but also to ensure timely and closed loop communication occurred. This would pave the way for a more team centered approach to patient care and would alleviate any barriers to communication with radiologists perceived by physicians and other allied healthcare workers.

METHODS

A single email address managed by an administrative assistant was created and every radiology report starting on April 1, 2016 has included automatically a line stating, "for report clarification, please contact [this email]". The administrative assistant screens the

emails to ensure the request is within the scope of report clarification and then routes it to the specific radiologist who had reported that study. The reporting radiologist uses "reply all" to answer the clarification request and the communication loop is closed. For patient privacy concerns, if a non-secure email (eg. Hotmail) is used, the radiologist issues an addendum to the report itself and indicates this in the "reply all" email. The requester receives the addendum in the usual secure communication method. Subsequent improvements that have been made since initiation include allowing fax in requests to be scanned and sent to the email if a requester does not use email communication. Analysis was completed by obtaining data sets from the beginning, middle, and just before the implementation of a new EMR system. Each data set included 100 requests each which were analyzed to determine (1) if they were in or out of the scope for report clarification, and if out of scope, how the request was redirected or what led to the wrong email being used; (2) if in scope, what were commonly requested clarifications; and (3) what was the average turnaround time (if available).

RESULTS

Out of 300 requests, 49 requests were deemed outside of the scope of the email address. From these, 18 were sent by patients, 5 were related to booking studies, and 6 were related to imaging or biopsies being denied. Out of the 251 in scope requests, 68 were for general clarifications, 60 were for a missed finding or second look, 57 were typographical errors, and 39 were related to follow up. The remaining requests were related to miscellaneous or clerical error. The average number of requests received per day was 2 and the average turnaround time (when known) for a response was 2 days.

QI04-D3 Increased Bleeding Risk After Image Guided Percutaneous Random Liver Biopsy In Patients Undergoing Workup For Cardiac Transplant

Participants
Alexandra Morris, MD, Detroit, Michigan (*Presenter*) Nothing to Disclose

PURPOSE

Patients undergoing image-guided percutaneous random liver biopsy as part of a pre-cardiac transplant workup were observed to have a markedly increased incidence of hemorrhagic post-procedure complications (20%) compared to patients undergoing liver biopsy for other indications (0.4%). Hemorrhagic post-procedure complications were defined as hemoperitoneum and/or subcapsular hematoma identified at post-procedure imaging. Post-procedure imaging was obtained based on clinical concern of post-procedure complications including hemorrhage. The purpose of this study is to determine the incidence of post biopsy hemorrhage in the pre-cardiac transplant patients relative to other patient populations and propose a new safety protocol to reduce the bleeding risk in patients undergoing image-guided percutaneous random liver biopsy as part of a pre-cardiac transplant workup. By assessing various factors that may contribute to an increased bleeding risk in this patient population and reviewing the effects on outcomes after proposed safety measures are implemented, we will be able to propose new guidelines for liver biopsy in this specific patient population.

METHODS

An IRB approved retrospective database review of all patients who underwent percutaneous image guided liver biopsy between 1/1/19 and 12/31/20 tabulated the hemorrhagic complication rate of the pre-cardiac transplant population versus the complication rate in all other patients. A collaborative risk mitigation process involving cardiology, cross-sectional interventional radiology, and vascular interventional radiology was instituted in an effort to reduce the hemorrhagic complication rate. These strategies were employed and complication rates in this subset of high-risk patients after the implementation of the safety protocols were recorded and compared.

RESULTS

For patients undergoing percutaneous liver biopsy for all indications other than patients being evaluated for cardiac transplant at our institution, the hemorrhagic complication rate overall was 0.4% (5/1225). In patients undergoing a liver biopsy as part of the workup for a cardiac transplant, the hemorrhagic complication rate was substantially higher at 20% (5/25) (Figure 1). We believe this is likely due to patient comorbidities, including elevated right heart pressures and anticoagulation requirement. We implemented multiple measures to reduce risk of complication including pre-procedural interventions as well as an alteration in how the procedure was performed. Improved clinical screening was employed to decrease the number of patients requiring biopsy. Prior to the procedure, we flag these high risk patients through orders in the electronic medical record to alert the team and schedule biopsies in the morning with close monitoring post-procedure in extended 24 hour overnight recovery with serial hemoglobins. Additionally, anticoagulation is held prior to the procedure using the Society of Interventional Radiology consensus guidelines for procedures with high risk of bleeding and anticoagulation is not resumed for 24 hours since all observed bleeding complications occurred in this time period. During the procedure, we obtain a single 18-gauge core sample only and perform routine placement of a gelfoam slurry at the biopsy site. Additionally, in patients with proven elevated right heart pressure, we utilize trans-jugular liver biopsy instead of percutaneous biopsy. Preliminary data since implementing these changes over the past six months is limited with no hemorrhagic complications observed in the 3 core biopsies performed in pre-cardiac transplant patients. While the preliminary data is promising, we will continue to gather data on these high risk patients after implementation of the safety measures to ensure continued improvement in complication rates.

QI04-D4 A Chat Bot Interface For Instant Access To Radiology Departmental Resources And Protocols

Participants
Satyam Ghodasara, MD, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

PURPOSE

Our radiology department, part of a quaternary academic medical center, maintains an internal website to host policies and information for trainees, attendings, and staff. The site includes dozens of phone numbers for the various reading rooms and technologists across the multitude of hospitals that our department covers, as well as departmental protocols for handling critical events, such as intravenous contrast reactions and extravasations, power outages, and IT downtimes. Over the years, many resources have accumulated on this website, making it more frustrating and less efficient to find information when it is needed. This is especially problematic during call shifts—when these resources are most valuable—and when onboarding new staff who must learn both the departmental policies and infrastructure as well as the website's complicated structure.One solution to this problem is a chat bot. A chat bot can provide instantaneous access to any resource in response to a natural language query. This can enable radiologists to quickly handle a broad range of issues that may unexpectedly arise on call, while minimizing time taken away from image interpretation and patient care. Additionally, the natural language interface allows new staff to use the chat bot to find critical information without a substantial learning curve. In this work, we assess the feasibility of creating a chatbot for a radiology

department and evaluate its early performance.

METHODS

Our group used Microsoft's QnA Maker (a simple tool requiring no coding knowledge) to develop a chat bot, which was then hosted on Microsoft Azure, a cloud computing service. Our department uses Microsoft Teams for video calls and communication among staff. Teams also includes a chat function allowing for text-based communication not only from person-to-person, but also with chat bots hosted on Azure. As our department is already familiar with Teams, we deployed the primary interface for our QnA Maker chat bot inside of Teams itself to minimize barriers to use and provide a new feature without needing new software.To create the chat bot's knowledge base, plain-text answers were paired with various phrasings of plain-text questions. These pairings were saved in the knowledge base using the QnA Maker interface. The answers serve as the possible range of outputs from the chat bot, and the questions serve as potential inputs that could solicit the paired answer. For example, "emergency department phone" and "ED phone" are saved as two questions that are both paired with a single list of our emergency department's phone numbers (the answer). Once deployed inside of Teams, QnA Maker matches natural language queries provided by the user to the questions within its knowledge base. QnA Maker then returns the answer paired with the best matching question. These pairings were created for all of the phone numbers in our department. Additional pairings were created between imaging modality assignments for each of our radiology subspecialty divisions and specific shifts (i.e., mappings to identify which divisions are responsible for reading particular imaging modalities during specific shifts).To evaluate the utility of our chat bot, we supplied 20 unique natural language queries and assessed each of the responses as either adequate or inadequate. Responses were deemed adequate if they answered the given query without needing to rephrase the input or consult an additional resource to obtain the requested information.

RESULTS

13 of 20 natural language queries (65%) inputted to the chat bot resulted in adequate responses. In 5 of the 7 inadequate responses, the chat bot returned the correct information but for the wrong location. For example, when provided with "Main ED phone" as the input, the chat bot returned the emergency department phone number for a sister hospital within our health system rather than the main hospital's emergency department phone number.

QI04-D5   Impact Of Multidisciplinary Team Review On The Management And Surgical Upgrade Rates Of High-risk Breast Lesions Identified On Imaging-guided Needle Biopsy

Participants
Dogan Polat, MD, Dallas, Texas (*Presenter*) Nothing to Disclose

PURPOSE

To compare the surgical excision, cancer upgrade and chemoprophylaxis rates before and after the implementation of multidisciplinary management review (MDC) to guide the management of high-risk breast lesions in our institution.

METHODS

We retrospectively reviewed all high-risk breast lesions (atypical ductal hyperplasia, atypical lobular hyperplasia, lobular carcinoma in-situ, atypical papilloma, and radial scar) diagnosed before and after implementation of MDC in 08/2018 on imaging-guided biopsies. MDC involves obtaining input of multiple specialties including radiology, pathology, genetics, surgical and medical oncology disciplines to determine an optimal management strategy. Lesion size, biopsy variables (number of core samples and needle size used, percent of lesion removed at biopsy) ; pathological severity extent and number of atypical foci are reviewed along with patient risk factors and comorbidities. We compared surgery and upgrade rates of lesions referred to MDC to lesions to nonreviewed ones or those identified prior to MDC implementation using Fisher exact test.

RESULTS

Of 747 high-risk breast lesions identified between 2014-2020, 527 (70.5%) were before, 220 (29.5%) after MDC implementation. Surgical excision rate was significantly lower post-MDC (68.1% vs 30.5%, OR:4.8, 95%CI:3.5-6.8, p<0.001) while cancer upgrade rate did not change significantly (16.4% without vs 22.4% with MDC, p>0.05). Of 220 lesions diagnosed post-MDC, 81(38.8%) underwent MDC review and 139 (63.2%) did not. Surgery rates (33.1% without vs 25.9% with MDC, p>0.05) and upgrade rates (21.7% without vs 23.8% with MDC, p>0.05) of lesions did not change significantly with MDC review. Chemoprevention uptake increased significantly post-MDC (18.7% before vs 26.4% post-MDC, OR:1.5, 95%CI:1.06-2.3, p=0.02), while rate was lower for MDC-reviewed lesions post-MDC (30.5% without and 18.5% with MDC, p=0.04). Compliance with MDC recommendation was 54% for surgery and 45% for chemoprevention recommendation.

QI04-D6   Close Monitoring Of Barotrauma In Critically Ill COVID-19 Patients-Need Of The Hour

Participants
Tanushree Banerjee JR, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose

PURPOSE

Management of critically ill COVID-19 positive patients has proven to be a major challenge for the medical fraternity due to several complications one of which is barotrauma. Increased incidence of barotrauma (pneumothorax, pneumomediastinum and subcutaneous emphysema) has been noted in critically ill COVID -19 patients in several studies. The exact mechanism for the same is not known yet but is hypothesised to be due to increased lung parenchymal frailty and increased intrathoracic pressure due to coughing and mechanical ventilation. It has also been studied that the morbidity and mortality is higher in these patients and these patients can develop subsequent recurrent episodes of barotrauma. In this study we aimed to closely monitor patients in COVID dedicated ICU through bedside radio-graphs for early signs of barotrauma and immediately conveyed the same to the intensivists for undertaking urgent measures for decreasing/reversing the barotrauma complications.

METHODS

Critically ill COVID-19 patients admitted in COVID dedicated ICU were monitored through bedside radio-graphs obtained on 12-24 hourly basis (as per clinical and radiological discretion). Patients with subtle features of barotrauma were immediately identified and the information regarding the same was conveyed to the clinicians on an urgent basis. The clinicians and intensivists undertook measures to arrest/reverse the barotrauma and follow up radiograph was obtained for these patients at 12 hour interval. Measures that were undertaken by the intensivists were- • In intubated patients - o optimisation of PEEP was done to the lowest possible value (maintaining a balance between the minimum PEEP required and preventing worsening of barotrauma). o Increasing supplemental oxygen concentration • In patients with spontaneous pneumothorax- o Increasing supplemental oxygen concentration

First repeat radio-graph following the measures was taken at 12 hour interval and if decrease/no change was noted in barotrauma, subsequent radiographs were obtained at 24 hour intervals.

RESULTS

The stringent initiative was undertaken over a period of 6 months from November 2020 to April 2021 and data was collected and analysed to study the trend of admissions of critically ill COVID-19 patients in the ICU ,number and percentage of patients requiring intubation and those developing barotrauma both spontaneous and post mechanical ventilation. The number of patients admitted in COVID dedicated ICU rose in February with very few patients needing intubation and developing barotrauma.However the percentage of patients requiring intubation rose from mid-March and was about 53.8% in April. From this it could be interpreted that the disease severity encountered in mid-March to April was high. A possible explanation for this could be increased virulence and severe disease caused by double mutant strain (E484Q and L452R mutation) of COVID -19 virus which was discovered in the Indian population during the same time span.The number and percentage of patients developing barotrauma also rose significantly from mid-March to April. The possibilities for this rise could be due to increased number of intubations and/or because of the increased frailty of the lung parenchyma due to the mutant virus.On the positive side it was noted that undertaking measures to prevent further barotrauma, led to reversal of these complications in a significant fraction of these patients.

QI04-D7 Building Trust And Empathy: Effect Of A Radiology Clinical History In The Radiologist-Patient Relationship

Participants
Eduardo Hernandez-Rangel, MD, Monterrey, Mexico (*Presenter*) Nothing to Disclose

PURPOSE

The imaging requisition form (IRF) is the prevailing communication system where the referring physician communicates with the radiologist. The IRF has clinical information that directly impacts the imaging study interpretation quality. Radiologists need to rely on the accuracy of the information, that it is timely, correct, and relevant.Worldwide in many practice environments, a radiologist usually has no direct contact with a patient and does not have access to the patient clinical information while making the imaging interpretation.Some studies evaluated the utility of adequate communication between patients and diagnostic imaging technologists to obtain relevant clinical information and create notes for the radiologist. Although this practice proved a significant improvement for interpreting imaging examinations, the radiologist work can be considered only as a commodity service provider rather than a certified medical doctor or an expert medical consultant that treats patients using medical imaging.The Patient-Centered Radiology Practice Initiative by the RSNA supports the concept of communicating directly with patients, and according to their results, the main limitation is the time and workload.The purpose of our project is the application of a clinical history performed by radiology residents before outpatients imaging computer tomography or magnetic resonance imaging study, to obtain an adequate clinical context, current symptoms, past medical history, and treatment to support the imaging studies interpretation. Also, we see it as an opportunity for direct communication between the radiologist and patient.

METHODS

We included a total of 883 outpatient computed tomography (CT) or magnetic resonance imaging (MRI) studies from November 2nd, 20 to May 1st, 21. Patients arrived 30 minutes before their scheduled appointment for clinical history.In a private interrogation area, first-year radiology residents took a medical history, including the surgical history, family medical history, social history, contrast allergies, and medications/treatment the patient is taking or may have recently stopped. For a female patient, age-appropriate questions about their last menstrual period and their pregnancy history. A senior resident or radiology attending evaluated the information in the radiology requisition compared with the clinical history, the need for detailed information, application or elimination of specific acquisition techniques. Finally, the patent answered a small survey about their satisfaction with the clinical history.

RESULTS

40.7 % (423/883) of the radiology requisitions mentioned the pertinent clinical condition, which corresponds to a 95 % confidence interval of 32.5-49.3 %. 83% (732/883) of the clinical history performed by radiology residents mentioned the pertinent condition. The condition rate in the radiology requisition is correlated significantly with the clinical history rate (?2 test, P<0.00001).In 39.6 % (350/883) of the cases, a specific requisition technique was requested, especially for brain MRI and head and neck pathologies.96 % (850/883) of the patients replied that they prefer to be evaluated with a brief clinical history and informed by a radiologist before their imaging study, and 88% referred to be comfortable for the radiologist to discuss their imaging findings if necessary.

QI04-D-HC1 Automated Generation Of Customized Impression Generation For Radiology Reports Through Natural Language Processing (NLP) Model.

Participants
Eric Purdy, PhD, Berkeley, California (*Presenter*) Employee, Rad AI

PURPOSE

To demonstrate superior customization of the impression in a production-deployed natural language processing system

METHODS

We use NLP-based models to generate customized radiology report impressions using the findings section as an input. The baseline models are trained on tens of millions of reports. Then the models get trained individually for each radiologist, on their historical reports, to be able to produce an impression that is customized in the unique voice of each radiologist.3600 chest radiograph reports from 12 radiology practices were run through an impression-generating model, and ROUGE-L scores were calculated. ROUGE-L scores for previous models in the literature are taken from the respective papers. All scores are reported on a realistic distribution of chest radiographs; privacy and other concerns prevent us from comparing two of these models on the same dataset.

RESULTS

We observed large increases relative to published values from the literature in the ROUGE-L score, a standard measure of text similarity. This demonstrates that the produced summaries are better customized to the style of each individual radiologist.

Abstract Archives of the RSNA, 2021

ED010

Nuclear Medicine Case of the Day

Sub-Events

x08   Sunday Uploader

Participants
Elizabeth Dibble, MD, Warwick, Rhode Island (*Presenter*) Nothing to Disclose

x22   Monday Uploader

Participants
Elizabeth Dibble, MD, Warwick, Rhode Island (*Presenter*) Nothing to Disclose

x36   Tuesday Uploader

Participants
Elizabeth Dibble, MD, Warwick, Rhode Island (*Presenter*) Nothing to Disclose

x50   Wednesday Uploader

Participants
Elizabeth Dibble, MD, Warwick, Rhode Island (*Presenter*) Nothing to Disclose

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ED005

Gastrointestinal Case of the Day

Sub-Events

x05 **Sunday Uploader**

Participants
Joseph Owen, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose

x19 **Monday Uploader**

Participants
Joseph Owen, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose

x33 **Tuesday Uploader**

Participants
Joseph Owen, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose

x47 **Wednesday Uploader**

Participants
Joseph Owen, MD, Lexington, Kentucky (*Presenter*) Nothing to Disclose

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ED003

Chest Case of the Day

Sub-Events

x03   Sunday Uploader

Participants
Demetrios Raptis, MD, Frontenac, Missouri (*Presenter*) Nothing to Disclose

x17   Monday Uploader

Participants
Demetrios Raptis, MD, Frontenac, Missouri (*Presenter*) Nothing to Disclose

x31   Tuesday Uploader

Participants
Demetrios Raptis, MD, Frontenac, Missouri (*Presenter*) Nothing to Disclose

x45   Wednesday Uploader

Participants
Demetrios Raptis, MD, Frontenac, Missouri (*Presenter*) Nothing to Disclose

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ED004

Multisystem: ER Case of the Day

Sub-Events

x04   Sunday Uploader

Participants
Sowmya Mahalingam, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

x18   Monday Uploader

Participants
Sowmya Mahalingam, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

x32   Tuesday Uploader

Participants
Joseph Cavallo, MD, New Haven, Connecticut (*Presenter*) Nothing to Disclose

x46   Wednesday Uploader

Participants
Scott Steenburg, MD, Indianapolis, Indiana (*Presenter*) Nothing to Disclose

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ED001

Breast Case of the Day

Sub-Events

x01   Sunday Uploader

Participants
Jane Karimova, MD, Newton, Massachusetts (*Presenter*) Research Consultant, WIRB-Copernicus Group, Inc

x15   Monday Uploader

Participants
Jane Karimova, MD, Newton, Massachusetts (*Presenter*) Research Consultant, WIRB-Copernicus Group, Inc

x29   Tuesday Uploader

Participants
Jane Karimova, MD, Newton, Massachusetts (*Presenter*) Research Consultant, WIRB-Copernicus Group, Inc

x43   Wednesday Uploader

Participants
Jane Karimova, MD, Newton, Massachusetts (*Presenter*) Research Consultant, WIRB-Copernicus Group, Inc

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ED009

Neuroradiology Case of the Day

Sub-Events

x09   Sunday Uploader

Participants
Noushin Yahyavi-Firouz-Abadi, MD, Potomac, Maryland (*Presenter*) Nothing to Disclose

x23   Monday Uploader

Participants
Noushin Yahyavi-Firouz-Abadi, MD, Potomac, Maryland (*Presenter*) Nothing to Disclose

x37   Tuesday Uploader

Participants
Noushin Yahyavi-Firouz-Abadi, MD, Potomac, Maryland (*Presenter*) Nothing to Disclose

x51   Wednesday Uploader

Participants
Noushin Yahyavi-Firouz-Abadi, MD, Potomac, Maryland (*Presenter*) Nothing to Disclose

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ED008
Musculoskeletal Case of the Day

Sub-Events

x07　　　**Sunday Uploader**

Participants
Hillary Garner, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

x21　　　**Monday Uploader**

Participants
Hillary Garner, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

x35　　　**Tuesday Uploader**

Participants
Hillary Garner, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

x49　　　**Wednesday Uploader**

Participants
Hillary Garner, MD, Jacksonville, Florida (*Presenter*) Nothing to Disclose

ED007

Interventional Case of the Day

Sub-Events

x14 **Sunday Uploader**

Participants
Susan Shamimi-Noori, MD, Philadelphia, Pennsylvania (*Presenter*) Consultant, Sirtex Medical Ltd;Consultant, Boston Scientific Corporation

x28 **Monday Uploader**

Participants
Ryan Cobb, MD, BA, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

x42 **Tuesday Uploader**

Participants
Ryan Cobb, MD, BA, Philadelphia, Pennsylvania (*Presenter*) Nothing to Disclose

x56 **Wednesday Uploader**

Participants
Gregory J. Nadolski II, MD, Fort Washington, Pennsylvania (*Presenter*) Nothing to Disclose

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Genitourinary Case of the Day

Sub-Events

x06   **Sunday Uploader**

Participants
Elizabeth Edney, MD, Omaha, Nebraska (*Presenter*) Nothing to Disclose

x20   **Monday Uploader**

Participants
Elizabeth Edney, MD, Omaha, Nebraska (*Presenter*) Nothing to Disclose

x34   **Tuesday Uploader**

Participants
Elizabeth Edney, MD, Omaha, Nebraska (*Presenter*) Nothing to Disclose

x48   **Wednesday Uploader**

Participants
Elizabeth Edney, MD, Omaha, Nebraska (*Presenter*) Nothing to Disclose

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Multisystem: Ultrasound Case of the Day

Sub-Events

x13   Sunday Uploader

Participants
David Fetzer, MD, Dallas, Texas (*Presenter*) Research support, Koninklijke Philips NVResearch support, Siemens AGResearch support, GE HealthcareConsultant/Advisory Board, Philips HealthcareConsultant/Advisory Board, GE Healthcare

x27   Monday Uploader

Participants
David Fetzer, MD, Dallas, Texas (*Presenter*) Research support, Koninklijke Philips NVResearch support, Siemens AGResearch support, GE HealthcareConsultant/Advisory Board, Philips HealthcareConsultant/Advisory Board, GE Healthcare

x41   Tuesday Uploader

Participants
David Fetzer, MD, Dallas, Texas (*Presenter*) Research support, Koninklijke Philips NVResearch support, Siemens AGResearch support, GE HealthcareConsultant/Advisory Board, Philips HealthcareConsultant/Advisory Board, GE Healthcare

x55   Wednesday Uploader

Participants
David Fetzer, MD, Dallas, Texas (*Presenter*) Research support, Koninklijke Philips NVResearch support, Siemens AGResearch support, GE HealthcareConsultant/Advisory Board, Philips HealthcareConsultant/Advisory Board, GE Healthcare

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ED015

Molecular Imaging Case of the Day

Sub-Events

x71   Sunday Uploader

Participants
Gary Ulaner, MD,PhD, Irvine, California (*Presenter*) Speaker, Siemens AG;Speaker,Lantheus Holdings;Research support, General Electric Company;Research support, F. Hoffmann-La Roche Ltd;Research support, Lantheus Holdings;Research support, Novartis AG

x72   Monday Uploader

Participants
Gary Ulaner, MD,PhD, Irvine, California (*Presenter*) Speaker, Siemens AG;Speaker,Lantheus Holdings;Research support, General Electric Company;Research support, F. Hoffmann-La Roche Ltd;Research support, Lantheus Holdings;Research support, Novartis AG

x73   Tuesday Uploader

Participants
Gary Ulaner, MD,PhD, Irvine, California (*Presenter*) Speaker, Siemens AG;Speaker,Lantheus Holdings;Research support, General Electric Company;Research support, F. Hoffmann-La Roche Ltd;Research support, Lantheus Holdings;Research support, Novartis AG

x74   Wednesday Uploader

Participants
Gary Ulaner, MD,PhD, Irvine, California (*Presenter*) Speaker, Siemens AG;Speaker,Lantheus Holdings;Research support, General Electric Company;Research support, F. Hoffmann-La Roche Ltd;Research support, Lantheus Holdings;Research support, Novartis AG

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ED013

Physics Case of the Day

Sub-Events

x12   Sunday Uploader

Participants
Timothy Szczykutowicz, PhD, Madison, Wisconsin (*Presenter*) Consultant, AiDoc Medical Ltd;Consultant, Flowhow.ai;Consultant, medInt Holdings, LLC;Consultant, Alara, Inc;Consultant, AstoCT, Inc;Research Grant, General Electric Company;Research Grant, Canon Medical USA

x26   Monday Uploader

Participants
Pankaj Patel, Detroit, Michigan (*Presenter*) Nothing to Disclose

x40   Tuesday Uploader

Participants
Ke Li, PhD, Madison, Wisconsin (*Presenter*) Research Consultant, Pulmera Inc.

x54   Wednesday Uploader

Participants
John Vetter, PHD, Madison, Wisconsin (*Presenter*) Stockholder, Transmed 7, LLC

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ED011

Reproductive Imaging Case of the Day

Sub-Events

x10   Sunday Uploader

Participants
Nishat Bharwani, FRCR,MBBS, Surbiton, United Kingdom (*Presenter*) Nothing to Disclose

x24   Monday Uploader

Participants
Nishat Bharwani, FRCR,MBBS, Surbiton, United Kingdom (*Presenter*) Nothing to Disclose

x38   Tuesday Uploader

Participants
Nishat Bharwani, FRCR,MBBS, Surbiton, United Kingdom (*Presenter*) Nothing to Disclose

x52   Wednesday Uploader

Participants
Nishat Bharwani, FRCR,MBBS, Surbiton, United Kingdom (*Presenter*) Nothing to Disclose

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ED002

Cardiac Case of the Day

Sub-Events

x02   Sunday Uploader

Participants
Lara Walkoff, MD, Rochester, Minnesota (*Presenter*) Nothing to Disclose

x16   Monday Uploader

Participants
Phillip M. Young, MD, Rochester, Minnesota (*Presenter*) Advisory Board, Arterys Inc

x30   Tuesday Uploader

Participants
Prabhakar Rajiah, MD, FRCR, Rochester, Minnesota (*Presenter*) Nothing to Disclose

x44   Wednesday Uploader

Participants
Phillip M. Young, MD, Rochester, Minnesota (*Presenter*) Advisory Board, Arterys Inc

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Abstract Archives of the RSNA, 2021

ED012

Pediatrics Case of the Day

Sub-Events

x11   Sunday Uploader

Participants
David Saul, MD, Wilmington, Delaware (*Presenter*) Nothing to Disclose

x25   Monday Uploader

Participants
David Saul, MD, Wilmington, Delaware (*Presenter*) Nothing to Disclose

x39   Tuesday Uploader

Participants
David Saul, MD, Wilmington, Delaware (*Presenter*) Nothing to Disclose

x53   Wednesday Uploader

Participants
David Saul, MD, Wilmington, Delaware (*Presenter*) Nothing to Disclose

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